SECURING NUCLEAR WEAPONS AND MATERIALS:

SEVEN STEPS FOR IMMEDIATE ACTION

Matthew Bunn
John P. Holdren
Anthony Wier

May 2002

PROJECT ON MANAGING THE ATOM

BELFER CENTER FOR SCIENCE AND INTERNATIONAL AFFAIRS
JOHN F. KENNEDY SCHOOL OF GOVERNMENT
HARVARD UNIVERSITY

Printed in the United States of America

Project on Managing the Atom
Belfer Center for Science and International Affairs
John F. Kennedy School of Government
Harvard University
79 JFK Street
Cambridge, MA 02138
Fax: (202) 495-8963
Email: atom@harvard.edu
Web: http://www.ksg.harvard.edu/bcsia/atom

Nuclear Threat Initiative
1747 Pennsylvania Avenue NW, 7th Floor
Washington D.C. 20006
Fax: (202) 296-4811
Email: contact@nti.org
Web: http://www.nti.org

This report is available on the Web at http://www.nti.org.

TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... **v**

1. INTRODUCTION **1**

Nuclear Weapons Terrorism: Why Action is Needed Now 1
Nuclear Security First: The Focus of This Report 7
Dispelling Five Common Myths 9
A Time to Act 13

2. THE BUSH ADMINISTRATION'S FISCAL YEAR 2003 BUDGET FOR COOPERATIVE THREAT REDUCTION **15**

The FY 2003 Threat Reduction Request 16
The Budget by Department 20
Conclusion 23

3. A GLOBAL COALITION TO SECURE WEAPONS OF MASS DESTRUCTION **25**

Russia: From Assistance to Partnership 27
Seizing the Opportunity 30

4. SINGLE LEADERS FOR U.S. AND RUSSIAN EFFORTS TO SECURE NUCLEAR WEAPONS, MATERIALS, AND EXPERTISE **31**

A Single Leader for Russian Nuclear Security Efforts as Well 33

5. ACCELERATED AND STRENGTHENED SECURITY UPGRADES FOR WARHEADS AND MATERIALS IN RUSSIA **35**

Accelerating the Pace 37
Strengthening Security 41
Sustaining Security 42
Moving Forward 43

6. GLOBAL CLEANOUT AND SECURE: ELIMINATING OR SECURING STOCKPILES OF WEAPONS-USABLE MATERIAL **45**

Eliminating or Securing Insecure Weapons Material Stockpiles 46
A Case-by-Case Approach to the Most Sensitive Cases 52
Moving Ahead 55

7. LEADING TOWARD STRINGENT GLOBAL NUCLEAR SECURITY STANDARDS **57**

Time for a New Approach 59
The Need for Stringent Standards 60

8. ACCELERATED BLEND-DOWN OF HIGHLY ENRICHED URANIUM **65**

The HEU Purchase Agreement 65
Structuring an HEU Accelerated Blend-Down Deal 66
Costs of an Accelerated Blend-Down Deal 70
Moving Forward 72

9. NEW REVENUE STREAMS FOR NUCLEAR SECURITY **73**

A "Debt for Nonproliferation" Swap 74
Spent Fuel Storage 77

EXECUTIVE SUMMARY

The possibility that terrorists could acquire a nuclear weapon and explode it in a U.S. city is real. This would be a more difficult feat than chemical or biological terrorism, but the massive, assured, instantaneous, and comprehensive destruction of life and property that would result may make this a priority for terrorists. While efforts to reduce the chances of this happening have been underway since long before last September 11 – and have recently been bolstered in some respects – the size and the speed of the U.S. and international response is not yet remotely commensurate with the magnitude of the threat. This report briefly reviews the dimensions of the danger and the efforts now underway to combat it, and then recommends seven sets of actions that ought to be undertaken immediately to bolster the barriers against this horrifying threat.

Dimensions of the Danger

The attacks of September 11 demonstrated that the threat from well-organized terrorist groups with global reach, bent on inflicting massive harm to the people of the United States, is not hypothetical but real. Terrorists have already tried chemical and biological weapons – nerve gas in the Tokyo subway, anthrax mailed to U.S. public figures. Their failure to use nuclear weapons so far must be assumed to be due to lack of means rather than lack of motivation. But they are trying.

One route to terrorists' acquiring a nuclear weapon would be for them to steal one intact from the stockpile of a country possessing such weapons, or to be sold or given one by such a country, or to buy or steal one from another subnational group that had obtained it in one of these ways. Another route to a terrorist bomb is via stealing the needed nuclear-explosive material (either plutonium or highly enriched uranium) – or buying it from someone else who has stolen it – and using this to fabricate a bomb from scratch. With enough nuclear material in hand (ranging from a few kilograms of plutonium for an implosion weapon to a few tens of kilograms of highly enriched uranium for the technically simpler gun-type design), it would likely be within the reach of a sophisticated and well-organized terrorist group to build at least a crude nuclear explosive.

If stolen or built abroad, a nuclear bomb might be delivered to the United States, intact or in pieces, by ship or aircraft or truck, or the materials could be smuggled in and the bomb constructed at the site of its intended use. Intercepting a smuggled nuclear weapon or the materials for one at the U.S. border would not be easy. 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 operate in favor of the terrorists. The huge volume of drugs successfully smuggled into this country provides an alarming reference point.

The detonation of such a bomb in a U.S. (or any other) city would be a catastrophe almost beyond imagination. A 10-kiloton nuclear explosion (from a "small" tactical nuclear weapon from an existing arsenal or a well-executed terrorist design) would create a circle of

near-total destruction perhaps 2 miles in diameter. Even a 1-kiloton "fizzle" from a badly executed terrorist bomb would have a diameter of destruction nearly half as big.

These possibilities have not escaped the notice of terrorists. It is known that Osama bin Laden and his Al Qaida terrorist network have made repeated attempts to buy stolen nuclear material from which to make a nuclear bomb, and that they have also tried to recruit scientists to help them with the task of weapon design and construction. Their being deprived of their sanctuary in Afghanistan will slow them down, but it may not stop them. And Al Qaida is not the only terrorist group that might aspire to nuclear weapons.

Are the intact nuclear weapons in the arsenals of countries adequately protected against theft? Each country known to possess nuclear weapons insists that its weapons are secure. But Russia possesses perhaps 20,000 such weapons, and the conditions in that country's economy and military and intelligence forces – although improving – are not conducive to confidence that none could go astray. Or consider Pakistan, with far fewer nuclear weapons – perhaps a few tens of them – but political circumstances that are far more precarious and a military with reputed links to terrorists. Nearly all U.S. nuclear weapons are fitted with sophisticated "permissive action links" designed to foil unauthorized use, but this is not thought to be true of all Russian nuclear weapons and even less is it likely to be true of Pakistani (or Indian) ones.

Nuclear-explosive materials are harder to account for and far more widely dispersed than intact nuclear weapons. Compared to the few to tens of kilograms needed to make a nuclear weapon, there are hundreds of thousands of kilograms of military plutonium and highly enriched uranium spread across the former Soviet Union, much of it dangerously insecure, and smaller but still immense amounts in the other seven nuclear-weapon states. An additional 20,000 kilograms of highly enriched uranium are spread across hundreds of civilian research facilities – some of them destitute – in scores of countries, and a further 200,000 kilograms of separated "civil" plutonium (usable in weapons despite the name) are associated with the nuclear energy programs of a dozen countries.[1]

If there have been thefts of intact nuclear weapons, this has not been publicly admitted. But theft of the nuclear-explosive materials needed to make these weapons is not a hypothetical worry, it is an ongoing reality. Over the last decade there have been multiple confirmed cases of theft of kilogram quantities of weapons-usable nuclear material. Of course, how much theft has not been detected cannot be known. Those seeking material for a nuclear bomb will go wherever it is easiest to steal, moreover, or buy it from anyone willing to sell. Thus security for bomb material is only as good as its weakest link. Insecure nuclear bomb material anywhere is a threat to everyone, everywhere. Yet there are no binding international standards for how well these stockpiles should be secured.

[1] These figures are usually expressed in metric tons – a metric ton is 1,000 kilograms – but the comparison with the quantities needed for a weapon is more transparent when the quantities are stated in kilograms.

What Is Being Done So Far

Since the end of the Cold War, the largest efforts to reduce the dangers of theft of nuclear weapons and nuclear-explosive materials have been focused, quite understandably, on Russia and the other countries of the former Soviet Union. U.S.-Russian cooperation (notably the Nunn-Lugar Cooperative Threat Reduction program at the Department of Defense and related efforts funded by the Department of Energy and the Department of State), along with other international efforts to address this problem, have made substantial progress. Hundreds of tons of potential bomb material and thousands of nuclear weapons are demonstrably more secure; enough nuclear material for thousands of nuclear weapons has been permanently destroyed; and thousands of under-employed nuclear weapons experts have received support for redirecting their talents to civilian work.

These efforts have represented an extremely cost-effective investment in the security of the United States, Russia, and the world. Much has been accomplished – but much, much more remains to be done. To date, initial "rapid upgrades" – such as bricking over windows or piling heavy blocks on top of material – have been accomplished for only 40% of the weapons-usable nuclear material in Russia; less than one-seventh of Russia's stockpile of highly enriched uranium (HEU) has been destroyed; the infrastructure to create jobs for the tens of thousands of nuclear weapons workers who will lose their jobs in Russia in the next few years has not yet been built. HEU-fueled research reactors in countries around the world remain dangerously insecure.

Since September 11, President Bush has described the effort to keep weapons of mass destruction (including not only nuclear but also chemical and biological weapons) out of terrorist hands as "our highest priority", and members of his administration have taken important initial steps to accelerate efforts to secure stockpiles of nuclear weapons and their essential ingredients around the world. But, in stark contrast to homeland security, which has seen dramatic budget increases, the creation of a major new organization with a senior leader, and sustained attention from the most senior officials of the U.S. government, the effort to secure and account for the world's nuclear weapons and nuclear-explosive materials has seen none of these.

The budget the Bush administration has proposed for cooperative threat reduction efforts for fiscal year 2003 is approximately $1 billion (compared to the $38 billion requested for homeland security), essentially the same as what President Clinton requested long before September 11 for the same programs in the budget for fiscal year 2001. As was true in the Clinton administration, moreover, there is no one in the government in overall charge of the effort to prevent nuclear weapons from falling into terrorist hands, and moving these efforts forward is not a priority to which the President or other senior officials devote much of their time and energy. The U.S. response is still not remotely commensurate with the magnitude of the threat – or the opportunities available to address it.

Immediate further steps are therefore warranted to ensure that all of the tens of thousands of nuclear weapons and hundreds of tons of weapons-usable nuclear materials around the world are secure and accounted for. Accomplishing this as rapidly as possible

must be a top U.S. homeland security objective. After September 11, "business as usual" is simply not good enough.

Seven Steps for Immediate Action

This report offers seven specific recommendations for immediate action to improve security and accounting for nuclear weapons and their essential ingredients around the world. Though we diagnose a number of problems with the status quo, most of these have existed for a number of years, and it is not our intention to point a finger of blame at anyone. Rather, we hope that the administration and the Congress will find our recommendations helpful in better matching the U.S. response to a threat that President Bush himself has forcefully articulated. Our recommendations are:

1. Forging a Global Coalition to Secure Weapons of Mass Destruction. Stockpiles of weapons of mass destruction (WMD) – not just nuclear weapons but chemical and biological ones as well – and their essential ingredients exist in dozens of countries throughout the world, in both the military and civilian sectors. This is a global problem requiring global solutions. President Bush should seek to forge a global coalition to secure stockpiles of WMD and their essential ingredients everywhere. Participants would pledge to secure and account for their own stockpiles to stringent standards, cooperate to interdict WMD theft and smuggling, share critical intelligence on these threats, and prepare to respond to WMD threats and attacks. The United States and Russia, with the world's largest WMD stockpiles, bear a special responsibility to lead such an effort. In this effort, Russia could be a leader and partner rather than being a passive recipient of assistance – and a shift from an assistance focus to a genuine partnership approach could greatly strengthen cooperative efforts to secure and account for Russia's own stockpiles as well. We recommend that launching such a global effort be a significant focus of the coming Bush-Putin summit. In our remaining recommendations, we outline specific further steps, which could be agreed and announced at the summit, for addressing the nuclear dimension of the problem.

2. Appointing One U.S. and One Russian Official to Lead the Respective Countries' Efforts to Secure Nuclear Weapons and Materials. Today, there is no senior official anywhere in the U.S. government with full-time responsibility for leading and coordinating the entire panoply of efforts related to securing nuclear weapons and materials – setting priorities, eliminating overlaps, seizing opportunities for synergy – and keeping the mission of moving these programs forward on the front burner at the senior levels of the White House every day, as Governor Ridge does for homeland security. We recommend that President Bush appoint someone in the White House, who reports directly to him, who has no other mission but this – someone tasked to wake up every morning thinking: "what can I do today to keep nuclear weapons out of the hands of terrorists?" That official would also be charged with leading U.S. participation in the nuclear element of a global coalition to secure WMD, and helping to forge the necessary sensitive security partnerships with countries around the world. The Russian government similarly lacks a senior official who has the responsibility for securing all nuclear weapons and materials – and that responsibility alone – and we recommend that President Putin appoint one, who can work closely with his or her U.S. counterpart.

3. Accelerating and Strengthening Security Upgrades for Warheads and Materials in Russia. Every effort should be made to ensure that all nuclear warheads and materials in the United States and Russia are secured and accounted for to standards adequate to meet the likely threats as rapidly as possible – and that they are secured in a way that will last for the long haul. We recommend that the United States and Russia jointly set a target of accomplishing all "rapid upgrades" of security and accounting for warheads and materials within two years and comprehensive upgrades within four. We recommend, further that, in order to accomplish that goal, they shift from an assistance-based approach to one based on genuine partnership, in which Russian experts would be integrated into every aspect of the planning, design, and implementation of the effort, and Russia's own resources would help fund the cooperative effort. We offer a range of other specific recommendations intended to help accelerate the upgrades, ensure that they meet stringent standards, and are sustained effectively over time.

The new nuclear arms reduction agreement to be signed at the Bush-Putin summit represents a substantial step forward for international security. But it also represents a missed opportunity to reduce threats of nuclear terrorism, as it does not require that the reduced warheads be dismantled, or their security improved, and it does not address tactical nuclear warheads at all. There remains an opportunity for a next-phase accord that would substantially reduce nuclear terrorism risks by placing all excess U.S. and Russian warheads (both strategic and tactical) in secure, monitored storage; committing them to verifiable dismantlement once appropriate procedures are developed; committing the plutonium and HEU from dismantling these warheads to secure, monitored storage; and moving forward as rapidly as practicable to eliminate these (and other) excess plutonium and HEU stockpiles as rapidly as practicable, using secure, agreed procedures.

4. Launching a "Global Cleanout and Secure" Effort to Eliminate or Secure Stockpiles of Weapons-Usable Nuclear Material Worldwide. Highly enriched uranium and plutonium exist in dozens of countries, in hundreds of buildings, in both the civil and military sectors. Security for this material varies widely, from excellent to appalling – yet vulnerable nuclear material anywhere could be stolen and made into a terrorist bomb that would be a threat to everyone, everywhere. A globalized approach to cooperative threat reduction is needed to address this threat. We recommend that a flexible new program be established, funded at approximately $50 million per year for several years, which would (a) provide a range of targeted incentives to facilities around the world to give up their highly enriched uranium or plutonium, and (b) implement rapid security upgrades at facilities where these materials would remain. In combination with the ongoing effort in the former Soviet Union, such an effort could eliminate the most urgent risks worldwide within a few years. Cooperatively upgrading security for nuclear weapons and nuclear materials in countries with emerging nuclear weapons programs (such as India, Pakistan, and Israel) would be particularly sensitive, and would have to be approached carefully, on a case-by-case basis.

5. Leading Toward Stringent Global Nuclear Security Standards. Although nuclear security is only as strong as its weakest link, there are today no binding international standards for how well nuclear weapons and materials should be secured. Current efforts to

amend the Physical Protection Convention are important and should be continued – but no such formal negotiations are likely to succeed in putting stringent international standards in place on a timescale commensurate with the threat. We recommend that the United States join with a number of like-minded states with substantial nuclear activities – ideally including Russia – in making a politically binding commitment to meet a stringent, agreed standard for security and accounting for all their nuclear material and facilities, military and civilian. Over time, these states could move to require states they supply with nuclear material and technologies to meet the same stringent standards, and help them do so. Ultimately, effective security and accounting for weapons-usable nuclear material should be part of the "price of admission" for doing business in the international nuclear market.

6. Accelerating the Blend-Down of Highly Enriched Uranium. The surest means to prevent highly enriched uranium (HEU) from being stolen and used in a nuclear bomb is to destroy it -- by blending it with natural uranium until the content of the nuclear-explosive isotope, U-235, is below the level required to create a nuclear explosion, transforming it into low-enriched uranium. Thirty tons of HEU is currently being blended down each year under the U.S.-Russian HEU Purchase Agreement, for use as proliferation-resistant low-enriched uranium (LEU) fuel for nuclear power reactors. By paying Russia a fee for service to blend additional HEU to LEU and then hold it in storage in Russia (rather than flooding the market with it), the national security objective of destroying HEU could be decoupled from market constraints. We recommend that the Bush administration begin negotiating an accelerated HEU blend-down approach with Russia, and that Congress provide a provisional appropriation of perhaps $50 million to fund the first year's accelerated blending – probably sufficient to blend 20-30 tons of additional HEU. If the blending rate were doubled, more than a thousand bomb's worth of additional HEU would be destroyed every year – clear, measurable threat reduction for each dollar invested.

7. Creating New Revenue Streams for Nuclear Security. On-budget government expenditures – by the states of the former Soviet Union, the United States, and other donor countries – have been the main source of funding for securing nuclear weapons and materials in the former Soviet Union and for other cooperative threat reduction efforts, and will remain so in the future. Nevertheless, given the scale of the activities that need to be funded, and the need for a strapped Russian budget ultimately to provide full funding for securing Russia's huge stockpiles of nuclear weapons and materials, it makes sense to develop new revenue streams that can supplement on-budget government expenditures. We recommend that two particular approaches be pursued:

- a "debt for nonproliferation" swap, modeled on past debt-for-environment swaps, in which a portion of Russia's debts would be canceled in return for Russia making payments into an auditable fund to finance agreed arms reduction and nonproliferation projects; and

- *if* arrangements for commercial Russian spent fuel imports can be developed that meet the criteria for support we outline in our report, using the leverage provided by U.S. veto rights over U.S.-obligated spent fuel to seek Russian commitments to

devote a portion of the proceeds to a similar auditable fund to finance agreed nuclear security efforts.

A Time to Act

The time for action is now. Our leaders need to be asking themselves: "On the day after a terrorist nuclear attack, what actions would we wish we had taken to prevent it?" – and then taking those steps before disaster strikes. While effective actions to prevent nuclear terrorism will cost money, the costs and risks of failing to act are far higher than the costs of effective action now. How will any leader explain it to his country – or his children –if the next terrorist attack uses a nuclear weapon and the terrorists got the material they needed for this because the world's leaders failed to take the obvious and practical actions to secure it?

1. INTRODUCTION

Nuclear Weapons Terrorism: Why Action is Needed Now

"All the world faces the most horrifying prospect of all: 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."

– President George Bush, speech to the United Nations General Assembly, November 10, 2001[1]

The attacks of September 11 demonstrated that the threat from well-organized terrorist groups with global reach, bent on inflicting massive harm to the people of the United States, is not hypothetical but real. While the attackers achieved horrifying destruction with box-cutters, there can be little doubt that if they had possessed a nuclear bomb, they would have used it – and today this country could be mourning not just the loss of the two towers but the loss of the lower half of Manhattan.

Osama bin Laden has called the acquisition of weapons of mass destruction (WMD) a "religious duty."[2] It is known that Osama bin Laden and his Al Qaida terrorist network have made repeated attempts to buy stolen nuclear material from which to make a nuclear bomb, and that they have also tried to recruit scientists to help them with the task of weapon design and construction. The extensive downloaded materials on nuclear weapons (and crude bomb design drawings) found in Al Qaida camps in Afghanistan make clear the group's continuing desire for a nuclear capability.[3] There is no evidence that Al Qaida has yet acquired the material needed for a bomb, or yet has the expertise to make a bomb if it got the material – but one cannot know what has not been detected, and even if it has not yet occurred, such a proliferation disaster could occur at any time. And Al Qaida is not the only terrorist group that might aspire to nuclear weapons. That is the terrifying reality the world now faces.

It is clear that terrorist interest in weapons of mass destruction includes chemical and biological as well as nuclear possibilities, and it is important that the nuclear-weapon threat

---

[1] "President Bush Speaks to United Nations: Remarks by the President To United Nations General Assembly, U.N. Headquarters, New York, New York," The White House, Office of the Press Secretary, Washington, DC, November 10, 2001 (available as of May 13, 2002 at http://www.whitehouse.gov/news/releases/2001/11/20011110-3.html).

[2] "Interview with Bin Laden: 'World's Most Wanted Terrorist'," *ABCNews.com* (available as of May 13, 2002 at http://more.abcnews.go.com/sections/world/DailyNews/transcript_binladen1_990110.html).

[3] See, for example, David Albright, Kathryn Buehler, and Holly Higgins, "Bin Laden and the Bomb," *Bulletin of Atomic Scientists*, Jan.-Feb. 2002 (available as of May 13, 2002 at http://www.isis-online.org/publications/terrorism/binladenandbomb.pdf); Mike Boetcher and Ingrid Arnesen, "Al Qaeda Documents Outline Serious Weapons Program," *CNN,* January 25, 2002 (available as of May 13, 2002 at http://www.isis-online.org/publications/terrorism/cnnstory.html); Gavin Cameron, "Multi-Track Microproliferation: Lessons from Aum Shinrikyo and Al Qaeda," *Studies in Conflict and Terrorism,* Vol. 22, No. 4, 1999; and Kimberly Mclound and Matthew Osborne, "WMD Terrorism and Usama bin Laden," Monterey Institute for International Studies, Center for Nonproliferation Studies (available as of May 13, 2002 at http://cns.miis.edu/pubs/reports/binladen.htm).

not be exaggerated in relation to the other WMD terrorism threats or indeed in relation to threats of terrorism by more conventional means. The nuclear-weapon threat is probably the most difficult of all for terrorists to implement and to that degree might be regarded as the least likely. But the massive, assured, instantaneous, and comprehensive destruction of life and property that would result may make nuclear weapons a priority for terrorists despite the difficulties.[4] The almost unimaginable devastation that would result if they succeeded means that everything practical should be done to reduce this risk, and that is the focus of this report.

Specifically, the international community must do everything it can to prevent a situation from arising in which any well-organized and well-financed terrorist group – or hostile state – that wanted a nuclear weapon could steal or buy one (or its essential ingredients) on a nuclear black market. An essential element of the war on terrorism should be a campaign to secure weapons of mass destruction and their essential ingredients throughout the world, so they cannot be stolen and sold to terrorists or hostile states. This must be done as rapidly as technology will allow. After September 11, the world can no longer allow bureaucratic obstacles or limited budgets to slow the accomplishment of this mission. "Business as usual" is simply not good enough.

Unfortunately, despite President Bush's strong words, the modestly increased budgets for these efforts, and the energetic and capable efforts of some in his administration, the U.S. response is still not remotely commensurate with the "most horrifying prospect" the President identified – or the opportunities available to address it. Only about $1 billion – just a third of one percent of the U.S. defense budget – is allocated to all cooperative threat reduction efforts; roughly two-thirds of that amount is devoted to programs related to managing nuclear weapons, materials, and expertise. (See Chapter 2, "The Bush Administration's Fiscal Year 2003 Budget For Cooperative Threat Reduction," p. 15.) As was also true in the Clinton administration, moreover, there is no one in the government in overall charge of the effort to prevent nuclear weapons from falling into terrorist hands, and moving these efforts forward is not a priority to which the President or other senior officials devote much of their time and energy. A sea-change in the level of sustained, high-level leadership applied to this problem is urgently needed.

Moreover, in recent months yet another obstacle has been allowed to delay progress in securing and accounting for nuclear weapons and their essential ingredients. The Bush administration has decided not to certify to Congress that Russia is committed to complying with its arms control commitments, preventing any additional obligations of Nunn-Lugar funds – an event which has already delayed efforts to improve security for nuclear warheads in Russia.[5] It is crucial that Congress act quickly on the national security waiver legislation

[4] For a useful discussion of the relative dangers posed by different types of mass destruction terrorist threats, see Richard A. Falkenrath, Robert Newman, and Bradley Thayer, *America's Achilles' Heel: Nuclear, Biological, and Chemical Terrorism and Covert Attack* (Cambridge, MA: MIT Press, 1998).

[5] For the non-certification, see, for example, Judith Miller, "U.S. Warns Russia of Need to Verify Treaty Compliance," *New York Times,* April 8, 2002. Nuclear weapons security delay from interviews with Department of Defense officials.

that the Bush administration has proposed, and that the administration then implement the waiver promptly.

As former Senator Sam Nunn has asked: "If our objective is to ensure that nuclear, biological, and chemical weapons and materials don't fall into the hands of rogue nations and terrorists, is this a priority or an afterthought? If it's an afterthought -- after what? What comes before it? If it is a priority, is that reflected in our effort and investment?"[6] Like the war on terrorism itself, securing nuclear weapons will require intensive heavy lifting at the highest political levels, in Washington and other capitals, to forge robust security partnerships around the globe despite national sensitivities and prerogatives concerning these weapons and the relevant technologies.

This report is not intended as a criticism of the Bush administration *per se*. President Bush has correctly identified the key goal – "we must keep the world's most dangerous technologies out of the hands of the world's most dangerous people" – and has reportedly directed his national security team to give nuclear terrorism priority over all other security threats to the United States.[7] Since September 11, the Secretary of Energy and his staff have worked closely with their Russian counterparts – with some success – to accelerate efforts to ensure that weapons-usable nuclear material are secure and accounted for.[8] The remaining problems we identify in this report were equally present in the Clinton administration. Our aim here is to describe, in a constructive spirit, a set of specific additional steps that can help match the U.S. response to the magnitude of the threat President Bush has identified. It is our hope that both the Bush administration and the Congress – where a bipartisan group of leaders has pushed for more comprehensive action on these issues for years[9] – will find these suggestions helpful.

---

[6] Sam Nunn, "Toward a New Security Framework," Presentation to the Woodrow Wilson Center, Washington, DC, October 3, 2001 (available as of May 13, 2002 at http://www.nti.org/c_press/c_index.html).

[7] The quote is from Bush's speech at the Citadel, Charleston, South Carolina, December 11, 2001 (available as of May 13, 2002 at http://www.whitehouse.gov/news/releases/2001/12/20011211-7.html), in which he also committed himself to ask Congress for additional funds to cooperate with Russia to secure stockpiles of WMD. The directive to give nuclear terrorism priority over other threats was reported in Barton Gellman, "Fears Prompt U.S. to Beef Up Nuclear Terror Detection: Sensors Deployed Near D.C., Borders: Delta Force on Standby," *Washington Post,* March 3, 2002.

[8] See, for example, Secretary of Energy Spencer Abraham's speech to the Los Angeles World Affairs Council, February 8, 2002 (available as of May 13, 2002 at http://www.energy.gov/HQPress/releases02/febpr/pr02022.htm). Since September 11, a new agreement on access to sensitive facilities to carry out security and accounting upgrades has been signed, and a number of other steps to accelerate security upgrades have been taken – including an effort to negotiate large "omnibus" contracts to comprehensively upgrade security and accounting for all the weapons-usable nuclear material at Russia's largest nuclear weapons complex sites.

[9] In addition to former Senator Sam Nunn (D-GA) and Senator Richard Lugar (R-IN), sponsors of the original Nunn-Lugar legislation, particularly important leaders on these issues have included, among others, Senator Pete Domenici (R-NM), sponsor of the expanded Nunn-Lugar-Domenici initiative and "godfather" of many of the initiatives specifically related to security and disposition of nuclear materials; Senator Joseph Biden (D-DE) and Senator Carl Levin (D-MI), chairmen, respectively, of the Senate Foreign Relations Committee and the Senate Armed Services Committee, both of whom have pressed effectively for stronger action to address these threats; and Senators Robert Byrd (D-WV) and Tom Daschle (D-ND), who, in the aftermath of September 11, added hundreds of millions of dollars in new funding to address these threats to the emergency supplemental appropriation. On the House side, particularly important leaders in these areas have included Representative David Obey (D-WI), Representative John Spratt (D-NC), Representative Ellen Tauscher (D-CA),

What are the overall outlines of the threat? With respect to nuclear weapons and materials in particular, the threat is defined by the huge size of the global stockpiles, the large number of countries and facilities where these stockpiles are held, and the poor state of security for some of them.

More than a decade after the end of the Cold War, there are still some 30,000 strategic and tactical nuclear weapons in the world (more than 95% of them in the U.S. and Russian arsenals). The world's stockpiles of separated plutonium and highly enriched uranium (HEU), the essential ingredients of nuclear weapons,[10] are estimated to total some 450 metric tonnes of military and civilian separated plutonium, and over 1700 tonnes of HEU.[11] (These figures include the plutonium and HEU in intact weapons and their components, as well as additional material stored mainly in metallic and oxide forms. This additional material is enough to make tens of thousands of additional weapons.)

The world's nuclear weapons stockpiles and the world's stockpiles of weapons-usable materials (both military and civilian) are overwhelmingly concentrated in the five nuclear weapon states acknowledged by the nuclear Non-Proliferation Treaty (NPT). Additional nuclear weapons or components exist in Israel, India, and Pakistan. In addition, enough civilian plutonium for many nuclear weapons also exists in Belgium, Germany, Japan, and Switzerland, and some 20 tonnes of civilian HEU exist at 345 operational and shut-down civilian research facilities in 58 countries, sometimes in quantities large enough to make a bomb.[12]

Representative Chet Edwards (D-TX), and Representative Mac Thornberry (R-TX). Recently, Senator Jean Carnahan (D-MO) has introduced legislation incorporating a number of the initiatives suggested in this report. This list, of course, is inevitably a partial one, leaving out many other Senators and Representatives who have also played important roles at key junctures, but it makes clear that these efforts have been thoroughly bipartisan from the outset.

[10] The simplest nuclear weapons derive all of their explosive power from nuclear fission (the splitting of heavy elements); their nuclear-explosive cores require plutonium or highly enriched uranium. More complicated nuclear weapons – "boosted" fission weapons and thermonuclear weapons – derive some of their energy from the fusion of light elements. These weapons require, in addition to plutonium and/or HEU, fusion fuels such as tritium and deuterium. While nuclear weapons of these more advanced types could conceivably be stolen and then exploded by terrorists, their design and construction from scratch are too difficult to be mastered by any subnational group short of a giant corporation.

[11] For a detailed review of these stockpiles, 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); civilian plutonium figures (increasing by many tonnes every year) have been updated for these totals on the basis of declarations to the IAEA since then. See, e.g., David Albright and Mark Gorwitz, "Tracking Civil Plutonium Inventories: End of 1999," ISIS Plutonium Watch (Washington, DC: Institute for Science and International Security, October 2000, available as of May 13, 2002 at http://www.isis-online.org/publications/puwatch/puwatch2000.html).

[12] Figures on the number of countries and research reactors with HEU fuel are from U.S. Department of Energy, *FY 2003 Budget Request: Detailed Budget Justifications—Defense Nuclear Nonproliferation* (Washington, DC: DOE, February 2002, available as of May 13, 2002 at http://www.cfo.doe.gov/budget/03budget/content/defnn/nuclnonp.pdf), p. 172. The 20 ton figure is from Albright, Berkhout and Walker, *Plutonium and Highly Enrched Uranium, 1996,* op. cit., p. 398. This estimate includes fresh, in-core, and irradiated HEU. In many cases the irradiated HEU also poses a proliferation and terrorism threat, because at many research reactors the fuel was only lightly irradiated, has been cooling for many years, and is in fuel elements of modest size, meaning that the fuel elements are not sufficiently

Security for these nuclear stockpiles varies widely, from excellent to appalling. Most of the nuclear weapons themselves are reasonably well secured (though even there, there is crucial work to be done), and they are large, countable objects that cannot be smuggled out in a briefcase. By contrast, while many facilities with weapons-usable nuclear material[13] are highly secure, at others the material is dangerously insecure and so poorly accounted for that if it were stolen, no one might ever know. Even in the United States, which probably devotes more resources to security for its nuclear facilities than any other country in the world, there have been repeated controversies over whether nuclear facilities are adequately secured.[14] The key facts bearing on the global threat of nuclear materials are stark:

- Producing or acquiring plutonium or highly enriched uranium (HEU) is the most difficult part of making a nuclear bomb. With enough nuclear material in hand, it would likely be within the reach of a sophisticated and well-organized terrorist group to build at least a crude nuclear explosive.

- The amounts required are small. Four kilograms of plutonium – an amount smaller than a soda can – or about three times that amount of HEU is potentially enough for a nuclear bomb.[15] Unless proper security and accounting systems are in place, a worker at a nuclear facility could put enough material for a bomb in a briefcase or under an overcoat and walk out.

- If stolen or built abroad, a nuclear bomb might be delivered to the United States, intact or in pieces, by ship or aircraft or truck, or the materials could be smuggled in and the bomb constructed at the site of its intended use. Intercepting a smuggled nuclear weapon or the materials for one at the U.S. border would not be easy. 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 operate in favor of the terrorists.

---

radioactive to be self-protecting against theft – especially by terrorists for whom death is part of the plan, such as those of September 11.

[13] Uranium enriched to more than 20% of U-235 or U-233, and any grade of separated plutonium, except plutonium containing 80% or more Pu-238.

[14] For a recent critique of U.S. nuclear weapons facility security, based on large numbers of internal documents, see *U.S. Nuclear Weapons Complex: Security at Risk* (Washington, DC: Project on Government Oversight, October 2001, available as of May 13, 2002 at http://www.pogo.org/nuclear/security/2001report/reporttext.htm). For a brutal official review (including a long history of past negative assessments), see President's Foreign Intelligence Advisory Board, *Science At Its Best, Security At Its Worst: A Report on Security Problems at the Department of Energy* (the Rudman Report), (Washington, DC: President's Foreign Intelligence Advisory Board, June 1999, available as of May 13, 2002 at http://www.fas.org/sgp/library/pfiab/). Recently the White House Office of Management and Budget reportedly slashed supplemental funding the Department of Energy had requested to improve security at its nuclear weapons facilities by 83%. See Matthew L. Wald, "White House Hasn't Sought Money to Guard Atomic Plants, Official Says," *New York Times*, April 22, 2002.

[15] These figures apply to implosion designs. The technically simpler gun-type design, which can only be made from HEU, not plutonium – typically 50-60 kilograms of very highly enriched material, and more if the enrichment is lower.

- The detonation of such a bomb in a U.S. (or any other) city would be a catastrophe almost beyond imagination. A 10-kiloton nuclear explosion (from a "small" tactical nuclear weapon from an existing arsenal or a well-executed terrorist design) would create a circle of near-total destruction perhaps 2 miles in diameter. Even a 1-kiloton "fizzle" from a badly executed terrorist bomb would have a diameter of destruction nearly half as big. If parked at the site of the World Trade Center, such a truck-bomb would level every building in the Wall Street financial area and destroy much of lower Manhattan.

- Compared to the few to tens of kilograms needed to make a nuclear weapon, there are hundreds of thousands of kilograms of military plutonium and highly enriched uranium spread across the former Soviet Union, much of it dangerously insecure, and smaller but still immense amounts in the other seven nuclear-weapon states. An additional 20,000 kilograms of highly enriched uranium are spread across hundreds of civilian research facilities – some of them destitute – in scores of countries, and a further 200,000 kilograms of separated "civil" plutonium (usable in weapons despite the name) are associated with the nuclear energy programs of a dozen countries.[16]

- Theft of the essential ingredients of nuclear weapons is not a hypothetical worry – it is an ongoing reality. Over the last decade there have been multiple confirmed cases of theft of kilogram quantities of weapons-usable nuclear material.

Those seeking material for a nuclear bomb will go wherever it is easiest to steal, or buy it from anyone willing to sell. Thus, security for bomb material is only as good as its weakest link. Insecure nuclear bomb material anywhere is a threat to everyone, everywhere. Yet there are no binding international standards for how well these stockpiles should be secured.

This is a global problem, requiring a global solution. But the United States and Russia, as the nations with the world's largest stockpiles of weapons of mass destruction – including about 95% of the world's nuclear weapons – bear a special responsibility for action. Moreover, some of the most acute problems are in Russia and the other countries of the former Soviet Union, where the collapse of the Soviet state left a security system designed for a closed society with closed borders, well-paid nuclear workers, and everyone under close surveillance by the KGB facing a new world it was never designed to address. Most of the documented seizures of stolen weapons-usable nuclear material that have occurred in the last decade appear to have originated in the Soviet Union, and all but a few of

[16] For a recent unclassified summary, see 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 as of May 13, 2002 at http://www.cia.gov/nic/pubs/other_products/icarussiansecurity.htm); for earlier accounts of the state of security and accounting for nuclear weapons and materials in the former Soviet Union, see Matthew Bunn, *The Next Wave: Urgently Needed New Steps to Control Warheads and Fissile Material* (Washington, DC: Carnegie Endowment for International Peace and Harvard Project on Managing the Atom, April 2000, available as of May 13, 2002 at http://ksgnotes1.harvard.edu/BCSIA/Library.nsf/pubs/Nextwave), and sources cited therein. Some of the research reactors are owned by institutions so poor that the reactors literally have dead rats floating in the spent fuel pool, or cannot afford a telephone.

the cooperative programs to reduce nuclear security threats have been focused there – and particularly in Russia, where all the nuclear weapons and more than 99% of the weapons-usable nuclear material from the former Soviet Union are located.

It was for these reasons that a senior bipartisan group led by former Senator Howard Baker and former White House Counsel Lloyd Cutler concluded that "the most urgent unmet national security threat to the United States today is the danger that weapons of mass destruction or weapons-usable material in Russia could be stolen and sold to terrorists or hostile nation states."[17] Hence, while this is a global problem, a particular focus of the problem is in Russia, and it can only be solved with the United States and Russia working actively together. President Putin's post-September 11 decision to swing Russia firmly into an anti-terrorist partnership with the United States represents an unprecedented – and possibly fleeting – opportunity, which must be seized upon.

Nuclear Security First: The Focus of This Report

The Baker-Cutler panel offered a powerful set of recommendations, arguing that to address this threat the United States government should: (1) designate it as a top priority; (2) put in place a strategic plan for addressing it as rapidly as practicable; (3) put someone in charge of carrying out the plan; and (4) provide the resources needed to implement the plan. In particular, the panel recommended a dramatic increase in funding for these efforts to some $3 billion per year (four times the current level of effort on these nuclear threats). As the panel pointed out, this would still amount to less than 1% of annual U.S. defense spending – yet it would be sufficient to radically reduce one of the most urgent and potentially catastrophic threats to U.S. security.

Our report does not attempt to offer a comprehensive plan of the sort the Baker-Cutler panel recommended. Rather, it outlines seven immediate first steps that should be taken to ensure that nuclear weapons and materials are secure and accounted for – in Russia, and worldwide. This represents a "security first" agenda – focusing on immediate security measures so that longer-term measures such as efforts to reduce plutonium stockpiles and re-employ nuclear experts have time to have their desired effect. The exclusion of any particular initiative from this report should not be interpreted as a judgment that it is not important; those included here are simply those that we judge to be most urgent and immediately actionable. The steps we describe should be seen in the context of what must ultimately be a comprehensive, integrated plan to secure nuclear weapons and materials; interdict nuclear smuggling; stabilize the lives of the custodians of nuclear weapons, materials, and expertise; monitor these stockpiles (and reductions in them); stop further production; and reduce these stockpiles and the nuclear complexes within which they exist to sustainable sizes appropriate for their post-Cold War missions. Dozens of programs are already in place in these areas, most of which have made significant progress.[18]

---

[17] Howard Baker and Lloyd Cutler, co-chairs, *A Report Card on the Department of Energy's Nonproliferation Programs with Russia* (Washington, DC: U.S. Department of Energy, Secretary of Energy Advisory Board, January 10, 2001, available as of May 13, 2002 at http://www.hr.doe.gov/seab/rusrpt.pdf).

[18] For an analysis of the programs in these areas and recommendations for next steps, see Bunn, *The Next Wave,* op. cit.

This report focuses only on the threats posed by nuclear weapons and weapons-usable nuclear materials – except for those cases where all WMD are more usefully treated together (such as a global alliance to secure WMD, discussed in Chapter 3). The threats posed by chemical and biological weapons and their possible use by terrorists will have to be addressed in other reports, by authors with different expertise.[19] Similarly, in this report, we do not address the other possible types of nuclear terrorism, including attacks on major nuclear facilities[20] or dispersal of radioactive material in a "dirty bomb."[21] Nor do we address the vulnerabilities of other toxic or high-energy targets in modern industrial societies whose destruction could lead to catastrophic consequences.[22] The nuclear weapons terrorist threat is problem enough for one short report.

There are three paths by which terrorists might acquire a nuclear weapon or the materials needed to make one. By far the most likely, we believe, given the thefts of weapons material that have already occurred, and the poor state of security that still exists for some weapons material, is theft – the possibility that a terrorist group would succeed either in stealing a nuclear weapon or nuclear material, or acquiring the weapon or material from someone else who had stolen it.

A second possibility, which has been an important part of the U.S. discussions of what to do about Iraq and its illegal weapons of mass destruction programs, is the possibility

---

[19] For discussions of steps to prevent chemical and biological terrorism, see, for example, Falkenrath, Newman, and Thayer, *America's Achilles' Heel,* op. cit.; the resources on the subject provided by the Center for Nonproliferation Studies, Monterey Institute of International Studies (available as of May 13, 2002 at http://cns.miis.edu/research/cbw/cbwt.htm); and the resources provided by the Johns Hopkins University Center for Civilian Biodefense Strategies (available as of May 13, 2002 at http://www.hopkins-biodefense.org/). For a discussion of the security of Russia's chemical and biological complexes against possible theft, see Amy E. Smithson, *Toxic Archipelago: Preventing Proliferation from the Former Soviet Chemical and Biological Weapons Complexes*, Report No. 32 (Washington, DC: Henry L. Stimson Center, December 1999, available as of May 13, 2002 at http://www.stimson.org/cbw/pubs.cfm?ID=27). For a nuanced discussion of past terrorist incidents involving chemical or biological weapons, see Jonathan B. Tucker, ed., *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons* (Cambridge, MA: MIT Press, April 2000).

[20] For discussion, see Matthew Bunn and George Bunn, "Preventing Nuclear Theft and Sabotage," *Journal of Nuclear Materials Management,* Spring 2002, and references therein. For a useful (though dated) overview of this issue, see Bennett Ramberg, *Nuclear Power Plants as Weapons for the Enemy: An Unrecognized Military Peril* (Berkeley, CA: University of California Press, 1984).

[21] See, for example, the testimony before the Senate Foreign Relations Committee hearing on "Dirty Bombs and Basement Nukes: The Terrorist Nuclear Threat," March 6, 2002. The testimony at this hearing of Henry Kelly, President of the Federation of American Scientists, is available as of May 13, 2002 at http://www.fas.org/ssp/docs/kelly_testimony_030602.pdf.

[22] For prescient pre-September 11 analyses of the problem of catastrophic terrorism, see, for example, Ashton B. Carter, John M. Deutch, and Philip D. Zelikow, *Catastrophic Terrorism: Elements of a National Policy* (Stanford, CA: Preventive Defense Project, Center for International Security and Cooperation, October 1998); and the three reports of the Gilmore Commission on U.S. capabilities to deal with terrorist use of weapons of mass destruction (available as of May 13, 2002 at http://www.rand.org/nsrd/terrpanel). For both pre- and post-September 11 analyses, see the resources provided by the Executive Session on Domestic Preparedness at Harvard University's Kennedy School of Government (available as of May 13, 2002 at http://ksgnotes1.harvard.edu/BCSIA/ESDP.nsf/www/Research), and the extensive set of links to other information they have prepared (available as of May 13, 2002 at http://ksgnotes1.harvard.edu/BCSIA/ESDP.nsf/www/Links).

that a state might intentionally provide a weapon or materials to a terrorist group. We regard this scenario as extremely unlikely, particularly in the case of nuclear weapons, despite the possible shared objective of causing catastrophic harm to the United States or its allies. Nuclear weapons are extremely difficult for such states to acquire, and are regarded as the ultimate deterrent, and therefore the ultimate guarantor of regime survival – and a terrorist nuclear attack on the United States or one of its major allies and friends could be expected to provoke an overwhelming, devastating response. Putting such an operation in the hands of a terrorist group that he could not absolutely control would run counter to everything about the way an absolute dictator such as Saddam Hussein operates.[23]

The third possibility – that terrorists might be able to actually produce plutonium or HEU themselves – appears to be implausible, given the technical obstacles.

Thus there is reason for optimism: *if all the nuclear weapons and nuclear weapons-usable materials in the world can be secured and accounted for, nuclear weapons terrorism can be avoided.* The technology exists to secure and account for these warheads and materials – it is a matter of mustering the political will to provide the necessary leadership and resources, and to forge the necessary sensitive security partnerships with other countries, to get the job done. This makes nuclear weapons terrorism very different from chemical or biological terrorism, as chemical and biological weapons can be manufactured from materials that exist in nature all over the world.

Dispelling Five Common Myths

There are five key myths that have undermined consensus on the need for immediate action to secure nuclear weapons and materials and that therefore need to be dispelled.

Myth 1: Nothing can be done.

Even among those who understand the gravity of the threat posed by insecure nuclear weapons and materials, there are many who believe that nothing effective can be done about it. Some U.S. officials and experts believe, in particular, that the relevant agencies of the Russian government are so profoundly dysfunctional that nothing can genuinely be accomplished in cooperation with them. This is simply wrong.

While cooperation in these sensitive areas is undeniably difficult, and there have been plenty of problems and missteps along the way, the reality is that as a result of cooperative programs already underway hundreds of tons of nuclear material and thousands of nuclear weapons are demonstrably more secure; enough nuclear material for thousands of nuclear weapons has been permanently destroyed; and thousands of under-employed nuclear weapons experts have received support for redirecting their talents to civilian work.

These efforts have represented an extremely cost-effective investment in the security of the United States, Russia, and the world. Much has been accomplished – although, as indicated in this report, much more remains to be done.

[23] For a useful discussion, see, Falkenrath, Newman, and Thayer, *America's Achilles' Heel*.

Myth 2: This problem is solved.

The opposite myth is that this problem is already solved. There may have been a serious problem in the early- to mid-1990s, when stolen plutonium and HEU were regularly being seized in Russia and Europe, but through a combination of the cooperative programs just mentioned and Russia's own efforts, the relevant weapons and materials have all been secured – so goes the myth – hence such thefts no longer occur, and the threat is no longer a serious one. Here, too, there is just enough truth to generate the myth – but the overall picture is profoundly wrong.

To date, U.S.-Russian cooperative programs have accomplished even initial "rapid upgrades" – such as bricking over windows or piling heavy blocks on top of material – on only 40% of the weapons-usable nuclear material in Russia, and comprehensive security and accounting upgrades on only half of that. Less than one-seventh of Russia's stockpile of HEU (and still less of the U.S. stockpile) has been destroyed, and virtually none of the weapons plutonium in either country has yet been eliminated. While salaries and conditions for nuclear workers and guards in the former Soviet Union have notably improved, Russia plans to lay off tens of thousands of nuclear weapons scientists and workers in the next few years, and the infrastructure to create jobs for these people has not yet been built. HEU-fueled research reactors in countries around the world remain dangerously insecure.

Because of these conditions, thefts and theft attempts continue to occur. In late 1998, there was an insider conspiracy at one of Russia's largest nuclear weapons facilities that attempted to steal 18.5 kilograms of HEU – the only publicly known case involving enough material for a bomb at a single stroke.[24] In April 2000, almost a kilogram of stolen HEU –

[24] For the original announcement, of this incident, see "FSB Agents Prevent Theft of Nuclear Material in Chelyabinsk," *ITAR-TASS*, December 18, 1999. The chief of the FSB for the Chelyabinsk region, Major General Valeriy Tretyakov, expressed "concern" about security for nuclear material at nuclear facilities in the region, and said that while U.S. MPC&A assistance was helpful, it was "far from being [the] permanent measure we need." (See also Monterey Institute for International Studies, Center for Nonproliferation Studies, NIS Nuclear Trafficking Database, *Document 19980790*, quoting Alevtina Nikitina, "Komu vygodno razrusheniye FSB?" *Chelyabinskiy rabochiy*, 19 December 1998, also available as of May 13, 2002 at http://www.nti.org/db/nistraff/1998/19980790.htm). The Monterey's NIS Trafficking Database is available through a password service at http://cns.miis.edu/db/nistraff/index.htm, but is also available to the public through the Nuclear Threat Initiative, at http://www.nti.org/db/nistraff/index.html. In late 1999, this incident was confirmed by the head of MINATOM's material accounting department, Victor Yerastov, in a published interview. Yerastov described the material as "a sort of semi-finished product made of fissile material," which "can be used in the manufacture of various military and civilian products in the nuclear industry," and said that if the theft had succeeded, it "it could have inflicted a significant damage to the [Russian] state." (See "Interview: Victor Yerastov: MINATOM Has All Conditions for Providing Safety and Security of Nuclear Material," *Yaderny Kontrol Digest*, Vol. 5, No. 1, Winter 2000.) Yerastov reported that "the attempt to steal this material was prevented at the very beginning, on the enterprise territory, and we do not find it correct to say that the theft occurred." Yerastov attributed the decline in thefts since 1995 to a combination of a decline in press exaggeration of the prices available to thieves, unilateral Russian government efforts to improve security, and international MPC&A cooperation, particularly with the United States. A senior MINATOM official later confirmed privately to one of the authors that the material in question was HEU.

probably of Russian origin – was seized in the former Soviet republic of Georgia.[25] So the job is *not* done – far from it. In the aftermath of September 11, there is more remaining to be done than has been accomplished so far.

Myth 3: Cooperation with Russia in this area only makes matters worse in other areas.

There are those who believe the United States should restrict cooperation with Russia in areas such as upgrading nuclear materials security in order to express its displeasure over Russian behavior in other areas – from nuclear cooperation with Iran to suppression of human rights in Chechnya. This would be unwise, for this cooperation is *not* foreign aid the United States is providing to Russia, but an investment undertaken to improve the military security of the United States (and which is possible because it simultaneously improves Russia's own security).

One particular form of this argument is that by continuing such cooperation, the United States actually worsens other problems – especially by freeing up money that would have been spent on these disarmament and nonproliferation tasks, but which can now be spent building new nuclear weapons, launching further strikes in Chechnya, providing loans to finance questionable reactor sales, and the like. The fallacy in this argument is that in most cases the activities funded in these cooperative efforts are ones Russia would be spending very little on in the absence of U.S. funding – so the U.S. funding simply does not "free up" any significant amount of money to spend in other areas.

The idea that most of the threat reduction money gets stolen and ends up in Swiss bank accounts is simply incorrect, moreover: while there has undoubtedly been some leakage to corruption in an array of programs of this size and complexity, the fact is that in virtually all of these efforts, these are not simply checks written to the Russian government, but payments provided to specific Russian facilities and firms only *after* they have demonstrably accomplished the work agreed to under a contract.[26] (An exception is the HEU Purchase Agreement, which does involve large sums going to the Russian government – because they are providing a commercial product, low-enriched uranium (LEU) reactor fuel made from bomb uranium.)

Not only is there no substantial evidence that cooperation in reducing threats of mutual concern has contributed to Russian activities the U.S. government opposes, there is substantial evidence of the opposite – the relationship established in the threat reduction programs has been a crucial part of building better U.S.-Russian relations and improved cooperation across a broad array of sensitive security areas. Indeed, at some of the low

[25] "Georgian Police Detain Four Uranium Smugglers in Batumi," *ITAR-TASS*, April 19, 2000 (summarized in *NIS Nuclear Trafficking Database,* available as of May 13, 2002 at http://www.nti.org/db/nistraff/2000/20000260.htm). This incident is in the IAEA's database of "confirmed" cases.

[26] Linton Brooks, Testimony before U.S. Congress, Senate Armed Services Committee, Subcommittee on Emerging Threats and Capabilities, March 6, 2002; see also, Ingrid Staudenmeyer, "Summary of Hearing by Senate Armed Services Committee, Subcommittee on Emerging Threats and Capabilities" (Washington, DC: Russian American Nuclear Security Advisory Council, available as of May 13, 2002 at http://www.ransac.org/new-web-site/whatsnew/armed_services_committee_hearing.html).

points of U.S.-Russian relations in the last decade, cooperative threat reduction efforts were one of the few activities that kept going essentially unimpeded, as both sides recognized them as serving their continuing interests.

Thus, the United States should continue to work energetically to convince Russia to change those policies with which the U.S. government disagrees – but it should not threaten cutoffs in threat reduction assistance if Russia does not agree.

Myth 4: Terrorists couldn't make or set off nuclear bombs anyway.

Unfortunately, while it is difficult to make a nuclear bomb, it is not as difficult as it is often been made to seem. Getting the nuclear material is by far the most difficult step. With HEU, terrorists could potentially make a simple "gun-type" bomb, little more than firing two subcritical pieces of HEU into each other to form a critical mass, with a device to generate a shower of neutrons to start the chain reaction when they come together. (The bomb that obliterated Hiroshima – which the United States never bothered to test, so high was the confidence it would work – used an Army surplus cannon barrel.) Making a bomb from plutonium would be more difficult, because it would have to be an "implosion" bomb, in which explosives are set off all around a plutonium core, crushing it down to smaller, denser configuration where the nuclear chain reaction will begin. While getting these explosives right was a difficult challenge in the Manhattan Project, today the relevant explosive technology is in wide use in conventional military and even commercial applications.

Some years ago, a senior group of U.S. weapons designers analyzed the question "Can Terrorists Build Nuclear Weapons?" and concluded that unfortunately, in some cases the answer was yes – if the terrorist group included someone with some physics knowledge, someone with explosive expertise, and someone able to do the machining of the relevant parts.[27] The Department of Energy (DOE) has officially warned that "with access to sufficient quantities of these materials, most nations and even some sub-national groups would be technically capable of producing a nuclear weapon."[28] Indeed, DOE internal security regulations envision the possibility of an "improvised nuclear device" – a nuclear bomb the terrorists might be able to put together while they were still inside the facility where they stole the HEU.[29]

Myth 5: This is only a Russia problem.

---

[27] See J. Carson Mark et al., "Can Terrorists Build Nuclear Weapons?" in Paul Leventhal, and Yonah Alexander, *Preventing Nuclear Terrorism* (Lexington, MA: Lexington Books, 1987, available as of May 13, 2002 at http://www.nci.org/k-m/makeab.htm). 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.

[28] U.S. Department of Energy, Office of Arms Control and Nonproliferation, *Final Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Excess Plutonium Disposition Alternatives,* DOE/NN-0007 (Washington, DC: DOE, January 1997), p. vii.

[29] 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, DC: DOE, July 15, 1994, available as of May 13, 2002 at http://www.fas.org/irp/doddir/doe/m5632_1c-1/m5632_1c-1_c1.htm).

Because so many of the seizures of stolen nuclear material in the last decade have occurred or originated in Russia, and such a huge fraction of the international cooperative effort to address these issues has focused there, many policymakers have come to believe that the problem of "loose nukes" is only a Russia problem – a unique feature of the aftermath of history's first collapse of an empire that possessed thousands of nuclear weapons. Unfortunately, while a major part of the problem is located in the former Soviet Union, there are sources of danger that must be addressed scattered around the world -- hundreds of facilities in scores of countries where separated plutonium or HEU is located, many with marginal security arrangements at best. The fact that uranium fuel just below the boundary of HEU, stolen from a research reactor in Congo recently showed up in the hands of the Italian mafia, is just one indicator of the global scale of the problem.[30]

A Time to Act

The time for action is now. Our leaders need to be asking themselves: "On the day after a terrorist nuclear attack, what actions would we wish we had taken to prevent it?" – and then taking those steps before disaster strikes.[31] While effective actions to prevent nuclear terrorism will cost money, the costs and risks of failing to act are far higher than the costs of effective action now. How will any leader explain it to his country – or his children – if the next terrorist attack uses a nuclear weapon and the terrorists got the material they needed for this because the world's leaders failed to take the obvious and practical actions to secure it?

[30] Jeffrey Fleishman, "Sting Unravels Stunning Mafia Plot," *Philadelphia Inquirer* (January 12, 1999, summarized in *NIS Nuclear Trafficking Database*, available as of May 13, 2002 at http://www.nti.org/db/nistraff/1999/19990110.htm).

[31] This way of posing the question was first proposed by Graham T. Allison, Owen R. Coté, Richard A. Falkenrath, and Steven E. Miller, *Avoiding Nuclear Anarchy: Containing the Threat of Loose Russian Nuclear Weapons and Fissile Material* (Cambridge, MA: MIT Press, 1995), p. 17.

2. THE BUSH ADMINISTRATION'S FISCAL YEAR 2003 BUDGET FOR COOPERATIVE THREAT REDUCTION

The Bush administration has proposed a budget of roughly $1 billion for cooperative threat reduction efforts in the former Soviet Union in fiscal year (FY) 2003.[1] This represents a significant step forward when compared to the administration's attempt to cut these efforts the previous year. But the proposed spending is still not remotely commensurate with the threat that the Baker-Cutler panel described – even before September 11 – as "the most urgent unmet national security threat to the United States today."[2] Total former Soviet Union cooperative threat reduction funding under the administration's proposal would be 26% more than what the administration proposed last year – but more than 5% *less* than what Congress appropriated for FY 2002. In effect, this is a "steady as you go" budget, slightly less than the Clinton administration proposed for FY 2001 – long before September 11 occurred.[3] While the administration is working to accelerate some existing efforts, the budget proposal provides no funds for any new initiatives such as those recommended in this study.[4] The

---

[1] While the problem of insecure nuclear weapons and materials is a global one, nearly all U.S. funding for programs to manage nuclear weapons, materials, and expertise beyond the United States' own borders has focused on the former Soviet Union. This budget analysis, therefore, focuses only on those programs focused in the former Soviet Union. Ultimately a broader analysis is needed that would include U.S. spending (both public and private) on securing and reducing its own nuclear stockpiles and facilities, as well as U.S. spending (and other countries' spending) on similar activities around the world – but some of this data would be much more difficult to gather. This analysis draws heavily on William Hoehn, "Analysis of the Bush Administration's Fiscal Year 2003 Budget Requests for U.S.-Former Soviet Union Nonproliferation Programs" (Washington, DC: Russian-American Nuclear Security Advisory Council, May 2002, available as of May 13, 2002 at http://www.ransac.org/new-web-site/whatsnew/analysis_bush03_requests.html). The authors are grateful to William Hoehn for extensive discussions of issues relating to current and historical threat reduction budgets.

[2] Howard Baker and Lloyd Cutler, co-chairs, *A Report Card on the Department of Energy's Nonproliferation Programs with Russia* (Washington, DC: U.S. Department of Energy, Secretary of Energy Advisory Board, January 10, 2001, available as of May 13, 2002 at http://www.hr.doe.gov/seab/rusrpt.pdf). Specific funding figures are drawn from *Budget of the United States Government, Fiscal Year 2003* (Washington, DC: Government Printing Office, 2002, available as of May 13, 2002 at http://www.whitehouse.gov/omb/budget/fy2003/budget.html); U.S. Department of Energy, *FY 2003 Budget Request: Detailed Budget Justifications—Defense Nuclear Nonproliferation* (Washington, DC: DOE, February 2002, available as of May 13, 2002 at http://www.cfo.doe.gov/budget/03budget/content/defnn/nuclnonp.pdf); U.S. Department of Defense, *Defense Budget Materials, FY 2003 Budget, Operation and Maintenance Budget Justification, Volume I, Part 2, Former Soviet Union Threat Reduction* (Washington, DC: Department of Defense, April 2002, available as of May 13, 2002 at http://www.dtic.mil/comptroller/fy2003budget/budget_justification/pdfs/operation/fy03_CTR.pdf); and U.S. Department of State, *FY 2003 Congressional Budget Justification for Foreign Operations* (Washington, DC: Department of State, April 15, 2002, available as of May 13, 2002 at http://www.state.gov/m/rm/rls/cbj/2003/). These were supplemented by interviews with executive branch officials.

[3] The amount proposed by the Clinton Administration was approximately $970 million for the same set of projects. See William Hoehn, "The Clinton Administration's Fiscal Year 2001Budget Requests For Nuclear Security Cooperation with Russia" (Washington, DC: Russian-American Nuclear Security Advisory Council, March 13, 2000, available as of May 13, 2002 at http://www.ransac.org/new-web-site/related/congress/status/FY01-budget.html).

[4] The one exception is a new effort on helping states improve their border security, a $40 million item in the Cooperative Threat Reduction request. This effort – whose specifics were still being fleshed out as this report went to press – would complement a broad range of other efforts already underway in this area, funded by the Departments of Defense, State, and Energy.

budget can be summed up in a simple phrase: "status quo plus." In the aftermath of September 11, modest additions to the status quo are simply not good enough.

Although insecure weapons of mass destruction (WMD) and related materials around the world pose one of the greatest terrorist threats of truly mass destruction in the U.S. homeland, the $1 billion allocated for threat reduction – about two-thirds of which is devoted to efforts relating to managing nuclear weapons, materials or expertise – is a tiny fraction of the $38 billion allocated for homeland security. It represents only 3% of the $33 billion increase in U.S. defense spending President Bush requested before September 11 occurred. By contrast, the Baker-Cutler panel outlined a much faster, more far-reaching approach to securing nuclear weapons, materials, and expertise that would cost $3 billion every year – still less than 1% of U.S. annual defense spending.[5]

Funding for some key initiatives – such as securing nuclear material, securing nuclear warheads, and reducing the Russian nuclear weapons complex – is actually reduced in the administration's proposed budget, compared to FY 2002. The Bush administration argues that given the large emergency appropriations provided in FY 2002, these programs could not effectively spend more than requested in FY 2003. As discussed below, this argument is probably correct in the near term (at least with respect to nuclear material and weapons security, though not with respect to downsizing the Russian weapons complex). But it is, in a sense, a self-fulfilling argument: because access problems and bureaucratic obstacles have been allowed to fester until large quantities of unspent funds built up, adding more money now will not suffice to accelerate these efforts. But if, as this report recommends, an accelerated partnership is put in place to secure all stockpiles of nuclear weapons and related materials as quickly as possible, a sustained application of resources will be needed to get the job done.

Today, it seems clear that other steps are more important than budget increases for FY2003 in accelerating efforts to secure nuclear material around the world, including focusing sustained, high-level leadership on this issue; building an accelerated partnership with Russia; and forging an effective global coalition to secure and account for nuclear weapons and materials and other WMD stockpiles worldwide. Nevertheless, funding remains a constraint to be considered: the proposed budget, for example, would not provide the funds needed to implement most of the specific recommendations made in this report. To succeed, U.S.-Russian cooperative threat reduction programs must be well managed, properly focused on addressing the most urgent threats, and built on genuine partnership – but they must also have the money they need.

The FY 2003 Threat Reduction Request

Overall, the Bush administration proposes to spend approximately $957 million in FY 2003 on cooperative threat reduction activities in the former Soviet Union.[6] This funding is

[5] Baker and Cutler, *A Report Card*, op. cit.

[6] A fundamental issue in analyzing cooperative threat reduction budgets – which drives the differences in numbers from different sources – is that there is not universal agreement on "what's in and what's out." In general, we include in our definition: (a) all the programs that were included in the executive branch analyses of

spread between the Departments of Defense, State, and Energy. This proposed funding level effectively puts the Bush administration in support of continuing threat reduction activities at more or less the scale at which they had been underway before – a substantial improvement compared to the large cuts the administration proposed in FY 2002, which were reversed by Congress. But the budget remains lower than what Congress actually appropriated after September 11, and proposes few new initiatives or changes in the shape and direction of the government's efforts. The total budget request for cooperative threat reduction in the former Soviet Union is outlined in Table 1.

Table 1 - FY 2003 Budget Proposal for Cooperative Threat Reduction

(Dollars in Millions)

Program	FY 2001 Funding	FY 2002 Request	FY 2002 Appropriation	FY 2003 Budget	FY 2003 vs. FY 2002 Request (Percent)	FY 2003 vs. FY 2002 Approp. (Percent)
Department of Energy	**313.2**	**229.3**	**417.6**	**419.7**	**83.1%**	**0.5%**
Department of Defense	**450.4**	**417.6**	**411.7**	**428.3**	**2.6%**	**4.0%**
Department of State	**112.5**	**112.7**	**184.9**	**108.9**	**-3.4%**	**-41.1%**
Total, Cooperative Threat Reduction	**876.1**	**759.6**	**1,014.3**	**956.9**	**26.0%**	**-5.7%**

After September 11, Congress substantially boosted funding for programs focused on keeping weapons of mass destruction out of the hands of terrorists and defending against them on U.S. soil. The Department of Energy (DOE) received an extra $120 million for its Material Protection, Control, and Accounting (MPC&A) program, above the $171.9 million approved for the program in the FY 2002 Energy and Water Appropriations Act, a nearly 70 percent increase. Another $15 million extra (above the regular appropriations of $42 million) of the $40 billion Emergency Response Fund (ERF) was directed toward DOE's Russian Transition Initiatives, designed to shrink Russia's nuclear complex and provide civilian jobs for excess weapons experts in the former Soviet Union. In addition, the President approved $42 million in additional funding from the ERF for the State Department's Export Control and Border Security programs in Central Asia (above the estimated $40.7 million allocated to these programs through the regular process). In addition, a supplemental measure in the FY

---

the "Expanded Threat Reduction Initiative" in early 2000; (b) a small number of programs with clearly similar objectives that were left out of those analyses (such as U.S.-Russian warhead dismantlement transparency work funded by the Department of Energy); and (c) similar new initiatives that have begun since then (such as funding for take-back of vulnerable Soviet-supplied HEU to Russia). We do *not* include either the cost of parallel efforts that are taking place in the United States (such as the $350 million proposed for disposition of U.S. excess weapons plutonium) or the cost of initiatives that relate exclusively to safety, not security (such as the nearly $15 million DOE has proposed for the international nuclear reactor safety program), both of which are sometimes included in administration tallies of the proposed "cooperative threat reduction" budget. We have, however, included several Defense Department threat reduction programs that are more focused on conventional forces than on weapons of mass destruction, in order to conform to the common definition that includes the entire Former Soviet Union Threat Reduction account. Other threat reduction efforts that are not focused on the former Soviet Union (including a substantial fraction of the State Department's Export Control and Border Security program, for example) are also not included.

2002 Defense Appropriations Act directed that $30 million of unused FY 2000 balances be taken from the Department of Defense (DOD) and added into the new funding available to the State Department for its efforts to redirect the work of former Soviet biological weapons scientists.[7]

In sum, these increases tacked an extra $207.2 million, or nearly 26 percent, on to the $807.1 million appropriated for cooperative threat reduction through the regular appropriations process. Even in the initial appropriations process, Congress clearly rejected the funding levels proposed in the first Bush budget, and the administration acquiesced. But September 11 demanded a stark reevaluation of the threat posed by WMD materials and expertise in the states of the Former Soviet Union, and, as Table 1 shows, the Congress and the Bush administration responded by increasing the level of resources available to address that threat.

Roughly one month after the final FY 2002 appropriations bill became law, President Bush submitted to Congress his proposed budget for FY 2003.[8] The budget sets the war on terrorism overseas and the defense of the homeland as the top priority for the nation, and the administration states that in so doing it is proposing $38 billion for homeland security spending, an $18 billion increase over FY 2002 (a "virtual doubling," as the budget document itself proclaims).[9] The dramatic increase in resources leaves no doubt that the administration has determined that the threat facing the nation is grave enough to warrant decisive and immediate shifts in priorities and policies.

The information on the FY 2003 budget in Table 1, then, might come as a surprise: few expenses are being spared in securing the homeland and combating overseas terrorism, but the total budgets proposed for cooperative threat reduction programs are lower than those appropriated in FY 2002.[10] The contrast between the homeland security budget and the administration's approach to addressing the threat at its source – by securing the weapons of mass destruction, materials, and expertise in the former Soviet Union and around the world – could hardly be more stark.

---

[7] The FY 2002 appropriations also ordered the rescission of $32 million from the Department of Defense FY 2000 funds for the plutonium reactor shutdown program. The negative amount, like the $30 million described above, has been counted as part of the FY 2000 total funding level in this analysis. For specific bill language, see "Status of FY 2002 Appropriations Bills" (Washington, DC: Library of Congress, updated on January 15, 2002, available as of May 13, 2002 at http://thomas.loc.gov/home/approp/appover.html).

[8] On March 21, 2002, the President also submitted to Congress a request for additional $27.1 billion in supplemental FY 2002 funding. The Congress has not, as of early May 2002, acted upon the request, which included $19.4 million to improve the Department of Energy's emergency nuclear response capabilities.

[9] *Budget of the United States Government,* p. 17.

[10] The President's budget states that it is proposing $1.5 billion on cooperative threat reduction efforts, but this figure results from a broad definition of what should be included. In this definition, U.S. Plutonium Disposition is included, as is all DOE Nonproliferation and Verification Research and Development. See *Budget of the United States Government,* p. 26.

Table 2 - FY 2003 Budget for Securing Nuclear Material and Expertise

(Dollars in Millions)

Program	FY 2001 Funding	FY 2002 Request	FY 2002 Appropriation	FY 2003 Budget	FY 2003 vs. FY 2002 Request (Percent)	FY 2003 vs. FY 2002 Appropriation (Percent)
Securing Warheads and Materials	**353.2**	**222.2**	**381.3**	**318.5**	**43.4%**	**-16.5%**
DOE MPC&A[1]	170.5	138.8	291.9	233.1	67.9%	-20.2%
DOD Fissile Material Storage Facility-Russia	56.4	-	-	-	N/A	N/A
DOD Warhead Security-Russia	89.7	56.0	55.0	40.0	-28.6%	-27.3%
DOD Warhead Transport-Russia	14.0	9.5	9.5	19.7	107.4%	107.4%
DOE Kazakhstan BN-350 Reactor Project	15.9	8.9	15.9	8.1	-9.2%	-49.0%
DOE Russia/NIS Safeguards Sustainability	2.3	2.3	2.3	2.3	2.0%	2.0%
DOE Russian HEU Fuel Return	1.0	1.0	1.0	9.5	852.0%	852.0%
DOE RERTR Program	1.0	5.6	5.6	5.8	2.0%	2.0%
DOE Spent Fuel Storage & Repository	2.4	-	-	-	N/A	N/A
Interdicting Nuclear Smuggling	**48.0**	**53.8**	**91.3**	**84.3**	**56.8%**	**-7.6%**
DOE "Second Line of Defense"[2]	1.9	4.0	[24.0]	[24.0]	[500.0%]	[0.0%]
State Dep't. Export Control and Border Security[3]	44.0	40.7	82.9	35.4	-13.1%	-57.3%
DOD/FBI/USCS Counterproliferation	2.1	9.1	8.4	9.0	-1.3%	7.1%
DOD WMD Proliferation Prevention	-	-	-	40.0	N/A	N/A
Stabilizing Nuclear Custodians	**99.8**	**79.8**	**108.0**	**105.3**	**32.1%**	**-2.5%**
Russian Transition Initiatives[4]	50.8	28.8	57.0	39.3	36.8%	-31.0%
International Science and Technology Centers[5]	35.0	37.0	37.0	52.0	40.5%	40.5%
CRDF	14.0	14.0	14.0	14.0	0.0%	0.0%
Monitoring Stockpiles and Reductions	**26.1**	**23.0**	**23.0**	**34.9**	**52.0%**	**52.0%**
DOE HEU Transparency Implementation	14.6	14.0	14.0	17.2	23.5%	23.5%
DOE Warhead Dismantlement Transparency	9.5	7.5	7.5	16.2	115.3%	115.3%
DOE Trilateral Initiative	1.5	1.5	1.5	1.5	0.0%	0.0%
DOE Pu Registry	0.5	-	-	-	N/A	N/A
Ending Further Production	**32.1**	**41.7**	**41.7**	**49.3**	**18.3%**	**18.3%**
DOD Pu Reactor Shutdown Program	32.1	41.7	41.7	-	-100.0%	-100.0%
DOE Pu Reactor Shutdown Proposal	-	-	-	49.3	N/A	N/A
Reducing Excess Stockpiles	**39.5**	**15.0**	**19.0**	**34.0**	**126.7%**	**78.9%**
DOE Russian Pu Disposition	39.5	15.0	19.0	34.0	126.7%	78.9%
Other Nuclear Cooperative Efforts	**3.5**	**7.0**	**7.0**	**7.5**	**7.1%**	**7.1%**
State Dep't Nonprolif. and Disarmament Fund[6]	3.5	7.0	7.0	7.5	7.1%	7.1%
Total, Securing Nuclear Materials and Expertise	**602.1**	**442.4**	**671.2**	**633.9**	**43.3%**	**-5.6%**

[1] FY 2002 includes $120 million in supplemental funding.

[2] Rolled into MPC&A beginning in FY 2002 Appropriation.

[3] Limited to FSU states only. Includes $42 million in FY 2002 supplemental funding, and $18 million in FY 2003 in funding from the

[4] Includes $15 in FY 2002 supplemental funding.

[5] Includes unallocated amount FY 2003 funding for State Dep't. Biological Weapons Redirect program.

[6] Only funds specifically allocated to programs in the states of the Former Soviet Union, which typically constitute about half of NDF funding. Total of $15 million is proposed for FY 2003.

Of the nearly $1 billion requested for cooperative threat reduction activities in FY 2003, approximately two-thirds is focused on efforts related to securing, monitoring, or reducing nuclear weapons, materials, and expertise. These programs and their budgets are identified in Table 2. The pattern here is the same: the proposed FY 2003 budget reverses past Bush administration attempts to cut back these programs, but still represents a cut compared to what was appropriated in FY 2002.

The Budget by Department

Overall, proposed funding for DOE's former Soviet threat reduction activities is nearly identical to what it received last year for the same programs, while DOD's is moderately increased. (Actually, since $49 million in funding for the Russian Plutonium Reactor Shutdown program is being moved from DOD to DOE, the remaining programmatic activity for DOE is lower than FY 2002, while for DOD, it is higher.) At the same time, the State Department's level of new funding is very similar to the regular level of appropriations for FY 2002 and FY 2001, and is much lower than the FY 2002 total, which was an abnormally high level owing to the $72 million in the emergency supplemental for border security and BW redirection.

Department of Energy

DOE receives a very small increase over the final FY 2002 appropriated level in the administration's budget for FY 2003 for the Department of Energy's nuclear threat reduction programs in the Former Soviet Union. At first glance, the requested level appears to maintain the heightened level of new funding provided by the $135 million in supplemental funding provided as part of the Emergency Response Fund. However, as noted above, $49 million has been added to DOE's budget for it to run the Russian Plutonium Reactor Shutdown program. When that is factored in for an apples-to-apples comparison, overall funding proposed for FY 2003 is significantly lower than what Congress approved for FY 2002.

The President's budget proposes $233.1 million in new funding for DOE's flagship MPC&A program. This represents a $58.8 million cut below the total provided last year. This is justified on the grounds that the large FY 2002 appropriation will cover a range of activities that will continue into FY 2003, so that less new funding is required.[11] As noted earlier, for the near term this is probably correct, as the MPC&A program has substantial unspent balances resulting from difficulties with access to Russian facilities – now at least partly overcome, as described in Chapter 5 – and other bureaucratic obstacles that have been allowed to slow progress. But if an intensive effort to build an accelerated partnership with Russia actually occurs, as proposed in this report, additional resources are likely to be required. In comparing the MPC&A budget to those of previous years, it must be remembered that both the Second Line of Defense program (slated for $24 million in FY 2003) and a new initiative to control radiological sources that could be used in "dirty bombs" are now included in the MPC&A budget, along with its traditional focus on securing nuclear weapons and weapons-usable materials – and both could consume enormous resources in FY 2003.

[11] Department of Energy, *Detailed Budget Justifications—Defense Nuclear Nonproliferation,* pp. 115, 117, 119, 125. Several separate programs, including Material Conversion and Consolidation and Naval Nuclear Warhead Storage Sites, explain in the section titled "Detailed Program Justification" that the FY 2003 "Decrease [is] due to the ability to place several large comprehensive upgrade contracts during FY 2002 (from funds provided in the FY 2002 supplemental appropriation)…."

The President's budget proposes $39.3 million for the Russian Transition Initiatives account, which includes funding for both the Initiatives for Proliferation Prevention and the Nuclear Cities Initiative. This is a $17.7 million cut – nearly one-third – from the FY 2002 appropriation, $2.7 million less even than was appropriated before the emergency supplemental. In this case, it is very difficult to make a tenable argument that existing balances mean that more is not needed. Congress should consider returning this account to its FY 2002 appropriated level of $57 million.

The largest contribution to the apparent increase in DOE's nuclear threat reduction level over last year actually represents only a slight increase in programmatic activity. Following the December 2001 conclusions of the administration's review of nonproliferation and threat reduction assistance to Russia, the administration is transferring from the Defense Department to DOE the management and funding for a program aimed ending new Russian plutonium production.[12] This shows up as increase of $49.3 million in new funding being proposed for DOE. Last year the Defense Department received $41.7 million in new funding for this program.

Other notable moves in the programs aimed at preventing theft and smuggling of nuclear material include a significant increase in the new funding proposed for the Russian Highly Enriched Uranium (HEU) Fuel Return program, from approximately $1 million in FY 2002 funding to $9.5 million proposed for FY 2003, and a decline in the new amount of funding proposed for securing plutonium at Kazakhstan's BN-350 breeder reactor, from $15.9 million in FY 2002 to $8.1 proposed for FY 2003.

The Bush administration is also proposing to increase the level of new funding being provided for monitoring stockpiles and reductions. The budget proposes increases the amount of new funding by $3.2 million, or nearly 24 percent over the FY 2002 level of funding, for carrying out transparency measures in the implementation of the HEU deal between Russia and the United States. In addition, the budget more than doubles the new amount of funding proposed for DOE's efforts to develop measures for warhead dismantlement transparency, going from $7.5 million in FY 2002 to approximately $16.2 million of new funding proposed for FY 2003.

Following the administration's separate review, DOE's Russian Plutonium Disposition program is scheduled to receive $34 million in new funding, a $15 million increase over the level provided in FY 2002. Though not included in this analysis of the overall cooperative nuclear threat reduction budget, the President's budget also proposes increasing the pace of funding provided to DOE's efforts to dispose of the United States' own excess plutonium stockpiles.

[12] "Fact Sheet: Administration Review of Nonproliferation and Threat Reduction Assistance to the Russian Federation," The White House, Office of the Press Secretary, Washington, DC, December 27, 2001 (available as of May 13, 2002 at http://www.whitehouse.gov/news/releases/2001/12/20011227.html).

Department of Defense

Overall, the President's budget proposes a slight increase in the total funding for DOD's cooperative threat reduction efforts in the former Soviet Union, as Table 1 shows. However, as discussed above, the Plutonium Production Reactor Shutdown program has been transferred to the Energy Department, so the funding level represents a larger programmatic increase over that funded in FY 2002.

The administration is proposing, however, to decrease the level of new DOD funding for securing nuclear warheads in Russia. The budget seeks to reduce the amount of new funding being provided to the Russian Warhead Security program, down to $40 million from $56 million in FY 2002, a decrease of over 28 percent. This decrease is partially offset by an increase of $10.2 million, to $19.7 million, for the Russian Warhead Transportation program, which helps the Russian Ministry of Defense transport warheads from operational sites to secure storage facilities. The administration argues, probably correctly, that the decrease in warhead security funding will not substantially slow efforts in FY 2003, because of the substantial unspent balances already available to this program – resulting from having allowed past access obstacles to stymie most efforts to upgrade security at Russian nuclear warhead storage sites for some years.

In addition to slightly increasing the amount of new funding for DOD's collaborative effort with the US Customs Service and the FBI to interdict nuclear smuggling, the President's FY 2003 budget also seeks $40 million for the first year of a new initiative, called WMD Proliferation Prevention. It is believed that this program will be aimed at improving customs and border controls in the states of the Former Soviet Union, in tandem with Energy's Second Line of Defense program and the State Department's Export Control and Border Security program – but DOD officials report that details are still being fleshed out.[13]

Department of State

The President's FY 2003 budget request for the State Department mostly follows the overall funding pattern set by the regular FY 2002 appropriations level, minus the additional $72 million added in supplemental legislation.[14]

The budget proposes an estimated combined total of $35.4 million in new funding for export control and border security assistance for the states of the former Soviet Union.[15] The

[13] William Hoehn, "Analysis of the Bush Administration's Fiscal Year 2003 Budget Requests," op. cit., and interviews with DOD officials, April 2002.

[14] One significant change proposed is the movement of funding of most of the State Department's threat reduction programs out of the FREEDOM Support Act (FSA) account and into the Nonproliferation, Anti-terrorism, Demining and Related Programs (NADR) account. This will make it substantially easier to track the State Department's threat reduction budgets, because decisions on how FSA funds will be spent are often not made until well into the fiscal year, and are often not made public even then, whereas the handling of the NADR account is much more transparent (as are the budget justifications for this account).

[15] Most of this new funding is being requested in the NADR account, except for an estimated $18 million in the FREEDOM Support Act.

request treats the $42 million in Emergency Response Funds as a one-time event, not requiring replenished funding at the same level.

Another significant shift proposes merging the funding for the State Department Biological Weapons Redirection program with the International Science and Technology Centers funding. Though the BW Redirection program is only tangentially related to controlling Russia's nuclear expertise, it is included in this analysis in the Stabilizing Nuclear Custodians because the President's FY 2003 budget leaves it unclear how much will be allocated to each program.

Finally, the estimated funding level in the FY 2003 budget for the Civilian Research and Development Foundation (CRDF) is the same as FY 2002. In addition, as the note in the chart describes, the total funding for the Nonproliferation and Disarmament Fund (NDF) is proposed to be $15 million, up from $14 million in FY 2002. The level of support the NDF will dedicate in FY 2002 and FY 2003 to reduction of the threat posed by nuclear material and expertise in the states of the Former Soviet Union is as yet unknown. Typically, funds specifically allocated to programs in the states of the Former Soviet Union constitute about half of NDF funding, so a nominal figure of $7.5 million is counted here, up from $7 million in FY 2002.

Conclusion

Funding levels should be considered in terms of what those resources are intended to accomplish. If what will be accomplished with those budgets is not adequate for the task at hand, given all other constraints, then one should not view that budget favorably. As long as the former Soviet Union's nuclear material is not adequately secured, and as long as its expertise is not appropriately utilized, the United States faces a chillingly serious threat. Therefore, the measure of success in this effort is not dollars budgeted in a given year as compared to last year, or even dollars spent. Success comes only as that threat is reduced. By that measure, the President's FY 2003 budget still leaves far, far too much left undone.

3. A GLOBAL COALITION TO SECURE WEAPONS OF MASS DESTRUCTION

An essential element of the war on terrorism should be a struggle to ensure that all the weapons of mass destruction (WMD) and related materials worldwide are secure and accounted for. Toward that end, the United States should seek to build a "Global Coalition to Secure WMD."[1] The case for such a coalition rests on three simple points:

- The possibility of terrorist acquisition and use of WMD poses a serious and urgent security threat to nations around the world.

- Insecure WMD or WMD material anywhere is therefore a threat to everyone, everywhere.

- Given that WMD and WMD material exist in many countries, no state can resolve this threat to its security alone – security can only be achieved through cooperation, to ensure that stringent security standards are put in place everywhere.

Defense against serious threats to the vital interests of the state that can only be countered collectively is the traditional rationale for forming alliances.[2]

The United States, as the current leader of the global anti-terrorism coalition, the victim of the September 11 attacks, and the state that has devoted more resources than any other to securing its own stockpiles of WMD and related materials, is the natural leader of such a global effort. U.S. NATO and Asian allies and Russia would be essential participants and natural co-leaders of such a coalition. As Senator Richard Lugar (R-IN) has put it, the United States and its allies need to stand "shoulder to shoulder" in the war against catastrophic terrorism, "just as we confronted the Soviet Union during the Cold War," making "the same kind of political commitment to hammer out common objectives and policies and recast our institutions to meet this challenge."[3]

---

[1] Senator Richard Lugar and former Senator Sam Nunn have taken the lead in making the case for such a global coalition. See, for example, Richard Lugar, "NATO After 9/11: Crisis or Opportunity?" Address to the Council on Foreign Relations, March 4, 2002 (available as of May 13, 2002 at http://www.senate.gov/~lugar/030402.html); Sam Nunn, "Building Global Cooperation for Threat Reduction," Address to the Wilmington World Affairs Council, Wilmington, Delaware, March 11, 2002 (available as of May 13, 2002 at http://www.nti.org/c_press/c_index.html#speeches). See also Graham Allison and Andrei Kokoshin, "A US-Russian Alliance Against Megaterrorism," *The Boston Globe,* November 16, 2001 (available as of May 13, 2002 at http://ksgnotes1.harvard.edu/BCSIA/Library.nsf/pubs/AllianceMega). The authors are grateful for discussions of this concept, and sharing of unpublished papers on aspects of the idea, with Graham Allison, Ashton Carter, Charles Curtis, and others. While nuclear, chemical, and biological weapons, materials, and facilities do pose somewhat different issues, nonetheless it seems clear that a single coalition to address WMD generally – which would have specific activities within it focused separately on each of these key areas – would be more effective than attempting to build multiple separate coalitions.

[2] Steven Walt, *The Origins of Alliances* (Ithaca, NY: Cornell University Press, 1990).

[3] Lugar, "NATO After 9/11," op. cit.

Such a global coalition could function in a fluid manner, with each participant choosing the roles it wishes to play. Early participants would hammer out understandings on common standards of security and accounting for these stockpiles that should be reached, common approaches to upgrades, reasonable divisions of labor, and the like (see Chapter 7, "Leading Toward Stringent Global Nuclear Security Standards," p. 57). Key roles would include:

- ***Securing and accounting for domestic stockpiles.*** Every participant would be expected to ensure that its own stockpiles were secure and accounted for – or to ask for and permit the help it needs to do so. As Senator Lugar put it: "We have to make sure that every nation with nuclear, biological, or chemical weapons capacity accounts for what it has, secures what it has, and pledges that no other nation or group will be allowed access."[4]

- ***Beefing up interdiction.*** Interested participants would work together to strengthen all relevant countries' ability to detect, interdict, and investigate WMD theft and smuggling.

- ***Sharing intelligence.*** Just as in the current war on terrorism, in-depth sharing of intelligence – in this case on real or attempted theft and smuggling of WMD and related materials and technologies, and on security of these stockpiles – would also be a key element of participation in the coalition.

- ***Preparing for response.*** Coalition participants should work together to put in place the capability to respond effectively in the event of a credible WMD threat or attack – and to exercise those capabilities regularly. In particular, it would make sense to ensure that in the event of a nuclear threat or incident in another country participating in the coalition, capabilities similar to those of the U.S. Nuclear Emergency Search Team (NEST) were available.

- ***Helping with security and accounting upgrades.*** Given the scale of the threat, and the shadow it casts over all countries, some participants might also choose to join with the United States in making significant investments in a globalized cooperative threat reduction effort to help other countries secure and account for their stockpiles.

Such a global effort would have to focus not just on military stockpiles, but on all the stockpiles of materials from which a terrorist group would readily produce a weapon of mass destruction, whether military or civilian. As noted earlier, in the nuclear area, there are hundreds of civilian research reactors in 58 countries that are fueled with highly enriched uranium (HEU) – the easiest material from which to make a nuclear bomb. In the chemical and biological areas, civilian facilities and stockpiles are also critical concerns.[5]

---

[4] Sen. Richard Lugar, "Eye on a Worldwide Weapons Cache," *Washington Post,* December 6, 2001 (available as of May 13, 2002 at http://www.nti.org/c_press/c_index.html#opeds).

[5] For a discussion of security for civilian and military biological stocks, and the need for new global security standards in that area, see Michael Barletta, Amy Sands, and Jonathan B. Tucker, "Keeping Track of Anthrax: The Case for a Biosecurity Convention," *Bulletin of the Atomic Scientists,* May/June 2002.

Not every country will have the expertise and resources to move rapidly to ensure high levels of security for all its stocks of materials that might be used for weapons of mass destruction. Some will need help. Hence, such a global effort would require, in effect, globalizing the concept of cooperative threat reduction.

The difficulty of forging an effective coalition to secure all the world's stockpiles of WMD and related materials should not be underestimated. As with the current war on terrorism, it will take sustained engagement at the highest levels of governments to build and sustain the necessary partnerships in very sensitive areas. Cooperation with states with emerging nuclear weapons programs, such as Pakistan and India, will have to be handled with extreme care, in order to address the proliferation issues effectively while assuaging important sensitivities on all sides. In many cases, bilateral (and possibly even secret) cooperation will be more effective than trying to involve a large number of countries. Dealing with the WMD stockpiles in states not likely to participate in such a coalition – such as Iraq or North Korea – will be particularly challenging.

Russia: From Assistance to Partnership

Such a global coalition to secure WMD cannot succeed without active and dedicated Russian participation. Like the United States, Russia has experienced large-scale terrorism in its capital city and elsewhere; Russia has large stocks of WMD that must be secured; Russia has considerable expertise to bring to bear in helping other nations secure their stockpiles; and Russia has a range of political relationships with key states (including states the United States has little or no relationship with) that can be crucial in building their cooperation in this effort to secure global stockpiles. Fundamentally, as the two states with by far the world's largest nuclear and chemical stockpiles (and which once had the world's largest biological weapons programs as well), the United States and Russia bear a special responsibility to lead – first by securing their own WMD and related materials, and then in working with other states around the world to ensure that their stockpiles are secured as well. In this effort, rather than being a passive recipient of assistance, Russia could be a major leader and partner, working with the United States and others to help states around the world improve security and accounting for their stockpiles of WMD and related materials.

The upcoming May 2002 Bush-Putin summit would be an excellent moment to announce the launch of such a global alliance. The groundwork was laid at the November 2001 Crawford summit, where President Bush said that he and President Putin had agreed that "our highest priority is to keep terrorists from acquiring weapons of mass destruction."[6] At this summit, the two Presidents should:

- Announce that they will join in seeking to build an international coalition to secure all WMD and related materials worldwide, and invite other states to join them in that effort;

[6] "President Announces Reduction in Nuclear Arsenal**:** Press Conference by President Bush and Russian President Vladimir Putin," The White House, Office of the Press Secretary, Washington, DC, November 13, 2001 (available as of May 13, 2002 at http://www.whitehouse.gov/news/releases/2001/11/20011113-3.html).

- Designate keeping weapons of mass destruction out of the hands of terrorists as a top national security priority of both countries;

- Agree to sharply accelerate and strengthen their efforts (both unilateral and cooperative) to ensure that all WMD and related materials in their possession, and particularly nuclear weapons and materials, are secured and accounted for to stringent standards as rapidly as technology will allow;

- Agree that each President will designate a single senior official to report to him directly, and be accountable to him, for seeing that this overall effort moves forward as rapidly as practicable, and for quickly overcoming obstacles as they arise. These senior officials would be in constant contact to coordinate the cooperative efforts (see Chapter 4, "Single Leaders for U.S. and Russian Efforts to Secure Nuclear Weapons, Materials, and Expertise," p. 31).

In combination with the expected nuclear arms reduction agreement, such a Bush-Putin initiative on WMD control would build the post–Cold War relationship on shared vital interests. It would be a crowning achievement of this summit – and, if successful, would represent a vital legacy for both men in protecting future generations from the horror of mass-destruction terrorist attack.

Working in partnership with Russia in a global effort to secure WMD and related materials would also improve prospects for accelerated and strengthened U.S.-Russian cooperation to upgrade the security of Russia's own stockpiles of nuclear and chemical arms and materials (as well as its biological facilities), by putting the imprimatur of both Presidents on securing these stocks as a top national security goal. (See Chapter 5, "Accelerated and Strengthened Security Upgrades for Warheads and Materials in Russia," p. 35.) With Russia taking the role of partner in global leadership toward improved security, and not just recipient of U.S. assistance, could substantially improve political support for these efforts among the Russian political and security elite, and increase the priority the top Russian leadership places on them. At the same time, Russia could help make the case for such an effort in ways and in places the United States could never do alone. For example, of the 58 countries with HEU-fueled research reactors, roughly 40 received their HEU from the United States, and the remainder from the Soviet Union – giving Russia supply relationships with these countries that could be crucial in getting that HEU removed or secured. Russia continues to have a broad range of relationships with countries the United States would be unable to work with effectively – such as Iran, North Korea, Libya, and Belarus, to name but a few (all four of these have HEU-fueled research reactors, and all but Belarus have substantial chemical weapons programs).

Joint participation in a global coalition to secure WMD would help reverse an unfortunate trend toward U.S.-Russian threat reduction cooperation becoming ever more focused on the United States as donor and Russia as recipient, rather than a genuine partnership. On the U.S. side, there has been a tendency in many programs to take the view that since the United States is paying the piper, it should call the tune. On the Russian side,

and particularly at many Russian facilities participating in programs to upgrade security or re-employ weapons experts, this donor-recipient approach has fostered an unfortunate culture of dependency, in which the Russian side invests few of its own resources in accomplishing the common objectives, expecting the U.S. government to cover the entire tab. And on both sides, continuing suspicions and bureaucratic delays have undermined the partnership that is needed.

Shifting toward a true partnership approach is essential, though it cannot be accomplished overnight.[7] A real partnership is needed because ultimately, Russia's nuclear, chemical, and biological stockpiles and facilities are Russia's to protect: Russian support for and buy-in to all the approaches taken in upgrading security and accounting (from the top political level to the level of the individual guards and workers who must follow the new procedures) is essential to achieving lasting security for these stockpiles, as is a significant commitment of Russia's own resources.

A shift to a genuinely partnership-based approach will require some significant changes in approach on both sides. (See discussion in Chapter 5, "Accelerated and Strengthened Security Upgrades for Warheads and Materials in Russia," p. 35.) On the U.S. side, it will require integrating Russian experts into all aspects of the planning, design, and implementation of these cooperative efforts, including the development of truly joint strategic plans for how they will be accomplished – and designing the efforts to serve the security of both sides, equally. The United States will have to forego its occasional efforts to link continuation of these efforts to extraneous political issues, from Chechnya to Iran. More flexible approaches to the issue of access to sensitive facilities will be needed on both sides. Finally, a genuine partnership approach would also mean acknowledging that Russian expertise, and not just U.S. expertise, may be useful in solving proliferation problems – not only through involving Russian experts in upgrades elsewhere in the world, but also, for example, through joint development of improved safeguards and security technologies.

On the Russian side, in addition to the access issue, a genuine partnership approach would mean a commitment to put Russia's own resources into these joint efforts – both in the near term and in the longer term, to provide the resources necessary to sustain effective security and accounting for these stockpiles after U.S. assistance phases out. Russia's proliferation-sensitive exports and occasionally lax enforcement of its own export controls are key issues which will inevitably undermine efforts to build a genuine partnership. Russia's nuclear cooperation with Iran poses a particular problem. As the Baker-Cutler panel warned, "if Russian cooperation with Iran continues in a way that compromises nuclear nonproliferation norms, it will inevitably have a major adverse effect on continued

[7] See, for example, Kenneth N. Luongo, "Improving U.S.-Russian Nuclear Cooperation," *Issues in Science and Technology,* Volume 18, Number 1, Fall 2001 (available as of May 13, 2002 at http://www.nap.edu/issues/18.1/luongo.html); Siegfried S. Hecker, "Thoughts About an Integrated Strategy for Nuclear Cooperation with Russia," *The Nonproliferation Review*, Volume 8, Number 2, Summer 2001 (available as of May 13, 2002 at http://cns.miis.edu/pubs/npr/vol08/82/heck82.htm); and Hecker, Testimony to the Senate Committee on Foreign Relations, April 23, 2002.

cooperation in a wide range of other ongoing nonproliferation programs."[8] Ultimately, a partnership in securing WMD should be just a stepping-stone to rebuilding the broader nonproliferation partnership that the United States and the Soviet Union had – based on their shared vital interest in preventing the spread of WMD to additional states – throughout some of the darkest days of the Cold War. It was that partnership that built the Nonproliferation Treaty and other crucial agreements.

Seizing the Opportunity

The post-September 11 opportunity to build a global alliance to secure WMD will not last forever. If action is not taken soon, the chance to act will fade as the forces of business-as-usual strengthen. The time to act is now.

[8] Howard Baker and Lloyd Cutler, co-chairs, *A Report Card on the Department of Energy's Nonproliferation Programs with Russia* (Washington, DC: U.S. Department of Energy, Secretary of Energy Advisory Board, January 10, 2001, available as of May 13, 2002 at http://www.hr.doe.gov/seab/rusrpt.pdf).

4. SINGLE LEADERS FOR U.S. AND RUSSIAN EFFORTS TO SECURE NUCLEAR WEAPONS, MATERIALS, AND EXPERTISE

After September 11, there can be no doubt that keeping nuclear weapons out of the hands of terrorists and hostile states is a fundamental part of ensuring the security of the U.S. homeland – as crucial to U.S. security as is the mission of the Office of Homeland Security. Indeed, there were some in the White House and elsewhere who argued strongly – but unsuccessfully, in the end – that this mission should be included in that office's mandate.

Today, unlike the ingredients of homeland security embraced in the mandate of the office with that name, there is no one person in charge of keeping nuclear weapons out of terrorist hands. A patchwork quilt of important related programs is in place, spread through multiple Cabinet departments and independent agencies. Many of these are led by energetic and dedicated officials, and many of them are making significant progress in reducing the threat – but each is in its own "stovepipe," with no integrated overall plan. There is no senior official anywhere in the U.S. government with full-time responsibility for leading and coordinating the entire panoply of related efforts, setting priorities, eliminating overlaps, seizing opportunities for synergy – and keeping the mission of moving these programs forward on the front burner at the senior levels of the White House every day, as Governor Ridge does for homeland security. President Bush needs to appoint some one in the White House, who reports directly to him, who has no other mission but this – some one tasked to wake up every morning thinking "What can I do to keep nuclear weapons out of terrorist hands today?"[1] That official would be charged, in particular, with leading U.S. participation in the nuclear elements of a global coalition to secure weapons of mass destruction (WMD), as proposed in the previous chapter, including the many sensitive aspects of cooperation with countries around the world that will inevitably be involved in such an effort.

This need has been clear and compelling for years – long before September 11. The list of senior commissions and major reports that have highlighted this as a critical problem for U.S. efforts in these areas, and have called for the appointment of a senior official to correct the problem, is long. A panel of the President's Committee of Advisors on Science and Technology (PCAST) recommended the creation of such a position in 1995;[2] in the Nunn-Lugar-Domenici legislation, Congress attempted to direct that such an official be appointed in 1996 (after extensive hearings documented the need);[3] the Deutch Commission

---

[1] The need for such a single leader in the case of nuclear weapons and materials is clear and compelling. Chemical and biological weapons pose issues that are quite different, but in some respects equally challenging. A decision would need to be taken as to whether it made more sense to have the single leader focus only on nuclear issues – our focus here – and have others manage chemical and biological issues, or whether to have a single leader focused on keeping all weapons of mass destruction out of terrorist hands.

[2] Two of the present authors participated in that secret study, Holdren as chairman and Bunn as study director. For an unclassified summary of its recommendations, see John P. Holdren, "The Threat from Surplus Nuclear-Bomb Materials," Testimony to the U.S. Senate Foreign Relations Committee, Subcommittee on Europe, 104th Congress, 1st Session, August 23, 1995.

[3] U.S. Senate Committee on Government Affairs, Permanent Subcommittee on Investigations, *Global Proliferation of Weapons of Mass Destruction*, 3 volumes, 104th Congress, 1st Session, Senate Hearing 104-422 (Washington, DC: Government Printing Office, 1996).

on the organization of the government to deal with proliferation recommended the creation of such a position in 1999;[4] the Baker-Cutler Commission called for the creation of such a position in early 2001;[5] and the list goes on.[6] The time has come to act on these repeated recommendations.

The current organizational structure of the government, with programs scattered through many departments and no senior leadership engaged on a daily basis at the White House, is simply not suited to the task of managing the huge range of programs needed to address this threat. Effective and coordinated action to reduce these risks will require designating a senior, full-time point person for the effort, with appropriate staff and resources, and with direct access to and authority deriving directly from the President – at least on the model of former Secretary of Defense William Perry's return to government to reshape the U.S. approach to the North Korean nuclear and missile threat in the Clinton administration, or of the White House Office of National Drug Control Policy, the office of the "drug czar" who leads U.S. anti-drug efforts, if not on the model of the Office of Homeland Security. It is crucial that this be a full-time assignment, and not simply another in the myriad tasks facing the Vice President or the National Security Advisor; for otherwise other distractions will inevitably intervene. It is also crucial that such a coordinator have direct access to the President – both to give the coordinator the ability to rapidly raise key policy matters for immediate resolution when necessary, and to keep the President's attention on these issues – and that he or she have the authority needed to get the job done.[7] Preventing WMD from falling into the hands of terrorists is certainly no less critical to U.S. security than the other missions that have been deemed to warrant creation of leadership positions with this sort of access and authority.

Therefore a U.S. leader for these efforts would work closely with Russian officials, including a Russian counterpart leader, should one be appointed (see discussion below). More broadly, building and managing a global coalition to secure weapons of mass destruction would inevitably be a major focus of the efforts of such a single leader – and of other senior officials of the government. Working with the Cabinet secretaries to ensure that each of the individual programs has the effective management it needs would be another key task for the leader.

---

[4] John Deutch, chair, *Combating Proliferation of Weapons of Mass Destruction,* Report from the Commission to Assess the Organization of the Federal Government to Combat the Proliferation of Weapons of Mass Destruction (Washington, DC: Deutch Commission, July 1999, available as of May 15, 2002 at http://www.senate.gov/~specter/11910book.pdf).

[5] Howard Baker and Lloyd Cutler, co-chairs, *A Report Card on the Department of Energy's Nonproliferation Programs with Russia* (Washington, DC: U.S. Department of Energy, Secretary of Energy Advisory Board, January 10, 2001, available as of May 16, 2002 at http://www.hr.doe.gov/seab/rusrpt.pdf).

[6] For a cogent post-September 11 explication of the case for a Deputy National Security Advisor to oversee efforts to reduce threats from weapons of mass destruction, see Laura S.H. Holgate, Testimony to the Senate Committee on Governmental Affairs, Subcommittee on International Security, Proliferation, and Federal Services, November 14, 2001.

[7] For a detailed discussion of the organizational problems facing nonproliferation efforts in the U.S. government, see Deutch, *Combating Proliferation of Weapons of Mass Destruction*, op. cit. The Commission recommended a senior coordinator similar to that recommended here, but covering all nonproliferation issues throughout the government; unless such a coordinator had a substantial staff, comparable to the White House drug office, such a broad coordinator might be swamped with too many critical issues to be effective.

The wide range of programs needed to address this nuclear terrorism threat have many common purposes; the potential for synergy among them is enormous. In the area of nuclear-threat reduction work with Russia, for example, some programs require nuclear experts to design and build systems to secure, monitor, and reduce nuclear stockpiles; other programs are seeking to provide jobs for nuclear experts. Some programs require facilities to process plutonium or uranium; other programs are seeking to convert plutonium and uranium processing facilities once used for the weapons program to new missions. Many are dealing with the same Russian nuclear institutions and facilities, often with the same individuals. Mistakes made by one program will color Russian attitudes and affect other programs, just as good will generated by one program may make it easier for another to get in the door. While each of these programs has its own unique circumstances, all of them face the common problems and obstacles endemic to nuclear security cooperation with Russia.

Unfortunately, today these programs are being pursued individually, and though interagency coordination has improved over the past year, there is still virtually no systematic effort to pursue possible synergies. Moreover, it is clear that not everything on this broad agenda can be done with equal energy at the same time, yet there has been very little effort to identify which efforts are the highest priorities. Both Russian and U.S. officials working on these programs are suffering from "initiative overload" and are unable to keep track of all the important efforts under way. While there is some virtue in letting a thousand flowers bloom (with the understanding that only a fraction will bear fruit), the need for a clear set of priorities is becoming increasingly obvious.

To reinvigorate these efforts with new initiatives, to make them work as a package, to coordinate, prioritize, and integrate them into a strategic plan, to forge a global coalition to pursue these objectives around the world, and to negotiate specific measures with Russia and other participants in the global coalition, will require a dramatic increase in sustained leadership from the highest levels of the U.S. government. President Bush has clearly stated that keeping the world's most dangerous technologies out of the hands of the world's most dangerous people has to be "our highest priority."[8] It is now time to put some one in place with the power, access, resources, and responsibility to keep that priority on the front burner, develop a plan for addressing it, and see that the job gets done.

A Single Leader for Russian Nuclear Security Efforts as Well

The need for a single leader for efforts to ensure security and effective control for Russia's Cold War nuclear legacies is equally urgent in Moscow. The Soviet legacy has left Russia with a government system that is, if anything, more heavily bureaucratized than that in the United States. Significant decisions often have to be reviewed by many agencies with conflicting agendas and few staff to review them. To ensure that Russia's nuclear weapons and materials are secured and accounted for as rapidly as practicable – and that Russia plays an effective leadership role in a global coalition toward that end – President Putin should also

[8] "President Announces Reduction in Nuclear Arsenal**:** Press Conference by President Bush and Russian President Vladimir Putin," The White House, Office of the Press Secretary, Washington, DC, November 13, 2001 (available at http://www.whitehouse.gov/news/releases/2001/11/20011113-3.html).

appoint a single senior official, reporting directly to him, with responsibility to lead all aspects of securing these dangerous stockpiles and facilities. With single leaders in place on both sides of the Atlantic with the requisite access, resources, and authority, the chances of success in securing and accounting for all nuclear weapons and materials before disaster strikes would be immeasurably improved.

5. ACCELERATED AND STRENGTHENED SECURITY UPGRADES FOR WARHEADS AND MATERIALS IN RUSSIA

To prevent nuclear weapons terrorism, all nuclear weapons and weapons-usable materials must be secured and accounted for as rapidly as possible. Working with Russia, the United States should take immediate steps to meet the three key policy objectives of these efforts, ensuring that the two countries' nuclear stockpiles:

- Are secured and accounted for as rapidly as technology will allow;
- Are secured and accounted for to standards adequate to meet the threat; and
- Stay secured and accounted for the long term.

Cooperative U.S.-Russian efforts to install modern security and accounting systems for Russia's warheads and materials – replacing the "guards, guns, and gulag" approach of the past – have made substantial progress. Hundreds of tons of nuclear material and thousands of nuclear warheads are demonstrably more secure than they were a few years ago.[1]

But much more remains to be done than has been done to date. After eight years of effort, only about 40% of the nuclear material in Russia has had even "rapid upgrades" installed, and more effective "comprehensive" upgrades are in place for less than half of that 40%.[2] The Department of Energy (DOE) hopes to accelerate the upgrades so that they are completed by the end of 2008,[3] but achieving such a dramatic acceleration (much less the

---

[1] These programs include the Department of Energy (DOE) Material Protection, Control, and Accounting (MPC&A) program, which is working with Russia to upgrade security and accounting for weapons-usable nuclear material and Navy warheads; the Department of Defense (DOD) Cooperative Threat Reduction (CTR) projects on warhead storage security and warhead transportation security, which are working to upgrade security and accounting for the rest of Russia's warheads; and the CTR Fissile Material Storage Facility (FMSF), which is designed to provide secure storage for 50 tons of plutonium from dismantled warheads, and is scheduled for completion in the fall of 2002. For descriptions of the MPC&A program, see *MPC&A Program Strategic Plan* (Washington, DC: U.S. Department of Energy, July 2001); U.S. General Accounting Office, *Nuclear Nonproliferation: Security of Russia's Nuclear Material Improving; Further Enhancements Needed,* GAO-01-312 (Washington, DC: General Accounting Office, February 28, 2001, available as of May 16, 2002 at http://www.gao.gov/cgi-bin/getrpt?rptno=GAO-01-312); and Oleg Bukharin, Matthew Bunn, and Kenneth N. Luongo, *Renewing the Partnership: Recommendations for Accelerated Action to Secure Nuclear Material in the Former Soviet Union* (Washington, DC: Russian-American Nuclear Security Advisory Council, August 2000, available as of May 16, 2002 at http://www.ransac.org/new-web-site/pub/reports/mpca2000.pdf).

[2] DOE estimates that 42% of the weapons-usable nuclear material will have rapid upgrades installed by the end of FY 2002, with 18% having comprehensive upgrades installed by that time; DOE estimates that 15% of the material had comprehensive upgrades installed by the end of FY 2001, so only an additional 3% is expected to have comprehensive upgrades installed during FY 2002. If that pace were not accelerated, it would require an additional 27 years to complete the comprehensive upgrades. See U.S. Department of Energy, *FY 2003 Budget Request: Detailed Budget Justifications—Defense Nuclear Nonproliferation* (Washington, DC: DOE, February 2002, available at http://www.cfo.doe.gov/budget/03budget/content/defnn/nuclnonp.pdf), p. 24 and pp. 103-106.

[3] Ibid.

still faster pace we propose) will require some new approaches, as discussed below. Meeting the second two objectives – security standards adequate to meet the threat, and ensuring that security standards will be sustained over time – is also likely to require new approaches.

The picture for security upgrades for warheads is much the same: while there has been considerable progress in improving security for warhead transport (the most vulnerable part of the warhead life cycle), in providing some national-level infrastructure, and in upgrading security at naval warhead sites, because of disputes over access little progress has been made in upgrading security for the sites where most of Russia's nuclear warheads are stored. Since September 11, the Department of Energy and the Department of Defense, working with Russian counterparts, have sought to accelerate these efforts, and in particular, as discussed below, each has made significant progress on the crucial issue of access to sites where the cooperative upgrades are to take place – but much more still remains to be done.

The nuclear arms reduction agreement to be signed at the Moscow summit represents a major step forward for international security. But with respect to reducing the danger of nuclear theft and terrorism, it represents a missed opportunity – because the warheads to be reduced will be kept in storage, where they might be vulnerable to theft, with no joint monitoring or checks on their security.[4] Moreover, tactical nuclear warheads are not addressed at all – but these warheads pose a particularly serious terrorist threat, as they are often more portable than strategic warheads, and many may not be equipped with modern electronic locks to prevent unauthorized use.[5] Simply requiring that warheads be dismantled might not reduce the risk of nuclear terrorism, as the plutonium and HEU they contain could still be tempting targets for theft that would have to be effectively secured and accounted for. But there remains an opportunity for a next-phase accord that could substantially reduce this threat, by requiring that (a) each side place their excess warheads (including both the strategic warheads reduced under recent agreements and a substantial fraction of their tactical warheads) in highly secure storage facilities with joint monitoring; (b) these monitored warheads be dismantled verifiably, once procedures for doing that while protecting sensitive information had been agreed; (c) the plutonium and HEU from these dismantled warheads be placed in highly secure, jointly monitored storage facilities (such as the Mayak storage facility now nearing completion in Russia); and (d) these plutonium and HEU stockpiles, along with other excess plutonium and HEU, be eliminated, using secure, agreed procedures, as rapidly as practicable.[6] With such an approach, thousands of potentially vulnerable

[4] For a critique of this approach, see Tom Z. Collina and Jon B. Wolfsthal, "Nuclear Terrorism and Warhead Control in Russia," *Arms Control Today,* April 2002 (available as of May 15, 2002 at http://www.armscontrol.org/act/2002_04/colwolfapril02.asp).

[5] See, for example, Alistair Millar, "The Pressing Need for Tactical Nuclear Weapons Control," *Arms Control Today,* May 2002 (available as of May 15, 2002 at http://www.armscontrol.org/act/2002_05/millarmay02.asp); and William Potter, Nikolai Sokov, Harald Müller, and Annette Schaper, *Tactical Nuclear Weapons: Options for Control* UNIDIR/2000/20 (Geneva, Switzerland: United Nations Institute for Disarmament Research, 2000, available as of May 15, 2002 at http://www.unog.ch/UNIDIR/TNWPott.pdf).

[6] For an earlier proposal along these lines, see Matthew Bunn, "Act Now, Mr. President," *Bulletin of the Atomic Scientists,* March/April 1998 (available as of May 15, 2002 at http://ksgnotes1.harvard.edu/BCSIA/Library.nsf/pubs/actnow). For warheads using modern hollow-shell "boosted" primaries, technology also exists that would allow the stored warheads to be verifiably and permanently disabled, so that they could not go off, pending eventual dismantlement. See Matthew Bunn, "'Pit-Stuffing': How to Disable Thousands of Warheads and Easily Verify Their Dismantlement," *Federation of*

nuclear warheads could be placed in secure storage facilities, open to joint monitoring, within a few months.[7]

Accelerating the Pace

To succeed in getting these stockpiles as secure as possible as fast as possible, the United States and Russia will have to (a) rebuild a partnership approach that can sustain broad Russian support; (b) set an agreed deadline; (c) jointly develop a strategic plan to meet the deadline; (d) provide the necessary resources to carry out the plan; (e) resolve the access issues; and (f) overcome the many bureaucratic obstacles. Achieving these goals will require sustained, high-level leadership attention in both Washington and Moscow, focused on driving the process forward and overcoming obstacles as they arise.

Building a renewed partnership approach

Much of the work that remains to be done is at highly sensitive nuclear-weapons-complex facilities or nuclear-weapon storage sites. This work will simply not get done quickly without genuine enthusiasm for moving it forward on the part of Russian government officials, military leadership, and site managers – which is only likely to be forthcoming if the work is implementing approaches that they understand and had a hand in designing. And sustaining security over time will also require that Russian officials and experts, from the President and Prime Minister down to the guards and workers using the security and accounting systems every day, "buy in" to the need for the new approach to security and accounting of nuclear weapons and nuclear material. However much American experts have learned about Russian facilities, moreover, Russian safeguards approaches, Russian rules and regulations, and the Russian bureaucratic system in recent years, Russian experts inevitably understand these matters better than Americans do. For all these reasons, building a genuine partnership in which Russian experts are integrated into, and come to support, all aspects of the planning, design, and implementation of the effort is crucial to success.

Unfortunately, in recent years some of the U.S. programs have too frequently taken a "made in America" approach, drafting strategic plans without any Russian input, setting standards for what security levels should be achieved and how without any Russian input, and reviewing progress in the programs without asking the Russians for their assessments. As might be expected, these approaches have provoked considerable negative reactions on the Russian side, significantly undermining progress in some areas.[8]

American Scientists Public Interest Report, March 1998 (available as of May 15, 2002 at http://ksgnotes1.harvard.edu/BCSIA/Library.nsf/pubs/pitstuff).

[7] Large central storage facilities for nuclear warheads already exist in both the United States and Russia, whose security could be upgraded as needed.

[8] See discussion in Bukharin, Bunn, and Luongo, *Renewing the Partnership,* op. cit; see also Siegfried S. Hecker, "Thoughts About an Integrated Strategy for Nuclear Cooperation With Russia," *The Nonproliferation Review*, Volume 8, Number 2, Summer 2001 (available at http://cns.miis.edu/pubs/npr/vol08/82/heck82.htm). For a Russian perspective, see Gennadi Pshakin, Vladimir Samsonov, and Victor Erastov, *U.S.-Russian Collaboration on Nuclear Materials Protection, Control, and Accounting* (Obninsk, Russia: Institute for Physics and Power Engineering, Analytical Center for Nonproliferation, April 2002).

Today, with President Putin firmly committed to U.S.-Russian partnership after September 11, there is a new opportunity to shift course and renew the partnership between U.S. and Russian experts in securing nuclear weapons and materials in Russia. Specifically, this strengthened partnership should include the following elements, some of which are discussed in more detail below:

- Rapidly developing a truly joint strategic plan for the effort, allocating both U.S. and Russian resources (see discussion below);

- A more flexible approach on both sides to the key issue of access to sensitive facilities, and more broadly to providing assurances that U.S. taxpayer funds are being spent as intended (see discussion below);

- A Russian commitment to begin putting Russia's own resources into security and accounting upgrades, and to joint planning of those investments to avoid gaps or overlaps;

- Jointly agreeing on the security and accounting standards to be pursued in the effort, and the approaches to be taken, building from both the U.S.-developed guidelines and Russia's own regulations;[9] and

- Incorporating Russian views and inputs into the reviews of progress at individual sites.

Setting a deadline

The United States and Russia should agree to aim for having "quick fixes" or "rapid upgrades" for *all* nuclear weapons and weapons-usable nuclear material in Russia finished within 2 years, and completing the comprehensive security and accounting system upgrades within 2 years after that (that is, by mid-2006). With energetic leadership on both sides, a genuine partnership approach, resolution of the access issue and other bureaucratic obstacles, and sufficient resources, that goal could be met. The United States and Russia should enunciate this goal at the highest levels, and design their cooperative programs to achieve it. There would still be more work to be accomplished after that deadline – focusing both on sustaining the improvements that had been made and on further upgrades to still higher standards – but the main security risks would have been addressed by then.

[9] Where U.S. and Russian views of what security upgrades are worthwhile to invest in continue to differ even after the two sides have talked through the reasons for their views, it would make sense to allocate U.S. resources to those upgrades identified as most important by U.S. experts, and Russian resources to the additional upgrades Russian experts believe are also important. (Russian resources might contribute to upgrades at outer perimeter fences, for example, which U.S. experts argue are less important.) Similarly, if there are particular areas where it proves impossible to work out access or assurance arrangements satisfactory to both sides, Russian resources might be used to do the needed upgrades.

A joint strategic plan

To meet the ambitious schedule we propose, it is likely to be essential for U.S. and Russian experts to work out a joint overall plan to meet the deadline. (One model for such an effort would be the joint lab-to-lab nuclear material protection, control, and accounting (MPC&A) plan developed in 1994-1995.) Getting the buy-in of the senior leadership of Russia's Ministry of Atomic Energy (MINATOM) and the relevant parts of the Ministry of Defense (MOD) for a comprehensive, accelerated program will be crucial, and giving their experts a role in planning the effort will be an important part of achieving that. Specific joint plans should be developed with the leaderships of each of the large Ministry of Atomic Energy (MINATOM) nuclear weapons complex sites, designed to fit the timetables in the overall plan. DOE has recently had some important initial success in getting MINATOM to consider undertaking "omnibus" contracts for comprehensive security and accounting upgrades at some of the largest nuclear weapons complex sites – but there is still much more to do if a truly joint plan to meet a substantially accelerated schedule is to be achieved.

Flexible approaches to access and assurances

In recent years, a combination of U.S. insistence that cooperative upgrades could not go forward without U.S. personnel having direct access to all the facilities where they would be installed, and Russian refusal to provide access at some sensitive facilities, has been the principal obstacle slowing progress in upgrading security and accounting for both nuclear material and nuclear warheads. Since September 11, DOE's MPC&A program and DOD's warhead storage security project have both reached new agreements on access – but the proof is in the implementation of these accords, which is only just beginning.[10] Unless suspicion between the United States and Russia entirely disappears, it remains likely that there will be some places where nuclear weapons or weapons-usable materials are located where U.S. personnel simply will not be allowed to go (just as there are some places in the United States where security officials would not let Russians go). Flexibility on both sides will be needed.

The recent agreements are clear indications of new flexibility on the Russian side, and it will be important to ensure that they are actually implemented. At the same time, this flexibility needs to be matched on the U.S. side, with greater recognition of the genuine security sensitivity of some of these sites, and of the impact of entirely one-sided inspection demands on Russian national pride – which is especially strong in the nuclear area.

[10] DOE's MPC&A program signed an access agreement in September 2001, which has already unlocked new contracts at several sensitive facilities. The Russian side has not turned down any site visit requests since the agreement was signed – but there remain substantial areas of a number of the largest nuclear weapons complex facilities where no access has yet been granted. (Interviews with DOE and laboratory officials, March and April 2002.) For DOD's warhead security project, as of April 2002, Russian Prime Minister Mikhail Kasyonov had approved a new access approach that was expected to allow both "quick fix" and comprehensive upgrades to move forward – but progress was then stymied by the U.S. decision not to certify Russia's commitment to complying with arms control agreements, which has temporarily blocked obligation of Department of Defense Cooperative Threat Reduction funds. Program officials hope this logjam will be overcome in the summer of 2002, allowing warhead security upgrades to move forward. (Interviews with Defense Threat Reduction Agency officials, March and April 2002.)

The U.S. government should offer Russian experts reciprocal access at U.S. facilities engaged in comparable activities. Offering to let the Russians see the same things the U.S. wants to see will help build trust, undermine the argument that the United States is spying through such visits, familiarize additional Russian experts with how similar security and accounting issues are addressed in the U.S. system, and make clear to U.S. officials just how difficult and sensitive it is to arrange the kinds of access they are seeking in Russia. Offering such reciprocity will help overcome access barriers, and thus accelerate progress in upgrading security and accounting at sensitive facilities.

The U.S. government should also be willing to accept, in certain limited circumstances, the possibility of providing assurance that the taxpayer's funds are being spent appropriately without the physical presence of U.S. personnel. A variety of innovative approaches have been developed to accomplish this objective, including provision of photos and videotapes of installed equipment, detailed reports on the day-to-day performance of the equipment, and the use of "trusted agents" – Russians with Russian security clearances employed by U.S. contractors, who can confirm that particular work has been done.[11] Senior DOE and DOD officials need to work closely with Congress in making the case that it is possible to have high confidence that U.S. assistance is being used appropriately even in the absence of direct U.S. access to these sensitive facilities. Ultimately, if it comes to a trade-off, the U.S. government has to ask itself: "is it more important to ensure that nuclear warheads and materials do not go missing, or to ensure that a few dollars do not go missing?" Posed in that way, the answer to the question should be obvious.[12]

Providing necessary resources

Adequate resources will be fundamental to meeting any agreed deadline. The U.S. government can no longer afford – if it ever could – to allow progress in securing nuclear weapons and materials to be slowed by lack of funds or personnel devoted to the task. Recognizing this urgent need, in the emergency supplemental appropriation approved after the September 11 attacks, Congress provided hundreds of millions of dollars in additional funding for securing weapons-usable nuclear material and related efforts. As a result of that Congressional initiative (and the buildup of unspent balances resulting from past delays) the funding available in fiscal year (FY) 2002 is adequate to carry out upgrades at the maximum pace the current structures and approaches can sustain – though if new goals are set and a new partnership built, more funds may be needed at peak years in the future. If there is only modest acceleration in these efforts beyond the current pace, the reduced Bush administration request for some of these efforts in FY 2003 will be adequate. But more may be needed if a major acceleration is achieved, and Congress and the administration should act to keep that option open. Once a strategic plan to meet an accelerated deadline has been developed, Congress and the administration need to be willing to provide the necessary resources.

[11] This "trusted agent" approach has been used in the CTR warhead transport project, to confirm that train trips paid for with U.S. funds really are carrying warheads to dismantlement facilities.

[12] For an extended discussion of the access issue and past U.S. mishandling of it, see Bukharin, Bunn, and Luongo, *Renewing the Partnership,* op. cit., pp. 71-78.

Sweeping aside bureaucratic obstacles

Finally, sustained leadership from high levels will be needed in both Washington and Moscow to sweep aside the myriad bureaucratic obstacles that arise in programs of this kind. Two of the biggest factors slowing progress at present are the Russian inability to process and implement contracts quickly in sensitive areas,[13] and the still extended U.S. process for travel approvals. These are the kinds of issues that can absorb inordinate amounts of the time of the experts implementing programs, if senior officials do not put in the effort to resolve them.

Strengthening Security

It is critically important to ensure that the security and accounting systems installed in such joint efforts are adequate to defeat the threats they are likely to face. This raises the obvious question: "how much is enough?" Obviously it will not be possible in the near term to make a Fort Knox of every facility with plutonium or highly enriched uranium (HEU) – and it is surely more important to get all the materials upgraded to at least a minimum effective level first, rather than securing some material to a very high standard while leaving the rest unprotected. But it is equally crucial to ensure that the designs of the security systems do not underestimate the likely threats.

There are two issues here: how large the "design basis threat" that security systems should be designed to defeat should be, and how best to ensure that the systems as they are being installed and operated can in fact defeat the threats they are designed for. The United States and Russia need to (a) reach agreement on at least the general outline of the design basis threat the jointly installed security systems are to be designed to meet; and (b) put in place a program of regular vulnerability assessments and realistic performance tests to monitor each site's ability to protect itself against the agreed threat.[14] The MPC&A program has begun installing so-called Maintenance and Operations Monitors (MOM) – security cameras and other sensors – to give site managers, headquarters personnel, regulators, and U.S. experts new abilities to monitor how the installed equipment is actually being used, and how procedures are actually being followed, day-to-day.[15]

[13] Russia's government processes in these areas are even more heavily bureaucratized than those of the United States. Each contract has to be reviewed by a number of offices and agencies (including the security agencies that succeeded the KGB), but the relevant agencies often have very few personnel devoted to international cooperative projects, who can keep the process moving. On both sides of the Atlantic, it is not unusual for a particular project to get caught in a bureaucratic hurdle for weeks or months at a time, without any senior officials actually being opposed to it –- but this happens even more often in Moscow than in Washington.

[14] For a discussion of the importance of performance testing and how the United States might help foster the establishment of entities to conduct realistic performance tests in Russia, see Bukarin, Bunn, and Luongo, *Renewing the Partnership,* op. cit., pp. 79-86.

[15] Office of International Material Protection and Cooperation, *MPC&A Operations Monitoring (MOM) Project* (Washington, DC: U.S. Department of Energy, February 2002).

Sustaining Security

Finally, it is crucial to build Russia's capacity and commitment to sustaining security for these stockpiles into the future, long after U.S. assistance phases out. The transition from dependence on U.S. funding to sustainable security based on Russia's own resources is fundamental to an "exit strategy" for these programs.[16]

The DOE MPC&A program has been working on a broad range of aspects of the sustainability problem for several years. There is an increasing focus on installing "inherently sustainable" upgrades (the classic example being the large concrete blocks placed on top of thousands of potentially vulnerable plutonium canisters at Mayak). There are programs to develop an indigenous Russian infrastructure for equipment operation and maintenance, and security system design and upgrades. There are extensive training programs to build up an adequate cadre of Russian experts trained in modern safeguards techniques. There are also education programs focused on building a strengthened nonproliferation and safeguards culture – a critical aspect that deserves further attention. An important further step would be for the DOD warhead security projects also to begin focusing seriously on what will be needed for Russia to be able to sustain effective security after upgrades are installed.

While there are many essential elements to building up a sustainable modern security and safeguards culture in Russia, three in particular stand out as needing more attention. First is the problem of Russian commitment. The United States should seek a clear commitment from the Russian government to provide its own resources to sustain and improve the security and accounting systems now being put in place once U.S. assistance phases out. Russian nuclear facilities are not likely to be able to take on funding responsibility for nuclear security and accounting for their own material overnight, but it is important to begin the process and gain high-level Russian commitment to following it through.

The second key issue is to get the *incentives* faced by all the participants in the Russian system pointing in the right direction. In particular, as long as Russian site managers have budgets that force them to look for places to cut back, and at the same time face little risk of serious penalty for failing to maintain adequate security and accounting, they can be expected to cut safeguards and security budgets, and the goal of sustainable security will not be achieved. Thus it is crucial to build up effective regulation in Russia, so that managers know that they have to meet stringent standards to avoid being fined or shut down. This should include working not only with GOSATOMNADZOR, the Russian equivalent of the Nuclear Regulatory Commission, but also with internal MINATOM regulators, and the MOD group charged with regulating military nuclear materials both at MOD and at MINATOM. It would also be a useful and important step for the United States to 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

[16] The term "exit strategy" should not be interpreted too literally. Even if an accelerated effort can succeed in completing all comprehensive upgrades within four years, limited funding for specific sustainability and further upgrade projects should be maintained for a significant period thereafter.

work to convince other leading nuclear states to do the same. (See Chapter 7, "Leading Toward Stringent Global Nuclear Security Standards," p. 57.)

The third key problem is to drastically reduce the number of buildings and facilities where nuclear warheads, plutonium, and HEU are stored. The surest way to prevent nuclear theft from a building is to remove all the nuclear weapons or materials from it – and the smaller the number of buildings and facilities to be secured, the lower the cost of ensuring effective security. The MPC&A program has an effort in place to consolidate material at fewer locations, and dozens of buildings in Russia that once held plutonium or HEU no longer do – but much more remains to be done. In particular, it will be important to offer incentives targeted to the needs of each facility to convince facilities to give up their HEU or plutonium.[17] (See Chapter 6, "Global Cleanout and Secure: Eliminating or Securing Stockpiles of Weapons-Usable Material," p. 45.) The United States should begin discussing with Russia the desirability of a substantial consolidation of warhead storage areas, as well.

Moving Forward

There remains an enormous amount to do to ensure that all the nuclear weapons and weapons-usable nuclear materials in Russia are sustainably secured against the post-September 11 threat. This effort is fundamental to the security of Russia, the United States, and the world: if even one bomb's worth of material fell into the hands of a terrorist group like Al Qaida, the history of the world might be changed forever. Hence, these efforts must be placed at the very top U.S.-Russian security agenda. The United States should make clear that quick progress in this area is a fundamental requirement for improved nuclear relations, something to be emphasized at every level on every occasion until the problem is adequately addressed (as is now done with issues such as cooperation with Iran, to take one example). The United States should also work to convince other leading nuclear powers to take a similar approach. While there is much to do, with sustained high-level leadership in both Washington and Moscow focused on building a new partnership to get this job done, it should be possible to secure all of these stockpiles to an initial, interim level within two years, and complete comprehensive upgrades within four years. That would be an outstanding security legacy for President Bush and President Putin to leave to their successors

[17] For discussion, see Bukharin, Bunn, and Luongo, *Renewing the Partnership,* op. cit., pp. 13-20.

6. GLOBAL CLEANOUT AND SECURE: ELIMINATING OR SECURING STOCKPILES OF WEAPONS-USABLE MATERIAL

In the aftermath of September 11, the time has come to establish a fast-paced, focused program to eliminate stocks of highly enriched uranium (HEU) and plutonium – the essential ingredients of nuclear weapons – wherever they are no longer needed, and upgrade security and accounting for these materials, and for nuclear weapons themselves, wherever they will remain. As former Senator Sam Nunn has said, "An acceptable level of accountability, transparency, safety and security must be established and maintained in every nation that has nuclear weapons or dangerous nuclear material."[1]

Such an effort would be a central element of the global expansion of cooperative threat reduction that Sen. Richard Lugar (R-IN) has proposed – and indeed, Sen. Jean Carnahan (D-MO) has proposed legislation designed in part to initiate a global cleanout and secure effort similar to that proposed in this chapter.[2] It is crucial to emphasize that this would *not* be an effort by the United States to disarm everyone else, or seize control of other countries' nuclear stockpiles, but an international cooperative effort to ensure that all HEU and plutonium stocks were secure and accounted for – and to avoid wasting money and incurring risk by guarding these materials at scores of sites where they are no longer required.

Plutonium and HEU – the essential ingredients of nuclear weapons – exist in dozens of countries, in hundreds of buildings. As noted earlier, there are 345 operational or shut-down research reactors fueled with HEU in 58 countries. Eight countries have large quantities of separated plutonium in their civilian nuclear-energy programs. A large number of the facilities in the world with HEU or plutonium no longer have any real need for this material, and cannot afford the substantial costs of the security force and equipment required to secure it effectively. Security at these hundreds of buildings varies widely, from excellent to appalling. In some cases security is provided by a single sleepy watchman and a chain link fence. Yet vulnerable nuclear material anywhere could be stolen and made into a terrorist bomb that would be a threat to everyone, everywhere. In short, the threat of nuclear theft is *not* limited to the former Soviet Union. A global effort is needed to address this threat by ensuring that all vulnerable stockpiles of plutonium or HEU are either eliminated or provided with high levels of security as rapidly as practicable – and that nuclear weapons themselves are secure as well. Such a global program can build on, and complement, the existing cooperative threat reduction efforts in the former Soviet Union.

---

[1] Sam Nunn, "Building Global Cooperation for Threat Reduction," Address to the Wilmington World Affairs Council, Wilmington, Delaware, March 11, 2002 (available as of May 13, 2002 at http://www.nti.org/c_press/c_index.html#speeches).

[2] See "Lugar Introduces Nunn-Lugar Expansion," press release, Office of Senator Richard Lugar, Washington, DC, March 18, 2002 (available as of May 13, 2002 at http://www.senate.gov/~lugar/031802.html). Sen. Lugar's bill is S. 2026, introduced on March 18, 2002. See also "Carnahan Introduces Legislation to Help Safeguard Nuclear and Radiological Materials," press release, Office of Senator Jean Carnahan, Washington, DC, May 7, 2002 (available as of May 13, 2002 at http://carnahan.senate.gov/Press2002/may_7_2002.htm). Sen. Carnahan's bill is S. 2470.

Such an effort is most urgently needed for small, insecure stocks, such as those at civilian research reactors. Cooperation to ensure that effective security and accounting arrangements are in place for nuclear weapons themselves in those countries that have them – and for the large civilian stockpiles of separated plutonium in those countries that use this material in their civilian nuclear energy programs – is also important, but will in many cases be more difficult and sensitive, and will have to be pursued carefully, on a case-by-case basis. Both a fast-paced global effort for the small, insecure stockpiles and tailored approaches to these more sensitive stocks are discussed in this section.

Eliminating or Securing Insecure Weapons Material Stockpiles

The need for an accelerated effort in this area was vividly highlighted recently by the scientist Armando Travelli, who has long led efforts to develop proliferation-resistant low-enriched fuels to replace the HEU in research reactors:

> Today we know that if a nuclear weapon were to fall in the hands of those who organized the September 11 attacks there would be no threats and no negotiations. Millions [sic] of innocent victims would die in a flash, without warning, killed by people driven by a twisted ideology and devoid of any respect for human life, including their own.
>
> It is with this terrible vision in mind that we must face the task ahead of us: how to remove from civilian traffic any amount of highly enriched uranium that a terrorist could use to manufacture an explosive device. Achieving this goal will eliminate one of the most dangerous pathways that a terrorist could follow.[3]

The proliferation risk posed by HEU in research reactors is not hypothetical, but real. Thefts of uranium from research reactors have already occurred, both from within in the former Soviet Union and elsewhere (such as the fuel from Congo's research reactor that recently showed up in the hands of the Italian Mafia).[4] And the problem extends to state use of the HEU as well: Iraq planned to use both fresh and irradiated HEU from its research reactor in its "crash" program to make a single bomb as quickly as possible after the invasion of Kuwait.[5]

---

[3] Armando Travelli, "Progress of the RERTR Program in 2001," paper presented at the International Conference on Research Reactor Fuel Management (RRFM 2002) Ghent, Belgium, March 17-20, 2002. With a pure fission bomb that a terrorist group might make from HEU, it is likely that tens of thousands, rather than millions, would die in the first flash.

[4] Jeffrey Fleishman, "Sting Unravels Stunning Mafia Plot," *Philadelphia Inquirer*, January 12, 1999 (summarized in *NIS Nuclear Trafficking Database*, available as of May 13, 2002 at http://www.nti.org/db/nistraff/1999/19990110.htm). For a similar discussion of the threat posed by HEU at research reactors around the world after September 11, see George Bunn and Lyudmila Zaitseva, "Efforts to Improve Nuclear Material and Facility Security," in *SIPRI Yearbook 2002* (Stockholm, Sweden: Stockholm International Peace Research Institute, forthcoming).

[5] For a discussion of Iraq's "crash" program, see International Atomic Energy Agency (IAEA), *Fourth Consolidated Report of the Director General of the International Atomic Energy Agency Under Paragraph 16 of Security Council Resolution 1051 (1996)*, IAEA Document S/1997/779 (Vienna, Austria: IAEA, October 8, 1997 (available as of May 13, 2002 at

Consider just a few of the civilian research facilities whose stockpiles have been publicly discussed:

- In Yugoslavia, near Belgrade, a facility without adequate funds to operate or clean up its research reactors – or to provide effective security for the long haul – has enough fresh 80% enriched HEU for a gun-type bomb (or several implosion-type bombs).[6]

- In Ukraine, a similarly impoverished research facility – whose nuclear research facilities are no longer operating – has 75 kilograms of 90% enriched HEU powder, even more than the Yugoslav facility.[7]

- In Belarus, another facility whose nuclear research reactor is shut down and no longer requires the material – and which also has little revenue to support effective security – has more than 300 kilograms of HEU.[8]

Current U.S. and international efforts to address this problem are not remotely commensurate with the threat. There are many small programs that address pieces of this problem:[9]

- For 24 years, the Reduced Enrichment for Research and Test Reactors (RERTR) program has been developing proliferation-resistant low-enriched fuels to replace HEU research reactor fuels, and helping U.S. and U.S.-supplied reactors convert.[10] Scores of reactors have successfully converted, many more HEU-fueled reactors have ceased operation, tons of HEU fuel have been shipped back to the United States and replaced with low-enriched uranium (LEU) fuel. Only a few research reactors anywhere in the world with a power greater than one megawatt (the type that regularly require substantial fresh supplies of fuel) are still running on HEU. There is still more to be done, however, in developing higher-density fuels so that all HEU-

---

http://www.iaea.org/worldatom/Programmes/ActionTeam/reports/s_1997_779.pdf. This is the 1997 summary report of the IAEA Iraq Action Team to the U.N. Security Council. Section 1.3 of the Annex details the Team's findings on the crash program.

[6] For discussions of this material, see, for example, David Albright, "What About Yugoslavia's Nuclear Explosive Material?" (Washington, DC: Institute for Science and International Security, April 21, 1999, available as of May 13, 2002 at http://www.isis-online.org/publications/yugoslavia/yugoslavia499.html), and William C. Potter, Djuro Miljanic, and Ivo Slaus, "Tito's Nuclear Legacy," *Bulletin of the Atomic Scientists,* March/April 2000 (available as of May 13, 2002 at http://www.thebulletin.org/issues/2000/ma00/ma00potter.html).

[7] For a description, see Jon B. Wolfsthal, Christina Chuen, and Emily Ewell Daughtry, eds., *Nuclear Status Report: Nuclear Weapons, Materials, and Export Controls in the Former Soviet Union* (Washington DC: Carnegie Endowment for International Peace and Monterey Institute for International Studies, 2001, available as of May 13, 2002 at http://www.ceip.org/files/publications/StatusReport.asp?p=8&PublicationID=712).

[8] Ibid.

[9] For another account of these efforts, see Robert L. Civiak, *Reducing Stockpiles of Weapons-Usable Highly Enriched Uranium (HEU) in Russia and Other Nations* (Washington DC: Federation of American Scientists, forthcoming 2002).

[10] For a summary, see Armando Travelli, "Progress of the RERTR Program in 2001," op. cit.; see also the RERTR program home page, available as of May 13, 2002 at http://www.td.anl.gov/Programs/RERTR/RERTR.html.

fueled reactors worldwide can convert to LEU. The program is funded at only about $5-6 million per year – and there are significant opportunities to complete development of fuels that would allow essentially all research reactors worldwide to be converted, that could be pursued with another $2-4 million in fiscal year 2003.[11]

- The United States also has in place a major take-back effort for irradiated HEU from U.S.-supplied research reactors. This is an essential element of the RERTR program, for the offer to take the spent fuel off reactor operators' hands if they agree to convert to LEU is a key part of the incentive for reactor operators to convert.[12] Unfortunately, this effort will run out in 2009 – and under current plans, tons of irradiated HEU, much of it no longer self-protecting against terrorists who are willing to receive substantial (but not immediately fatal) radiation doses, will remain at research reactors around the world after the U.S. take-back offer expires. As with the RERTR program itself, the take-back effort has focused primarily on research reactors with a thermal power of more than one megawatt – but if we are worried not only about fresh HEU supplies but about irradiated HEU as well, smaller facilities that have largely slipped through the cracks of this effort may have substantial amounts.

- A similar Russian RERTR program and HEU take-back effort is now getting underway, with funding from the United States.[13] The fuel development program is now working to test and license a fuel that should be applicable to converting most Soviet-design research reactors around the world. Funding for the fuel development effort has been only $1.5 million to date – an amount which has now run out and needs to be replenished.[14] With additional funds to complete the fuel development and finance actual reactor conversions, a significant number of insecure facilities (both inside and outside the former Soviet Union) could be converted to LEU. What incentives will be offered to reactor operators both within Russia and elsewhere to convert their reactors to the new LEU fuel remains unclear. The take-back effort is being organized as a Russia-U.S.-International Atomic Energy Agency (IAEA) trilateral initiative, with the United States providing the funding (separately from the RERTR budget) on condition that reactors sending their HEU back to Russia agree to convert to LEU.[15] The HEU will be shipped to secure facilities in Russia, and may be blended down to LEU. The first major take-back of HEU in this effort, from

[11] Personal communication with U.S. laboratory experts, April 2002.
[12] David Gary Huizenga et al., "Progress of the U.S. FRR SNF Acceptance Program," paper presented at the International Conference on Research Reactor Fuel Management (RRFM 2002) Ghent, Belgium, March 17-20, 2002.
[13] Oleg Bukharin, Christopher Ficek and Michael Roston, "U.S.-Russian Enhanced Research and Test Reactor (RERTR) Cooperation," forthcoming; Alexander Vatulin et al., "Progress of Russian RERTR Program: Development of a new type of fuel element for Russian-built research reactors," paper presented at the International Conference on Research Reactor Fuel Management (RRFM 2002) Ghent, Belgium, March 17-20, 2002.
[14] Personal communication with U.S. laboratory experts, April 2002.
[15] This program has been described in interviews with State Department, Department of Energy, and International Atomic Energy Agency officials, 2001 and 2002. Funding for some shipments of vulnerable HEU to secure storage in Russia will likely come from the State Department's Nonproliferation and Disarmament Fund; in addition, the Department of Energy is requesting funds to support such shipments in fiscal year 2003.

Uzbekistan (a country where a heavily armed insurgent group with very strong links to Al Qaida, on the U.S. terrorist group list, has its home base) was agreed during Uzbek President Islam Karimov's recent visit to Washington.[16] The Yugoslav, Belarusian, and Ukrainian stockpiles mentioned above would presumably also be high priorities for this effort, as would other dangerous HEU stockpiles that are not as well known.

- Under the Atomic Energy Act (as amended by the Nuclear Nonproliferation Act of 1978), countries supplied by the United States are required to maintain adequate security for U.S.-obligated nuclear material, and the U.S. government is required to check to ensure that they are doing so. Some other nuclear suppliers impose similar requirements and have similar programs to check that they are being met. Unfortunately, such checks are neither frequent nor rigorous: in a typical year, the United States only spends about $100,000 on this activity, and many years typically go by between one time a facility is checked and the next. The checks do not typically include doing any rigorous assessment of the facilities' vulnerability to insider or outsider attack or theft, but rather a quick overall check to see if they seem to generally be following international recommendations. No money is set aside in the budget to finance security upgrades, should a review determine that such upgrades are needed.[17]

- In a number of specific cases, there have been bilateral efforts to cooperate to improve security and accounting for nuclear weapons and materials. The former Soviet countries and their cooperation with the United States, the European Union, the IAEA and others are the obvious cases, but there are others – such as the U.S.-Chinese lab-to-lab discussions of nuclear material protection, control, and accounting (MPC&A) that were unfortunately nipped in the bud by the fallout from the scandal over alleged Chinese nuclear espionage.[18] Similarly, there have been press reports in recent months of new U.S.-Pakistani discussions of security for Pakistan's nuclear stockpiles.[19]

- For some years, the IAEA has organized an International Physical Protection Advisory Service (IPPAS), which offers international peer reviews of nuclear security

[16] See "U.S. and Uzbekistan Cooperation on Nonproliferation -- Agreement Protects Nuclear Materials and Technologies," press release, U.S. Department of Energy, Washington, DC, March 12, 2002.
[17] Interviews with Department of Energy officials, March 2002. The international recommendations in this area are contained in the International Atomic Energy Agency's *Information Circular (INFCIRC) 225, Revision 4, The Physical Protection of Nuclear Material and Nuclear Facilities* (Vienna, Austria: IAEA, available as of May 13, 2002 at http://www.iaea.org/worldatom/program/protection/inf225rev4/rev4_content.html). See also, George Bunn and Matthew Bunn, "Reducing the Threat of Nuclear Theft and Sabotage," IAEA-SM-367/4/08, paper presented to the IAEA Symposium on Nuclear Verification and Security of Material, October 30, 2001 (available as of May 13, 2002 at http://ksgnotes1.harvard.edu/bcsia/library.nsf/pubs/nuclear theft).
[18] Nancy Prindle, "U.S.-Chinese Lab-to-Lab Technical Exchange Program," *The Nonproliferation Review*, Volume 5, Number 3, Spring-Summer 1998 (available as of May 13, 2002 at http://cns.miis.edu/pubs/npr/vol05/53/prindl53.pdf); and interviews with U.S. national laboratory experts, 2001.
[19] Douglas Frantz, "U.S. and Pakistan Discuss Nuclear Security," *The New York Times*, October 1, 2001; see also Alex Wagner, "U.S. Denies Talks With Pakistan on Nuclear Security," *Arms Control Today*, November 2001 (available as of May 13, 2002 at http://www.armscontrol.org/act/2001_11/paknucnov01.asp).

arrangements at the request of member states – and has helped to organize donor states to provide equipment for needed upgrades. IPPAS has also provided services such as workshops on how states can develop their own "design basis threats" – the threat nuclear security systems in their state should be designed to defeat – and how to implement these in national regulations. A recent donation from the Nuclear Threat Initiative, matched by the U.S. government, should make it possible to double or triple the pace of the IPPAS effort – but it remains extremely small, amounting to less than $1 million per year, and can therefore provide such services to only a small number of facilities in a small number of states. And its upgrade efforts are focused on those states that ask for help – which may or may not be those states where the need is most urgent.[20]

- There are a variety of other small related efforts, focusing on matters such as assistance for safety of research reactors, help with decommissioning, and the like.

All of these programs are valuable and are making genuine contributions to international security. But there is no consolidated effort with the authority and flexibility to provide targeted packages of incentives to each facility to give up its HEU or plutonium – or to participate in a rapid security-upgrade program. That is what is needed now (in addition to, not instead of, these existing programs, each of which would serve as important supports for such a consolidated effort). At one facility, the incentive might simply be to buy the HEU; at another it might be help with decommissioning the research reactor and managing the spent fuel; at a third, it might be a grant to support research that would no longer require the research reactor; at a fourth, it might be help converting the research reactor to LEU. Combinations of such incentives might also be possible. For facilities that *do* have a continuing need for substantial quantities of HEU or plutonium, there would be help in upgrading to stringent security standards as rapidly as practicable.

Project Sapphire (which airlifted nearly 600 kilograms of HEU from Kazakhstan to the United States at the request of the Kazakh government in 1994) and Project Auburn Endeavor (which removed the HEU from a vulnerable site in Georgia in cooperation with the Georgian government in 1998) can be seen as the models for such an effort to eliminate insecure HEU stockpiles.[21] In each case, the HEU was removed from a vulnerable site to a secure one; the costs of packaging and shipment were paid for (in these cases, by the United States); and a package of specific incentives were offered in return for the cooperation of the

[20] For a discussion of IPPAS, see International Atomic Energy Agency, General Conference, *The Agency's Programme and Budget for 2002-2003: Major Programme 4: Nuclear Verification and Security of Material*, GC(45)/8 (Vienna, Austria: IAEA, August 2001, available as of May 13, 2002 at http://www.iaea.or.at/worldatom/About/GC/GC45/Documents/Budget/prog4-n.pdf); also International Atomic Energy Agency, *Guidelines for IAEA International Physical Protection Advisory Service (IPPAS)*, IAEA Services Series No. 3 (Vienna, Austria: IAEA, February 1999, available as of May 13, 2002 at http://www.iaea.org/worldatom/program/protection/guideline.html).

[21] Monterey Institute of International Studies, Center for Nonproliferation Studies, "Kazakhstan: Project Sapphire" (Washington, DC: Nuclear Threat Initiative, September 28, 2001, available as May 13, 2002 at http://www.nti.org/db/nisprofs/kazakst/fissmat/sapphire.htm); Monterey Institute of International Studies, Center for Nonproliferation Studies, "Georgia: Operation Auburn Endeavor" (Washington, DC: Nuclear Threat Initiative, May 10, 2001, available as of May 13, 2002 at http://www.nti.org/db/nisprofs/georgia/auburn.htm).

facility from which the HEU came and the host government. But each of these efforts required months of interagency discussion within the United States, and months of international negotiation and preparation. With a focused program in place with this mission, with the flexibility to provide funds to cover the various different kinds of costs and incentives that may be involved at particular sites, and with the ability to pursue several such initiatives at a time, such initiatives could be pursued far more rapidly – and ultimately at lower cost for each one.

The goal should be to eliminate all of the highest-risk HEU stockpiles in the world within a few years. The longer-term goal should be to eliminate the HEU from all the world's civilian facilities, reducing the number of purely civilian sites around the world with HEU from hundreds to zero. Given the availability of high-density LEU fuels developed or under development in the RERTR program, and the risks posed by HEU, there is no longer any need for HEU in the civil sector that outweighs the dangers of its use. More broadly, only a fraction of the hundreds of research reactors still in operation around the world are genuinely needed, for research, training, and isotope production. It is absurd and unsafe for facilities that are so poor they do not have a telephone, or have dead rats floating in the spent fuel pool, to be attempting to run a research reactor. An international effort should be put in place to help countries assess the real benefits and dangers posed by their research reactors, and assist in shutting down and decommissioning those facilities where the benefits no longer outweigh the costs and risks.

While there are hundreds of small civilian sites in the world with HEU or plutonium, the number that have enough fresh HEU or separated plutonium for a bomb in one place is substantially smaller – in the range of a few dozen or less worldwide, making the problem potentially manageable. (That number increases significantly if sites with enough HEU for a bomb in forms that are irradiated, but not radioactive enough to deter a terrorist willing to incur substantial radiation doses, are also included, as research reactor spent fuel is typically far smaller and less radioactive than power reactor spent fuel.) With a program funded at $50 million per year, and given an appropriately high level of political priority, many of the most urgent security hazards posed by HEU and plutonium outside of the former Soviet Union (where a large cooperative security upgrade program already exists) could be addressed within a few years. If the program were successful in moving quickly to work with a wide range of important sites, funding levels might have to be somewhat higher than this level for a few years. Similar efforts should be undertaken within Russia itself, as part of the ongoing nuclear warhead and material security cooperation there, accelerating consolidation of the number of sites with weapons-usable nuclear material by providing targeted incentives directly to individual facilities to give up their HEU or plutonium.

Relationships are already in place that would allow such a global cleanout and secure effort to move forward. The U.S.-supplied facilities (roughly 40 of the 58 countries with HEU-fueled research reactors) already have agreements with the United States requiring them to provide effective security for this material and allowing the United States to check on that security, paving the way for an effort of this kind. Virtually all of the other countries with HEU-fueled research reactors were Soviet-supplied, giving Russia similar leverage – and many of these facilities, both inside and outside the former Soviet Union, have

substantial quantities of highly vulnerable HEU. This is thus an area where a global partnership to secure weapons of mass destruction (WMD), with Russia as a leading partner, is particularly critical to success (see Chapter 3, "A Global Coalition to Secure Weapons of Mass Destruction," p. 25).

A Case-by-Case Approach to the Most Sensitive Cases

Obviously, states such as India, Pakistan, and Israel – as well as accepted nuclear weapon states such as China – will pose particular difficulties for cooperative international efforts to upgrade security for nuclear material, because of the secrecy and political sensitivities surrounding their nuclear efforts. Any moves toward cooperation with these states in these areas will have to be handled extremely carefully. Nevertheless, there are steps which could be undertaken which would serve both U.S. interests and those of these countries, and would not undermine the Nonproliferation Treaty or other U.S. nonproliferation policy. It should be remembered, after all, that the United States and Russia were Cold War adversaries – and yet they have succeeded in carrying out cooperative upgrades of security and accounting for thousands of nuclear warheads and hundreds of tons of nuclear material at highly sensitive facilities.

Pakistan. The war in Afghanistan, the revelations of extensive contacts between the Taliban, Al Qaida, and senior participants in Pakistan's nuclear weapons program, and the broad popularity of extremist Islamic beliefs in Pakistan (including among participants in the nuclear weapons program) have raised concerns over the potential vulnerability of Pakistan's nuclear stockpiles to insider theft of weapons or material, or leakage of weapons-related knowledge.[22] The United States and Pakistan have reportedly been discussing steps to ensure high levels of security for Pakistan's nuclear stockpiles.[23] Given the enormous secrecy surrounding Pakistan's nuclear program and facilities, considerable care will have to be taken to develop options for cooperation that can address Pakistani sensitivities. From the very little that is publicly known about how Pakistan secures its nuclear assets, it appears that serious attention is given to security – but that, like other countries at similar early stages of their nuclear weapons programs, the emphasis is largely on "guards, guns, and gates"; Pakistan may not have extensively implemented modern safeguards and security technologies such as electronic intrusion sensors, tamper-resistant seals, detectors to set off an alarm if an insider attempts to smuggle nuclear material out of a facility, and security cameras in the areas where nuclear weapons and materials are stored and handled. Having been isolated from the world nuclear community for many years because of weapons-related sanctions, Pakistan's nuclear community might well be eager to explore what could be done to improve security with the most modern technologies available. Cooperation relating to improved vulnerability assessments, personnel screening, sensors, security cameras, and the like could be undertaken without violating the Nonproliferation Treaty or other U.S. international commitments, without changing existing U.S. nonproliferation and export control policies, and without in any way accepting or acknowledging Pakistan's nuclear weapons program. Given the intense secrecy and sensitivities surrounding Pakistan's nuclear

[22] See, as one example, Dennis Overbye and James Glanz, "Pakistani Atomic Expert, Arrested Last Week, Had Strong Pro-Taliban Views," *The New York Times*, November 2, 2001.
[23] Frantz, "U.S. and Pakistan Discuss Nuclear Security," op. cit.

activities, adapting past cooperative threat reduction approaches to Pakistan will be extremely challenging – but it is important to try.[24]

India. Cooperation with India in this area may be less urgent (because of the much lower likelihood that Indian nuclear "insiders" would be sympathetic to Al Qaida), but here, too, it is likely that India's post-1974 isolation from much of the world nuclear community has led to a reliance on nuclear security and accounting technologies and approaches that are not the most modern available. As in Pakistan, considerable care will have to be taken to develop options for cooperation that can address Indian sensitivities and stay within the bounds of U.S. and international nonproliferation obligations and policies. Here, too, with India's program led by civilian scientists who have especially chafed at their isolation from the world nuclear community, there may be a real interest in a genuine technical interchange on modern safeguards and security technologies and approaches. India must be treated as a separate, and different, case from Pakistan – but as with Pakistan, while the challenges are great, if they can be overcome there may be important work to be done cooperatively.[25]

China. The United States and China had launched a significant lab-to-lab effort to cooperate in nuclear material protection, control, and accounting (MPC&A) technologies in the late 1990s, but this was cut off entirely as the scandal over alleged Chinese nuclear espionage hit.[26] The time has come to restart this cooperation – in a carefully controlled way, to assuage concerns (on both sides) over nuclear spying. From what little is publicly known about China's nuclear security approaches, it appears that like the Soviet Union, China has relied heavily on "guards, guns, and gates," and on a closed society where all nuclear workers could be carefully monitored and controlled, to ensure security for its nuclear weapons and materials. As the Chinese economy becomes ever more market-based, Chinese society becomes ever more open and mobile, and with corruption and theft remaining very serious problems, increasing reliance on modern safeguards and security technologies will be important.

Israel. Given the extraordinary secrecy that surrounds Israel's unacknowledged nuclear weapons program, international cooperation on actual upgrades for security and accounting arrangements at Israeli facilities is not likely to be possible in the near term. Israel could be asked to commit itself to meet stringent, agreed standards for security as part of a global coalition to secure WMD and related materials, as described in earlier chapters.

France and Britain. France and Britain are both believed to maintain reasonably stringent standards of security and accounting for their nuclear weapons and materials (though in these cases, too, as in the United States, there are well-informed critics who

---

[24] For a thorough examination of both the challenges and some of the potential opportunities of expanding cooperative threat reduction work to South Asia, see Rose Gottemoeller and Rebecca Longsworth, *Enhancing Nuclear Security in the Counter-Terrorism Struggle: India and Pakistan as a New Region for Cooperation,* forthcoming. See also David Albright, "Securing Pakistan's Nuclear Weapons Complex," paper presented to the Stanley Foundation 42nd Strategy for Peace Conference, October 25-27, 2001 (available as of May 13, 2002 at http://www.isis-online.org/publications/terrorism/stanleypaper.html).

[25] See Gottemoeller and Longsworth, *Enhancing Nuclear Security in the Counter-Terrorism Struggle,* op. cit.

[26] Prindle, "U.S.-Chinese Lab-to-Lab Technical Exchange Program," op. cit.

suggest that more should be done).[27] As NATO members, both countries already have very extensive security cooperation with the United States underway. Both, however, are extremely sensitive to any U.S. criticism in this area – because of their disagreements with the United States over plutonium reprocessing (see discussion below).

The plutonium powers. Several European states, Japan, Russia, and India reprocess their civilian spent fuel to separate the plutonium for use as new fuel. China plans to do so as well, but has not yet begun civilian reprocessing on any substantial scale. As a result, tens of tons of separated, weapons-usable plutonium are processed and shipped from place to place every year – when only a few kilograms is enough for a bomb.[28] In Britain, France, and non-nuclear-weapon states such as Japan and Germany, this material is under international safeguards, and is therefore accounted for to international standards – but these safeguards are designed only to detect whether the host state might be diverting civilian material for military purposes, not to prevent theft. Most of this material is well secured, but standards vary widely from one country to the next. Because reprocessing of plutonium has outpaced its use as fuel, over 200 tons of civilian separated weapons-usable plutonium is in storage – an amount that increases by many tons each year, and will soon surpass the total of all the plutonium in all the world's nuclear weapons arsenals. In the aftermath of September 11, this practice simply does not make sense: whatever safeguards and security measures are in place, a world in which tens of tonnes of plutonium are being separated, processed, fabricated, and shipped to dozens of locations around the world every year is a world that poses significant risks above and beyond those of a world in which that is not occurring. Hence, we believe that there should be a phased-in moratorium on current approaches to reprocessing and recycling plutonium. Nuclear power's future will be best assured by making it as cheap, as safe, as secure, as proliferation-resistant, as simple, and as uncontroversial as possible – and current reprocessing and recycling technologies point in the wrong direction on every count.[29] We are under no illusions, however, that such a moratorium is likely, given the very large commercial investments and interests in continuing on the present course.

---

[27] See, for example, Xavier Coeytaux, Yacine Faid, Yves Marignac and Mycle Schneider, *La Hague Particularly Exposed to Plane Crash Risk* (Paris: WISE-Paris, September 26, 2001, available as of May 13, 2002 at http://www.wise-paris.org/english/ourbriefings_pdf/010926BriefNRA1v4.pdf).

[28] While this plutonium is largely "reactor-grade," all separated plutonium (except plutonium with 80% or more of the isotope Pu-238) is weapons-usable. Terrorists or unsophisticated states could make a crude bomb from reactor-grade plutonium, using technology no more sophisticated than that of the Nagasaki bomb, which would have an assured, reliable yield in the kiloton range (and therefore a radius of destruction roughly one-third that of the Hiroshima bomb), and a probable yield significantly higher than that; sophisticated states could make weapons with reactor-grade plutonium that would have similar yield, weight, and reliability to those made from weapons-grade plutonium. For an authoritative unclassified discussion, see U.S. Department of Energy, Office of Arms Control and Nonproliferation, *Final Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Excess Plutonium Disposition Alternatives,* DOE/NN-0007 (Washington, DC: DOE, January 1997), pp. 37-39.

[29] For a discussion, see, for example, John P. Holdren, "Improving U.S. Energy Security and Reducing Greenhouse-Gas Emissions: The Role of Nuclear Energy," Testimony to the Subcommittee on Energy and Environment, Committee on Science, U.S. House of Representatives, 106th Cong., 2nd Sess., Washington, D.C., July 25, 2000.

Whatever approach is taken to reprocessing, however, it would make sense for all the relevant states to cooperate to ensure that all stocks of separated plutonium are secured and accounted for to stringent standards. This could be a key element of the proposed global alliance to secure WMD. This effort, too, will be politically sensitive and challenging, even though nearly all of the relevant players are close allies of the United States, because many of these states see U.S. concerns over security and accounting for separated plutonium as a thinly veiled attack on their reprocessing policies. (See Chapter 7, "Leading Toward Stringent Global Nuclear Security Standards," p. 57.)

Moving Ahead

The Bush administration and the Congress should work together to establish a "global cleanout and secure" program, funded at roughly $50 million in fiscal year 2003 – and the administration should consider making funds available from fiscal year (FY) 2002 appropriations to get started. As an integral part of that effort, adequate funding should be provided to the RERTR program, the RERTR HEU fuel take-back effort, and the equivalent efforts for Soviet-designed reactors to ensure that funding is not a serious constraint on the rate at which these proliferation risks from insecure HEU stockpiles can be reduced. Similarly, additional funding should be provided for the IAEA's efforts to review state's physical protection arrangements – as there may be a number of cases where an approach embedded in an international organization with international standards works better than a U.S.-led approach. At the same time, the Bush administration should press forward, carefully but quickly, to work with as many of the more sensitive countries as possible to ensure that all nuclear weapons and weapons-usable nuclear material worldwide is secure and accounted for. There is no time to lose. As former Senator Sam Nunn has said, "We are in a new kind of arms race: terrorists and rogue states are racing to get weapons of mass destruction. We ought to be racing to stop them and to secure vulnerable weapons and materials."[30]

[30] Nunn, "Building Global Cooperation for Threat Reduction," op. cit.

7. LEADING TOWARD STRINGENT GLOBAL NUCLEAR SECURITY STANDARDS

Terrorists and hostile states will steal nuclear weapons or materials wherever they are easiest to get, and buy them from anyone willing to sell. Hence, as Mohammed ElBaradei, Director-General of the International Atomic Energy Agency (IAEA) has said, "nuclear security is as good as its weakest link."[1] As a result, ensuring that all weapons-usable materials are secure and accounted for is an absolutely fundamental nonproliferation responsibility of all states handling such materials – and the international community has an overwhelming interest in ensuring that each state where these materials exist carries out that responsibility appropriately. A stringent international standard for security and accounting of these deadly nuclear stockpiles, which all states would be expected to meet, is now urgently needed.[2] Building such a standard will require a substantial leadership investment from the United States – as part of a global coalition to secure weapons of mass destruction and related materials (see Chapter 3, "A Global Coalition to Secure Weapons of Mass Destruction," p. 25).

Traditionally, security for nuclear weapons and materials was seen as a purely national responsibility, in which the international community had little role. As a result, today security and accounting for nuclear materials varies enormously from one country to the next, and there are *no* binding international standards for nuclear security in place.

There is an international Convention on the Physical Protection of Nuclear Material, but it is quite vague in its requirements, applies primarily to international transport of materials, does not cover military materials at all, and has no provisions for verification or enforcement.[3] Moreover, many countries, including some who possess significant quantities of weapons-usable material, are not parties to the Convention.[4] There are IAEA

---

[1] International Atomic Energy Agency (IAEA), "Calculating the New Global Nuclear Terrorism Threat," press release, November 1, 2001 (available as of May 13, 2002 at http://www.iaea.org/worldatom/Press/P_release/2001/nt_pressrelease.shtml).

[2] For discussions, see, for example, Charles Curtis, "Reducing the Nuclear Threat in the 21st Century," Address to the IAEA International Symposium on Safeguards: Verification and Nuclear Material Security, October 29, 2001 (available as of May 13, 2002 at http://www.iaea.org/worldatom/Press/News/curtis.pdf); Lawrence Scheinman, "Transcending Sovereignty in the Management and Control of Nuclear Material," Address to the same symposium (available as of May 13, 2002 at http://www.iaea.org/worldatom/Press/Focus/Nuclear_Terrorism/scheinman.pdf); and Matthew Bunn and George Bunn, "Reducing the Threat of Nuclear Theft and Sabotage," speech to the same symposium (available as of May 13, 2002 at http://ksgnotes1.harvard.edu/bcsia/library.nsf/pubs/nuclearetheft).

[3] International Atomic Energy Agency, *The Convention on Physical Protection of Nuclear Material, Information Circular (INFCIRC) 274* (Vienna, Austria: IAEA, 1980, available at http://www.iaea.org/worldatom/Documents/Infcircs/Others/inf274r1.shtml).

[4] India joined the Convention after September 11, and Pakistan had joined shortly before – though with a reservation that would so undermine the Convention's value that the European Union has objected to it (see Hughes Belin, "EU, Euratom Object to Pakistan's Reserve on Physical Protection Text," *Nuclear Fuel*, October 29, 2001); for current status of parties, see "Convention on the Physical Protection of Nuclear Material" (Vienna, Austria: IAEA, May 7, 2002, available as of May 13, 2002 at http://www.iaea.org/worldatom/Documents/Legal/cppn_status.pdf).

recommendations on security for nuclear material – which were upgraded in 1999 – but these are purely advisory. Even these IAEA recommendations are not very specific in what they require – and they are focused on setting rules for where there should be fences, locked vaults, and the like rather than on setting standards for how well a physical protection system should perform (that is, what threats it ought to be able to defeat).[5] Neither the IAEA nor any other organization monitors or compiles accurate, up-to-date information on physical security procedures worldwide; thus, there is no means for the international community to know where remedial action may be most necessary, or where the next marginal dollar for international physical protection cooperation could best be spent. In the aftermath of September 11, allowing this absence of binding standards to continue would pose an unacceptable risk to international security.[6]

In recent years, there have been efforts to formally negotiate more stringent standards, but they have made limited progress. The IAEA's recommendations on security for nuclear materials were revised in 1999 – but still do not include a recommendation for *any* armed guards (even at nuclear facilities with enough weapons-usable material for dozens of nuclear weapons), or any performance standard that all states' nuclear security systems should be able to meet.

In 1998, the United States proposed that the Convention be amended to (a) extend its coverage to civilian nuclear material in *domestic* storage, use, and transport; (b) require that at a minimum, states provide levels of protection comparable to those in the IAEA recommendations; and (c) require that states provide reports on their physical protection arrangements every five years, to be discussed at international conferences that would also take place every five years.[7] The IAEA Director General convened an experts' meeting, which did, after considerable initial disagreement, recommend drafting an amendment to the Convention. Their pre-September 11 consensus report recommended extending the Convention's coverage to civilian nuclear material in domestic use, storage, and transport; adding a requirement to protect against sabotage of nuclear facilities as well as theft of nuclear material; and stating 12 general principles for physical protection in the Convention. These principles included, for example, a call for each party to the treaty to adopt a national regulatory framework to govern its physical protection practices, and to have regulators independent of the operators of nuclear facilities. The report was welcomed by the September 2001 IAEA Board of Governors and General Conference meetings, and the 12 principles were approved.[8]

---

[5] IAEA, *The Physical Protection of Nuclear Material, INFCIRC 225*, op. cit.

[6] See, for example, discussion in Curtis, "Reducing the Nuclear Threat," op. cit., and Scheinman, "Transcending Sovereignty," op. cit.

[7] For a discussion of the early stages of these discussions, see George Bunn, "Raising International Standards for Protecting Nuclear Materials from Theft and Sabotage," *Nonproliferation Review,* Summer 2000; for a review of more recent discussions, see George Bunn and Fritz Steinhausler, "Guarding Nuclear Reactors and Material From Terrorists and Thieves," *Arms Control Today,* October 2001, and Patricia A. Comella and Burrus Carnahan, "Revising the Convention on the Physical Protection of Nuclear Material," in *Proceedings of the 42nd Annual Meeting of the Institute for Nuclear Materials Management* (Northbrook, IL: INMM, July 2001).

[8] Informal Open-Ended Expert Meeting to Discuss Whether there is a Need to Revise the Convention on the Physical Protection of Nuclear Material, *Final Report* (May 23, 2001) (to be distinguished from the February working group final report cited in the next note which contains more specific recommendations and the working papers, mostly from the IAEA staff, used by the experts). Another example: "Responsibility for the

The experts' consensus recommendations did not include any specific standards for domestic physical protection. They did not include any requirement that states prepare a report to the IAEA or to other states on their physical protection arrangements and regulations; any mechanism for international peer review of such arrangements; or any reference to the much more detailed IAEA physical protection recommendations (INFCIRC 225/Rev.4), even that these be "taken into account." The experts' "principle" calling for a national regulatory framework also called for an independent national regulatory agency and national inspections to verify compliance with national requirements[9] – all of which has been used by some experts to justify opposing any *international* standards or reviews.

Efforts to negotiate even an amendment reflecting these limited, pre-September 11 expert recommendations have made only slow progress; a series of discussions have ended with little consensus, and some U.S. allies (such as Belgium) have tabled proposals which would effectively undo even the limited positive aspects of the consensus previously reached.[10] Even if these talks succeed, any draft amendment produced by a working group must be formally reviewed by the Convention's parties, a majority of whom must agree to convene an amendment conference; then, two-third of the parties must ratify the amendment before it can enter into force.[11] Years are likely to elapse before that can happen.

Similarly, Russia took the lead in proposing, several years ago, a Nuclear Terrorism Convention, and discussions of such a convention have been underway at the United Nations off and on ever since. As the draft currently stands, however, that convention would have no standards for security for nuclear weapons and materials – and in any case negotiations have been blocked by efforts by some non-nuclear-weapon states to use these talks as a means to gain a legally binding no-first-use commitment from the nuclear weapon states.[12]

Time for a New Approach

Efforts to amend the Convention on Physical Protection, negotiate a Nuclear Terrorism Convention, and strengthen IAEA recommendations should be continued – each could make a valuable contribution in its own right.[13] But after September 11, these formal international negotiations are simply too slow and too uncertain of success to be relied on as the central element of the push to achieve stringent global nuclear security standards.

---

establishment, implementation and maintenance of a physical protection regime within a State rests entirely with that State." Principle A, IAEA Secretariat Paper No.13, "Physical Protection Objectives and Fundamental Principles" attached to February 2001 Working Group report, o*p cit.*

[9] Working Group of the Informal Open-Ended Meeting to Discuss Whether there is a Need to revise the Convention on Physical Protection of Nuclear Material, *Final Report of the Working Group* (Feb. 2, 2001), Attachment 4, Principle C.

[10] George Bunn, personal communication, based on proposals formally tabled in the amendment discussions.

[11] Convention on the Physical Protection of Nuclear Material, Art. 20.

[12] George Bunn, personal communication, based on discussions with participants in the negotiations.

[13] For discussion of these and other steps to strengthen national and international standards for nuclear security, see Matthew Bunn and George Bunn, "Preventing Nuclear Theft and Sabotage," *Journal of Nuclear Materials Management,* Spring 2002.

The time has come for a new approach. The United States should join with a number of like-minded states with substantial nuclear activities – ideally including Russia – in making a politically binding commitment to meet a stringent, agreed standard for security and accounting for all their nuclear material and facilities, military and civilian; that they will report to the IAEA on their nuclear security regulations and procedures; that they will allow managed peer review of physical protection at selected facilities, to help confirm that they are fulfilling their commitment to stringent standards; and that they will encourage other states to make comparable commitments. Over time, these states could move to assist states that they supply with nuclear materials and technologies to meet the same stringent standards, and ultimately require them to do so as a condition of continuing supply.[14] Ultimately, effective security and accounting for weapons-usable nuclear material should be part of the "price of admission" for doing business in the international nuclear market.

Such an initial joint commitment to stringent standards could be made quickly – perhaps as a key element of participation in a global alliance to secure weapons of mass destruction (WMD). It might be desirable, to take into account cases such as Russia's without unduly singling them out, to have the commitment be to come into compliance with the agreed standard as quickly as possible, or by some particular deadline, rather than immediately. The group could begin as a relatively small one, and add adherents over time as additional countries could be convinced of the wisdom of joining (as occurred with the Nuclear Suppliers Group and other politically binding commitments in the nuclear area).

U.S. leadership will be the essential ingredient of building such new international standards for nuclear security. The Bush administration should begin discussions now with key nuclear states, with the aim of announcing an initial group that will make such a political commitment to stringent standards before the year is out.

The Need for Stringent Standards

The new standards that should be put in place should be stringent ones. The existing IAEA recommendations have some appeal as a potential global standard – since they are the only standard on which an international consensus exists today – but they are not likely to be sufficient to the task. The IAEA standards are almost entirely rule-based, rather than performance-based: they call for nuclear material to be in a locked vault, but do not say how hard the lock should be to pick or break; they call for a fence around the facility without saying how difficult it should be to get through the fence undetected. Unfortunately, it is possible to be in full compliance with these IAEA recommendations, and still not be adequately secured against attack.

---

[14] There is some precedent for this approach. As noted earlier, under U.S. law the United States requires that countries receiving U.S. nuclear material follow IAEA recommendations in this area (though the checks on this are quite modest). Following the U.S. lead, the Nuclear Suppliers Group has adopted guidelines for physical protection of material originating within its member states. See International Atomic Energy Agency, *Communications Received From Certain Member States Regarding Guidelines for the Export of Nuclear Material, Equipment, or Technology*, *INFCIRC 254* (Vienna, Austria: IAEA, 1978, available as of May 13, 2002 at http://www.iaea.org/worldatom/Documents/Infcircs/Others/inf254.shtml). The approach advocated here would, in effect, make these physical protection requirements more stringent.

Ideally, a new global standard ought to be performance-based, centered on a minimum threat that nuclear security systems should be designed to be able to defeat. As threats of terrorism do differ from one country to another, it does not make sense to have a single "design basis threat" for all facilities with weapons-usable nuclear material throughout the world. But in this day of terrorist groups with global reach – as both Al Qaida and the Japanese terror cult Aum Shinrikyo, which also sought nuclear weapons, have demonstrated themselves to be – it is very difficult to argue there is *any* country in which one to two small groups of well-trained, well-armed outside attackers, possibly in collusion with one well-placed insider, is not a plausible threat that facilities with kilograms or more of weapons-usable nuclear material should be able to defeat (and defeat reliably). Thus, it does make sense for there to be agreement on at least a *minimum* design basis threat that security systems for weapons-usable nuclear material everywhere should be able to meet.

Indeed, given that proliferating states have been willing to spend billions of dollars on their efforts to produce fissile material – and given that a single bomb could threaten tens of thousands of lives – the level of effort devoted to securing and accounting for stocks of even a few kilograms of weapons-usable material should be even higher than that devoted to protecting stores of millions of dollars worth of cash, gold, or diamonds. This is demonstrably not the case at many nuclear facilities with weapons-usable nuclear material today.

In 1994, a committee of the U.S. National Academy of Sciences went farther, recommending that, because gaining access to weapons-usable material is by far the most difficult technical obstacle to producing a nuclear bomb, to the extent possible, all weapons-usable materials should be guarded and accounted for as rigorously as nuclear weapons themselves are – a goal the report called the "stored weapons standard." The committee recommended that new international standards be negotiated to meet that goal.[15]

Meeting the stored weapon standard would mean that all areas with weapons-usable materials, military or civilian, would be within highly secure vaults or work areas, with multiple layers of protection to prevent any insider or outsider theft, continuous monitoring, and substantial armed guard forces. As in the U.S. and Russian nuclear weapon security systems, no individual would be permitted to be alone with weapons-usable nuclear material, and individuals with access to such material would be carefully screened for reliability (including examination of their financial status) – and rescreened at periodic intervals. The protection systems would be designed with the goal of providing reliable protection against insider theft by individuals in any position – even in collusion with outside forces – and against covert or forcible outsider theft, even by teams of well-armed and well-trained attackers. None of these objectives would be impossible to achieve for weapons-usable nuclear material worldwide, and indeed, substantial quantities of weapons-usable nuclear material are already protected to such standards. The report acknowledged, however, that the bulk processing of material "will unavoidably make accounting more difficult than in the case of nuclear weapons, and it may also be institutionally difficult to preserve the strict

[15] U.S. National Academy of Sciences, Committee on International Security and Arms Control, *Management and Disposition of Excess Weapons Plutonium* (Washington, DC: National Academy Press, 1994), pp. 31, 136-137. Holdren was, and remains, chair of this committee, while Bunn was the plutonium study director.

security arrangements associated with nuclear weapons themselves." But the report argued that "precisely because of the difficulty of the task, it is important to preserve the goal."

A major international effort to improve security and accounting for weapons-usable nuclear materials worldwide would be costly, probably adding tens of millions of dollars a year to the costs currently paid for such activities. Physical protection would remain, however, a tiny fraction of the overall costs of nuclear activities worldwide; meeting the "stored weapon standard" would not require measures that would add in any significant way to the overall costs of nuclear-generated electricity (particularly as most such electricity is today generated without the use of directly weapons-usable material). In any case, the cost of mitigating proliferation risks should be considered an essential part of the cost of operating a facility that uses weapons-usable materials – an externality that should be internalized, just as the costs of pollution prevention and mitigation should be paid by the polluters. The catastrophe for the nuclear industry worldwide that would result if terrorists succeeded in stealing nuclear bomb material from an insecure facility anywhere makes it in the industry's own interest to accept the higher costs of more stringent standards in return for a reduction of this risk.

For stringent international standards to have real teeth, there would have to be some means to confirm, or at least to build confidence, that the standards were being met. As Senator Richard Lugar (R-IN) has argued, victory in the war to prevent catastrophic terrorism will not be achieved until all states have not only secured and accounted for their nuclear stockpiles to stringent standards, but done so "in a manner that is internationally verifiable."[16] Measures toward this end could include exchanges of information about national nuclear security procedures and standards, and bilateral or international visits or peer reviews at selected facilities, with managed access to protect sensitive information. But gaining broad agreement to such transparency will be difficult, as specific approaches to nuclear security are a closely guarded secret in almost every country. Many countries emphasize that maintaining secrecy about security arrangements, so that terrorists will not know what they are up against, is fundamental to effective security. But with sufficient creativity on the part of the negotiators and high-level leadership, ways can be found to exchange sufficient information among the states that have agreed to stringent standards to build confidence that those standards are being met, without making information available to potential terrorists and thieves. Agreement on a stringent standard requiring some form of international access and review could also greatly ease the access problem in U.S.-Russian cooperation on security and accounting upgrades – just as the agreed treaty-based inspection requirements for eliminating strategic offensive arms have made access for those cooperative threat reduction efforts much less controversial and difficult to arrange. (See Chapter 5, "Accelerated and Strengthened Security Upgrades for Warheads and Materials in Russia," p. 35.)

Creating a regime of greatly strengthened international standards for physical protection will inevitably be difficult, and require the expenditure of considerable diplomatic capital. Many countries, including some of the United States' closest European and Asian

[16] Sen. Richard Lugar, "NATO After 9/11: Crisis or Opportunity?" Address to the Council on Foreign Relations, March 4, 2002 (available as of May 13, 2002 at http://www.senate.gov/~lugar/030402.html).

allies, still consider their own physical protection arrangements a matter of exclusive national sovereignty, not a subject for international discussion – and have traditionally resisted any move toward more stringent standards. Cultural differences in approaches to physical protection will complicate discussions of specific strengthened approaches or standards. Nuclear industries using weapons-usable materials will object to the potential for increased costs, and these industries typically have strong influence on their governments with respect to issues perceived to be technical nuclear issues, such as this one. Putting together a group of countries willing to make a joint political commitment to stringent standards is likely to require intervention at the level of Presidents and Prime Ministers, going over the heads of middle-level officials who have been resistant to change. While a binding "stored weapon standard" regime should be the ultimate goal, the initial steps need not go that far – it is more important to begin taking large strides in the right direction than to agree on just how far to travel.

8. ACCELERATED BLEND-DOWN OF HIGHLY ENRICHED URANIUM

In the aftermath of September 11, there is an opportunity to drastically accelerate the on-going blend-down of potentially vulnerable Russian highly enriched uranium (HEU) – potentially destroying enough additional material for more than a thousand nuclear bombs every year. HEU is the easiest material for terrorists to make nuclear weapons from, because unlike plutonium, HEU can be used in a simple "gun-type" bomb. Destroying as much of this HEU as possible is the highest-confidence way to ensure it will never fall into hostile hands. By paying Russia to blend this material to a form that can never again be used in weapons and then store it in Russia, held off the market for a specified period, the national security objective of destroying HEU could be decoupled from market constraints, and the accelerated blend-down could be accomplished without disturbing world nuclear fuel markets.[1] This would be clear, measurable threat reduction: for a certain number of dollars expended, a certain number of tons of HEU would be destroyed.

The HEU Purchase Agreement

Such an accelerated blend-down effort would build on what is already the largest, most successful (despite a large number of difficulties and crises in its implementation) and probably most important U.S.-Russian cooperative effort to address threats posed by weapons-usable nuclear material – the HEU Purchase Agreement. Under this deal, 500 tons of HEU from dismantled Russian nuclear weapons are being blended to low-enriched uranium (LEU) (which cannot support an explosive nuclear chain reaction) and sold to the United States for use as commercial nuclear reactor fuel. Signed in 1993, the deal is to be implemented over 20 years, and is expected to have a total value of over $10 billion – qualifying it, as Russia's Ministry of Atomic Energy (MINATOM) frequently put it in the 1990s, as "the contract of the century." At one stroke, the HEU purchase provides financial incentives to dismantle thousands of warheads, destroys hundreds of tons weapons-usable material that could otherwise be vulnerable to theft, provides employment to thousands of Russian nuclear workers, and provides hundreds of millions of dollars a year to the desperate Russian nuclear complex – all at little net cost to the U.S. taxpayer, since the funds to

---

[1] During the Clinton administration, the U.S. government considered – and discussed with Russia – a variant of an accelerated blend-down initiative, which was dubbed "HEU II," but the plan was primarily based on near-term marketing of the additional blended material, rather than storing it, so that it ran into the constraints of the commercial market. For a rare public discussion of such earlier versions of the idea by one of its originators, see Mark Mullen, *Improving the Security of Weapons-Usable Uranium in the Former Soviet Union: Next Steps* LA-UR-01-2385 (Los Alamos, NM: Los Alamos National Laboratory, 1998). For previous discussions of accelerated HEU concepts along the lines proposed here, see Matthew Bunn, *The Next Wave: Urgently Needed New Steps to Control Warheads and Fissile Material* (Washington, DC: Carnegie Endowment for International Peace and Harvard Project on Managing the Atom, April 2000, available as of May 13, 2002 at http://ksgnotes1.harvard.edu/BCSIA/Library.nsf/pubs/Nextwave), pp. 99-102; Matthew Bunn, "Accelerated HEU Blend-Down: Faster Reduction of Nuclear Weapons Risks," Presentation to the 8th International Nuclear Materials Policy Forum: Disposition, Stewardship, and Utilization of Weapons Grade Materials and Spent Fuel, Washington, DC, September 26, 2001; Matthew Bunn, "The Cost of Rapid Blend-Down of Russian HEU," unpublished paper, July 11, 2001; and Robert L. Civiak, *Reducing Stockpiles of Weapons-Usable Highly Enriched Uranium in Russia and Other Nations* (Washington, DC: Federation of American Scientists, forthcoming 2002).

purchase the material come from its value as commercial fuel.[2]

As of March 2002, 141 tons of HEU had been blended and delivered – and Russia had earned over $2 billion from these sales.[3] While the deal was in crisis for much of 2001, a new contract amendment was reached in early 2002 that should – if all goes well – allow the deal to continue for some time to come.[4]

An accelerated HEU blend-down agreement could only be a complement to, not a replacement for, this existing purchase agreement. The first priority, from a nonproliferation perspective, must be to make sure that the existing agreement remains on a stable footing – and any accelerated blend-down should be designed to avoid interfering in the existing HEU deal.

Currently, 30 tons of Russian HEU is being blended to LEU each year. This level was determined by what the commercial market would bear, not by what the national security demands. At that rate, blending three-quarters of the roughly 1000 tons of highly enriched uranium (HEU) remaining in the Russian stockpile would take 25 years. From a national security perspective, it would be desirable to destroy every kilogram of excess Russian bomb uranium tomorrow. There is an opportunity now to decouple the national security objective from the market constraint, by simply paying Russia its cost to blend the HEU much faster than is now being done, as a national security investment. It is very likely that for less than the cost of one B-2 bomber, all excess Russian bomb uranium, the equivalent of tens of thousands of nuclear weapons, could be destroyed.

Structuring an HEU Accelerated Blend-Down Deal

To work effectively, an HEU accelerated blend-down deal would have to serve both U.S. and Russian interests. Both countries, of course, have an interest in preventing HEU from falling into the hands of terrorists and hostile states. U.S. interests would be served by destroying as much Russian HEU as possible, as rapidly as possible, for the minimum cost. Russia has interests in maintaining a large and stable revenue stream from the HEU deal for as long as possible; maintaining large numbers of jobs involved in processing the HEU;

---

[2] For a brief overview of the HEU deal, see Bunn, *The Next Wave,* op. cit, pp. 65-67; for accounts of some of the recent problems the deal has encountered, see Thomas L. Neff, "Decision Time for the HEU Deal: U.S. Security vs. Private Interests," *Arms Control Today*, June 2001 (available as of May 13, 2002 at http://www.armscontrol.org/act/2001_06/nefjun01.asp), and Thomas L. Neff, "Privatizing U.S. National Security: The U.S.-Russian HEU Deal at Risk," *Arms Control Today,* August/September 1998 (available as of May 13, 2002 at http://www.armscontrol.org/act/1998_08-09/tnas98.asp). For more optimistic accounts, see Philip Sewell, Senior Vice President, USEC Inc. "Megatons to Megawatts: The Groundbreaking Pact That Has Turned 5,000 Nuclear Warheads into Fuel for Electric Power Plants," Address to the 8th Annual International Nuclear Materials Policy Forum, September 26, 2001 (available as of May 13, 2002 at http://www.usec.com/v2001_02/Content/News/NewsTemplate.asp?page=/v2001_02/Content/News/Speeches/09-26-01.htm), and Civiak, *Reducing Stockpiles of Weapons-Usable Highly Enriched Uranium (HEU) in Russia and Other Nations*, op. cit.

[3] USEC, "Fact Sheet: U.S.-Russian Megatons to Megawatts Program" (Bethesda, MD: USEC, March 1, 2002 (available as of May 13, 2002 at http://www.usec.com/v2001_02/HTML/megatons_fact.asp).

[4] See, for example, "USEC and Tenex Strike a Deal," *Nuclear Engineering International*, April 30, 2002, p. 12 (available at LexisNexis™ Academic Universe, May 10, 2002).

keeping enough HEU in its stockpile for its military needs (both for weapons and for naval and icebreaker fuel); and avoiding undue political pain (that might be provoked by an arrangement perceived as too unequal). These interests overlap in some areas and are in conflict in others; with good faith on both sides, it should be possible to work out an accelerated HEU blend-down arrangement that both sides strongly support. Indeed, Russian Minister of Atomic Energy Alexander Rumiantsev has supported a joint feasibility and cost study of the concept, sponsored by the non-government Nuclear Threat Initiative.

There are many possible variations of such a deal – different parties paying the cost, different arrangements for storing and marketing the material, different quantities of material to be blended, blending at different rates, blending to different enrichment levels, and more.

In principle, an HEU accelerated blend-down deal could be very simple. The United States would pay Russia its capital and operating costs to blend large quantities of additional HEU each year, beyond the 30 tons being blended for commercial sale, to LEU. Russia would agree that this additional LEU would be held off the market in monitored storage cylinders in Russia (to avoid crashing the uranium and enrichment prices with a flood of additional material onto the market – an approach that would also undermine the existing HEU deal, which depends on these markets). To avoid undermining the prices on the uranium and enrichment markets (and to protect domestic enrichment production), the U.S. government has limited the amount of blended HEU that can be marketed in the United States, and both the United States and most other major nuclear markets have trade restraints in place limiting Russia's commercial uranium and enrichment exports. This blend-and-store approach could be accomplished within these existing constraints.

These additional blended stocks could then be blended to commercial levels and metered onto the market at the 30-ton-per-year rate once there was no more material to blend (the current 500-ton deal expires in 2013). While serving the U.S. national security interest, such a deal would serve Russia's financial interest as well: Russia would get additional employment for blending workers in the near term, and larger profits when the blended material was eventually sold (since the United States would have paid for the cost of the initial blending to 19%).

Some important variants of the accelerated blend-down idea include:

How much faster to blend

Once the blend rate is decoupled from market constraints by the mechanism of storing the blended material rather than selling it immediately, the blend rate becomes a matter of choice, negotiation, and the physical capacity of the available facilities. The Russians already have nearly all the needed machines at their blending facilities to double the current blending rate to 60 tons per year.[5] In this scenario, 30 tons of HEU a year would be

[5] An internal study by U.S. national laboratory and Department of Energy experts who had been to the Russian blending facilities estimated that Russia might be able to blend 40-50 tons of HEU per year with existing equipment; with a small (~$1 million) investment in additional glovebox lines for the chemical purification step, as much as 60 tons of material per year could be processed. (Interviews with DOE officials.) Similarly,

blended and sold, as is currently being done, and an additional 30 tons per year would be blended and placed in monitored storage. This means that nearly 2,000 bombs' worth of additional bomb material would be destroyed *every year*.[6] This would deal with the excess bomb uranium problem in an indisputable, easy-to-understand fashion – bomb material verifiably destroyed, on a payment-for-product-delivered basis.

Which material to blend

It would be desirable, from the U.S. point of view, to get the blending for the existing 500-ton HEU deal done faster, long in advance of the currently scheduled 2013 completion date.[7] It would be even more desirable, however, if agreement could be reached to go beyond the existing 500 tons, and destroy a larger fraction of Russia's huge HEU stockpile. Even after having blended more than 150 tons of HEU in the last decade in the HEU purchase agreement and other transactions, Russia is believed to have a stockpile of roughly 1,000 tons of HEU remaining.[8] The 360 tons remaining to be blended in the HEU deal will still leave well over 500 tons of HEU in Russia. If Russia reduces its total nuclear arsenal (tactical and strategic) to something in the range of 4,000 weapons, and we assume that to maintain each weapon requires roughly 30 kilograms of HEU (counting both material in the weapon itself and material in spares and other parts of the production pipeline), then this would require roughly 120 tons of HEU; even if Russia also retained 100 tons of HEU for naval fuel, its military needs would amount to just over 200 tons of HEU – a small fraction of its current stockpile.[9] Thus, in principle, Russia should be willing to go well beyond the 500 tons of HEU to be blended already agreed to; that figure, after all, was picked in 1992, long before Russia had decided on the very deep reductions in its nuclear weapons arsenal to which it is now committed. One approach might even be to have the accelerated blend-down apply *only* to material above and beyond the first 500 tons, which that original material continuing on its present path just as previously planned. If, however, Russia is going to contemplate very deep reductions in the stockpile of HEU it retains for military purposes, Russian negotiators may very well seek some additional reductions in the U.S. military HEU stockpile. Unlike Russia, which already declared 500 tons of its HEU stockpile excess to its

---

Evgeniy Adamov, when he was Minister of Atomic Energy, estimated that Russian facilities could already blend 50 tons of HEU per year. The joint U.S.-Russian feasibility and cost study, sponsored by the Nuclear Threat Initiative, is now under way, which is expected to provide more detail on current capabilities and the costs of expanding them.

[6] DOE has officially declassified the fact that it is possible to make a bomb with 4 kilograms of plutonium; the amount required with 90% enriched HEU is roughly three times that.

[7] This might not be so desirable from a Russian perspective, as it would mean that the jobs for thousands of nuclear workers provided by the HEU blending operation would not last as long.

[8] David Albright and others at the Institute for Science and International Security estimate 970 tons as of the end of 1999, and an additional 60 tons has been subtracted since then – but they do not include stocks in the naval fuel and production-reactor fuel pipelines. See figures in "Russia," available at http://www.isis-online.org/mapproject/russia.html (updated from David Albright, Frans Berkhout, and William Walker, *Plutonium and Highly Enriched Uranium 1996: World Inventories, Capabilities, and Policies* (Oxford, UK: Stockholm International Peace Research Institute [SIPRI] and Oxford University Press, 1997). These figures are metric tons of 90% enriched equivalent: that is, if the estimate is 1,000 tons, and the actual average enrichment of the stockpile was 80%, the total number of tons of HEU would actually be 1,160 tons. These figures are estimated to have an uncertainty of plus or minus 30%.

[9] See discussion in Bunn, *The Next Wave*, op. cit., pp. 54-55.

military needs, the United States has declared only 174 tons excess – keeping a huge reserve for future use as naval fuel. We believe this reserve is much larger than is needed, and should be reconsidered in any case.

The original HEU deal included a commitment that the 500 tons would be material drawn from dismantled weapons – and the arrangement includes transparency measures to provide at least some confidence that this is the case. The deal, in other words, was focused on disarmament as a key objective. But if the focus is on nonproliferation, any potentially vulnerable HEU is a hazard, whether it comes from a dismantled nuclear weapon or not. Thus, if there is to be a second round of the HEU deal, going beyond the 500 tons initially agreed, it would make sense to make an explicit shift of focus: the additional HEU could come from any existing stockpile, not just from dismantled weapons, making it possible to use this mechanism to destroy vulnerable HEU stockpiles from throughout Russia.

What enrichment level to blend to

The enrichment level used in most commercial power plants today is less than 5% U-235. In an accelerated blend-down deal, however, it might make sense to have the initial blending be to an interim level of 19% – below the internationally defined 20% cutoff for HEU, but well above commercial levels. Blending to this intermediate level would require far less blendstock, reducing costs and avoiding other potential obstacles (see discussion below). It would also decrease such a deal's impact on the uranium and enrichment markets, for if the material was not only held off the market by agreement in monitored storage, but also in a physical form that was not yet suitable for commercial sale, the market would have greater confidence that the material was not going to come flooding onto the market unexpectedly at some point in the future.[10]

Who pays, how, and with what arrangements for commercial sale

The simplest approach to such a deal would be for the United States government to simply pay Russia to blend down specified amounts of HEU on a fee-for-service basis, as an investment in national security. Other, more complex approaches are possible, however, ranging from attempting to convince European or other governments to pay all or part of the cost, to making the payments as advance payments against later future deliveries of LEU.

One important element of ensuring that Russia's interests are met is the problem of agreeing on the extra blended material's eventual sale on the commercial market. Russia would not be at all interested in an accelerated blend-down approach that meant that Russia was paid only the small actual cost of blending HEU to LEU (probably in the range of $1-$3 million per ton of original HEU), and never received the huge commercial value of the LEU (in the range of $20 million per ton of original HEU). But an arrangement that guaranteed that Russia would continue to get a huge annual revenue stream long after the 2013 expiration of the current deal might be attractive to Russia's leaders. Thus, one specific variant that appears to serve both U.S. and Russian interests well would be for the United

[10] The authors are grateful to the members of the Nuclear Threat Initiative's Fuel Market Evaluation Team (FMET) for discussions of this and other points regarding the accelerated blend-down concept.

States to pay for the initial blending to 19% as this work was performed, while simultaneously guaranteeing that for any amounts blended beyond 500 tons, Russia would continue to be able to sell into the U.S. market at the rate equivalent to 30 tons of HEU per year, as at present.

Who blends

If the blending capacity of Russia's nuclear facilities were a major constraint, it might make sense to ship some of the material to the United States as HEU, to be blended at U.S. facilities. This would, in effect, export the blending jobs to the United States – something Russia is not likely to be willing to do at this juncture, despite some Russian officials having explored the idea in the past.

Ensuring against new production

If the United States is going to get into the business of paying Russia to blend HEU to LEU, it will be extremely important to ensure that Russia is not simply producing more HEU to blend down, in an endless cycle. Today, however, while both the United States and Russia say they are no longer producing HEU, there is no bilateral or international monitoring in place to confirm this. With transparency measures already in place at Russia's enrichment facilities to monitor implementation of the existing HEU deal, it should be possible to negotiate modest additional measures that would provide good confidence that no new HEU was being produced. To gain Russian agreement, it would probably be necessary to accept similar measures to confirm that no HEU was being produced at U.S. enrichment facilities. Such U.S.-Russian monitoring of non-production of HEU would be desirable in any case, in part as a step toward confirming that a worldwide cutoff of production of bomb material could be verified.[11]

Costs of an Accelerated Blend-Down Deal

The costs of accelerated blend-down can be divided into two categories: initial capital cost to provide the needed blending capacity, and operating costs. It appears that the initial capital costs would be negligible – as already mentioned, U.S. estimates suggest that Russian facilities already have the capacity for a doubled blending rate, with the addition of just a few more machines to remove some key bottlenecks. (No one has yet attempted to estimate how much capital investment would be needed to triple or quadruple the rate.)

Operating costs have not been estimated in as much detail, but it appears they would also be modest by comparison to the security stakes. A rough U.S. estimate, based on an analysis of the labor and materials inputs that appear to be required, suggested that the net

[11] Bunn, *The Next Wave*, op. cit., pp. 49-50, 57, Frank von Hippel, "Recommendations for Preventing Nuclear Terrorism," *F.A.S. Public Interest Report: Journal of the Federation of American Scientist (F.A.S.)*, Volume 54, Number 6, November/December 2001, pp. 1-10.

marginal costs to Russia for blending additional HEU were probably in the range of $1-$3 million per ton of HEU blended, depending on the specific assumptions.[12]

In essence, under current approaches, HEU that starts off as metal weapons components must be chopped into metal shavings; roasted in an oven to convert the metal shavings to uranium oxide; dissolved in acid to purify the uranium; converted to uranium hexafluoride; transported; blended by feeding one pipe carrying 90% enriched HEU hexafluoride gas into another carrying 1.5% enriched LEU blendstock,[13] producing 4.4% enriched LEU; and if the LEU is not to be sold for an extended period, it must be stored. All of these operations cost money. The most expensive part, however, is the production of the LEU blendstock, in part because the enrichment capacity used for that purpose might otherwise be sold abroad as commercial enrichment (limited mainly by trade restraints on Russia's uranium and enrichment exports in most major nuclear markets). This is one of the important advantages of an accelerated blend-down approach that would blend the material initially to 19%: far less blendstock would be needed, at far less cost – and the issue of whether Russia has sufficient remaining material to make all the blendstock from would not be a serious problem.[14]

How much it really costs the Russian government to blend down its bomb uranium will probably never really be known in detail. (Indeed, given the oddities of the Soviet-era accounting systems still used in the Russian nuclear complex, one can be confident that the Russian government itself does not know what the real cost is.) Ultimately, the cost that would be paid would be a matter of negotiation – not so much the exact amount that it costs the Russian government, but the amount that provides sufficient incentive for the Russian government to go ahead and carry out the blend-down.

In short, it is very likely that enough bomb material for many thousands of nuclear weapons could be verifiably destroyed for a few hundred million dollars. Blending an additional 30 tons a year of Russian HEU might cost in the range of $30-$90 million per year – more likely toward the low end of that range, if unenriched blendstock can be used. To put it another way, this is roughly $20-$60,000 per bomb's worth of HEU destroyed (assuming 20 kg of HEU per potential bomb).

---

[12] Bunn, "The Cost of Rapid Blend-Down of Russian HEU," op. cit. If, in fact, the initial blending to 19% could be accomplished with natural or depleted uranium, while still meeting commercial specifications, the cost would be closer to the $1 million per ton end of this range. This possibility was not factored in to the cited paper.

[13] The HEU is blended with 1.5% enriched material rather than natural or depleted uranium in order to dilute the U-234 contaminant in the original HEU sufficiently to meet typical commercial standards for LEU fuel.

[14] Indeed, it appears that the HEU could be blended to 19% using natural or depleted uranium, and then the final blending done with material slightly more enriched than the current 1.5% blendstock, and still meet the same U-234 specifications. In that case, no enrichment work at all would have to be put into making blendstock for the initial accelerated blend-down, and the total enrichment work for the entire process would not be significantly increased. Robert George, U.S. Department of Energy, personal communication, 2001.

Moving Forward

The Bush administration and Congress should begin immediately to put in place an accelerated HEU blend-down deal that serves both U.S. and Russian interests. Congress could play a key role by providing a "provisional appropriation" of perhaps $50 million to finance the first year of accelerated blending, conditional on the Bush administration negotiating a satisfactory accelerated blend-down deal with Russia. That amount ought to be sufficient to finance blending of 20-30 tons of HEU in the first year.

Having appropriated funds in hand would allow the administration to be able to make a firm offer to Russia to pay for accelerated blend-down, substantially improving the chance of a successful negotiation. Russia's Ministry of Atomic Energy has agreed to participate in a detailed feasibility and cost study of different options for accelerated blend-down sponsored by the Nuclear Threat Initiative, but is unlikely to take the concept very seriously unless there is U.S. government money on the table to pay for the actual blending. Just as Congress's 1999 action to provide a $200 million appropriation for plutonium disposition, provisional on conclusion of a U.S.-Russian plutonium disposition agreement, helped make such an agreement possible in September 2000 – by giving the Russian side some confidence that U.S. money to finance disposition would indeed be forthcoming – so a provisional appropriation for accelerated HEU blend-down could leverage a U.S.-Russian accelerated HEU blend-down deal.

A doubling of the rate at which Russia's HEU was blended would mean that by the end of the decade, over 200 tons of additional HEU could be destroyed – enough for well over 10,000 nuclear weapons. That would be a lasting national security legacy for this President and this Congress.

9. NEW REVENUE STREAMS FOR NUCLEAR SECURITY

As the global effort to secure stockpiles of weapons of mass destruction (WMD) and their essential ingredients throughout the world accelerates and expands in the aftermath of September 11, a critical element will be to develop new sources of revenue to sustain these efforts into the future – through such mechanisms as debt-for-nonproliferation swaps or agreements to set aside a portion of the revenue from commercial deals such as spent fuel imports. Efforts to arrange such secure long-term revenue streams to finance arms reduction and nonproliferation have received strong bipartisan support on Capitol Hill and in the executive branch – but further action is needed to bring them to fruition.

Such supplementary revenue stream cannot be an alternative to governments fulfilling their own budget responsibilities. The United States, in its own security interest, will have to make substantial investments in cooperative threat reduction for years to come. (Indeed, the Bush administration has taken an internal decision to continue funding threat reduction efforts at roughly $1 billion per year for another decade.)[1] The Russian government itself must commit its own resources – both to finance a portion of agreed security and accounting upgrades in the near term, and to sustain effective security and accounting for the long term. U.S. European and Asian allies can and should contribute more as well – as the Bush administration is now asking them to do.[2]

But the costs of securing and reducing Russia's vast nuclear stockpiles will be high, foreign assistance will not cover everything or last forever, and the Russian government's own resources are limited. Finding additional revenue streams that can supplement on-budget government assistance is thus important – even in the near term, and still more so for the long term.

How high the ultimate costs of managing Russia's Cold War nuclear legacies will be depends on what goals are set, and what approaches taken. The Baker-Cutler panel envisioned a $30 billion investment over 10 years in securing and reducing Russia's nuclear stockpiles and nuclear complex, and controlling its nuclear expertise.[3] Senator Joseph Biden (D-DE), chairman of the Senate Foreign Relations Committee, has estimated that if the costs of securing and destroying chemical and biological stockpiles and facilities are added, along with those of managing radiological sources, the total might come to $45 billion.[4] The ongoing operations and maintenance costs for keeping nuclear weapons and materials in

---

[1] Interviews with White House and State Department officials, March and April 2002.
[2] Ibid.
[3] Howard Baker and Lloyd Cutler, co-chairs, *A Report Card on the Department of Energy's Nonproliferation Programs with Russia* (Washington DC: Secretary of Energy Advisory Board, January 2001, available as of May 15, 2002 at http://www.hr.doe.gov/seab/rusrpt.pdf). A study by one of the present authors was more optimistic (and did not envision going as far in some areas), calling for $5-$8 billion in investment over 5 years.
[4] Senator Joseph J. Biden, Jr., "Hard Choices for America's Future: Strategic Opportunities for a New Century," Address at the Center for Strategic and International Studies, Washington, DC, February 4, 2002 (available as of May 16, 2002 at http://foreign.senate.gov/press/020204_speech.html).

Russia secure and accounted for after initial upgrades are complete could themselves come to hundreds of millions of dollars a year.[5]

If judged by comparison to other expenditures on nonproliferation – which are typically a tiny fraction of governments' foreign affairs and security expenditures – such costs seem very large. But if judged by comparison to what nations routinely spend to provide for their military security – including security against threats much less dire than this one – the price is extremely modest, given the potential return on the investment. As the Baker-Cutler panel pointed out, their plan could be financed with less than 1% of the U.S. annual defense budget.

Russia itself can and must make a substantial contribution to meeting these long-term costs, but its resources are limited. While the Russian government's financial picture has dramatically improved in recent years, with the budget now balanced and tax collections substantially increased, the fact is that the entire budget of the Russian federal government, for a country that covers 11 time zones and faces a daunting intersection of expensive crises, is only slightly larger than the budget of the City of New York[6] – placing tight constraints on the amounts from its Russia is likely to be willing to spend, from its existing revenue base, to manage its WMD stockpiles and facilities. (As an example, the on-budget Russian federal expenditure for its entire nuclear weapons complex in 2001 was $200 million – roughly 4% of what the United States spent on its smaller nuclear weapons complex.)[7] Two approaches in particular to new revenue streams that could supplement Russia's ability to meet the near-term and long-term costs of securing and reducing its nuclear stockpiles merit immediate consideration.

A "Debt for Nonproliferation" Swap

Sen. Biden and Senator Richard Lugar (R-IN) have co-sponsored the "Debt Reduction for Nonproliferation Act," which was unanimously approved by the Senate Foreign Relations Committee. This Biden-Lugar initiative was included in the Security Assistance Act, which the full Senate approved by unanimous consent on December 20, 2001. Even Senator Jesse Helms (R-NC), a long-time critic of both foreign assistance in

[5] The U.S. Department of Energy proposes to spend $345 million in fiscal year 2003 on securing and accounting for nuclear weapons and materials within its own complex. This is the total for protective forces, security systems, and materials control and accountability at all DOE sites. See U.S. Department of Energy, *FY 2003 Budget Request: Detailed Budget Justifications—Weapons Activities* (Washington, DC: DOE, February 2002, available as of May 16, 2002 at http://www.cfo.doe.gov/budget/03budget/content/weapons/OthrWeap.pdf).

[6] Keith Bush, *The Russian Economy in March 2002* (Washington, DC: Center for Strategic and International Studies, Russia and Eurasia Program, March 2002, available as of May 14, 2002 at http://www.csis.org/ruseura/rus_econ0203.pdf), pp. 3-4; New York City, Office of Management and Budget, *Executive Budget Fiscal Year 2003: Expense, Revenue, Contract Summaries* (New York City: The City of New York, April 17, 2002, available as of May 14, 2002 at http://www.nyc.gov/html/omb/pdf/erc4_02a.pdf).

[7] Reported in "Bronya Krepka i Tanki Nashi Bystry," *Rossiiskie Vesti*, October 3, 2001 (provided by Oleg Bukharin, Princeton University).

general and Russia in particular, co-sponsored the bill.[8] Similar legislation has now been introduced in the House as well. Russia has taken a generally positive view of the idea, with Russia's chief debt negotiator highlighting the legislation as "a very important aspect of solving Russia's debt problem," which would allow money that would otherwise be used for debt payments to go to destroying "chemical, bacteriological, and other weapons."[9]

The basic concept of the legislation is a "debt for nonproliferation" swap, modeled on the "debt for environment" swaps of the past, some of which have been highly successful. In such a swap, a portion of Russia's debt would be canceled – and Russia would agree that instead of debt service on that debt, it would pay into an auditable fund to finance agreed nonproliferation and arms reduction initiatives.[10] For the creditor countries, a debt swap makes it possible to get something positive (in this case, crucial investments in international security) out of contentious debt negotiations; for the debtor country, a debt swap means being able to make payments in local currency, to be spent within the domestic economy, rather than sending hard currency abroad in debt payments. (Depending on the specific arrangements of the particular swap, the amount paid into the fund is also sometimes smaller than the amount of debt forgiven).

"Debt-for-environment" swaps have been successful in many countries. In 1991, for example, the creditor nations of the Club of Paris agreed to a substantial debt-for-environment swap with Poland, in which a portion of Poland's debt was cancelled, and in return, Poland made contributions to a newly established independent foundation, the Ecofund, so that the expenditure of the money on the agreed environmental purposes could be easily verified. The Ecofund now has some $500 million available through 2010 from debt swaps with several countries (with the United States the biggest donor), and has been a leading force in improving the environment in Poland and stimulating the Polish market for environmental goods and services.[11] The amount of money Poland puts into the Ecofund and how that money is spent are fully auditable, and all expenditures must be approved by a board that includes both Polish and donor-country representatives. Moreover, the creation of the Ecofund, with its Polish managers and staff, has helped build in-country capacity to finance and manage large environmental projects that would not have existed if the same funds had been applied in more traditional forms of aid.

Russia suffers from an enormous burden of foreign debt: total Russian external debt comes to some $147 billion, 3 times the *total* annual expenditure of the Russian

---

[8] James Fuller, "Debt for Nonproliferation: The Next Step in Threat Reduction," *Arms Control Today,* January/February, 2002 (available as of May 14, 2002 at http://www.armscontrol.org/act/2002_01-02/fullerjanfeb02.asp).

[9] Victor Sokolov, "Victor Supyan: 'The U.S. Could Set a Serious Precedent in Solving the Problem of Russia's Debts," *Strana.ru,* January 31, 2002.

[10] In fact, there are also more complex approaches than outright cancellation, including buybacks by the creditor, sale of the debt instruments to a third party who then cancels or restructures them, and so on. See discussion in Fuller, "Debt for Nonproliferation," op. cit.

[11] For more on the Ecofund and its success, see its website, http://www.ekofundusz.org.pl/us/index.htm, and *Swapping Debt for the Environment: The Polish Ecofund* (Paris: Organization for Economic Cooperation and Development, March 1998).

government.[12] Half of that amount is debt incurred by the communist Soviet Union, rather than by the democratic Russian governments that succeeded it. The London Club of commercial banks has already restructured Russia's Soviet-era commercial debt. The Russian economy is improving, and Russia is currently making its debt payments on schedule, leading some members of the Paris Club of government creditors (notably Germany, Russia's largest creditor) to oppose restructuring or canceling Russia's debts. Nonetheless, given the huge magnitude of Russia's total debt compared to Russia's government budget, to support Russian reform it makes sense to consider some restructuring, especially of the Soviet-era debt incurred by a totally different government – and to build a fund for key security initiatives, it makes sense to consider a debt-for-nonproliferation swap as part of that restructuring. Swapping only 5% of the $45 billion in Russian debt held by the Paris Club of creditor nations – in which the United States and its European and Asian allies are the key participants – would provide a $2 billion fund (hundreds of millions of dollars a year over several years) to pay for key initiatives to respond to the post-September 11 terrorist mass destruction threat – a dramatic new complement to Nunn-Lugar Cooperative Threat Reduction budgets.

As in the case of the Ecofund, U.S. leadership would likely be essential to initiate such a debt swap concept; but in this case other countries might make the largest contributions. The United States holds slightly less than $3 billion of Russia's official bilateral debt.[13] Germany and Italy are the largest government debt-holders, with $26.3 billion and $6.4 billion respectively.[14] Thus, an overall debt-for-nonproliferation swap might include hundreds of millions of dollars in canceled U.S. debt (as envisioned in the Biden-Lugar initiative) and substantial quantities of canceled debt from other countries as well, creating an additional mechanism to attempt to convince European countries to increase their overall contributions to threat reduction in Russia. Any U.S. debt canceled or restructured for this purpose should be in addition to, not instead of, continuing appropriations for cooperative threat reduction.

One key advantage of a debt-for-nonproliferation swap is that the mechanism effectively transfers the financing discussion from negotiating groups focused on nonproliferation – for whom a billion dollars is vast sum – to negotiating groups focused on international finance and the global economy on a broad scale, who routinely deal in units of tens of billions of dollars. Such a shift could significantly improve the prospects for arranging large-scale additional funding for threat reduction.

The time has now come for Congress to complete passage of this legislation, and for the Bush administration to begin negotiating with Russia and with other potential creditor nations to begin implementing an auditable and transparent debt-for-nonproliferation swap.

---

[12] Debt figures from Fuller, "Debt for Nonproliferation," op. cit.; Bush, *The Russian Economy in March 2002*, op. cit.

[13] Fuller, "Debt for Nonproliferation," op. cit.

[14] James L. Fuller and K. Mark Leek, "Debt for Ecology: A Concept to Help Stabilize Russian Nuclear Cities," Presentation to the International Forum on Energy and Environmental Opportunities in the Russian State Research Centres and Nuclear Cities, Como, Italy, April 2001, PNNL-SA-34546.

Spent Fuel Storage

Russia has modified its laws to make it possible for Russia to import foreign spent nuclear fuel for long-term storage and reprocessing in Russia. Russia's Ministry of Atomic Energy (MINATOM) projects that it might be possible to earn $20 billion in gross revenue from importing 20,000 tons of spent fuel over 10-20 years.[15] This idea has been hugely controversial in Russia, however, with polls typically showing 80-90% of Russians opposing imports of other countries' spent nuclear fuel. If such an effort does go forward, the United States has substantial leverage that it could use to convince Russia to spend a portion of the revenue on agreed nonproliferation and arms reduction needs: because a very large fraction of the fuel Russia would like to import originated in the United States or was irradiated in U.S.-origin reactors, the United States has a veto over whether it can be shipped to Russia.

Russia's offer to serve as host for other countries' spent fuel raises a complex set of safety, security, economic, political, and policy issues. Such a facility could make a substantial contribution to international security and would deserve support *if*:[16]

- Effective arrangements (including independent regulation) were in place to ensure that the entire operation achieved high standards of safety and security;
- Negotiation over the project provided an opportunity to effectively resolve the proliferation risks posed by Russian nuclear cooperation with Iran;
- A substantial portion of the revenues from the project were used to fund disarmament, nonproliferation, and cleanup projects that were agreed to be urgent, such as securing nuclear material and eliminating excess plutonium stockpiles;
- The project did not in any way contribute to separation of additional unneeded weapons-usable plutonium, or to Russia's nuclear weapons program; and

[15] Then-First Deputy Minister of Atomic Energy Valentin B. Ivanov, *Technical-Economic Basis for the Law of the Russian Federation: "On the Proposed Amendment to Article 50 of the Law of the RSFSR 'On Environmental Protection'"* (Moscow, Russia: Ministry of Atomic Energy, 1999, leaked and translated by Greenpeace International). How much of this gross revenue would be profit has been the subject of some dispute.

[16] For more extensive discussions of the issues surrounding the Russian spent fuel import concept and other proposals for international spent fuel storage facilities, see Matthew Bunn, John P. Holdren, Allison Macfarlane, Susan E. Pickett, Atsuyuki Suzuki, Tatsujiro Suzuki, and Jennifer Weeks, *Interim Storage of Spent Nuclear Fuel: A Safe, Flexible, and Cost-Effective Approach to Spent Fuel Management* (Cambridge, MA: Managing the Atom Project, Harvard University, and Project on Sociotechnics of Nuclear Energy, University of Tokyo, June 2001, available as of May 14, 2002 at http://ksgnotes1.harvard.edu/BCSIA/Library.nsf/pubs/spentfuel), Chapter 4; Matthew Bunn, "Russian Import of Foreign Spent Fuel: Status and Policy Implications," in *Proceedings of the 42nd Annual Meeting of the Institute for Nuclear Materials Management*, Indian Wells, CA, July 15-19, 2001; and Matthew Bunn, "Prospects for Russian Spent Fuel Import: Insights from the Harvard-Tokyo Study and Beyond," in *Proceedings of the Institute for Nuclear Materials Management Spent Fuel Seminar XIX*, Washington, DC, January 9-11, 2002.

- The project had gained the support of those most likely to be affected by it, through a democratic process, including giving them ample opportunity to ensure that their concerns were effectively addressed.

Whether an arrangement that meets these criteria can be put in place in Russia – and what the reaction will be if a proposal advances which meets the first four criteria but not the fifth – remains to be seen.

Since most of the spent fuel Russia might import cannot be shipped to Russia without U.S. approval, the principal obstacle now standing between MINATOM and $10-$20 billion in revenue is the U.S. government's permission – giving the United States potentially huge leverage in negotiations over the spent fuel import issue. Under the Atomic Energy Act, the U.S. government cannot give its permission without a Section 123 agreement for nuclear cooperation. To date, the U.S. government has not been willing to negotiate such an agreement with Russia because of Russia's ongoing nuclear cooperation with Iran. To the extent that Bush administration policy-makers have focused on the Russian spent fuel import issue, it has been largely as part of a larger strategy to try to reach an acceptable deal on the Iran nuclear cooperation issue. But in our judgment, it would be a mistake to use *all* of the available U.S. leverage on the Iran issue – some should be used to insist that a portion of any revenues from spent fuel imported with U.S. approval be spent on securing and destroying WMD stockpiles.

One example of such an approach has been put forward by a U.S. group known as the Nonproliferation Trust. In their proposal, 100% of the profit earned from Russia's spent fuel import would be controlled by auditable non-profit trusts based in the United States, which would spend the money – more than $10 billion by their estimate – on nonproliferation, arms reduction, and cleanup projects in Russia.[17] While it appears unlikely that Russia would ultimately agree to devote *all* of the profits from such a venture to these purposes, there is nonetheless an opportunity for negotiating an arrangement that would provide large sums – potentially billions of dollars – to financing nonproliferation and arms reduction.

To move such an initiative forward, the Bush administration, in consultation with Congress, needs to make decisions (and soon) on what criteria it will use to judge whether to support Russian import of U.S.-obligated spent fuel, and what it will seek in negotiations with Russia over U.S. approval. Then it will have to begin what will inevitably be extended negotiations with Russia to see where common ground can be found.

In short, there are opportunities that may make it possible to provide billions of dollars in additional revenue to finance both urgent and continuing costs of securing and destroying WMD and related materials in Russia. There is every reason to believe that terrorists and hostile states are still seeking to acquire these weapons and materials. These initiatives, if taken quickly, can help to stop them before they succeed.

[17] The Nonproliferation Trust proposal is described in Joseph Egan, *The Nonproliferation Trust Project: Frequently Asked Questions* (Washington, DC: Nonproliferation Trust, 2000).

ABOUT THE AUTHORS

JOHN P. HOLDREN is the Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology, and Public Policy in the John F. Kennedy School of Government, as well as Professor of Environmental Science and Public Policy in the Department of Earth and Planetary Sciences, at Harvard University. Trained in aeronautics/astronautics and plasma physics at MIT and Stanford, he is the author of some 300 publications on energy technology and policy, global environmental change, and nuclear arms control. He is a member of the National Academy of Sciences (NAS) and the National Academy of Engineering (NAE), chairing the NAS Committee on International Security and Arms Control and NAS/NAE committees on the comprehensive test ban treaty, plutonium disposition, and US-India cooperation on energy. He is also US co-chair of the joint US-Russian Academies Committee on US-Russian Cooperation on Nuclear Nonproliferation. He was a member of President Clinton's Committee of Advisors on Science and Technology (PCAST) from 1993 to 2001 and chaired three PCAST studies on energy R&D and one on nuclear materials protection. In 1996–97, he co-chaired with Evgeniy Velikhov the U.S.-Russian Independent Scientific Commission on Plutonium Disposition, reporting to Presidents Clinton and Yeltsin.

MATTHEW BUNN is Assistant Director of the Science, Technology and Public Policy Program at Harvard University's John F. Kennedy School of Government. His current research interests include security for weapons-usable nuclear material in the former Soviet Union and worldwide; nuclear theft and terrorism; verification of nuclear stockpiles and of nuclear warhead dismantlement; disposition of excess plutonium; conversion in Russia's nuclear cities; and nuclear waste storage, disposal, and reprocessing. From 1994-1996, Bunn served as an adviser to the White House Office of Science and Technology Policy, where he took part in a wide range of U.S.-Russian negotiations relating to security, monitoring, and disposition of weapons-usable nuclear materials. He was the staff director for the classified study of security for nuclear materials conducted by the President's Committee of Advisers on Science and Technology in 1995, and for the 1997 report of the U.S.-Russian Independent Scientific Commission on Disposition of Excess Weapons Plutonium. The author or co-author of eight books or book-length technical reports and dozens of articles, Bunn previously directed the study *Management and Disposition of Excess Weapons Plutonium,* by the U.S. National Academy of Sciences' Committee on International Security and Arms Control, and served as editor of the journal *Arms Control Today.*

ANTHONY WIER recently joined the Project on Managing the Atom as a Research Associate. Prior to coming to the Project, he was a participant in the Presidential Management Internship (PMI) program, serving as a Program Examiner in the International Affairs Division of the Office of Management and Budget. In that capacity he performed program and budget oversight on the State Department's nonproliferation, arms control, and verification and compliance efforts, as well as represented the International Affairs Division in interagency working groups on various nonproliferation and arms control matters. He has a Master of Public Affairs and a Master of Arts in Russian, East European, and Eurasian Studies from the LBJ School of Public Affairs at the University of Texas at Austin, and a Bachelor of Arts *summa cum laude* from Trinity University in San Antonio.

ACKNOWLEDGEMENTS

This report was sponsored by the Nuclear Threat Initiative. Additional funding was provided by the W. Alton Jones Foundation and the John D. and Catherine T. MacArthur Foundation. The authors would like to thank the many officials of the U.S. and Russian governments and international organizations, and experts at U.S. and Russian nuclear facilities, who gave generously of their time in discussions of these critical issues. These officials and experts prefer to remain anonymous. Many of the ideas and arguments in this report evolved in discussions with a wide range of colleagues, including in particular those at the Nuclear Threat Initiative (especially Sam Nunn, Charles Curtis, Laura Holgate, and Brooke Anderson); at Harvard University (especially Graham T. Allison, Steven E. Miller, and John C. Reppert); and those associated with the Russian-American Nuclear Security Advisory Council (especially Frank von Hippel, Kenneth N. Luongo, William E. Hoehn III, and Oleg Bukharin). We are grateful to all of them, and to George Bunn, Christina Chuen, Rose Gottemoeller, Siegfried Hecker, Michael Jasinksi, Dmitri Kovchegin, Vladimir Orlov, Scott Parrish, William Potter, Elena Sokova, and Jon Wolfsthal for ideas, discussions, comments on drafts, and encouragement. All responsibility for remaining errors and misjudgments, of course, is our own.

MANAGING THE ATOM

The Project on Managing the Atom (MTA) addresses two key problems underlying the management of nuclear technology: the intersections between nuclear energy and nuclear weapons, and democratic governance in nuclear decision-making. In addition to focused studies in these two areas, MTA collaborates with other groups on issues that bear on the future of nuclear energy and nuclear arms control. Current research priorities include:

Nuclear weapons-energy linkages: Securing, monitoring, and reducing nuclear warhead and fissile material stockpiles, and reshaping nuclear complexes, in the United States and the former Soviet Union; limiting proliferation risks of the civilian fuel cycle, including management of spent nuclear fuel and radioactive wastes containing weapon-usable materials; adapting U.S. nonproliferation and trade policies for the post-Cold War period; and exploring the links between the futures of nuclear energy, nuclear arms reductions, and nonproliferation.

Nuclear decision-making: Improving the performance of key agencies that make and oversee nuclear policy; reducing unnecessary nuclear secrecy; increasing public input into nuclear decision-making; and exploring proposals to improve democratic governance of nuclear enterprises.

MTA is based in the Belfer Center for Science and International Affairs of Harvard University's John F. Kennedy School of Government. The core staff of the Project are:

- **John P. Holdren**, Co-Principal Investigator; Director, Science, Technology, and
- Public Policy Program
- **Henry Lee**, Co-Principal Investigator; Director, Environment and Natural Resources
- Program
- **Steven E. Miller**, Co-Principal Investigator; Director, International Security Program
- **James Walsh,** Executive Director, Managing the Atom Project
- **Matthew Bunn**, Assistant Director, Science, Technology, and Public Policy Program
- **Anthony Wier,** Research Associate, Managing the Atom Project

MTA provides its findings and recommendations to policy makers and to the news media through publications, briefings, workshops, and other events. The project also supports pre- and post-doctoral fellows at the Belfer Center for Science and International Affairs. MTA has received generous support from the Carnegie Corporation of New York, the Japan Foundation Center for Global Partnership, the W. Alton Jones Foundation, the John D. and Catherine T. MacArthur Foundation, the Rockefeller Foundation, and the U.S. Department of Energy.

Our web site, at **http://www.ksg.harvard.edu/bcsia/atom**, has the full text of all our publications, summaries of current projects, and biographies of all participating researchers.