ARMS CONTROL ASSOCIATION

Arms Control Today June 2001

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Missing the Forest for the Trees: U.S. Non-Proliferation Programs in Russia

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Despite early indications that the Bush administration's budget would deal a severe blow to nuclear threat reduction efforts in Russia, it now appears that most, if not all, U.S. non-proliferation programs in Russia will continue apace.

In its recently adopted budget resolution for fiscal year 2002, for example, Congress strongly urged the Bush administration to restore its initial cuts to programs run by the Department of Energy (DOE). Although some DOE programs need significant increases to meet their objectives in the coming year, as a first step, this congressional marker augurs well. U.S. non-proliferation programs in Russia operated by the departments of State and Defense, meanwhile, weathered the first round of Bush administration budget assessments and, for the moment, appear to be in reasonably good shape. As the new administration's National Security Council completes its formal review of these activities, reports suggest that slowly but surely the enormous value of these programs to U.S. national security is being recognized.

Still, along the way, the new team in Washington seems to have missed a unique opportunity to make the programs run better, cheaper, and smarter—supposedly the touchstone of the corporate-style Republican worldview. The problem has been the tendency to look at these programs one by one rather than together. The United States needs a strategic approach that allows cross-program synergies, impacts, and investment opportunities to be recognized and addressed. Administered by three different departments and a major publicly held corporation, the various non-proliferation program in Russia often work without knowledge of what the others are doing and sometimes work at cross-purposes. Examples of missed opportunities and, sometimes, perverse consequences are all too frequent, making it essential that these programs be made to function together more effectively.

Implementation of a comprehensive strategic planning process was the lead recommendation of a recent blue-ribbon study and has long been urged by other observers, but it appears that the Bush administration is uninterested in this essential management tool.[1] There are a number of simple steps the administration should take and a number of simple tools it can use to increase greatly the return on the U.S. investment in securing Russia's nuclear arsenal.

The Zheleznogorsk Conundrum

A telling example of unrecognized synergies and impacts that cut across multiple U.S. non-proliferation programs in Russia is the situation in the closed nuclear city of Zheleznogorsk, located in Siberia. Here, in 1998, city fathers advised DOE officials from the Nuclear Cities Initiative (NCI)—a program intended to accelerate the closure of Russian nuclear weapons facilities by providing non-defense jobs for displaced workers—that some 8,000 new jobs were urgently needed to employ nuclear workers who were about to lose their positions.

Why are the jobs needed? Because another U.S. program, known as the Plutonium Production Reactor Shutdown Program (formerly the "Core Conversion Program"), is seeking to end Zheleznogorsk's annual production of 50 bombs' worth of weapons-grade plutonium. This important Department of Defense (DOD) Cooperative Threat Reduction program has been working to close the city's plutonium production reactor and plutonium separation plant, the municipality's principal source of employment and revenue. Fortunately, the reactor in question is not to be shut down until an alternative source for the heat and electricity it produces can be brought online, probably a fossil-fuel-burning plant, and that is not scheduled to happen until 2006—a point the city fathers failed to note, but one that makes the challenge of finding employment for the displaced works more manageable.

As it looked ahead, the NCI team then realized that a third U.S. program—the DOE Plutonium Disposition Program—was planning to build a major plutonium fuel fabrication plant at Zheleznogorsk. The Plutonium Disposition Program will render 34 metric tons of Russian weapons-grade plutonium effectively unusable for nuclear weapons. It will combine the plutonium with depleted uranium to make "mixed oxide" (MOX) fuel for use in eight Russian nuclear power plants. As a result, the plutonium will be transformed, at a rate of two metric tons per year, into highly radioactive spent fuel, many hazardous processing steps away from nuclear arms.

As currently envisioned, the plant producing MOX powder would be built in Ozersk, a major nuclear processing center in the Urals, and the MOX fuel rods would be manufactured at a new plant in Zheleznogorsk. Construction at the latter site would start in 2004 or 2005, and the first fuel rods would be introduced into Russian reactors in 2007. Thereafter, the Zheleznogorsk MOX fuel fabrication plant would remain in operation for many years. Thus, because of the requirements of the Plutonium Disposition Program, there would be a sizable construction project at the site and, by 2006 or 2007, a significant number of high-technology jobs for plutonium workers displaced by the termination of new plutonium production. If one takes into account the retirement of older workers, a fair start will have been made toward meeting the city's looming employment challenge.

It looks to be a seamless web, woven by a team of ace Clinton administration policymakers. In fact, the apparent integration of job loss and job creation through these programs at Zheleznogorsk was completely unplanned and based on coincidence and blind luck. The U.S.-Russian agreement on ending plutonium production originally specified that plutonium production at Zheleznogorsk was to end in 2000, and when it was signed, there was no Nuclear Cities Initiative to address the needs of displaced workers. Equally ironic is the fact that when the Nuclear Cities Initiative selected its first three target cities, Zheleznogorsk was included in large part because its future looked bleak; NCI personnel never consulted their counterparts in the Plutonium Disposition Program about the possibility of building a major new facility there, nor was the NCI team consulted when the Plutonium Disposition officials were reviewing Zheleznogorsk and alternative sites. Indeed, there was apparently not a single meeting at which the job impacts of the three U.S. programs operating in that city were examined in an attempt to align them.

There is more to the story, however, because the Plutonium Disposition Program appears to be working at cross purposes in Zheleznogorsk with another DOE initiative, the Material Protection, Control, and Accounting (MPC&A) program. The MPC&A program has the goal of enhancing the security of Russia's hundreds of metric tons of nuclear weapons material, and among its subsidiary activities is a far-sighted program to consolidate nuclear materials at as few sites in Russia as possible. Unfortunately, as noted above, the Plutonium Disposition Program appears to be moving in precisely the opposite direction with its plan to site the MOX powder plant and MOX fuel fabrication plant at two sites some 1,500 miles apart, rather than to co-locate them.

Because of the relative ease of processing unirradiated MOX into pure plutonium for weapons, MOX powder and fuel have been subject to the most stringent "Category I" security standards in the U.S. civilian nuclear industry and are similarly treated under International Atomic Energy Agency (IAEA) security guidelines. The United States has required other countries to adopt equally strict standards when processing or using MOX produced with plutonium created in U.S.-exported reactors or obtained from U.S.-origin fuel.[2]

In effect, siting the Zheleznogorsk MOX fuel fabrication plant 1,500 miles from the MOX powder plant in Ozersk will lead to unnecessarily transporting a weapon's worth of plutonium three-quarters of a million miles a year for 17 years—the equivalent of 30 trips around the Earth—albeit under presumably strict security arrangements.[3] Once again, not a single meeting was held within the executive branch to permit the proponents of alternative siting options to wrestle with this problem.[4]

And, so, the unplanned confluence of four U.S. programs in Zheleznogorsk leaves a conundrum: should the United States take advantage of a fortuitous proposal to build the MOX plant there and create needed jobs to keep nuclear workers from selling their skills to third parties, while increasing security risks over nuclear material; or should the United States build the plant in Ozersk to reduce security risks over materials, while leaving displaced Zheleznogorsk workers with no ready employment alternatives?

Fissile Material and Fuzzy Math

The lack of cross-program strategic planning with respect to U.S. initiatives to eliminate and secure fissile materials can be observed in other programs as well. For example, it appears that the MPC&A program is not taking account of the positive impact on its mission of U.S. programs for eliminating or halting the production of Russian fissile material and of the construction of the high-security Mayak Fissile Material Storage Facility (FMSF) at Ozersk.

U.S. programs for eliminating or halting the production of fissile materials include the Highly Enriched Uranium (HEU) Purchase Agreement, the Plutonium Disposition Program, and the Plutonium Production Reactor Shutdown Program.

Under the HEU Purchase Agreement, over the course of 20 years, Russia is to blend down 500 metric tons of weapons-quality highly enriched uranium into low-enriched uranium, which is suitable for use as nuclear power plant fuel but no longer usable for nuclear weapons. The blended-down material is to be purchased by the now-privatized United States Enrichment Corporation for some $10 billion. To date, the HEU Purchase Agreement has resulted in the blending down of 113 metric tons of Russian HEU, and for each of the next 13 years, an additional 30 metric tons will be transformed into reactor fuel, reducing Russia's total inventory of HEU accordingly.

In addition, beginning in 2007, over a period of 17 years, the Plutonium Disposition Program, as noted earlier, will render 34 metric tons of Russian weapons-grade plutonium highly difficult to use for nuclear arms (and no longer in need of special physical security arrangements), a disposition rate of two metric tons per year.

As also referred to earlier, under the Plutonium Production Reactor Shutdown Program, Russia will end the production of weapons plutonium by 2006, as the United States (assuming congressional approval) underwrites the refurbishment and construction of fossil fuel plants to provide an alternative source of heat and electricity now provided by Russia's three plutonium production reactors (two of which are in Seversk and one of which is in Zheleznogorsk). This will end the addition of 1.2 metric tons of weapons plutonium to the Russian fissile material inventory annually.

The MPC&A program itself will also eliminate material through its Materials Consolidation Program, which seeks to remove smaller quantities of HEU from various sites in Russia, bring it to one or two processing points, and blend it into low-enriched uranium. In this case, rather than being sold commercially, the material remains in Russia for use at Russian facilities. The MPC&A program hopes use this approach to eliminate 13-27 metric tons of HEU by 2011 and therefore to end the need for security measures at the sites from which the material is removed.

Finally, the Mayak FMSF will sequester 50 metric tons of Russia weapons plutonium in a virtual plutonium Fort Knox. The material is to be loaded into the facility, which is being built by the Cooperative Threat Reduction program, between 2002 and 2008.

Obviously, the processing and transportation of the material at issue in these programs will lead to certain new MPC&A requirements, but there can be no question that over time the programs will help end the production of new Russian fissile material and will take material of concern to the MPC&A program out of circulation and off the MPC&A inventory of material at risk. At the same time, new weapons dismantlements will add new fissile material of concern. The key point is that the inventory of Russian fissile outside of weapons is dynamic, and many of the trends in that inventory can be predicted.

Judging from information the MPC&A program provided to the General Accounting Office (GAO), however, the program is not taking this dynamism into account in plotting its future. The data supplied to GAO state that the MPC&A program will help secure 603 metric tons of Russian fissile material—and assume that this amount will remain constant until the program completes its task in 2011.[5]

The MPC&A program did not make public the assumptions behind these numbers, which, it should be noted, were accepted by GAO. But most observers believe that the 603 metric tons includes significant quantities of material from previously dismantled nuclear weapons or from Russian stocks of material prepared for use in weapons—i.e., material that will be eligible for the HEU Purchase Agreement, the Plutonium Disposition Program, Material Consolidation, or the Mayak Fissile Material Storage Facility.

If this is true, it would mean that, by 2011, 300 metric tons of the 603 metric tons of concern to the MPC&A program could have been eliminated under the HEU Purchase Agreement, 50 metric tons of plutonium could have been secured in the Mayak Fissile Material Storage Facility, 13-27 tons could have been down-blended under the Material Consolidation Program, and eight metric tons of plutonium could have been rendered safe under the Plutonium Disposition Program.

Of course, certain additions to inventory would also occur, and not every ton of material eliminated automatically reduces the burden on the MPC&A program because a vault containing one metric ton of HEU may require virtually the same level of security as a vault holding 20 tons.

At a minimum, however, one can be confident that if the spectrum of cross-program impacts on Russian fissile materials described here were taken into account, the total material remaining at the end of the period would not be the same as it is today, and, quite possibly, the demands on the MPC&A program would have been significantly reduced.

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The cases noted above are illustrative of a far broader problem. Other examples of issues affecting multiple U.S. non-proliferation programs in Russia include the question of how IAEA inspections will follow Russian nuclear materials from the Mayak FMSF into the Plutonium Disposition Program; the prospects for utilizing additional storage capacity at the Mayak FMSF to secure Russian HEU and, possibly, additional plutonium; and opportunities to accelerate the down-blending of HEU under the HEU Purchase Agreement or to enlarge the scope of that agreement to eliminate additional HEU. Moreover, a strategic planning process covering all of the U.S. non-proliferation programs in Russia could

- allocate financial and diplomatic resources for maximum efficiency;
- permit tracking of programmatic milestones so as to allow the administration to accelerate one program if a related effort faltered; and
- identify unmet fissile material security threats, where new U.S. initiatives may be needed (for example, to curb Russia's continued separation of 1-2 metric tons of plutonium from nuclear power plant fuel each year, a matter that was not addressed until late in the second Clinton administration).

Why were these and other interagency issues not raised during the Clinton administration? The core reason was that each program faced so many challenges of its own that managers' time and energy were devoted to addressing the obstacles immediately in front of them. These challenges included pressing for sufficient budgets, addressing congressional concerns, and—most difficult—finding satisfactory approaches to meeting Russian requirements. This is not a throw-away point. The programs at issue often involved massive budgets; entailed highly complex activities at numerous sites in Russia; required maintaining complicated relationships with U.S. contractors; and, most demanding, sought to build novel relationships with the Russian Ministry of Atomic Energy that involved its most sensitive activities.

With these preoccupations, it is not surprising that mission-focused program managers often resisted the idea of incorporating additional dimensions—read, "additional headaches"—into their decision-making. Respect for colleagues' hard work and concern that, if one intruded on another's program, the favor might be returned also instilled caution. Diverse chains of command within and among U.S. agencies exacerbated the problem because of the difficulty of challenging a decision already tacitly or formally endorsed by a high-ranking official in a different chain.

Generally speaking, at the level where the various programs were understood in detail, authority was lacking to integrate them more effectively. At the same time, those possessing the necessary authority to improve program coordination, such as the staff members at the National Security Council and the Office of Management and Budget, lacked the detailed knowledge of the programs required to appreciate the need for such efforts and the opportunities they could have provided.

For its part, the interagency process, which convened principally to focus on the issues of the moment (in particular, coordination of the diplomatic initiatives), needed to keep the various programs moving forward. Periodic high-level meetings between Vice President Al Gore and his Russian counterparts through the U.S.-Russia Bilateral Commission fell prey to the same exigencies. Finally, the U.S. coordinator for Russia/NIS assistance at the

Department of State, although compiling useful cross-program information, lacked the authority over other agencies necessary to advance strategic planning.

Although these trends prevented broad strategic planning of the type urged here, important coordination did take place on individual issues. One example was the creation of a joint DOD-DOE budget and strategy for developing technologies to address complex transparency issues affecting the Mayak Fissile Material Storage Facility, the Plutonium Production Reactor Agreement, and other programs. In another instance, the Cooperative Threat Reduction program, in order to maintain an accelerated schedule for the dismantlement of Russian strategic submarines, sought the concurrence of other U.S. agencies for the reprocessing of the submarines' spent fuel. To help work the issue, DOE undertook a rapid study of the question, which became the basis for a consensus in support of the Pentagon initiative. Similarly, the departments of Defense and Energy collaborated closely on work with the Russian navy, with whom both had important programs, to avoid unintended impacts on each other's efforts.

Launching More Effective Planning

To exploit the opportunities that a better government-wide planning process would provide, the Bush administration needs to create a forum for identifying and working on issues that affect multiple U.S. non-proliferation programs in Russia. A number of outside specialists and panels have called for the creation of a senior coordinator or "czar" for these activities, to be situated in the National Security Council (NSC) with direct access to the president. The Clinton administration resisted this option, however, and the Bush administration's reorganization of the NSC has focused on other priorities.[6]

Appointing a powerful figure in the White House to set government-wide goals and priorities, coordinate the myriad programs at issue, drive agencies to meet objectives, and provide political clout to overcome obstacles may well be the ideal solution. More modest alternatives, however, implemented through an assistant-secretary-level working group coordinated by NSC Senior Director for Proliferation Strategy, Counterproliferation, and Homeland Defense Robert Joseph could achieve much and could be implemented far more easily, without the upheaval of realigning responsibilities within the executive branch.

The broad strategic goals for U.S. non-proliferation in Russia will be set shortly as the Bush team completes its program reviews, and these objectives will have the imprimatur of the president in the form of a presidential decision document. In all likelihood, these goals will look much like those of the Clinton administration: securing and eliminating fissile materials, irreversibly removing such materials from military use, creating non-defense employment opportunities for Russian weapons of mass destruction scientists, and facilitating the downsizing of the Russian nuclear weapons complex. Implementation then becomes the key issue.

The approach suggested here to improve program implementation is to build up gradually to better overall strategic planning through a series of manifestly useful, easy-to-implement, and relatively uncontroversial steps that examine cross-program interactions. Once cross-program issues or opportunities have been identified at the level of an interagency working group, they tend to be addressed. The critical first step is recognizing such linkages and their potential importance. If this is done, it is not unreasonable to hope that attentiveness to such issues will gradually be infused into program management.

The process could begin with tasking the planning group to prepare a number of studies to establish baselines for further action. A logical starting point would be to develop an inventory of the most obvious cross-program relationships, an integrated calendar of the coming year's anticipated activities with clear milestones (to be gradually expanded into two- and three-year plans), and a prioritized list of expected requirements for high-level diplomatic intervention to support specific program objectives.

With these tools, coupled with presidential articulation of overall program goals, important building blocks for more intensive strategic planning would be in hand. An agreed inventory of cross-program interactions would naturally lead to the establishment of subgroups to exploit or resolve such linkages; agreed program milestones projected into the coming year could be expected to help shape future budgeting decisions; and the very development of a list of prioritized diplomatic interventions would itself constitute a small-scale strategic planning effort.

Early attention should also be given to the preparation of a year-by-year projection of job requirements in a number of key Russian nuclear cities and a comparison of these requirements to the job creation impacts of all current and planned U.S. program activities at these sites, including programs whose principal goal is not job creation per se. By delineating where Russian nuclear complex downsizing was expected to have the greatest impact, U.S. policy-makers could focus job creation efforts on locations where the need was most urgent.

Also needed without delay is a year-by-year projection of the inventory of Russian fissile material not in weapons and an analysis that plots against this inventory the predicted accomplishments of the MPC&A and Mayak Fissile Material Storage Facility programs in enhancing the security of the remaining material. The author prepared such an analysis in the form of a spreadsheet, based largely on the assumptions outlined above along with several other projections, and then charted the combined impact of U.S. fissile material elimination and security programs.[7]

The results—shown in the **chart** below for illustrative purposes only—suggest that the MPC&A program might achieve its overall goal earlier than predicted because of reductions in the inventory at risk that are achieved by other U.S. programs.[8] Although much more work would be needed before such data would be sufficiently accurate to underpin administration policy-making, the overall approach is useful and rather straightforward. It appears, however, that no similar spreadsheet or chart has ever been produced within the executive branch.

Understanding Investment Costs

A planning process of this type would also permit development of interprogram cost analyses. These could play a crucial role in future investment decisions for U.S. non-proliferation programs in Russia, but they have rarely been used in the past.

For example, Russia might be willing to store additional fissile material in the Mayak Fissile Material Storage Facility, but presumably it would cost money to prepare the material and transport it to the site. If Russia asked the Cooperative Threat Reduction program to pay these costs, the Pentagon might be unwilling, perceiving the expenses as new costs that would detract from other programs. However, if one takes into account the impact that storing more material at Mayak would have on other programs, the investment might actually be far smaller than it initially seemed and could perhaps represent a net savings to the U.S. government as a whole. This would be the case, for example, if the material in question had yet to be covered by the MPC&A program. Because the material protected in Mayak would not have to be secured by MPC&A, the MPC&A program would avoid costs and save money.

A similar approach could be used as the Pentagon considers the possible completion of the second wing of the Mayak FMSF, which would allow much more weapons-usable material to be stored there and reduce the burdens on the MPC&A program. In all likelihood, the avoided-cost savings to the MPC&A program would not come close to fully offsetting the price of the new wing, but they might measurably reduce the overall outlay for the facility.

The DOE Plutonium Disposition Program used this approach in analyzing the domestic component of its activities. It recognized that by disposing of plutonium currently stored at the Rocky Flats plant near Denver, it would save some $350 million annually in storage costs, eventually recouping the expense of disposition. This “avoided cost” approach, however, has not been applied to U.S. non-proliferation investments in Russia.

Cross-program investment analyses could prove important in assessing choices concerning the elimination of Russian fissile materials. Current U.S. plans are to eliminate 30 metric tons per year of Russian HEU under the HEU Purchase Agreement through 2013 and to eliminate two metric tons of plutonium from 2007 through 2024 under the Plutonium Disposition Program. Given the complexity of the latter program, it is not unlikely that it will fall behind schedule. The United States could still meet its overall fissile material elimination goals, however, if in each year that the Plutonium Disposition Program were delayed beyond 2007, the United States arranged for the down-blending of an equivalent amount of HEU (6.25 metric tons) in addition to the 500 metric tons already covered by the HEU Purchase Agreement.9 Because blending down additional HEU would cost much less than eliminating a weapon-equivalent of plutonium under the Plutonium Disposition Program, the comparative budgetary impact of the HEU contingency plan would not be severe. For relatively little additional money, the United States could eliminate the same amount of weapons-equivalent fissile material annually even if the Plutonium Disposition Program were delayed.
Despite the obvious utility of such comparisons, U.S. officials overseeing non-proliferation efforts in Russia have rarely used cross-program investment analyses of the type described in these examples. Such analyses need to be made an integral part of the interagency planning process proposed here.

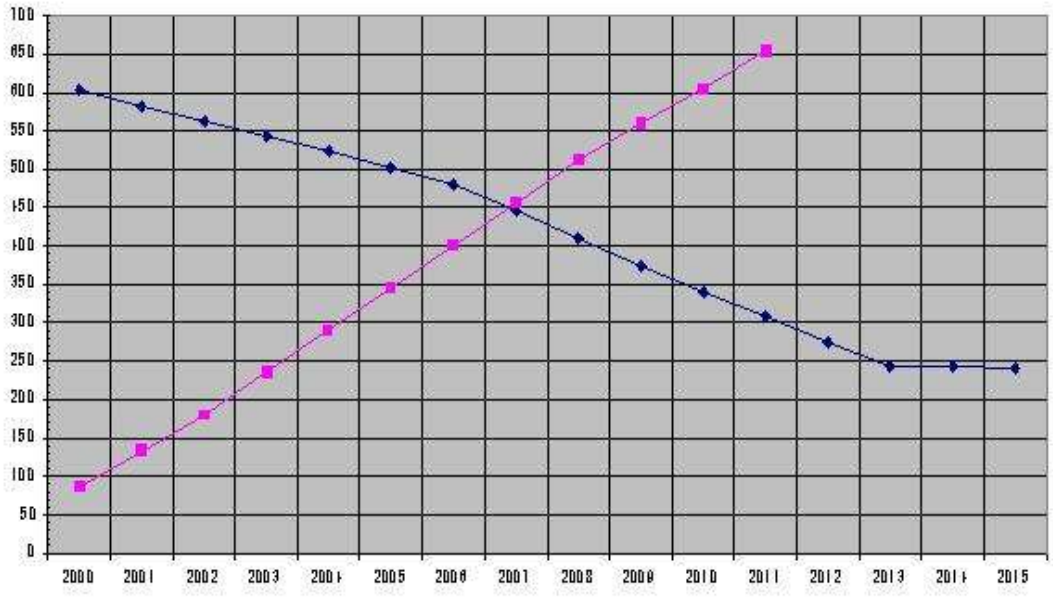
Conclusions

U.S. non-proliferation programs in Russia have been marked by innovation, dynamism, and considerable success. Nonetheless, because these efforts have been implemented by three separate U.S. government departments and a sizable publicly held corporation and because each program has been closely focused on achieving its objectives in the face of numerous obstacles, coordination among the programs has suffered, and numerous opportunities to enhance the combined impact of these activities have been missed.

An important step toward rectifying this situation would be the establishment of an NSC-led interagency strategic planning group, which could use a series of studies and periodic reports as a basis for improved coordination. Actions as simple as preparing an integrated annual calendar of milestones for all major programs and tracking them over the course of the year or establishing a comprehensive year-by-year projection of the inventory of Russian fissile materials covered by various U.S. programs would be significant steps forward. The process would help prioritize diplomatic initiatives, enhance efficient use of budgetary resources, and identify potential conflicts and synergies among the U.S. efforts. As the new Bush team completes its reviews of U.S. non-proliferation programs in Russia, this is one new initiative that would be widely applauded.

Progress in Eliminating and Securing Russian Fissile Material

Metric Tons of Fissile Material per Year



KEY

Blue Line	Purple Line
Inventory of highly enriched uranium and plutonium not in weapons and still of conern.	Highly enriched uranium and plutonium secured by the MPC&A program and in the Mayak Storage facility.

NOTES

I am indebted to Matthew Bunn, assistant director of the Science, Technology, and Public Policy Program at Harvard University's Kennedy School of Government, for his valuable comments on an early draft of this article.

1. See Secretary of Energy Advisory Board, A Report Card on the Department of Energy's Nonproliferation Programs with Russia, January 10, 2001, p. 2; Matthew Bunn, The Next Wave: Urgently Needed Steps to Control Warheads and Fissile Material, Belfer Center for International Affairs and Carnegie Endowment for International Peace, April 2000, p. 118-120; John P. Holdren, "Reducing the Threat of Nuclear Theft in the Former Soviet Union," Arms Control Today, March 1996, p. 20.

2. The MPC&A program has applied less stringent standards to similar materials in Russia—the same standards as those used at DOE facilities in the United States—but the involvement of other countries in funding the Plutonium Disposition Program will undoubtedly lead to MOX powders and fuel being subject to the more rigorous international rules.

3. Two tons of MOX powder—containing enough plutonium for 250 weapons, using the IAEA standard of eight kilograms per weapon—would be shipped from Ozersk to Zheleznogorsk for fabrication into fuel rods, and the rods would then be shipped back through Ozersk, a total distance of about 3,000 miles, en route to the reactors that will use them in western Russia. (The transportation link to the reactors would be unavoidable even if the two MOX plants were co-located in Ozersk; at issue is the added transportation required by siting the fuel fabrication plant at Zheleznogorsk.)

4. This point was confirmed by a former senior official in the Plutonium Disposition Program in a conversation in April 2001. A similar problem of potentially avoidable long-distance transportation of fissile material can be seen in the chain of Russian facilities processing HEU under the HEU Purchase Agreement. See General Accounting Office, Nuclear Nonproliferation: Status of Transparency Measures for U.S. Purchase of Russian Highly Enriched Uranium, September 1999, Figure 2 and Appendix I. Unfortunately, it does not appear that Russia has obtained the assistance of the MPC&A program in enhancing security over these transit links.

5. General Accounting Office, Nuclear Nonproliferation: Security of Russia's Nuclear Material Improving; More Enhancements Needed, February 2001.

6. See references in note 1. In fact, in 1996 Congress adopted legislation to establish a national coordinator for non-proliferation matters, whose responsibilities would have included coordinating U.S. non-proliferation programs in Russia. National Defense Authorization Act for Fiscal Year 1997 (P.L. 104-221) Title XIV, Subtitle D.

7. The spreadsheet examines the total Russian inventory of HEU and plutonium not in weapons and the accomplishments of U.S. programs to secure the material remaining in this inventory so as to identify the date when all material remaining in the inventory will be secured through the MPC&A program and in the Mayak FMSF. Based on the February 2001 GAO report on the MPC&A program, the spreadsheet assumes that the total beginning inventory in 2001 is 603 metric tons, that 86 metric tons of this total has received comprehensive security upgrades

under the MPC&A program, and that the remaining 517 metric tons will be secured by 2011. This implies that the program secures material at a rate of 47 metric tons per year. The Mayak FMSF is assumed to receive 50 tons of plutonium between 2002 and 2008.

Increases to the inventory of material occur because of (1) new weapon dismantlements (assumed, as a placeholder, to add 10 metric tons per year to the inventory of material not in weapons, for six years); (2) new production of weapons plutonium; and (3) new production of civil plutonium. (The last two categories taper off as relevant U.S. programs to end plutonium production take effect.) Decreases to the inventory occur because of (1) the HEU Purchase Agreement; (2) the MPC&A Materials Consolidation program; and (3) beginning in 2007, the Plutonium Disposition Program.

8. To be sure, "tons of material secured" is not the only valid metric for assessing program accomplishments; the proportion of buildings containing fissile material that have been secured compared to the number needing such upgrades might be better. However, tons of material secured is a standard used by the MPC&A program itself, and an integrated approach to assessing progress in this sphere would be a useful starting point for looking at progress building by building, which presumably will also be affected by the accomplishments of other programs.

9. Two metric tons of plutonium would be sufficient material for 250 weapons (at eight kilograms per weapon). Since 25 kilograms of HEU are needed for a weapon, 250 times this amount, or 6.25 metric tons would be the equivalent of the two metric tons of plutonium.

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