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Excess weapons plutonium: How to reduce a clear and present danger

Holdren, John P; Ahearne, John F; Garwin, Richard L; Panofsky, Wolfgang K H; et al. **Arms Control Today; Washington** Vol. 26, Iss. 9, (Nov/Dec 1996): 3-9.

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Abstract Translate

The ongoing dismantlement of tens of thousands of US and Russian nuclear weapons is creating a daunting new security challenge to control the risks of theft, proliferation and reversal of ongoing arms reductions posed by the growing US and Russian stockpiles of excess separated plutonium and highly enriched uranium. These materials present a "clear and present danger to national and international security."

Full text Translate

The ongoing dismantlement of tens of thousands of U.S. and Russian nuclear weapons offers immeasurable benefits for the security of the United States and the world. But it is also creating a daunting new security challenge: controlling the risks of theft, proliferation and reversal of ongoing arms reductions posed by the growing U.S. and Russian stockpiles of excess separated plutonium and highly enriched uranium (HEU). As some of us warned three years ago in the first volume of a two-part National Academy of Sciences (NAS) study of this issue, these materials pose a "clear and present danger to national and international security."

It is vital that these stockpiles be safely and securely transformed as quickly as possible into forms much harder to use for bomb building. Doing so will reduce the danger of theft of the materials for weapons use by rogue states or terrorists and will create significant barriers against its reincorporation into U.S. and Russian arsenals. This action, which will send a signal to the world that the United States and Russia do not intend to reuse these materials, will improve prospects for further nuclear arms reductions and strengthen the international non-proliferation regime.

Excess HEU can be readily transformed into proliferation-resistant low-enriched uranium (LEU) by straightforward blending with natural, depleted or slightly enriched uranium. The United States and Russia have already agreed that the United States will buy LEU "blended down" from 500 metric tons of HEU from dismantled Russian nuclear weapons over 20 years, and that the United States will similarly blend down its own excess HEU for

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peaceful uses. To reduce the security risks posed by excess HEU, the pace of blending down can and should be accelerated, going beyond the pace of anticipated Russian deliveries and its use as fuel in civilian nuclear reactors.

Dealing with the excess separated plutonium is much more difficult and controversial. No approach as simple as blending down HEU exists. We believe that the two approaches with the least problems for transforming separated weapons plutonium into forms sufficiently resistant to reuse in weapons are: (a) immobilizing it in massive glass or ceramic logs together with radioactive high-level wastes; and (b) embedding it into plutonium-uranium mixedoxide (MOX) fuel for use in a limited number of currently operating civilian power reactors on a "once-through" basis, that is, without subsequent separation of the plutonium. We also believe that U.S. non-proliferation and arms reduction goals will be best served by pursuing these two approaches in parallel-the "dual-track" approach which the Clinton administration announced on December 9 was its "preferred alternative" for eliminating these dangerous stockpiles. A final "Record of Decision" is expected in January, after the 30-day period required by the National Environmental Policy Act (NEPA).

The Dual-Track Approach

Excess plutonium poses a much more difficult challenge than excess HEU for both technical and economic reasons. Unlike HEU, plutonium cannot practically be blended to a proliferation-resistant form, as nearly all isotopic mixes of plutonium can be used to make nuclear explosives, and chemically separating plutonium from uranium with which it might be mixed in unirradiated reactor fuel requires only readily available civilian technology. In addition, unlike HEU, plutonium has no value in the current nuclear fuel market, as fuel made even from "free" plutonium is more expensive than uranium fuel bought on the open market.

In January 1994, the first volume of the NAS study recommended that disposition of excess weapons plutonium should meet the "spent fuel standard." Meeting that standard would make it roughly as difficult to recover the excess weapons plutonium and make bombs from it as it would be to recover and make bombs from the much larger quantity of plutonium that already exists in spent fuel from commercial reactors around the world. That goal has since been adopted by the U.S. government and by the Group of Seven industrialized democracies and Russia at the Moscow Nuclear Safety and Security Summit in April 1996.

The NAS study identified the immobilization and reactor options as the two most promising approaches for meeting this goal. In July 1995, the second volume of the NAS study recommended pursuing both options in parallel, "because it is crucial that at least one of the options succeed, because time is of the essence, and because the costs of pursuing both in parallel are modest in relation to the security stakes."2

Since these studies were completed, substantially more detailed analyses

have been completed by the Department of Energy (DOE) and its laboratories and contractors, with oversight by an interagency group on plutonium disposition, and similar studies have been undertaken with Russia as well. These studies, which addressed non-proliferation and arms reduction implications, environmental and safety factors, and cost, schedule, and technical maturity issues, also concluded that the immobilization and reactor options were the two most promising available approaches. Beginning in mid-1996, the authors of this article have had the opportunity to work with a group of distinguished Russian colleagues on the U.S.-Russian Independent Scientific Commission on Disposition of Excess Weapons Plutonium.

Following up on a suggestion by Russian President Boris Yeltsin, this group was chartered at the initiative of the Russian Academy of Sciences and the U.S. President's Committee of Advisors on Science and Technology, with a mandate to make recommendations to the U.S. and Russian presidents on specific steps to be taken to secure and reduce stockpiles of excess weapons plutonium. In its joint interim report, completed in September 1996, the commission unanimously recommended that the United States and Russia each move forward as quickly as practicable with both the immobilization and reactor options for plutonium disposition, beginning with existing reactors for the reactor option.

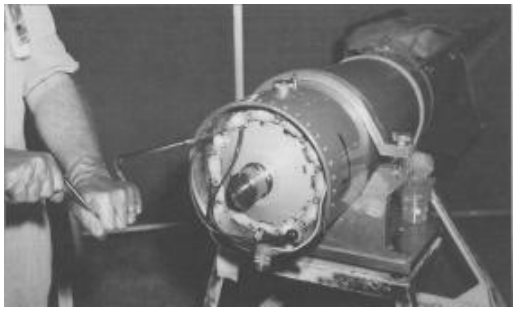
The Case for a Dual-Track Approach

As we wrote in a December 3 letter to President Clinton, it is essential to pursue both tracks in both countries. We gave four reasons. First, both options face technical and institutional obstacles that will need to be overcome, and it cannot be predicted a priori which set of obstacles will prove more time consuming. Moving ahead on both tracks increases the chance of having at least one implementable option without excessive delay. For the reactor option, the obstacles that could lead to delay relate more to political and institutional issues; for the immobilization option, the obstacles relate primarily to resolution of technical issues.

Second, while weapon-grade plutonium mixed with wastes in glass is about as difficult for third countries or terrorists to use for weapons as is plutonium in spent reactor fuel, the weapon-grade plutonium in glass would be somewhat easier for the United States or Russia to reincorporate into their own arsenals if they chose. Thus, immobilization alone sends a less reassuring signal about U.S. and Russian intentions to pursue irreversible nuclear arms reductions than does a dual-track approach. Moreover, there is good reason to think that Russia will not eliminate its plutonium stockpile at all if the United States implements only immobilization, leaving all U.S. plutonium weapon-grade. Russia might then merely store its stockpile of weapons plutonium indefinitely, which is what the United States should most seek to avoid.

Third, only the dual-track approach is likely to be able to muster the bipartisan domestic support that will be needed to fund U.S. plutonium

disposition over the long term, or the international support that will be needed to help fund plutonium disposition in Russia.



During the coming decades, the United States and Russia may dismantle tens of thousands of nuclear weapons, creating huge stockpiles of excess weapons plutonium and highly enriched uranium. The Clinton administration's recent decision to pursue a 'dual track' approach to eliminating excess weapons plutonium will, according to the authors, transform the material into forms sufficiently resistant to reuse in weapons. Above, a retired gravity bomb is dismantled at the Department of Energy Pantex plant near Amarillo, Texas.

Fourth, if the United States opts out of the reactor option, it will lose any leverage it might have had over the conditions and safeguards accompanying Russia's use of plutonium in its reactors. It is critically important for the United States to play a leadership role in any international effort to implement the reactor option in Russia. This will be extremely difficult to do if the United States rejects the reactor option for its own plutonium.

This last point bears some elaboration. The Russian government sees plutonium as a valuable material which should be used as fuel to recover its energy value. After many years of discussing this issue with the Russians, we do not expect this perspective to change. Thus, if disposition of excess Russian plutonium is going to occur at all in the near term, it is going to involve the use of this material as reactor fuel on a significant scale. In our discussions with our Russian colleagues on the commission, however, we found that with immobilization understood as a complement to the reactor option rather than as a competitor for an either-or choice, a basis for U.S.-Russian agreement on a dual-track approach can be found.

In principle, there is no inherent reason why the United States and Russia must both follow the same approaches to plutonium disposition. But a U.S. decision to pursue an immobilization-only approach would significantly undermine the chances of success in the already difficult task of pulling together a cooperative international program capable of paying for and managing the long-term job of eliminating excess plutonium stockpiles in Russia. That job will require high-level commitment and leadership and careful juggling of competing interests. The Clinton administration is already proposing a series of non-proliferation controls as conditions for its support for a reactor option in Russia. To do this while simultaneously publicly rejecting the reactor option for U.S. plutonium would be tying one hand behind the juggler's back.

In particular, if plutonium disposition is to genuinely contribute to non-proliferation objectives and further arms reductions, it will be critically important to ensure that appropriate non-proliferation controls are in place. U.S. participation will be essential to achieving that goal. Stringent security and accounting to prevent theft of nuclear material-approximating the measures applied to nuclear weapons themselves-will be required. As was agreed at the Moscow Nuclear Safety and Security Summit, international verification should be applied as early in the process as possible. As the international community's interest is in disarmament and non-proliferation-not in assisting Russia's development of a broad plutonium-fuel cycle the Clinton administration is also seeking assurance that for as long as excess weapons plutonium remains to be eliminated, any MOX fuel fabrication plant provided with Western assistance would be used only for excess weapons plutonium, and plutonium would not be reprocessed from the resulting irradiated spent fuel.

If the United States does not participate in a cooperative effort to implement plutonium disposition in Russia, such an effort will either not succeed or will go forward without a U.S. voice in determining the non-proliferation controls on the enterprise. Neither outcome would serve U.S. non-proliferation interests.

The Dual-Track Controversy

Despite these arguments, the Clinton administration's announcement of a dualtrack approach has ignited a debate in the non-proliferation community. Some nongovernmental organizations have denounced the option of using reactors for part of this disarmament mission, arguing that this approach: (1) would violate U.S. non-proliferation policy; (2) would encourage additional reprocessing and separation of weapons-usable plutonium; and (3) would increase the risk of nuclear theft. We believe that with appropriate attention devoted to non-proliferation controls, all of these issues can be satisfactorily addressed.

First, while we understand the concerns of those who fear that the use of excess weapons plutonium as fuel in civilian reactors might undermine the U.S. policy of not encouraging the civilian separation and use of plutonium in other countries, we believe that the dual-track approach is fully consistent with this policy. (Two of us were among the authors of the 1977 study, Nuclear Power Issues and Choices, which is widely regarded as the basis for this policy decision in the Carter administration.) The dual-track approach is about getting rid of an existing, dangerous stockpile of separated plutonium, not about separating more plutonium. It is precisely because of the dangers of separated plutonium that the United States should plan on using both of the best technologies at its disposal-reactors and immobilization with wastes-to get rid of it. This should reinforce, rather than undercut, the U.S. message to the rest of the world on the dangers posed by separated plutonium.

The Clinton administration has already made very clear that the long-standing U.S. policy on plutonium reprocessing and recycling remains in

effect. Consistent with that policy, should plutonium fuelfabrication facilities be built for this unique disarmament mission, they will be government-owned, and will be licensed and used only for that mission; the resulting spent fuel will not be reprocessed. In addition, only existing utility-owned reactors, not new ones, are being considered for this mission.

Second, using reactors to get rid of the existing excess plutonium stockpile would not lead to a new domestic reprocessing and plutonium recycling industry; nor would it increase the financial or technical incentives for other countries to reprocess and recycle plutonium. The fact is that U.S. utilities are not reprocessing because it is not economical to do so, and that is not going to change for decades to come.

(When the Reagan and Bush administrations reversed the Carter policy of discouraging domestic reprocessing, no utilities chose to take advantage of the change.) Even if a MOX plant built for disposition of weapons plutonium were to someday become available for utilities to use for commercial plutonium recycling, that would not change this calculus. The capital cost of a MOX plant is a small fraction of the overall cost of a reprocessing and recycling fuel cycle, and much less than the cost of a reprocessing plant.

Similarly, foreign utilities' decisions about whether to reprocess and recycle are likely to be determined by the costs, alternatives and incentives they face, not by U.S. decisions as to whether to use existing reactors to eliminate some U.S. excess weapons plutonium. The possibility that the U.S. use of plutonium in civilian reactors will be turned to political advantage by advocates of plutonium reprocessing in other countries is a much smaller and more manageable danger than the danger that rejecting reactors for U.S. plutonium disposition would greatly delay progress toward erecting physical barriers against reusing the excess plutonium in weapons. In the Russian case, in particular, the Clinton administration is pressing to ensure that if the West provides assistance to Russia for a MOXfabrication plant, that facility will be focused on the disarmament mission of getting rid of excess separated plutonium that already exists, not on supporting a civilian plutonium reprocessing economy.

Third, we believe that with appropriately stringent security and accounting measures, plutonium disposition using the dual-track approach will significantly reduce, not increase, the overall risk of nuclear theft. Over the long term, disposition of excess plutonium will transform vast stockpiles of material now at risk of theft into forms that are dramatically less attractive to potential proliferators. Possible short-term increases in risk resulting from bulk processing and transport of materials (compared to leaving them in secure and monitored storage) can be reduced by the application of appropriate security and accounting measures. The near-term tradeoff will then be more than balanced out by the long-term security benefits of transforming this material into forms much more difficult to steal or use in nuclear weapons. The risk of nuclear theft by overt armed attack during transport to and storage at reactors can be fully addressed by beefing up security. Indeed, DOE plans to use the same

security measures used for the transport of nuclear weapons. The risk of covert theft by insiders is greatest during bulk processing, and these risks apply to both the MOX and the immobilization options. While the immobilization approach may involve somewhat simpler overall processing (easing the safeguards task), safeguards technology and procedures for this process have not yet been demonstrated and implemented.

Some argue that given the current unsettled state of affairs in Russia, it would be better to wait, leaving the excess plutonium in storage without processing until some indefinite time in the future. We strongly disagree. The security imperative to eliminate these vast stockpiles of excess plutonium is compelling, and an international cooperative effort to do so, with Western participation, can ensure stringent standards of security and accounting throughout the process. Such an operation would clearly demonstrate to Russian nuclear managers that modern security and accounting systems are fully compatible with large-scale production. That would contribute significantly to the growth of Russia's nascent "safeguards culture," enhancing the security not just of weapons plutonium declared to be excess to military needs, but of all the various facilities in Russia handling plutonium and HEU.

Some also argue that because of what they see as the potential proliferation liabilities of the dual-track approach, the United States should continue to delay its decision pending further studies. We are convinced that delay is against the security interests of the United States and the world, and that the non-proliferation arguments are overwhelmingly in favor of the dualtrack approach. The plain fact is that delay on the U.S. side would mean delay on the Russian side as well. That would mean, in turn, prolonging the exposure of an immense quantity of Russian weapons plutonium to significant dangers of diversion (for reuse in Russian weapons) or theft (for use in somebody else's). It also would mean that both the United States and Russia would postpone signalling to each other and to the rest of the world their intention to "lock in" their progress in disarmament by transforming this material in ways that would make it more difficult to use again in nuclear weapons. Such a signal is important for enhancing prospects for further nuclear arms reductions (including bringing the second-tier nuclear powers into the disarmament process), and it is important to non-proliferation.

Correcting Misimpressions

Unfortunately, a considerable amount of misinformation has crept into the public debate on this subject, which should be corrected.

First, contrary to some reports, there never was a decision to put two-thirds of U.S. excess weapons plutonium into MOX fuel. Rather, the administration's preferred alternative is to pursue two options in parallel, and if both prove adequate, decide what precise mix of the two will be implemented in the future.

Second, some have interpreted the administration's statement that final decisions on pursuing either or both of the two approaches will be made in the future as a sign that plutonium disposition will be relegated to the back burner of further study and delay. In fact, top DOE officials have confirmed that they intend to move forward as quickly as practical with both approaches, and that the program plan for doing so has not changed since questions were raised about the reactor option.

Third, contrary to some statements, DOE officials have confirmed that the government has no intention of purchasing privately owned reactors or building new government reactors for this mission. Rather, if the reactor option is implemented, contractual arrangements will be worked out to provide fuel to private utilities for a price similar to the price they would pay for equivalent uranium fuel, and they will be provided a fee for irradiation services-yet to be negotiated-for their part in the plutonium disposition mission.

Fourth, it is not true that the government's estimates show that immobilization can begin much faster than the reactor option (some press reports have suggested a start date for a MOX facility no sooner than 2013). DOE's technical estimates suggest that a U.S. MOX facility could begin fullscale operation in about a decade, and contracting with existing European facilities to fabricate the initial MOX assemblies would allow a three- to four-year "jump start" on that date. For immobilization, if the "canin-canister" approach that makes it possible to use primarily existing facilities proves out, disposition could begin in about seven years (roughly the same time that MOX assemblies fabricated in Europe could begin to be used in U.S. reactors).5

Nor do the DOE estimates show a dramatic cost advantage for the immobilization option, as some have claimed. DOE's estimates of both the MOX-in-existing-reactors and the can-in-canister immobilization options come in at a net discounted present cost of just over $1 billion. (The cost of the reactor option, however, will increase somewhat once the cost of negotiated payments to the utilities for their use of MOX fuel are included in the estimate.) In any event, the cost of either approach would be spread over many years, and would therefore be a small fraction of the annual amount spent on cleaning up other nuclear wastes in the DOE complex, to say nothing of the far larger amounts spent to provide for U.S. military security. These DOE estimates are generally consistent with the estimates made in the earlier NAS studies, though less detail was available at the time those studies were done.

Finally, it is not true that the dual-track approach was foisted on the rest of the government by DOE over the objections of the Clinton administration's non-proliferation experts. In fact, President Clinton established an interagency process to address the plutonium disposition problem in 1993, and all of these issues and options were addressed in that process. Arms Control and Disarmament Agency Director John Holum did write a memorandum to Secretary of Energy Hazel O'Leary and Presidential Science Advisor John Gibbons expressing concern about the reactor

option, which was leaked to the press and provoked some of the current controversy But Holum personally took part in and supported the final announcement of the administration's approach.

The U.S.-Russian Commission

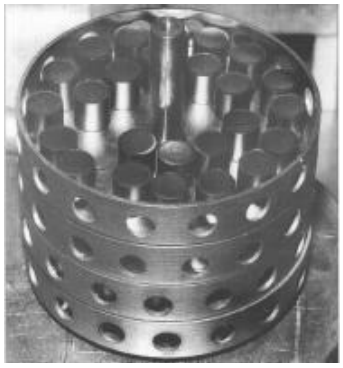
The U.S.-Russian Independent Scientific Commission on Disposition of Excess Weapons Plutonium, on which we served, came to unanimous agreement on a set of specific recommendations for securing and reducing these dangerous stockpiles. The commission was co-chaired by John P. Holdren on the U.S. side and Evgeniy P. Velikhov, president of the Kurchatov Institute and member of the Russian Defense Council on the Russian side. The Russian members included a spectrum of senior Russian nuclear scientists and energy experts, including leading figures from both Ministry of Atomic Energy (MINATOM) institutes and independent institutes.6

The commission's interim report recommended that the U.S. and Russian governments, with support and cooperation from the international community, take additional steps-beyond those already underway-to more rapidly reduce the security risks posed by excess weapons plutonium. In particular, it recommended that both the reactor option and the imobilization option should be brought into large-scale operation as rapidly as practicable in both countries. Each country would be free to decide for itself how much of its excess plutonium should go to each of these routes.

Because of the urgency of the task, our Russian colleagues agreed with us that plutonium disposition using the reactor option should begin using existing reactors. This represented a significant breakthrough, given MINATOM's long-standing desire to develop and build new BN-800 fast-neutron reactors or new high-temperature gas reactors for the mission of burning excess plutonium. The report urged that the highest standards of materials protection, control and accounting-corresponding to those applied to intact nuclear weaponsbe applied to excess weapons plutonium at all storage, processing and transport steps until the plutonium reaches the spent-fuel standard, and that the entire process be subject to international verification.

The commission pointed out that disposition of excess plutonium, while urgent, is a long-term job. Therefore, the panel also focused attention on urgent near-term steps that should be taken to improve security and build confidence in the management of this material. It recommended that current U.S.-Russian cooperation on the urgent task of improving security and accounting systems for plutonium and HEU should be accelerated and expanded, and that budgets for these programs should be increased by at least 50 percent over their 1996 levels. The commission also urged that cooperation to prevent smuggling of nuclear materials be substantially expanded, including joint work to ensure that relevant police, intelligence, customs and border patrol forces are appropriately trained and equipped and working together effectively.

The panel recommended a broad program of increased transparency involving inventories of nuclear warheads and nuclear-explosive materials possessed by the United States and Russia, as well as the steps being taken to reduce them. This would include periodic declarations of the quantities (increasing over time) of weapons and nuclear-explosive materials deemed excess to military needs, along with increasing bilateral and multilateral monitoring of warhead dismantlement and subsequent nuclear-materials management and disposition steps. The commission suggested that the U.S. and Russian governments set as a target date the first quarter of 1997 for implementing the exchange of data on nuclear stockpiles agreed to in principle by Presidents Clinton and Yeltsin. It further suggested accomplishing demonstrations of jointly developed technologies for confirming the dismantlement of warheads without compromising sensitive information by mid-1997, and having a full regime in place in 1998. To accomplish these objectives, the panel urged that negotiations resume on the U.S.-Russian agreement that will provide the legal basis for exchanging sensitive nuclear information (possibly limited initially, to assuage security concerns, to information needed to permit mutual reciprocal inspections of the plutonium and HEU removed from nuclear weapons).



Disposing of excess weapons plutonium by embedding it into plutonium-uranium mixed-oxide (MOX) fuel for use in civilian nuclear reactors is one of two options the Clinton administration has chosen for eliminating the U.S. stockpile. In March 1995, Los Alamos National Laboratory began producing MOX pellets (above) under the Parallex Project, a joint U.S.-Russian program. The pellets, each of which weighs approximately 15 grams and is the size of a pencil eraser, would be loaded into fuel rods.

Such a transparency regime would also include placing excess materials under International Atomic Energy Agency (IAEA) verification as quickly as practicable. The commission recommended that the United States and Russia work with the IAEA to develop modified safeguards approaches that would permit credible international monitoring of materials in classified forms (such as components from dismantled weapons) without revealing information that could contribute to proliferation.

The panel urged that the United States and Russia move as quickly as practicable to end additional production of weapons plutonium, including providing the necessary financing to complete the on-going cooperative project to convert the cores of the three remaining plutonium-production reactors at Seversk (Tomsk-7) and Zeleznogorsk (Krasnoyarsk-26), which continue to produce 1.5 tons of additional excess weapons plutonium each year. These

reactors have not been shut down because they provide needed heat and power to nearby communities. After conversion, production of plutonium in these reactors will be drastically reduced and the resulting spent fuel will be capable of being safely stored without reprocessing.

Following on the START model, which focuses not on equal reductions but on reductions to equal levels, the commission agreed that the U.S. and Russian programs of warhead dismantlement and management and disposition of the associated nuclear-explosive materials should continue to proceed in parallel, seeking to complete comparable steps in this process on comparable time scales and to reach equivalent remaining quantities of plutonium and HEU in the two military stockpiles. To further that objective, the panel argued that the United States and Russia should begin discussions with the goal of reaching a formal agreement governing plutonium disposition, setting out the quantities, schedules, and approaches involved. Aparticularly urgent near-term step the commission recommended was for Russia to declare how much of its plutonium it considers excess to its military needs, as the United States has already done.

To get the process of plutonium disposition started as quickly as possible-which we agreed was critical-the panel recommended that the United States and Russia move promptly to select, authorize, fund and bring to the point of operability at the necessary scale the specific variants of both the reactor and immobilization options to be implemented in each country. The commission recommended that increased funding for these activities be provided on an urgent basis, warning that in Russia, in particular, badly needed activities are being delayed by lack of money. The panel urged the two governments to establish appropriate managerial structures- one in each country, as well as an international framework for managing joint activities-to be responsible to the presidents for getting the job done on a specified timetable. In particular, recognizing that delays in licensing the various steps could be a significant roadblock, the panel recommended that the nuclear regulatory agencies in both countries be directed- and funded-to develop the procedures to review and license promptly the necessary tests and facilities for plutonium disposition.

The commission's report focused considerable attention on specific next steps in international cooperation between the United States, Russia and other countries to accomplish plutonium disposition. The report suggests:

increased cooperation on technologies for conversion of plutonium weapons components to oxide, with the goal of rapidly carrying out prototype-scale demonstrations in both countries sufficient to provide the information needed for licensing and construction of fullscale capacity;

increased cooperation related to analyzing, testing, licensing and demonstrating the fabrication of MOX fuel made from weapons plutonium and the use of this fuel in currently operating reactors, including work to determine how much plutonium can safely be loaded into each reactor and what modifications may be required; and

increased cooperation related to analyzing, testing, licensing and demonstrating immobilization of plutonium with high-level radioactive wastes, including conducting demonstrations at pilotplant scale in each country as a step toward full-scale operation.

The commission recognized that financing the needed facilities might well be the biggest obstacle to accomplishing plutonium disposition-particularly in Russia, with the severe economic difficulties now facing that country. The panel estimated the capital cost of the needed facilities in Russia at approximately $1 billion (spread over a number of years), and urged that a plan be developed and implemented for international cooperation in financing this cost. This cost, which is extremely modest by comparison to the sums that nations have traditionally been prepared to spend to ensure their military security, should be seen as a highly cost-effective security investment for the world.

Finally, the commission strongly urged that the United States and Russia get on with the job of disposition of excess weapons plutonium, regardless of their continuing differences of view over civilian plutonium and the future of the fuel cycle. The excess plutonium arising from nuclear arms reductions is a large amount when judged by the thousands of bombs that could be built from it; it is a tiny amount when judged on the scale of future global energy needs. There is therefore no reason why decisions on the urgent problem of transforming excess weapons plutonium into forms that meet the spent fuel standard need be linked to decisions on the future of the fuel cycle-and every reason why they should not be, since waiting until that distant day when the world agrees on the best approach to the future of the fuel cycle would be recipe for unconscionable delay.

Moving Forward

The Clinton administration's announcement of its support for a dual-track approach to plutonium disposition puts the United States on a credible track to reduce the serious security risks posed by excess weapons plutonium. The administration now needs to move quickly to implement the track it has set, and to begin constructing an effective cooperative parallel program to get the job done in Russia. Strong and focused leadership will be needed to overcome the political and diplomatic obstacles, achieve a long-term understanding with Russia and secure congressional support for the necessary funding. Putting in place-and moving ahead with-an effective plan for eliminating these stockpiles of excess weapons plutonium will help keep this material out of the hands of rogue states and terrorists, will help set a standard that can contribute to the protection of existing stocks of bombusable separated civil plutonium worldwide and will contribute to locking in nuclear arms reductions. Successful implementation of such a plan would be an outstanding legacy for Presidents Clinton and Yeltsin to leave future generations. ACT

Sidebar
For Further Reading

Sidebar

Other notable references in the burgeoning literature on the disposition of weapons-usable fissile materials include: Frans Berkhout, Anatoli Diakov, Harold Feiveson, Helen Hunt, Edwin Lyman, Marvin Miller and Frank von Hippel, "Disposition of Separated Plutonium," Science and Global Security 3:161-213, 1993; Arjun Makhijani and Annie Makhijani, Fissile Materials in a Glass Darkly: Technical and Policy Aspects of the Disposition of Plutonium and Highly-Enriched Uranium, Takoma Park, MD: Institute for Energy and Environmental Research, 1995; Graham T. Allison, Owen R. Cote, Jr., Richard A. Falkenrath and Steven E. Miller, Avoiding Nuclear Anarchy: Containing the Threat of Loose Russian Nuclear Weapons and Fissile Material, Cambridge, MA: MIT Press, 1995; Special Panel on Protection and Management of Plutonium, Protection and Management of Plutonium, LaGrange, IL: American Nuclear Society, August 1995; Office of Fissile Materials Disposition, U.S. Department of Energy (DOE), Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement, December 1996; Office of Fissile Materials Disposition, DOE, Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition, Rev. 1, October 31, 1996; Office of Arms Control and Nonproliferation, DOE, Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives, October 1,1996; and U.S.-Russian Plutonium Disposition Steering Committee, Joint United States-Russian Plutonium Disposition Study, Washington DC: Office of Fissile Materials Disposition, DOE, September 1996.

Footnote

NOTES

Footnote

1. Committee on International Security and Arms Control, National Academy of Sciences (NAS), Management and Disposition of Excess Weapons Plutonium, Washington, DC: National Academy Press, January 1994.

Footnote

2. Panel on Reactor-Related Options, NAS, Management and Disposition of Excess Weapons Plutonium: Reactor-Related Options, Washington, DC: National Academy Press, July 1995.

3. Interim Report of the U.S.-Russian Independent Scientific Commission on Disposition of Excess Weapons Plutonium, Washington, DC: Office of Science and Technology Policy, September 1996.

Footnote

4. Nuclear Power Issues and Choices, Report of the Nuclear Energy Policy Study Group, sponsored by the Ford Foundation, Cambridge, MA: Ballinger Publishing Company, 1977.

5. The "can-in-canister" approach involves immobilizing plutonium in glass or ceramic without fission products, and arraying small cans of this

plutonium-bearing material within large waste canisters into which molten glass containing high-level waste would be poured. This would permit the use of existing high-level waste vitrification facilities (which are not designed to handle plutonium), and the use of small melters installed in existing plutoniumhandling glove box lines.

Footnote

6. In addition to Velikhov, the Russian members of the commission included Alexsei A. Makarov director of the Institute of Energy Economics in Moscow and a corresponding member of the Russian Academy of Sciences; Academician Fedor M. Mitenkov, director of the MINATOM nuclear design institute at Nizhny Novgorod; Academician Nikolai N. Ponomarev-Stepnoi, vice president of the Kurchatov Institute; and Academician Fedor G. Reshetnikov, a longstanding expert on nuclear materials processing who until recently served as scientific advisor to MINATOM Minister Victor Mikhailov, and now directs plutonium disposition work at MINATOM's Bochvar Institute of Inorganic Materials in Moscow.

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John P. Holdren, John F. Ahearne, Richard L. Garwin, Wolfgang K. H. Panofsky and John J. Taylor are the U.S. members of the U.S.-Russian Independent Scientific Commission on Disposition of Excess Weapons Plutonium. Matthew Bunn is executive secretary for the U.S. side of the commission. For further information about the authors, see p. 8.

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