

**NEXT STEPS TO STRENGTHEN
THE NATIONAL NUCLEAR SECURITY ADMINISTRATION'S
EFFORTS TO PREVENT NUCLEAR PROLIFERATION**

TESTIMONY OF
MATTHEW BUNN
FOR THE
SUBCOMMITTEE ON ENERGY AND WATER APPROPRIATIONS
UNITED STATES SENATE

APRIL 30, 2008

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE: It is an honor to be here today to talk about critical issues for U.S. and world security – nuclear terrorism and nuclear proliferation, and what more the National Nuclear Security Administration (NNSA) can do to prevent them.

My basic message today is simple: while money is not the most important constraint on progress for most of the nation's efforts to prevent nuclear proliferation and terrorism, there are several areas where additional funds could help reduce major dangers to our national security.

NNSA's nonproliferation programs are critical tools in our nation's nonproliferation toolbox. There can be no doubt that America and the world face a far lower risk of nuclear terrorism today than they would have had these efforts never been begun. These programs are excellent investments in U.S. and world security, deserving strong support; Americans and the world owe a substantial debt of gratitude to the dedicated U.S., Russian, and international experts who have been carrying them out.

With this year's budget, Congress should focus on making sure a new team has the resources and flexibility to hit the ground running in reducing proliferation threats when they take office in January. I would urge Congress to complete a budget despite the pressures of an election year; operating on continuing resolutions until many months into a new fiscal year can be crippling for fast-changing programs such as these, making it very difficult to seize opportunities as they arise.

These programs are making substantial progress in reducing proliferation threats. But in many areas, there will still be much more to do when a new team takes office. While many of the programs in Russia are nearing completion, and their budgets will decline, efforts elsewhere around the world must expand to address the global threat, taking up the slack. Clear indicators of the global nature of the threat are everywhere – from the nuclear programs in North Korea and Iran, to the global attacks by al Qaeda and their repeated efforts to get the materials and expertise needed to make a bomb, to roughly 20 countries where the A.Q. Khan black-market nuclear network succeeded in operating for the more than 20 years before finally being disrupted, to the break-in at the Pelindaba site in South Africa last November, when four armed men penetrated the security fence without setting off any alarm at a site with hundreds of kilograms of weapon-grade highly-enriched uranium (HEU), and spent 45 minutes inside the facility without ever being engaged by the site's security forces.

I will not attempt to assess every element of NNSA's nonproliferation budget. Rather, I will outline several key nonproliferation priorities, and make recommendations for further steps NNSA or other parts of DOE can take to address them. Many of the needed actions to strengthen the global nonproliferation regime must be taken by the White House or the State Department; NNSA's critical role is in providing the technical expertise needed to back up nonproliferation initiatives, particularly in the management of nuclear weapons and materials.¹ Most of these programs are constrained more by limited cooperation (resulting from secrecy, complacency about the threat, concerns over national sovereignty, and bureaucratic impediments) than they are by limited budgets; sustained high-level leadership focused on overcoming the obstacles to cooperation is the most important requirement for success.² But in some cases, programs could move more quickly to seize risk reduction opportunities that already exist if their budgets were increased – and in still more cases, more money would be needed to implement a faster and broader effort if the other obstacles could be overcome.

Preventing Nuclear Terrorism

The first priority is to prevent terrorists from incinerating the heart of a major city with a nuclear bomb – as al Qaeda have made clear they hope to do. This remains a real danger, though no one can calculate the probability of such a catastrophe.³

The step we can take that most reduces this danger is securing nuclear weapons and materials at their source – for making plutonium or HEU is beyond the plausible capability of terrorist groups, and if we can keep these materials and nuclear weapons themselves out of terrorist hands, we can keep terrorists from ever getting a nuclear bomb. NNSA's programs are in the process of completing the security upgrades in Russia planned as part of the Bratislava initiative, and those upgrades are dramatically reducing critical risks. But the problem of inadequately secured nuclear stockpiles is not just a Russian problem, it is a global problem. Hundreds of buildings in more than 30 countries contain enough of the essential ingredients of nuclear weapons to require the highest standards of security. The world urgently needs a global campaign to ensure that *all* the caches of nuclear weapons and the materials needed to make them worldwide are secure and accounted for, to standards sufficient to defeat the threats terrorists and criminals have shown they can pose, in ways that will work, and in ways that will last. Overcoming the many obstacles to achieving this objective will require sustained political leadership from the highest levels of our government.

Budget increases for MPC&A and GTRI

¹ Most of that expertise resides at the national laboratories, not at DOE headquarters. This requires a continuing effort to build effective headquarters-laboratory partnerships, giving the labs the freedom to do what they do best, while keeping the policy-making functions with federal officials.

² For an in-depth assessment of the programs focused on security for nuclear weapons and materials, see Matthew Bunn, *Securing the Bomb 2007* (Cambridge, Mass.: Nuclear Threat Initiative and Project on Managing the Atom, Harvard University, September 2007). The 2008 edition is forthcoming.

³ See, for example, testimony of Charles Allen, Rolf Mowatt-Larsen, Matthew Bunn, and Gary Ackerman to the Senate Committee on Homeland Security and Governmental Affairs, hearing on "Nuclear Terrorism: Assessing the Threat to the Homeland," 2 April 2008.

But getting the job done as fast as it can be done will also require more money. In the case of the International Nuclear Materials Protection and Cooperation program (more commonly known as Materials Protection, Control, and Accounting, or MPC&A), construction costs in Russia have shot up since the administration prepared its budget request; helping Russian sites to prepare to sustain high levels of security is proving more expensive than expected; and new understandings have opened new opportunities for nuclear security cooperation in both Russia and South Asia. All told, I recommend an increase of \$60-\$70 million over the requested budget for the MPC&A effort.

In the case of the Global Threat Reduction Initiative (GTRI), there are now 45 HEU-fueled research reactors that could convert to low-enriched uranium (LEU) that cannot power a nuclear bomb with LEU fuels already available; GTRI has already accelerated the pace of these conversions, but with more money, these reactors could be converted faster. There will also be a need to build a fabrication plant for the higher-density LEU fuels now in development, in order to convert additional reactors, and GTRI will likely have to play a role in that – either by paying to build the plant or by guaranteeing fabrication contracts to give private firms sufficient incentives to pay for building their own facilities. Additional funds could also accelerate the pace of removing nuclear material from vulnerable sites around the world (in part because here, too, prices are escalating). And more money is also needed to secure radiological sources and research reactors around the world – including here in the United States, where upgrades are needed for some 1,800 locations with sources of 1,000 curies or more, and for the nation's 32 domestic research reactors. Moreover, GTRI is so far planning to return only a small fraction of the U.S.-origin HEU abroad; while most of the remainder is in developed countries, in many cases there is good reason to bring this material back as well, and more funds would be required to give these facilities incentives to give up their HEU. Finally, NNSA does not yet have a program focused on giving underutilized HEU-fueled reactors incentives to shut down – in many cases likely to be a quicker and easier approach than conversion. All told, I believe that an additional \$200 million or more is needed for GTRI to move forward as rapidly as possible in reducing these risks.⁴

Other needed nuclear security steps

Several additional steps could significantly contribute to efforts to secure nuclear stockpiles worldwide.

Building the sense of urgency. The fundamental key to success in these efforts is convincing political leaders and nuclear managers around the world that nuclear theft and terrorism are real threats to *their* countries' security, worthy of a major investment of their attention and resources. If they are convinced of this, they will take the needed actions to prevent nuclear terrorism; if they remain complacent about the threat and how much it could affect them, they will not take those actions. Congress should consider making funds available for activities to build this sense of urgency and commitment, including joint briefings on the nuclear terrorist threat, nuclear terrorism exercises and simulations, helping states perform

⁴ This does not include the potential cost of packaging and removing plutonium and plutonium-bearing spent fuel from North Korea, if an agreement to take those steps is reached. That substantial cost would likely have to be funded through a supplemental request.

realistic "red team" tests of their nuclear security systems, and more.⁵ Such efforts might be implemented under the rubric of the Global Initiative to Combat Nuclear Terrorism – which has the potential to become the kind of global campaign to improve nuclear security that is urgently needed, though to date it has focused more on matters such as police training and emergency preparedness than on nuclear security upgrades.

Forging effective global nuclear security standards. As nuclear security is only as strong as its weakest link, the world urgently needs effective global nuclear security standards that will ensure that all nuclear weapons and weapons-usable materials are protected against the kinds of threats terrorists and criminals have shown they can pose – at a bare minimum, against two small teams of well-trained, well-armed attackers, possibly with inside help, as occurred at Pelindaba. (In some countries, protection against even more capable threats is required.) UN Security Council Resolution 1540 legally requires all countries to provide "appropriate effective" security and accounting for all their nuclear stockpiles. The time has come to build on that requirement by reaching a political-level agreement with other leading states on what the essential elements of appropriate effective security and accounting systems are, and then working to ensure that all states put those essential elements in place. In last year's defense authorization act, Congress called on the administration to seek to develop such effective global standards; Congress should now act to ensure that the administration is taking this step, and provide funding to support such efforts if needed. Ultimately, effective security and accounting for weapons-usable nuclear material should become part of the "price of admission" for doing business in the international nuclear market.

Achieving sustainability. If the upgraded security equipment the United States is helping countries put in place is all broken and unused in five years, U.S. security objectives will not be accomplished. NNSA is working closely with Russia to try to ensure that Russia puts in place the resources, incentives, and organizations needed to sustain high levels of security for the long haul – but there is much left to do, and similar efforts will be needed wherever nuclear security upgrades are undertaken. As most nuclear managers only invest in expensive security measures when the government tells them they have to, strong regulation is essential to achieving and maintaining stringent standards of nuclear security, and there is far more to do to get effective nuclear security and accounting regulations in place around the world.

Strengthening security culture. As Gen. Eugene Habiger, former DOE "security czar" and former commander of U.S. strategic forces, has remarked: "good security is 20% equipment and 80% culture." We need to increase efforts to build security cultures that will put an end to guards patrolling without ammunition or staff propping open security doors for convenience. NNSA is working this problem hard, but changing the day-to-day attitudes and practices at scores of facilities in dozens of countries with many different national cultures, where we have only very limited influence, is an extraordinarily difficult policy problem. Convincing nuclear managers and staff that the threats of nuclear theft and sabotage are real will be fundamental, and many of the steps needed to build high-level commitment to nuclear security will also help in building strong security cultures. Efforts similar to those now being undertaken in Russia need to be undertaken wherever nuclear weapons and the materials to make them exist. We also need more effort to learn from cases where facilities or organizations have succeeded in transforming their security or safety cultures – and from cases where they have failed to do so.

⁵ For a list of suggestions, see Bunn, *Securing the Bomb* 2007, pp. xxx

Consolidating nuclear stockpiles. We need to do everything we can to reduce the number of buildings and bunkers worldwide where nuclear weapons and the materials needed to make them are located, achieving more security at lower cost. Our goal should be to remove all nuclear material from the world's most vulnerable sites and ensure effective security wherever material must remain within four years or less. Over time, the United States should seek an end to all civil use of HEU. And we should not encourage commercial reprocessing and recycling of plutonium, as proposed in the Global Nuclear Energy Partnership (GNEP); even the proposed GNEP processes that do not separate "pure plutonium" would tend to increase, rather than decreasing, nuclear theft and nuclear proliferation risks compared to not reprocessing this fuel.⁶ We should also work to reduce the total stockpiles of weapons and materials that must be guarded, including by ending production of more. NNSA's recent success in enabling Russia to shut down one of its three remaining plutonium production reactors -- and the shut-down of the remaining two, planned in the next two years -- is a major milestone. But there is more to be done. It is time to get serious about negotiating a verifiable global treaty ending production of nuclear materials for weapons forever, to stop the production of highly enriched uranium for any purpose, and to stop piling up ever larger stockpiles of separated civilian plutonium. In particular, Congress should direct NNSA to return to the negotiation of a 20-year moratorium on separating plutonium in the United States and Russia that was nearly completed at the end of the Clinton administration. The troubled plutonium disposition effort and opportunities for expanded disposition of HEU are important topics treated in more detail at the end of this statement. Over the longer term, if properly managed, serious pursuit of the steps toward a nuclear weapon free world advocated by Secretaries Shultz, Kissinger, and Perry and Senator Nunn could make a significant long-term contribution to reducing nuclear terrorism risks.⁷

Strengthening international approaches. The International Atomic Energy Agency (IAEA) has a key role to play in improving nuclear security -- helping to develop standards and recommendations, providing international peer reviews of nuclear security arrangements, coordinating efforts among different donors contributing to nuclear security improvements, and more. Some countries trust the IAEA in a way that they will never trust the United States, and the Agency is uniquely positioned to develop international security recommendations that will be broadly accepted around the world. But the IAEA's Office of Nuclear Security is constantly hampered by its very limited budget, which is tightly constrained by earmarks for donors' favored projects. While U.S. contributions to the IAEA largely flow through the State Department, NNSA has made substantial contributions to the Office of Nuclear Security in the

⁶ See discussion in Matthew Bunn, "Risks of GNEP's Focus on Near-Term Reprocessing," testimony before the Committee on Energy and National Resources, U.S. Senate, 14 November 2007, available as of 28 March 2008 at <http://belfercenter.ksg.harvard.edu/files/bunn-GNEP-testimony-07.pdf>. The radioactivity of the plutonium-bearing materials that would be recovered in proposed GNEP processes is not remotely enough to deter theft by determined terrorists. See Jungmin Kang and Frank Von Hippel, "Limited Proliferation-Resistance Benefits from Recycling Unseparated Transuranics and Lanthanides from Light-Water Reactor Spent Fuel," *Science and Global Security* 13, no. 3 (2005).

⁷ See George P. Shultz, William J. Perry, Henry A. Kissinger, and Sam Nunn, "Toward a Nuclear-Free World," *Wall Street Journal*, 15 January 2008, and Matthew Bunn, "Securing Nuclear Stockpiles Worldwide," in *Reykjavik Revisited: Steps Toward a World Free of Nuclear Weapons* (Palo Alto: Hoover Institution, forthcoming). For recent discussions of steps to reduce existing stockpiles of HEU and separated plutonium, see Matthew Bunn and Anatoli Diakov, "Disposition of Excess Highly Enriched Uranium," and "Disposition of Excess Plutonium," in *Global Fissile Materials Report 2007* (Princeton, NJ: International Panel on Fissile Materials, October 2007, available as of 28 March 2008 at <http://www.fissilematerials.org>), pp. 24-32 and 33-42.

past. I recommend that Congress direct an additional \$5-\$10 million contribution to the IAEA's Office of Nuclear Security, to strengthen its efforts to contribute to nuclear security worldwide.

Sharing nuclear security best practices. Just as the nuclear industry created the World Association of Nuclear Operators (WANO) after the Chernobyl accident, to bring the worst performers on safety up to the level of the best performers, the world needs a World Institute of Nuclear Security (WINS), to provide a focus for exchanging best practices in nuclear security and material control and accounting. The Nuclear Threat Initiative (NTI) and the Institute for Nuclear Materials Management are working with the nuclear community to establish such an institution. To be effective, this should ultimately be led by those with direct responsibility for managing nuclear material and facilities. But it may be necessary for NNSA and others to provide initial seed money to get it going; Congress should consider appropriating a few million dollars for that purpose.

Building genuine partnerships. To be successful, all of these efforts must be pursued in a spirit of genuine partnership, serving both our interests and those of the partner states, with ideas from each side's experts incorporated into the approach; the experts in each country know their materials, their facilities, their regulations and bureaucracies, and their culture better than we do, and we need to listen to them to get the "buy-in" essential to long-term sustainability. In particular, while these programs must look beyond Russia to the world, there is a special need for partnership with Russia, as Russia and the United States bear a special responsibility, with some 95% of the world's nuclear weapons and more than 80% of its stocks of weapons-usable nuclear material. The shift to a true partnership approach should include establishing joint teams that would help other states around the world upgrade security. The Global Initiative to Combat Nuclear Terrorism, co-led by the United States and Russia, is an important step in the right direction. But as the President and Congress consider actions which strongly affect Russian interests, from missile defense in Europe to the expansion of NATO to Russia's borders, they need to consider the potential impact on the prospects for effective nuclear security partnership as well.

Beyond nuclear security

While securing nuclear weapons and materials at their source is the most effective tool to reduce the risk, we cannot expect it to be perfect. We urgently need a substantially stepped-up effort to build police and intelligence cooperation focused on stopping nuclear smuggling and the other elements of nuclear plots in countries all over the world, including additional sting operations and well-publicized incentives for informers to report on such plots. This will make it even more difficult for potential nuclear thieves and those who would like to buy stolen material to connect, and to put together the people, equipment, expertise, and financing for a nuclear bomb conspiracy without detection.

The United States should also work with key states around the world to ensure that they put in place laws making any participation in real or attempted theft or smuggling of nuclear weapons or weapons-usable materials, or nuclear terrorism, crimes with penalties comparable to those for murder or treason.

The real, but limited, role of radiation detection. Radiation detection at ports, border crossings, and elsewhere will play a role in these later lines of defense, but its contribution to reducing the risk of nuclear terrorism will inevitably be limited. The length of national borders,

the diversity of means of transport, the vast scale of legitimate traffic across these borders, the small size of the materials needed for a nuclear bomb, and the ease of shielding the radiation from plutonium or especially from HEU all operate in favor of the terrorists. Neither the detectors now being put in place nor the Advanced Spectroscopic Portals planned for the future would have much chance of detecting and identifying HEU metal with modest shielding – though they likely would be effective in detecting plutonium or strong gamma emitters such as Cs-137 that might be used in a so-called “dirty bomb.”⁸ Most of the past successes in seizing stolen nuclear material have come from conspirators informing on each other and from good police and intelligence work, not from radiation detectors.

Hence, while it is worth making some investment in radiation detection, we should not place undue reliance on this line of defense. That being said, NNSA's Second Line of Defense program has been successful in cooperating with many countries to put radiation detection in place at key ports and border crossings, and to take advantage of all the opportunities for cooperation with key countries that it now has before it would require \$50-\$60 million beyond the budget request.

A modified approach to cargo scanning. Beyond the budget, Congress should act to modify the approach to radiation scanning of cargo containers approved last year. By requiring 100% of containers coming into the United States to be scanned (an extraordinarily difficult target to meet), offering the possibility of a waiver, and setting no requirements for the quality of the scanning or for what should be done with the information from the scans, Congress may have inadvertently created a situation where the requirement will repeatedly be waived and the scanning put in place will be of low quality and lead to little action. Congress should approve a revised approach in which terrorists would know that each container had a high *chance* of being scanned; the scans were done with the best available scanning technology; and the scans would be linked to immediate further search and other action in the event of unexplained detections. This would do more to keep terrorists from using containers to smuggle nuclear weapons and materials. At the same time, Congress should insist that the Department of Homeland Security provide a detailed assessment of the vulnerability posed by the countless potential pathways for nuclear smuggling between official points of entry, and should mandate an independent assessment of the cost-effectiveness of large investments in radiation detection at official points of entry when intelligent adversaries have options for going around them.⁹

A strengthened nuclear forensics effort. Congress should also act to strengthen U.S. and international efforts in nuclear forensics (the science of examining characteristics of seized nuclear material or nuclear material collected after a nuclear blast for clues to where it came from). I recommend that Congress increase funding for nuclear forensics R&D by at least \$10 million and direct that a robust portion of available funding be spent to maintain and expand the technical capabilities at the U.S. laboratories (currently so much of the funding is staying at the Department of Homeland Security that U.S. laboratories working on forensics of seized materials have had to lay off some of their staff). In addition, I recommend that Congress direct the administration to pursue expanded efforts to put together an international database of

⁸ See, for example, Thomas B. Cochran and Matthew G. McKinzie, “Detecting Nuclear Smuggling,” *Scientific American*, March 2008, available as of 28 April 2008 at <http://www.sciam.com/article.cfm?id=detecting-nuclear-smuggling>.

⁹ For a more optimistic view on this part of the problem, see Levi, *On Nuclear Terrorism*, pp. 87-96.

material characteristics. Congress should understand, however, that nuclear material has no DNA that can provide an absolute match: nuclear forensics will provide a useful but limited source of information to combine with other police and intelligence information, but will rarely allow us to know where material came from by itself.¹⁰

Coping with North Korea and Iran

The next priority is to cope with the nuclear programs of North Korea and Iran. If both North Korea and Iran become established nuclear weapon states, this will be a dramatic blow to the entire global effort to stem the spread of nuclear weapons, and will put significant pressure on some of their neighbors to follow suit. The Bush administration's no-engagement approach to Iran has clearly failed, allowing Iran to move forward unimpeded with a substantial enrichment capability, just as the administration's earlier "threaten and watch" approach to North Korea failed utterly, leaving North Korea with a tested nuclear bomb and enough plutonium to make 5-12 nuclear weapons. The next president needs to take a new tack, putting together international packages of incentives and disincentives large enough and credible enough to convince the North Korean and Iranian governments that it is in *their* national interests to agree to arrangements that would put a wide and verifiable gap between them and a nuclear weapons capability. If we want these governments to address our concerns, the U.S. government will have to address some of *their* key concerns – which may in the end require difficult choices, such as providing Iran with a security assurance as part of such an agreement, and acknowledging that at this point, a ban on all enrichment in Iran, however desirable, can no longer be achieved.¹¹ It is primarily the White House and the State Department that need to take action, but Congress should be prepared to provide supplemental funding as needed for NNSA support to verification, packaging and removing nuclear materials and equipment, and helping to decommission nuclear facilities and redirect nuclear experts.

Reducing Demand for Nuclear Weapons

The third priority is to reduce the demand for nuclear weapons around the world. Efforts to reduce demand have been more successful than is usually recognized. Today, there are more countries that started nuclear weapons programs and then decided to give them up and accept international inspections than there are states with nuclear weapons – meaning that even once

¹⁰ See Nuclear Forensics Working Group (Michael May, chair), *Nuclear Forensics: Role, State of the Art, Program Needs* (Washington, DC: American Physical Society and American Association for the Advancement of Science, February 2008).

¹¹ For a discussion of the risks to U.S. national security of continuing to insist on zero enrichment in Iran, see Matthew Bunn, "Constraining Iran's Nuclear Program: Assessing Options and Risks," presentation at Oak Ridge National Laboratory, 15 November 2007, available as of 28 April 2008 at http://belfercenter.ksg.harvard.edu/files/Matthew_Bunn_Oak_Ridge.pdf. For an imaginative proposal for a multilaterally owned and staffed enrichment facility in Iran, designed so that it can be easily and permanently disabled if Iran ever takes action to turn it to weapons use, see Geoffrey Forden and John Thompson, *Iran as a Pioneer Case for Multilateral Nuclear Arrangements* (Cambridge Mass.: Science, Technology, and Global Security Working Group, Massachusetts Institute of Technology, 2006 (revised 2007), available as of 28 April 2008 at <http://mit.edu/stgs/irancrisis.html>. For a discussion of the current issues, and of a proposal similar to the Forden-Thompson proposal, see William Luers, Thomas R. Pickering, and Jim Walsh, "A Solution for the U.S.-Iran Nuclear Standoff," *New York Review of Books*, 20 March 2008, available as of 28 April 2008 at <http://www.nybooks.com/articles/21112>.

states start nuclear weapons programs, efforts to convince them that nuclear weapons are not in their interest succeed more often than they fail.

Here, too, many of the needed steps require White House, State Department, or Defense Department action. But NNSA's programs can have an important effect on the demand for nuclear weapons as well. When the country with the most powerful conventional forces on earth insists that large numbers of nuclear weapons are essential to its security, that they will remain essential forever, that new nuclear weapons are needed, and that a transformed complex that is "responsive" in the sense that it could rebuild a larger nuclear arsenal if need be is also essential, this strengthens the arguments of those in other countries arguing that their country also needs nuclear weapons. Perhaps even more important, it will be far more difficult to get political support from non-nuclear-weapon states for stronger safeguards, more stringent export controls, tougher enforcement, and the other measures urgently needed to strengthen the global nonproliferation regime – all of which involve more constraints and costs for them – if the United States and the other NPT weapon states are seen as failing to live up to their legal obligation, under Article VI of the Nonproliferation Treaty (NPT), to move in good faith toward nuclear disarmament.

I believe that the case has not been made that the claimed benefits of the Reliable Replacement Warhead (RRW) outweigh these and other potential downsides. I recommend that the Congress continue to refuse to fund that program, and direct NNSA to focus on a smaller, cheaper complex designed only to support a much smaller nuclear stockpile for the future. The next president should recommit the United States to the Comprehensive Test Ban Treaty, and work to build the support in the Senate that will be necessary for ratification.

More broadly, the United States and Russia, as the states with the world's largest nuclear stockpiles, should agree to reduce their total stockpiles of nuclear weapons to a small fraction of those they hold today, and to declare all their HEU and plutonium beyond the small stockpiles needed to support the remaining agreed nuclear weapon stockpiles (and modest set-asides for naval fuel) as excess to their military needs. Both countries should put this excess material in secure storage sites subject to international monitoring, and reduce these stocks through use or disposal as quickly as that can safely, securely, and cost-effectively be done.¹²

Toward these ends, I recommend that Congress provide funding and direction for NNSA to:

- Further increase the rate of dismantlement of nuclear weapons and HEU components;
- Establish international monitoring of HEU and plutonium declared excess to date; and
- Participate in the British initiative to develop approaches to international verification of nuclear disarmament.

¹² In the Trilateral Initiative, the United States, Russia, and the IAEA developed technologies, procedures, and legal agreements that would make it possible for excess material to be placed under international monitoring irrevocably, without revealing classified information. I will address the issue of disposition of excess material in more detail at the end of this testimony. For visionary discussions of the need for both near-term steps to reduce nuclear danger and a broad vision of a world without nuclear weapons, see George P. Shultz, William J. Perry, Henry A. Kissinger, and Sam Nunn, "A World Free of Nuclear Weapons," *Wall Street Journal*, 4 January 2007, and "Toward a Nuclear-Free World," *Wall Street Journal*, 15 January 2008.

These steps are particularly important in the lead-up to the NPT Review Conference in 2010. In 2005, at a moment when the world needed to build consensus on steps to strengthen the global effort to stem the spread of nuclear weapons, the NPT Review Conference collapsed in disarray, in substantial part because the Bush administration refused to even discuss the steps toward disarmament the United States and all the other NPT parties had committed to at the previous review. We cannot afford a similar failure at the upcoming review in 2010. The next president will have to move quickly to re-establish U.S. credibility on nuclear disarmament.

I fear that the recent U.S.-India nuclear cooperation agreement, modifying long-standing nonproliferation rules, may also add to the arguments of nuclear weapons advocates in other countries. Already, Iranian colleagues tell me that nuclear hawks in Tehran have pointed to this accord, arguing that while much of the international community sanctioned India after the 1998 tests, the United States was soon back, looking for a strengthened relationship and expanded trade, and has now said, in effect, "all is forgiven" – and that in much the same way, sanctions on oil-rich Iran would never last long, however far it might push its nuclear program. Congress should carefully consider whether the benefits of this agreement are worth these risks.

Stopping Black-Market Nuclear Networks

The experience of the global black-market nuclear network led by Pakistan's A.Q. Khan – which operated in some 20 countries for over 20 years before it was finally disrupted, at least in part – makes clear that urgent steps are needed to strengthen the world's ability to detect and stop such black-market networks, and to strengthen global export controls. Unfortunately, it is clear that black-market nuclear networks continue to operate, and to pose serious dangers to the global future.

As with stopping smuggling of nuclear materials, stopping nuclear technology networks will require stepped-up international police and intelligence cooperation; the police and intelligence response must be just as global as these networks are.

It will also require a radical improvement in global controls over exports and transshipments of sensitive technologies. In addition to requiring "appropriate effective" nuclear security and accounting, UNSC 1540 requires every UN member state to put in place "appropriate effective" export controls, border controls, and transshipment controls. We should be making greater use of this new nonproliferation tool, helping to define what essential elements must be in place for states' controls in these areas to be considered appropriate and effective, and helping states put those essential elements in place. Today, important export control assistance programs are in place which are making a real difference – but they remain limited to a handful of key countries, despite the Khan network's demonstration that countries that no one thought of as having sensitive technology may provide key nodes for a black-market network. I recommend that Congress increase the budget for NNSA's export control assistance program by at least \$10-15 million, and direct the administration to develop a plan for making sure *all* countries fulfill their UNSC 1540 obligation to put effective controls in place.

Reducing the Proliferation Risks of Nuclear Energy

Today, demand for nuclear energy is growing, in response to concerns over fossil fuel prices and availability and over climate change. It is crucial to take steps today to ensure that the spread of nuclear energy does not contribute to the spread of nuclear weapons.¹³

The most critical technologies of concern are enrichment and reprocessing, either of which can be used to support a civilian nuclear fuel cycle or to produce material for nuclear weapons. Every state that establishes an enrichment plant or a reprocessing plant is in a position, should it ever choose to do so, to withdraw from the NPT and quickly produce nuclear material for nuclear weapons. Restraining the spread of these technologies is a critical nonproliferation goal.

There is no prospect, however, for an effective agreement that would ban additional states from developing enrichment and reprocessing technology; states simply will not agree to forswear this possibility indefinitely. The United States should eliminate "forswear" "forgo" and similar "f words" from our vocabulary in discussing these topics. The best that can be done is to convince suppliers to limit exports of these technologies to additional countries – which they have been doing since the mid-1970s – and, just as important, to give states strong incentives to rely on international suppliers for these services rather than making the large investments required to build enrichment and reprocessing plants of their own.

Congress took an important step in this direction last year in providing \$50 million for an international fuel bank, which would increase states' confidence that international supply would not be disrupted. The IAEA is still struggling to reach agreement on the terms and conditions for this bank, and to recruit additional donors. If all goes well, however, agreement on one or more fuel banks could be reached this calendar year.

A fuel bank will be a useful step – but as the commercial market already provides strong assurance of fuel supply for most states, a fuel bank alone will only create a modest additional incentive to rely on international supply. The United States, Russia, and other nuclear suppliers are now working together to put together other incentives – including help with infrastructure for nuclear energy, financing, and the like. "Fuel-leasing" – fresh fuel supply combined with a promise to take the spent fuel away – could be a particularly powerful incentive for states to rely on international supply, since it could potentially allow more states to use nuclear energy without having to establish their own geologic repositories. I do not believe that take-back of spent fuel from foreign countries will be politically tenable in the United States in the near term, whether the reprocessing and transmutation technologies proposed for the Global Nuclear Energy Partnership (GNEP) are under active development or not; but Russia has legislation in place that allows it to enter into such contracts, and others may decide to enter the market for taking back spent fuel in the future.¹⁴

¹³ For a discussion, see Matthew Bunn, "Proliferation-Resistance (and Terror-Resistance) of Nuclear Energy Systems," presentation to "Systems Analysis of the Nuclear Fuel Cycle," Massachusetts Institute of Technology, 20 November 2007, available as of 28 April 2008 at http://belfercenter.ksg.harvard.edu/files/bunn_proliferation_resistance_lecture.pdf.

¹⁴ Countries can already contract to send their spent fuel to France, the United Kingdom, or Russia for reprocessing, but France and the United Kingdom require that the high-level waste be returned, so countries still need a geologic repository.

One step the United States should *not* take is to build a reprocessing plant ourselves in the near-term.¹⁵ Sending the message that the United States, with the world's largest reactor fleet, considers reprocessing essential to the future of nuclear energy will make it more difficult to convince other countries not to pursue their own reprocessing facilities. This, like RRW and the weapons complex, is an area where there would be nonproliferation benefits from spending *less* than the administration's request. I recommend that Congress provide a fiscal 2009 budget for GNEP similar to the fiscal 2008 budget provided in the omnibus appropriation, with program direction similar to that this subcommittee provided in its bill last year. Within that overall budget, spending on development of small sealed-core reactors with high degrees of inherent safety and security should be increased, to roughly \$10 million. Such reactors – sometimes known as “nuclear batteries” – might be factory-built, transported to where they would be used with a lifetime core of fuel already inside, and then transported back intact after 10-20 years of electricity generation, with little access to plutonium-bearing fuel and little build-up of weapons-relevant nuclear expertise, potentially making nuclear energy widely available with reduced proliferation risks.

Strengthening Safeguards

Events in Iran, Libya, and elsewhere make clear that the world needs a stronger nuclear safeguards system. The U.S. government needs to do more to ensure that the International Atomic Energy Agency has the resources, authority, personnel, and technology it needs to do its job. In particular, the United States is behind on its assessed dues to the IAEA, and Congress should provide funding to pay the back dues and direct that the United States pay its dues on time each year. Congress should also provide increased funding for the U.S. voluntary contribution to the IAEA, in particular to ensure that funding is available for needed upgrades to the Safeguards Analytical Laboratory.

That funding largely flows through the State Department. NNSA's role has traditionally been focused more on technical support for safeguards. But the U.S. investment in safeguards technology and safeguards experts at the national laboratories has declined dramatically since the early 1990s. Neither the IAEA nor the U.S. programs to support it have the resources needed to adapt the most modern technologies being developed in the commercial sector to the needs of safeguards, or to pursue longer-term safeguards R&D. NNSA has undertaken a very thoughtful “Fundamental Safeguards Review,” and as a result of that has launched a “Next Generation Safeguards Initiative.” Within nuclear energy R&D, more focus is also needed on “safeguards by design” – building effective safeguards and security in from the outset in design and construction of new facilities, just as is done with safety today. I recommend an increase of \$10-\$15 million in the funding for this critical effort, to finance both expanded R&D and expanded efforts to recruit, train, deploy, and retain the next generation of safeguards experts.¹⁶

¹⁵ For a more extended discussion, see Matthew Bunn, “Risks of GNEP's Focus on Near-Term Reprocessing,” testimony before the Committee on Energy and National Resources, U.S. Senate, 14 November 2007, available as of 28 April 2008 at <http://belfercenter.ksg.harvard.edu/files/bunn-GNEP-testimony-07.pdf>. See also Edwin Lyman and Frank N. von Hippel, “Reprocessing Revisited: The International Dimensions of the Global Nuclear Energy Partnership,” *Arms Control Today*, April 2008, available as of 28 April 2008 at http://www.armscontrol.org/act/2008_04/LymanVonHippel.asp.

¹⁶ For a similar recommendation for reinvestment in safeguards, see American Physical Society Panel on Public

Limiting Proliferation of Nuclear, Chemical, and Biological Expertise

Despite the recent improvements in the Russian economy, I believe that NNSA's scientist-redirection programs continue to offer benefits to U.S. security worth the modest investments the U.S. government makes in them. Contrary to recent newspaper reports,¹⁷ the fact that some institutes that have received NNSA funds also have some experts who have worked on a safeguarded power reactor in Iran does not in any way mean that NNSA programs have somehow contributed to Iran's nuclear program. Moreover, while a substantial fraction of the long-term jobs these programs have created have gone to people who are not weapons scientists,¹⁸ that is hardly a surprise. It is hard to think of a new business in the United States or elsewhere that has former weapons scientists for 100%, or even 80%, of its employees.

At the same time, there is clearly a need to reform these efforts to match today's threats. The dramatically changed Russian economy creates a very different threat environment. The experience of the A.Q. Khan network suggests that dramatic leakage of proliferation-sensitive expertise may come from well-to-do experts motivated by ideology and greed, and not only from desperate, underemployed experts. For a terrorist group, a physicist skilled in modeling the most advanced weapons designs – the kind of person who has often been the focus of these programs in the past – may be much less interesting than a machinist experienced in making bomb parts from HEU metal, or a guard in a position to let thieves into a building undetected. Experts who are no longer employed by weapons institutes, but whose pensions may be inadequate or whose private ventures may have failed, could pose particularly high risks, but they are not addressed by current programs focused on redirecting weapons expertise. We need to find ways to address all of the highest-priority risks – but we are not likely to have either the access or the resources to do everything ourselves. The solution is likely to require working in partnership with Russia and other countries, to get them to do most of what needs to be done. I recommend that Congress provide roughly \$30 million (comparable to the fiscal 2008 appropriation) for the Global Initiatives for Proliferation Prevention program, with direction to provide an in-depth analysis of what the most urgent risks of proliferation of weapons expertise are, and how they might best be addressed.

Intelligence and Analysis to Support Policy

Good information and analysis is critical to implementing successful nonproliferation policies. I recommend increases in two areas.

First, the increased budgets for DOE intelligence that Congress has supported in recent years have supported a number of important new initiatives, such as the Nuclear Material Information Program (NMIP), intended to compile key information on nuclear stockpiles, their security, and the threats to them around the world. But this may have left too little remaining to support the critical capabilities at the national laboratories. It is my understanding that there

Affairs, Nuclear Energy Study Group, *Nuclear Power and Proliferation Resistance: Securing Benefits, Limiting Risks* (Washington, D.C.: APS, May 2005, available as of 28 April 2008 at <http://www.aps.org/policy/reports/popa-reports/proliferation-resistance/upload/proliferation.pdf>).

¹⁷ Matthew Wald, "U.S.-Backed Russian Institutes Help Iran Build Reactor," *New York Times*, 7 February 2008.

¹⁸ See U.S. Government Accountability Office, *Nuclear Nonproliferation: DOE's Program to Assist Weapons Scientists in Russia and Other Countries Needs to be Reassessed* (Washington, D.C.: December 2007).

have been drastic cuts in the budget for Livermore's Z Division, for example – which for decades has provided some of the highest-quality nuclear intelligence analyses available to the U.S. government (including having been correct about Iraq's aluminum tubes). I recommend that Congress act to ensure that these critical capabilities are maintained and expanded, while also ensuring that efforts like NMIP have the funding they need.

Second, many important ideas for preventing proliferation come from independent analysts outside the government. Yet U.S. nonproliferation programs rely much less on work by universities and non-government organizations than many other parts of the U.S. government do. The U.S. Department of Homeland Security, for example, despite being a relatively new department operating in areas that are often shrouded in secrecy, has established several "centers of excellence" for university-based analysis of particular categories of homeland security problems, along with other programs focused on bringing in academic expertise to contribute to improving homeland security. NNSA should do more to do the same. I believe that each of the largest and most important nonproliferation programs would benefit from having a standing advisory group of outside experts regularly reviewing its efforts and suggesting ideas for improvement. In addition, I believe that NNSA could benefit greatly from a small investment in non-government analyses of key proliferation risks and how they might be reduced more effectively. I recommend that Congress provide \$10 million specifically directed for NNSA to support such non-government analyses of effective approaches reducing proliferation risks – and to additional training of the next generation of nonproliferation experts. Depending on the degree of success of this effort, appropriate levels of funding might increase in later years.

Reducing Plutonium and HEU Stockpiles

Finally, disposition of the large excess stockpiles of plutonium and highly enriched uranium (HEU) in the United States and Russia continues to pose an important but difficult policy problem.¹⁹ As suggested above, the United States and Russia should agree to reduce their nuclear weapon stockpiles to very low levels and to eliminate all stocks of separated plutonium and HEU beyond those needed to support those low, agreed warhead stockpiles. This would mean disposition of far larger stocks of material in both Russia and the United States than have been declared excess so far. Since this will take many years, in the near term the United States and Russia should move to legally commit their excess material to peaceful use or disposal and place it under international monitoring to confirm that commitment – sending an important signal to the world that the United States and Russia are serious about their arms reduction obligations, at relatively minor cost.

Disposition of Excess Plutonium

Last year, Congress rescinded the remaining unobligated balances for U.S. and Russian plutonium disposition, and moved the U.S. plutonium disposition program to the Office of Nuclear Energy. This year, the requested funds are in Other Defense Activities.

The cost of the U.S. MOX program has skyrocketed over the years. DOE's latest published estimates indicate a life-cycle cost for the MOX facility of some \$7.2 billion (not

¹⁹ For more detailed discussions, see Bunn and Diakov, "Disposition of Excess Highly Enriched Uranium," and "Disposition of Excess Plutonium."

counting the substantial cost of the pit disassembly and conversion facility). DOE has never adequately explained why this facility is costing many times what comparable facilities in Europe with more capability cost to build. Even once the expected \$2 billion in expected revenue from MOX sales is subtracted, this still comes to over \$120 million per ton of excess plutonium.²⁰

Something has to be done with this plutonium, but it would be surprising if no effective approach could be found that would manage this material securely for less than \$120 million per ton. If judged solely as a nuclear energy initiative, building such a plant would certainly not be worthwhile; it would demonstrate nothing except the ability to replicate in the United States an expensive fuel cycle approach with significant proliferation risks that is already routinely done in Europe, and even if a demonstration fast reactor were built for GNEP in the near term (which I believe would be unwise), the initial core could be fabricated elsewhere at lower cost.

I recommend that Congress approve funding to proceed with the MOX plant for this year, while simultaneously directing DOE to carry out an in-depth study of potentially lower-cost alternatives. In particular, Congress should provide funding for DOE to restart development of plutonium immobilization technology, and direct DOE to outline the lowest-cost practicable immobilization option for the entire excess plutonium stockpile; Congress should also direct DOE to include, in its options assessment, the option of transporting the excess plutonium to Europe for fabrication and irradiation in existing facilities there. If, for example, the French were willing to take the U.S. excess plutonium for \$1 billion, the U.S. government would have saved billions compared to other approaches; if not, that would certainly make clear that even with high uranium prices, plutonium is a costly liability, not an asset.²¹

On the Russian side, critics have raised legitimate concerns about using excess plutonium in the BN-800 fast-neutron reactor, since it creates roughly as much plutonium as it burns. While DOE is working with Russia to modify the reactor from a plutonium "breeder" to a plutonium "burner," consuming more plutonium than it produces, this is largely a distinction without a difference, as the baseline design for the BN-800 produces only slightly more plutonium than it consumes, and the revised design produces only slightly less. More important is the fact that under the 2000 Plutonium Management and Disposition Agreement, spent fuel from plutonium disposition will not be reprocessed until decades from now, when disposition of all the plutonium covered by the agreement has been completed. Thus, a large stockpile of weapons-grade separated plutonium will be transformed into a stockpile of plutonium embedded in radioactive spent fuel – at least for some time to come.

The United States and Russia should agree that (a) the highest practicable standards of security and accounting will be maintained throughout the disposition process; and (b) all separated plutonium beyond the amount needed to support low, agreed numbers of warheads will be subject to disposition. If the United States and Russia agreed on those points, and also agreed

²⁰ Total project cost for construction is \$4.8 billion. Operations and maintenance is estimated at \$2.4 billion. See U.S. Department of Energy, *FY 2009 Congressional Budget Request: Other Defense Activities* (Washington, DC: DOE, February 2008), pp. . The per-ton calculation assumes, over-generously, that the 9 tons of excess plutonium announced in 2007 is entirely additional to the 34 tons covered under the 2000 disposition agreement and costs nothing to process.

²¹ Areva officials indicate that there are now trades among utilities in which some utilities agree to burn MOX fabricated from other utilities' plutonium, suggesting that if the price were right, it might be possible to convince utilities to burn this MOX in Europe.

that spent fuel from plutonium disposition (a) would not be reprocessed except when the plutonium was immediately going to be reused as fuel, and then under heavy guard, with stringent accounting measures, and (b) would only be reprocessed in ways that did not separate weapons-grade plutonium from fission products, and in which plutonium would never be separated into a form that could be used in a bomb without extensive chemical processing behind heavy shielding, then this disposition approach would deserve U.S. financial support. This is particularly the case as the BN-800 approach fits in to Russia's own plans for the nuclear energy future, unlike previous plans that focused on MOX in VVER-1000 reactors. If the United States does *not* provide promised financial support for disposition in Russia, Russia may conclude that it is free to use the BN-800 to breed more plutonium from this weapons plutonium, and to reprocess the spent fuel immediately, adding to Russia's huge stockpiles of separated plutonium. Congress should provide sufficient funding for DOE to explore such approaches, and support them if agreement can be reached.

Disposition of Excess HEU

The current 500-ton HEU Purchase Agreement expires in 2013. Russia is likely to have hundreds of tons of additional HEU at that time that are not needed either to support its nuclear weapons stockpile or for naval and icebreaker fuel. Russia has made clear that it has no interest in extending the current implementing arrangements for the HEU Purchase Agreement, under which Russia faces higher costs and lower prices than it would marketing new-production commercial LEU. But a variety of other arrangements are possible that could create substantial incentives for Russia to blend down additional HEU. Congress should direct DOE to enter into discussions with Russia concerning a broad range of possible incentives the United States might be willing to provide to help convince Russia to blend down additional HEU – and should consider setting aside a conditional appropriation in the range of \$200 million to finance such incentives if an agreement is reached that requires such funding.

Similarly, the United States can and should expand and accelerate the blend-down of its own excess HEU, beyond the roughly three tons per year now planned. Congress should provide additional funding targeted to accelerating the effort to get the HEU out of the canned sub-assemblies and blended down to LEU.

Conclusions

Mr. Chairman, from al Qaeda to North Korea to Iran to global black-market nuclear networks, the world today faces serious dangers from nuclear terrorism and nuclear proliferation. But there is no reason for despair. Indeed, the global effort to stem the spread of nuclear weapons has been far more successful than many people realize. Today, there are nine states with nuclear weapons; 20 years ago, there were nine states with nuclear weapons. (South Africa dropped off the list, become the first case of real nuclear disarmament, while North Korea joined the list.) That there has been no net increase during a period that saw the chaos following the collapse of the Soviet Union; secret nuclear weapons programs in Iraq, Iran, Libya, and, apparently, Syria; the entire period of the A.Q. Khan network's export operations; and the nuclear efforts of al Qaeda and Aum Shinrikyo is an amazing public policy success.

But if we hope to maintain that success into the future, there is a great deal to be done – and substantial parts of the work will need to be done by NNSA. For the coming year, I recommend additional funding and direction to:

- Move toward securing and consolidating *all* stocks of nuclear weapons and materials worldwide, to standards sufficient to defeat the threats terrorists and criminals have shown they can pose, in ways that will work, and in ways that will last.
- Build effective global standards for nuclear security, in part by building on the foundation provided by UNSC 1540's legal requirement that all countries provide "appropriate effective" security for whatever stockpiles they may have.
- Expand global police and intelligence cooperation focused on stopping nuclear smuggling and terrorist nuclear plots, while modifying our approach to radiation detection and cargo scanning.
- Expand R&D on nuclear forensics.
- Engage with North Korea and Iran to verifiably end their nuclear weapons programs.
- Eliminate funding for RRW; scale back funding for complex transformation to focus on a smaller, cheaper complex to support a smaller stockpile; and increase funding for dismantlement, placing excess materials under international monitoring, and developing international approaches to verifying nuclear disarmament.
- Expand global police and intelligence cooperation to stop black-market nuclear networks, and increase efforts to help countries around the world implement the UNSC 1540 obligations to put in place appropriate effective export controls, border controls, and transshipment controls.
- Provide incentives for states not to build their own enrichment and reprocessing facilities, while reducing the emphasis on near-term reprocessing in GNEP, reducing GNEP's requested budget, and increasing funding for development of small sealed-core reactors with low proliferation risks.
- Reinvest in the people and technology needed for advanced safeguards.
- Continue a modest investment in reducing the risk of proliferation of weapons expertise, while undertaking a fundamental review of the highest-priority risks and the best means to address them.
- Continue to support disposition of excess plutonium in the United States and Russia, while reviewing cost-effective alternatives and seeking new agreements to expand the amount of plutonium subject to disposition and ensure that disposition will be permanent and secure.
- Offer new incentives for Russia to blend far more of its HEU to LEU, and accelerate the blend-down of U.S. excess HEU.

This is an ambitious agenda. Implementing it will require sustained leadership from the next president, who must move quickly to pursue these and other steps to reduce the threat. I believe that it is critical that the next president appoint a senior White House official with full-time responsibility for leading these efforts and keeping them on the front burner at the White House every day – as Congress directed last year.

Implementing this agenda will also require sustained Congressional support. Congress has a responsibility and an opportunity to exercise in-depth and informed oversight of these efforts, through hearings such as this one and legislation. Congress should give the administration the funding and authority to get the job done, while holding the administration responsible for demonstrable results. In this year in particular, Congress should focus on laying the foundation of policy and authority that will allow the next president to hit the ground running. With a sensible strategy, adequate resources, and sustained leadership, the risks of nuclear terrorism and nuclear proliferation can be substantially reduced. American security demands no less.