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PLUTONIUM DISPOSITION AND THE U.S. MIXED OXIDE FUEL FABRICATION FACILITY

HEARING

BEFORE THE

STRATEGIC FORCES SUBCOMMITTEE

OF THE

COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES

ONE HUNDRED NINTH CONGRESS

SECOND SESSION

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PLUTONIUM DISPOSITION AND THE U.S. MIXED OXIDE FUEL FABRICATION FACILITY

HOUSE OF REPRESENTATIVES,
COMMITTEE ON ARMED SERVICES,
STRATEGIC FORCES SUBCOMMITTEE,
Washington, DC, Wednesday, July 26, 2006.

The subcommittee met, pursuant to call, at 3:04 p.m., in room 2212, Rayburn House Office Building, Hon. Terry Everett (chairman of the subcommittee) presiding.

OPENING STATEMENT OF HON. TERRY EVERETT, A REPRESENTATIVE FROM ALABAMA, CHAIRMAN, STRATEGIC FORCES SUBCOMMITTEE

Mr. EVERETT. We will come to order.

The Strategic Forces Subcommittee meets today to receive testimony on plutonium disposition and the mixed oxide fuel fabrication facility.

Thank you all for coming.

I welcome Dr. Matthew Bunn, senior research associate at the Belfer Center for Science and International Affairs at the John F. Kennedy School of Government; my good friend Ambassador Linton Brooks, Administrator, National Nuclear Security Administration; Mr. Charles Anderson, principal deputy assistant secretary for environmental management at the Department of Energy; and Ambassador Michael Guhin, fissile materials negotiator for the U.S. Department of State.

I have read the written testimony of the witnesses that has been submitted for the hearing, and I am concerned that the statements do not fully address specific questions that were posed by the subcommittee.

The Administration's process for clearing testimony can be quite onerous, so hopefully the oral statements will include more specifics. If not, I am sure the questions from the members will get right to the point, so we can have an informative hearing on this complicated topic.

We have two panels for the hearing today. The first panel, Mr. Bunn, will provide a scientific perspective on the cost and benefits of mixed oxide fuel, MOX, as compared to alternative plutonium disposition.

In the second panel, Ambassador Brooks will discuss whether the Department of Energy's MOX fuel fabrication facility is the most effective and appropriate means for managing and disposing of U.S. weapons-grade plutonium.

Mr. Anderson has been asked to discuss the Department of Energy's recent analysis of options for plutonium disposition and

present the Department's position on domestic plutonium disposition.

And Ambassador Guhin will provide testimony on the current status of negotiations with Russia over execution of the 2000 U.S.-Russian plutonium management and disposition agreement and the State Department's perspective on current non-proliferation negotiations with Russia.

This hearing is an important opportunity to discuss the disposition of surplus plutonium, including key issues such as the need to determine whether MOX is the most effective means, both from a cost and technical perspective, for managing and disposing of excess U.S. weapons-grade plutonium; finding a means to move forward with the plutonium disposition and avoid costs incurred by delays while preserving the diplomatic relationship; and how to ensure that MOX, if continued, remains on track with respect to the cost, schedule and technical challenges.

These issues also bring to bear a provision in the defense authorization bill for fiscal year 2007, H.R. 5122. This subcommittee included language that directs the Department of Energy to report on its plans for the disposition of all surplus plutonium within the Department's inventory. This includes both weapons-grade plutonium as well as plutonium that is not suitable for conversion to MOX fuel.

In addition, this subcommittee has directed the Department should do the following: First, give the cost to date of the U.S. MOX project and, considering other alternatives for plutonium disposition, certify that the U.S. MOX is the most effective means for managing and disposing of U.S. weapons-grade plutonium; and second, develop a corrective action plan for addressing the issues raised by the inspector general concerning the management of U.S. MOX project.

This session is open, and under Rule 9 of the committee I would ask members for their cooperation in keeping their line of questions completely unclassified.

Now, let me recognize my good friend and associate, the ranking member of the subcommittee, Mr. Reyes.

[The prepared statement of Mr. Everett can be found in the Appendix on page 39.]

STATEMENT OF HON. SILVESTRE REYES, A REPRESENTATIVE FROM TEXAS, RANKING MEMBER, STRATEGIC FORCES SUBCOMMITTEE

Mr. REYES. Thank you, Mr. Chairman.

And welcome to all the witnesses. I want to thank each of you for taking time from your busy schedules to be with us today.

But I also want to echo the concerns raised by you, Mr. Chairman, about the quality of the written statements we received from the members of the Administration, as I read them last night. They clearly did not answer the questions posed in the hearing invitation letters. Hopefully the witnesses can address these questions in their oral statements here today.

Mr. Chairman, my comments will be brief because I want to yield my time to Congressman Spratt, who is recognized probably

as the member that knows the most about what we are about to discuss in this hearing.

Almost 15 years have passed since the collapse of the old Soviet Union. Much has changed since that time. However, the legacy of our nuclear weapons and that competition with the former Soviet Union lives on in the weapons facilities and materials that remain today.

This hearing gives us a chance to examine what the United States is doing to consolidate and dispose of surplus fissile materials that can be used for nuclear weapons in both Russia and our own backyard.

Specifically, we have asked our witnesses to discuss plans for disposing of excess plutonium. In June 2000, the United States and Russia agreed to dispose of at least 34 metric tons of plutonium each, beginning next year, in 2007.

However, this program has been stalled for years over the issue of liability and more recently by uncertainty about the technical means by which the Russians would render their plutonium unusable for weapons.

The hearing today allows the subcommittee to reflect on the initial reasons for pursuing a vigorous plutonium disposition program and to explore the Administration's current plans for disposing of domestic plutonium, given the uncertainty surrounding the Russian program.

So with that, Mr. Chairman, thank you again for calling this very important hearing, and I look forward to the testimony of our witnesses.

At this time, I would yield the balance of my time to Mr. Spratt from South Carolina, who is probably the most knowledgeable member of the committee on this very subject.

[The prepared statement of Mr. Reyes can be found in the Appendix on page 49.]

STATEMENT OF HON. JOHN SPRATT, A REPRESENTATIVE FROM SOUTH CAROLINA

Mr. SPRATT. Thank you, Mr. Reyes, for yielding your time and for that kind compliment, though I am not sure I can vouch for its accuracy.

And, Mr. Chairman, thank you for responding to my letter of June 6 and holding this hearing on an issue of great importance to the Nation and to my native state, South Carolina.

For almost five years, the Department of Energy has proposed to build a mixed oxide or MOX fuel plant at Savannah River Site. The plant's purpose is to convert weapons-grade plutonium into fuel that can be burned or irradiated in light water reactors.

There are two benefits from this process. First, it degrades plutonium into elements that are no longer fissile or usable as warhead material. And second, it extracts the energy potential from the surplus plutonium.

Until recently, DOE's plan to build a MOX fuel plant at Savannah River Site was matched by parallel facilities in Russia. The Russian Federation, with foreign financial assistance, was to build a basically similar plant. Each plant would process at least 34 met-

ric tons of weapons-grade plutonium into mixed oxide fuel, which would then be burned in a nuclear reactor.

The House Energy and Water Appropriators have now decided to zero out funding for the MOX fuel program, citing mainly the Russians' renunciation of DOE's original proposal, but also citing cost growth and technical hurdles.

So the purpose of our hearing today is to take a thorough, close look at the MOX fuel program, assess its progress and status, and compare it with other options for the disposal of plutonium in light of the action the appropriators have taken.

To set the stage for our discussion, a little history might be useful. In 2002 the state of South Carolina, in an arrangement with the Department of Energy and Congress, agreed to accept 34 tons of weapons-grade plutonium for MOX processing.

In exchange, the state of South Carolina received assurances that the MOX fuel plant would be completed on schedule, and those assurances were backed by penalty payments of liquidated damages to which the Department of Energy agreed, and we entered into statute—that is, if the MOX fuel plant construction was delayed beyond a certain date, originally 2011.

In concert with this effort, the United States agreed to help fund a MOX fuel facility in Russia where the Russians would likewise convert 34 tons of weapons-grade plutonium into MOX fuel. To most, this seemed like a basically fair deal.

In the U.S., we would eliminate the expense and risk of safeguarding and storing weapons-grade nuclear material. In Russia, we would diminish the risk that weapons-grade materials might fall into terrorist hands. And for the nuclear power industry, we would provide a new source of reactor fuel.

For the last four years, we have been told by the Department of Energy that liability concerns for U.S. contractors in Russia were holding up the MOX fuel facility. We thought that problem was finally resolved last summer, but early this year a more fundamental disagreement came to light.

In February, the Russians informed the United States that they would move forward only if, one, the plutonium fuel could be burned in new so-called fast neutron reactors, which could raise proliferation concerns of their own, or two, if the international community agreed to pay for the entire MOX fuel project.

This development has called into question the non-proliferation benefits that the U.S. expected from the MOX fuel facility. However, in a joint statement with U.S., Russia has recently recommitted to dispose of 34 tons of plutonium in a method that we jointly agree upon.

I understand the appropriators' concerns about changes to the MOX fuel program recently. These are major changes. But without a MOX fuel fabrication plant, South Carolina is going to be stuck with tons, up to 34 metric tons, of weapons-grade plutonium with no clear pathway for disposal.

When South Carolina agreed to take the nation's plutonium, we did not agree to become the final burial place for that plutonium. We took the plutonium on the strength of DOE's promise that a fabrication facility was forthcoming. The penalty payments imposed

on the Department of Energy were our assurance that this would happen.

In the defense authorization bill this year, we took what I considered to be sensible steps to account for these new circumstances. The committee reaffirmed our conclusion that the MOX facility is worth pursuing, even separate of the Russian facility if need be.

The committee also reaffirmed our commitment to the construction of a MOX fuel facility in parallel, if possible.

But the committee fenced off a portion of the MOX fuel funds pending a report from the Department of Energy that emphatically reaffirms MOX as the preferred technology and the most cost-effective means for disposing of weapons-grade plutonium.

The decision by the energy and water appropriators to zero out MOX has stepped up the time line for this report, but it does not change the issues surrounding the MOX program.

I am not dogmatic about MOX. If there are other available options, and if these are cost-effective, and if they too are non-proliferating, I am open to those options. But sunk cost has to carry some weight. Over $500 million has been invested in the MOX facility already, and environmental impact statement (EIS) has been approved. Eighty-five percent of the design work on the facility has been completed. Seventy-three acres has been graded. The plutonium is stacking up in the K-Reactor, a facility that was not specifically designed for that use. This should make us all wary of scrapping the idea and starting over from scratch.

Mr. Chairman, in conclusion, I hope that today the testimony will give us an opportunity to weigh again the pros and the cons of the MOX program, particularly as it compares to other options.

To name just a few questions, I would like for our witnesses today to address these questions. How does the life cycle cost of the MOX fuel facility compare to other options such as immobilization? What technical challenges remain in the construction of a MOX fuel plant and, for that matter, immobilization or the other options? What is the effect of a decision today to delay or discontinue MOX on the schedule for plutonium disposition overall? What is the status of negotiations with Russia regarding MOX? Is the burning of plutonium fuel in fast neutron reactors an acceptable alternative with comparable end results? And what alternatives, other that MOX fuel and immobilization, are available for plutonium disposition, and how do their costs and benefits compare?

Chairman Everett, Ranking Member Reyes, let me thank you again for agreeing to hold this hearing, all our witnesses today. This is a good hearing, as attested to by the people who are here. It is a matter of great importance, and I look forward to the testimony and the discussion that follows.

Thank you very much, sir.

[The prepared statement of Mr. Spratt can be found in the Appendix on page 52.]

Mr. EVERETT. And I thank the gentleman and was more than glad to arrange this hearing at his request.

Mr. Bunn, we kind of set the stage, and——

Mr. BUNN. You sure did.

Mr. EVERETT [continuing]. We are ready for you to kick it off.

STATEMENT OF MATTHEW BUNN, SENIOR RESEARCH ASSOCIATE, BELFER CENTER FOR SCIENCE AND INTERNATIONAL AFFAIRS, JOHN F. KENNEDY SCHOOL OF GOVERNMENT, HARVARD UNIVERSITY

Mr. BUNN. All right. Well, it is an honor to be here today to talk about a subject that I do think is important to our national security. I have been working on plutonium disposition in and out of government since the inception of the program, beginning with directing the National Academy of Sciences study that laid many of the policy foundations for the U.S. disposition effort. I will summarize my written statement and, with your permission, I would like to submit that for the record.

Mr. EVERETT. Your entire statement will be made a part of the record.

Mr. BUNN. As you know, the plutonium disposition program has suffered delays, greatly increased costs, shifting approaches, and that has raised questions as to whether and how we should move forward from here.

Today I want to make four basic points. First, plutonium disposition is not among the top priorities for reducing the risk of nuclear theft and terrorism. But second, disposition of U.S. and Russian excess plutonium can offer security benefits that are worth the effort if and only if the 34 tons of weapons plutonium covered by the 2000 agreement is only the first step to a disposition of much larger amounts of plutonium. Third, Congress should support moving forward with disposition of excess weapons plutonium under appropriate conditions. But fourth, before providing the billions needed to build major facilities for this purpose either in the United States or Russia, Congress should ensure that a policy context is put in place that will make it possible for plutonium disposition to offer benefits that are worth the effort and that important technological alternatives are fully considered.

In short, we should move forward but only if there is agreement on a set of policies that will make doing so worthwhile, so let me elaborate on those points.

First, it is important to be clear what it is that the objectives are, what it is we are trying to buy with plutonium disposition. This effort can contribute to reducing the risk of nuclear theft and nuclear terrorism, which I believe is a very important U.S. policy objective, and it can contribute to ensuring that nuclear arms reductions are difficult and costly to reverse, which would strengthen international political support for our non-proliferation efforts.

Also, from the DOE perspective, there is what I call a good housekeeping function—that is, helping to reduce the number of sites in the U.S. complex where plutonium is stored and the costs and risks and political liabilities of storing it.

As currently planned, however, disposition of excess plutonium will have only minor benefits for reducing the risk of nuclear theft. The 34 tons of plutonium in Russia that would be covered by the agreement are some of the most secure plutonium in all of Russia, and the disposition of this material is not going to address the biggest risks of nuclear theft, which are at small vulnerable facilities with plutonium and highly enriched uranium.

If you applied disposition to a very large fraction of Russia's plutonium, that would certainly reduce the risk of nuclear theft. But the 34 tons covered by the agreement is less than a quarter of the roughly 145 tons of weapons-grade plutonium in Russia's stockpile.

Moreover, as the academy study pointed out, taking this material out of secure vaults and processing it and moving it around can actually increase the risk of theft unless you apply very stringent standards of security throughout, which is why we recommended what we called the stored weapons standard, protecting it more or less the same way we protect nuclear weapons themselves.

In short, plutonium disposition would be on a comprehensive and prioritized list of steps to reduce the risk of nuclear theft, but it wouldn't be close to the top of that list.

Similarly, while disposition of a large fraction of Russia's plutonium stockpile would make nuclear arms reductions much more difficult and costly to reverse, disposition of 34 tons of plutonium won't really accomplish that objective. Russia would still have over 100 tons of plutonium left over, which is enough to support a stockpile of over 20,000 nuclear weapons.

In short, if we want to make substantial national security contributions from disposition, we have to do a lot more than 34 tons.

From a good housekeeping point of view, that is certainly important. In fact, DOE has argued that simply storing all the excess plutonium at its current locations would be more costly than the quite costly disposition program that DOE proposes.

But if good housekeeping is the primary driver, then we have to be careful about which plutonium has storage that is costly and which plutonium has storage that is cheap. Because we will be storing reserve pits at Pantex in any case, and therefore need all the safety and security measures associated with pits in storage at Pantex, the excess material in storage at Pantex represents a pretty small net additional cost.

Now, there are other rationales for plutonium disposition as well. In particular, walking away from the 2000 agreement and from all of the other negotiations that have taken place could potentially call into question the credibility of U.S. threat reduction commitments going well beyond plutonium disposition itself.

On the other hand, the PMDA certainly will—that is, the plutonium management and disposition agreement—certainly will have to be modified in any case, and therefore I don't think we need to be absolutely fixed on the specific technologies that were identified in that agreement six years ago.

Now, speaking to technologies, the Academy recommended that as a first priority we focus on making sure everything is secure, that all stocks of separated plutonium and highly enriched uranium worldwide are secure and accounted for. Secure storage is clearly an essential first step for every option.

In terms of long-term disposition, the Academy recommended that options be chosen which had four properties. First, that they would meet what we called the spent fuel standard—that is, making the plutonium about as inaccessible for weapons use as the much larger amount of plutonium in commercial spent nuclear fuel.

Second, that on the road to that, they would meet as closely as possible the stored weapons standard.

Third, that they would meet all applicable environment, health and safety requirements.

And fourth, within those constraints, that they be the options that can get the job done most rapidly and cost-effectively.

The Academy concluded that the options that best met those criteria were MOX and immobilization. Advanced reactors and fuel cycles are not needed to meet those objectives, and therefore the committee recommended that we should neither wait for nor pay for advanced reactors to be developed as part of plutonium disposition.

But if they are developed for the purpose of nuclear energy and they become available when there is still excess plutonium to be dispositioned, by all means, we should consider using them for that purpose.

Now, estimates of various important matters like the cost and schedule for different options have changed since then. Russia's circumstances, its economy, has changed. Its economy and nuclear security have both improved. But I believe the fundamental foundation of that framework laid out in the Academy's studies remains valid.

One point I would add is that if we can only get major security benefits if we do more than 34 tons, we need to make our disposition options be scalable so that they can do more than 34 tons.

Now, in terms of Russian disposition, as you know, Russia has—what I would call reemphasizing its previous preference rather than a radical change—is that somehow, as it has recently been portrayed, that it would rather use the plutonium in new reactors rather than existing reactors, new reactors that would fit in its version of the future nuclear energy.

While the total cost of building those new reactors would be much higher than using plutonium in existing reactors, nonetheless Russia says that it might pay a portion of that total cost, and therefore the cost to the United States might be similar or smaller.

But before the United States agrees to support construction and operation of the BN–800 fast neutron reactor in particular, several policy issues would need to be addressed, I believe. Clearly, if you operated it as originally designed, so that it is making more weapons-grade plutonium than it is burning, that would not support our non-proliferation objectives. Russia might be willing to take off what are called the breeder blankets around a portion of the reactor, but that would leave, of course, the possibility that they could be added back on at any time.

And we would have to consider how much we cared about that subject and how much we cared about other subjects such as how much it matters that the spent fuel from such a reactor would typically be in smaller fuel assemblies with lower radiation fields and higher plutonium concentrations than if the plutonium had been used in a light water reactor.

High-temperature gas reactors, another option Russia is looking at, don't raise similar policy issues, but they are similarly expensive.

At the same time, we ought to continue to examine other options, including reactors outside of Russia where you might be able to export some of the plutonium fuel produced in Russia.

I have for years advocated that we should at least look at the notion of a plutonium swap. That is, there are ten tons of plutonium being burned as MOX every year in Europe. And if we simply shipped the U.S. and Russian excess plutonium to Europe, and they gave us title—put a U.S. flag and a Russian flag on the equivalent amount of civilian plutonium and burn the weapons plutonium instead—that would be much the most rapid and cheapest way of converting these stockpiles into safeguarded stockpiles sitting in Europe rather than unsafeguarded stockpiles in Russia.

I believe we should also restart a joint immobilization program with Russia, because I believe Russia probably has, as we do, much more plutonium that is unsuitable for use as MOX than it has been willing to acknowledge.

On the U.S. side, I think the two leading options are the ones proposed by the Department, as you will hear later, involving both MOX and immobilization in tandem for different parts of the excess plutonium stockpile, or an all-immobilization option.

I think all-immobilization should be seriously considered. Indeed, we currently believe that this option would be as expensive as doing both, but the previous DOE studies had come to the opposite conclusion even before the substantial cost growth for the MOX option.

DOE also believes that there may be a problem with having sufficient canisters of high-level waste for putting the immobilized plutonium into once a large-scale immobilization facility could come online down the road.

I think there are a variety of options that might be considered to address that issue, though I am not—can't by any means be certain that it could be fully addressed, those options are described in my full statement.

In the past, Russia has said that it would not carry out disposition of its plutonium if we did only immobilization, seeing the immobilization as just another form of storage.

They are wrong that it is just another form of storage. We certainly would not spend billions to put our plutonium into a form that it would take billions to get it back out of if we were really intending to store it for later use in weapons.

And I believe that if we move to a situation where we are supporting an approach that meshes with Russia's long-term vision of the nuclear energy future that we may very well have a little more flexibility on their side about what options we take in the United States. It is at least worth raising the question with them if immobilization otherwise looks attractive.

On the other hand, DOE's proposed strategy does have a number of benefits. In particular, by having both options in parallel, it would probably be easier to scale it to cover more than the initial 34 tons covered by the agreement.

So recommendations: As a first priority, we should do everything in our power to ensure that all stockpiles of nuclear weapons and the materials to make them worldwide are secure and accounted for. We have been doing a lot to do that. There is a lot more to be done. We describe that in some detail in our recent report, "Securing the Bomb 2006."

Second, DOE should move aggressively to consolidate its plutonium and HEU in fewer locations, achieving higher security at lower cost and should work with Russia and other countries to do the same.

Third, I believe the United States should adopt the policy of seeking deep, transparent and irreversible nuclear arms reduction, should seek agreement with Russia to reduce each country's total stockpile of assembled nuclear weapons and then to reduce the plutonium and HEU stockpiles to the minimum needed to support those reduced warhead stockpiles.

The United States should maintain both a domestic plutonium disposition program and support for Russia's plutonium disposition program, and funding for the MOX program should not be zeroed as proposed in the energy and water bill.

Fifth, however, the United States should only be prepared to invest the billions in construction and operation of the relevant facilities if we have adopted a policy of seeking irreversible nuclear arms reduction and we are seeking to convince Russia to go beyond the initial 34 tons, or, if the costs and risks of disposition are, in fact, less than the costs and risks of continued storage.

For disposition of the U.S. plutonium, we should focus on hybrid MOX and immobilization options or the all-immobilization options. And to help make that choice, Congress should direct that DOE provide detailed analyses of the costs, benefits and risks of each option which should be subjected to in-depth independent peer review.

For the Russian plutonium, we should continue to focus on a degree of linkage—that is, to try to ensure that Russia gets rid of roughly similar quantities of plutonium on a roughly similar time scale, but there is no need to have it be the same technologies as us or exactly the same time that facilities start being built and operated.

We should begin discussions now with Russia on declaring additional material excess to our military needs and on making sure that stringent standards of security approximating the stored weapons standard will be maintained throughout.

And we should seek an agreed decision on what disposition options are going to be implemented with Russia as soon as possible.

We should not support construction and operation of new fast neutron reactors until we are convinced that doing so will contribute to and not undermine our non-proliferation objectives.

So with that said, my bottom line is we should adopt policies that will make it possible for plutonium disposition to make a big contribution to our national security, and then we should move forward with disposition of a large fraction of both the U.S. plutonium stockpile and the Russian plutonium stockpile.

And I apologize for going on so long.

[The prepared statement of Mr. Bunn can be found in the Appendix on page 57.]

Mr. EVERETT. Very thorough and very interesting.

I need to take care of a little housekeeping thing here before we start the questioning. And that is, after consultation with the minority, I ask unanimous consent that Mr. Wilson, Mr. Barrett, Mr. Norwood, any other members that may attend the hearing who are

not on the committee be authorized to ask questions following all questions being asked by the members of the committee. So ordered.

Mr. Bunn, I appreciate your comment that—I want to talk about de-linking the projects. I got a little tired, you know, three years in. This thing comes up, and comes up, and comes up, and the Russians postponing and finding excuses.

One of the great things about dealing with the Russians—you can sign an agreement with them and they always find "technical reasons" that they can't fulfill that agreement.

Having said that, let me—as you know, the House Armed Services bill de-links the U.S. MOX project with the Russian MOX program. What concerns, if any, do you have about the steps we took to de-link the two projects?

And I think Mr. Spratt and his questions also mentioned something about that.

Mr. BUNN. Well, I think that we should partly de-link. We should continue to seek, as I said, that Russia—disposition of plutonium on a comparable scale and a comparable time frame to what we are doing. But that doesn't mean we have to wait to start construction on our end until the Russians move forward.

We do have reasons within our own complex, the interests of the state of South Carolina, and the costs and risks of storing plutonium in our own complex, to move forward if we decide that MOX is the right way to go.

So I think that it is worthwhile to be flexible about the linkage on the timing of construction of facilities. At the same time, if we are pessimistic that Russia is ever going to move forward, then I think that raises very serious questions as to whether it is worth going ahead and building these quite expensive facilities in the United States.

So those are my thoughts in a nutshell on the linkage front. I think we should de-link on the beginning of construction. On the technology front, we should de-link there.

And in fact, I think—although there has been a great deal of pessimism caused by the Russian change, I think if we can get into a position where we are pushing an option that the Russians are actually enthusiastic about, we will be in better shape.

The Russians do move forward on things they care about. It is only when we are pushing them to do something that they don't really care about doing that we have these kind of enormous delays that drag on for years.

So if we can get them into a position where they actually want to do plutonium disposition, we will be money ahead.

Mr. EVERETT. Isn't there some feeling that the Russians are not excited about moving ahead?

Mr. BUNN. They are very much not excited about moving ahead with plutonium as MOX in their existing light water reactors.

It is my belief that they are somewhat excited about the possibilities for use of plutonium fuel in the longer term vision of nuclear energy in the reactors that they are planning to build, not only fast neutron reactors but also future light water reactors and future high-temperature gas reactors.

Mr. EVERETT. I got a little ahead of myself there, but prior to that I was going to ask you, subject to your statements just a few minutes ago, that you have qualified whether or not PMDA is valid to continue with.

Mr. BUNN. Well, the reality is today the schedules in the PMDA are simply not going to be met. We were supposed to be starting by about now.

So the PMDA is going to have to be modified in some way, and it will probably, my guess is, have to be modified a bit on the technology front as well as on the timing front. And I think we should be willing to do that.

But the underlying structure of the PMDA that both sides would carry out disposition of a large chunk of plutonium I don't think necessarily does need to be modified.

I do think that as we focus on the 34 tons that is in the PMDA, as I said in my statement, we really need to be thinking about going well beyond that, because the security benefits of getting rid only of 34 tons and then stopping are really very minor.

Mr. EVERETT. Thank you very much.

Mr. Reyes.

Mr. REYES. Thank you, Mr. Chairman.

Thank you for your testimony. The disposition method of immobilization might take many different forms. How does vitrification in glass compare with other forms of immobilization such as the use of ceramic rather than glass matrix?

Mr. BUNN. Well, I think you will hear more recent studies described by the Administration witnesses at this hearing, but there are several ways that one could go forward that have been considered for different kinds of plutonium.

If you were going to do an all-immobilization option, as I understand it, it is still DOE's view that the best way to do that would be to put the plutonium in ceramic sort of pucks, put the pucks in the cans. The cans would then be arrayed inside the huge canisters into which molten high-level waste glass is poured.

That would create a form that, in my judgment, does meet the spent fuel standard. There are disagreements on that subject, but I believe it does. It would be a massive, intensely radioactive form. There would be about 28 kilograms of plutonium in each of those canisters.

If they were going to immobilize only that portion of the excess plutonium that is not suitable for MOX, then they might go a different route. They might put either the plutonium in glass in those little cans or maybe even try to just put it directly into the molten high-level waste glass.

I think the option we looked at in the Academy study was melting it right in with the high-level waste. There are various difficulties with that. Different temperatures involve certain of the radioactive species and so on.

And also, if you have a big melter like you have at the defense waste processing facility, and you put a lot of plutonium into it, you are liable to have a criticality accident with the plutonium settling down to the bottom.

So there are, I think, greater technical uncertainties remaining on immobilization on any of those fronts. I do think that from a

purely technical sort of how-good-is-the-waste-product perspective, ceramic is better. But it may be that you could go a little bit faster for a small amount of plutonium on glass. I defer to my Administration colleagues on that subject.

I chaired a sort of review panel at Livermore a few years ago on ceramic versus glass, and we concluded ceramic was the right answer, which was what DOE had concluded at the time.

I do think it has a few more technical obstacles on the immobilization front, but there are some reasons to be interested in it as well. It has fewer difficult-to-safeguard steps. It has less transport of plutonium that is potentially vulnerable to different places.

I don't think that getting the energy value out of the plutonium should be a major driver of our policies. While the amount of plutonium we are talking about is big in terms of the number of nuclear weapons you can make from it, it is small in terms of the future of nuclear energy. It is only enough to provide fuel for the world's nuclear reactor fleet for a few months.

And the cost of using that energy is much more than the energy is worth, so that plutonium is sort of like really low-grade oil shale at this point. It has got energy in it, but it is costly to get that energy out.

Mr. REYES. Mr. Chairman, I don't know how much time I may have left without the lights, but——

Mr. EVERETT. You are the ranking member. You have got all the time you want.

Mr. REYES. Actually, the reason I asked, Mr. Chairman, is because I was going to yield the rest of my time——

Mr. EVERETT. That won't be necessary. We are going to—Mr. Spratt is up next.

Mr. REYES. Okay. Then I will yield back my time.

Mr. EVERETT. Thank you.

Mr. Spratt.

Mr. SPRATT. Thank you, Mr. Chairman. I will be glad to alternate on both sides, though, if you want to go ahead with Mr. Thornberry or somebody.

Mr. EVERETT. Well, let's see.

Mr. Schwarz.

Dr. SCHWARZ. I would yield to my friend from South Carolina.

Mr. EVERETT. No, we won't do that, either. No. Non-members of the committee are not allowed to ask questions till after all members have asked questions.

Dr. SCHWARZ. I have no questions at this time.

Mr. SPRATT. Mr. Bunn, thank you for your excellent testimony, and you didn't have time to present your entire written testimony, but it is a substantial contribution to understanding the problem.

Mr. BUNN. Thank you.

Mr. SPRATT. Wouldn't you admit, however, that 34 tons is a pretty good first step out of 145 tons estimated plutonium, surplus plutonium? That is 25 percent of it—not bad for a first step.

Mr. BUNN. It is a good first step if it is a first step. My concern is that if we focus so much on the 34 tons, political leaders around the world being asked to finance various facilities and so on—when we get to 34 tons and they sort of wipe their hands and walk away

and say well, we solved that problem. And we won't have solved that problem.

If we understand that it is a first step, I believe we should move forward. If we believe that we are never going to go beyond 34 tons, I believe it is not worth the effort to move forward.

Mr. SPRATT. But we run the risk of letting the perfect be the enemy of the good if we push for more than we can really——

Mr. BUNN. I agree with that. I also think that——

Mr. SPRATT. This agreement was made with the Russians in the year 2000. We are now here in the year 2006 still struggling to bring it to fruition and get it off the ground.

Mr. BUNN. I agree with that. My testimony is not that we should not begin construction until we have an agreement with the Russians. My testimony is that we shouldn't begin construction until we have decided that we want to get an agreement with the Russians on going beyond 34 tons, including going beyond 34 tons for our own stockpile as well.

Mr. SPRATT. If our resort is to some form of immobilization with this can in a canister or whatever, the Russians will demur to that because they are wedded to this idea of extracting the maximum energy potential out of the plutonium.

So we don't advance in parallel directions, do we, if we—if we do that, we can indeed set aside and reduce some of our surplus plutonium, which I support fully. But we don't get the better half of the bargain by getting the Russians to do the same thing.

Mr. BUNN. Clearly, a big part of the purpose of getting rid of U.S. excess plutonium is to get the Russians to get rid of their excess plutonium. There is no doubt about that.

And in the past, the Russians have said that they would not move forward with the disposition of their excess plutonium if we were only immobilizing our plutonium.

The question I was raising in my testimony is whether if, in fact, we were shifting toward a policy of supporting an approach to plutonium in Russia that they were enthusiastic about, they might well be willing to be a bit more flexible on our pursuing an immobilization strategy.

I don't know that that is true, but I think it is worth at least asking the question. So that is my view on that subject.

Mr. SPRATT. With respect to the fast neutron reactor, is there some way we can agree with the Russians to use that technology for irradiating their surplus plutonium for some kind of plutonium fuel, and at the same time protect against the application of that reactor as a breeder reactor?

Mr. BUNN. Yes. I think that is potentially possible.

Mr. SPRATT. Does it require inspections, periodic inspections?

Mr. BUNN. I think as a first step would be getting their agreement to take off as many as can be done safely of the breeding blankets, so that it is converted from a net producer of weapon-grade plutonium to a net burner of weapon-grade plutonium.

The second step, I think, is already in the PMDA, which is that they would not reprocess any of that material and recover any of that plutonium that was produced until after disposition of all of the plutonium covered by the agreement had been completed.

We might want to consider whether to seek with Russia an agreement that would go further than that and would say they would never add additional breeder blankets to a reactor whose construction we have supported or that they would only reprocess using proliferation-resistant approaches that didn't separate weapons-usable plutonium or something of that nature, because fundamentally, the way they see it right now, that reactor would ultimately be a plutonium breeder reactor supporting a big plutonium fuel economy in Russia.

And I think there are serious questions as to whether that is in the U.S. non-proliferation interest.

Mr. SPRATT. And one of the criteria you specified was that the project be scalable. If we are to make this a first step, they should be able to scale the fuel conversion plants to accommodate and——

Mr. BUNN. Correct.

Mr. SPRATT [continuing]. To put additional nuclear materials down the road. Wouldn't the plant we are talking about, the MOX fuel fabrication plant and the plutonium—what is it, the plutonium—they chop up the plutonium and makes it——

Mr. BUNN. Plutonium immobilization.

Mr. SPRATT. Yes. Wouldn't that be scalable, all of that?

Mr. BUNN. Potentially. They are being designed for particular capacities, which are based on the 34 tons. But you could, for example, keep running them for a longer period of time, so as to consume more plutonium.

Or one thing I have always advocated, at least in the case of the Russian facility, is that once you are building a plutonium building, which involves a huge amount of sort of fixed cost, often adding another room is not a huge net addition to the percentage of the total cost.

And so you might think about whether you want to, you know, add more space so that if you wanted to add another fuel fabrication line or another immobilization line later that it would be less cost than building a whole new building to expand that capacity.

So I think we ought to at least be thinking about options for expanding capacity, particularly on the Russian end as we move forward.

Mr. EVERETT. Mr. Larsen, I am going to make you a deal. I have canvassed my side over here of the members of the committee, and I can assure you, if you would yield your time to Mr. Spratt that you would be next.

Mr. SPRATT. We are taking care of Hanford, you see, by taking their waste in, so he owes me one.

Mr. EVERETT. Would that be agreeable with you?

Mr. SPRATT. That is okay. I can come back around, Mr. Chairman.

Mr. EVERETT. All right. All right.

Mr. LARSEN. Actually, Mr. Everett, it was actually my intent to yield to Mr. Spratt.

Mr. EVERETT. You read my mind.

Mr. LARSEN. If you don't mind. I would much rather enjoy listening to Mr. Spratt than me ask questions on this.

Mr. SPRATT. One last question. Mr. Bunn, would you agree with the testimony that DOE is about to give that sitting still, doing

nothing, storing and immobilizing itself is a pretty expensive alternative?

In some respects, storage by itself may be the most expensive or immobilization could turn out to be substantially more expensive than anybody has estimated, particularly if you decide to ceramicize the waste or develop a new and better technology for the disposition of it in that form?

Mr. BUNN. Well, as I said, if you store everything in the form it is in now and the places it is in now, it is going to be very expensive, and I think it potentially is the most expensive of the available options.

But if your main goal on plutonium disposition is to cut back on that expense and to sort of consolidate the number of places and the forms of storage and so on, then mostly what you are worried about is the various impure forms of plutonium that are expensive to store, most of which are headed for an immobilization option rather than a MOX option.

Most of the material that is headed for the MOX option under current thinking is in pits at Pantex—not all, but most. And the pits at Pantex—we are going to have a lot of pits at Pantex anyway, and the net additional cost of storing more pits at Pantex is actually fairly modest.

Mr. SPRATT. Thank you very much, sir.

Thank you, Mr. Chairman.

Mr. EVERETT. Thank you.

And thank you for helping keep the train on track after denying Dr. Schwarz his attempt to get Mr. Barrett up first.

And I would like to yield five minutes to Mr. Wilson, who is a member of the House Armed Services Committee but not this committee.

Mr. WILSON. Thank you, Mr. Chairman.

And, Mr. Bunn, thank you very much for being here today.

Mr. BUNN. Thank you.

Mr. WILSON. I have the great opportunity of sharing with my colleague, Congressman Gresham Barrett, representing the physical location of the Savannah River Site. And I am grateful to be here with Congressman Charlie Norwood, who represents a huge number of constituents that work at the site. And so we, indeed, have a keen interest in this issue. I also have a unique distinction. I am a former DOE employee who has worked at Savannah River Site in a legal capacity.

I really enjoyed hearing your presentation, reading your testimony, and I know that you have worked for many years on plutonium disposition. And I look forward to meeting with you in the future some time, too, because I have a feeling this could be a long-term discussion.

Mr. BUNN. Unfortunately so.

Mr. WILSON. It is my view from what I have read, the presentations that we have here today, that the MOX is the best form of disposition for the American taxpayer.

I am opposed to the all-immobilization strategy for plutonium disposition due to problems that you have cited in your testimony. I believe this would result in a dramatic cost to the American taxpayer and eliminate the opportunity to fulfill the promises of the

historic non-proliferation agreement that we have made with Russia.

Critics claim that Russia is not willing to dispose of their plutonium, but I believe, and we will hear this from Ambassador Brooks, that indeed they may be ready to participate and keep the promises that have been made.

Building this facility sends a clear signal to the international community that we are serious about maintaining our agreement to dispose of excess plutonium.

I was very interested in your testimony regarding immobilization. There are some on the House Appropriations Committee that support an all-immobilization strategy, but knowing that—the issues that I see—if we move to all-immobilization, there is a potential that the state of Washington would need to accept most of DOE's excess plutonium to perform some, if not all, of the in-canister operations at the site currently under construction at Hanford.

And our good friend, the gentlelady from Washington state, Ms. McMorris, certainly would have a keen interest in that. And Rick, too. And we want to point out that—the soon-to-be-married Cathy McMorris, in ten days, and who is counting?

A pit disassembly and conversion facility would still be required to disassemble the course of nuclear weapons and convert the resulting plutonium into an oxide form. Significantly more high-waste canisters—a new immobilization facility would be needed, costing taxpayers millions, possibly billions.

Immobilization of weapons-grade plutonium has never been done before, and it is still in a research and development stage. MOX is mature, as we have seen in France, accepted technology currently being used in over 30 reactors worldwide.

The taxpayer would be responsible for paying penalties to the state of South Carolina as the waste would sit at SRS waiting to be immobilized.

Another problem, at a minimum, 2,100 additional canisters would be needed to be inserted into an already oversubscribed Yucca Mountain. As to the points that I made, could you comment?

Mr. BUNN. Sure. It is my understanding that current cost estimates for an all-immobilization and a MOX-plus-immobilization strategy are actually quite similar, rather than an all-immobilization strategy being much more.

In the past, DOE's estimates have been that an all-immobilization strategy would be cheaper, and I think one of the things that is worth looking into is exactly why they have reversed that conclusion even with the large cost growth that has occurred with the MOX plant.

Now, one could argue plausibly that the large cost growth that has happened with the MOX plant would likely happen once we got going on the immobilization plan and got past the very preliminary designs that exist now for an immobilization plant, and I think that is a plausible argument.

I think there are potentially options for providing sufficient waste canisters, but of course the Department of Energy folks know a lot more about what they are doing with immobilization of waste than I do.

In particular, while we are now accepting spent nuclear fuel from foreign research reactors at the Savannah River Site—also at Idaho, and that has been extended to 2019, and those contain millions of curies of radioactive waste that either will become liquid radioactive waste if those are reprocessed or some of it will be volatilized and caught in filters if the melt and dilute technology is applied.

And in either case, that will involve quite a number of canisters of high-level waste that will have to be immobilized above and beyond the high-level waste that is in the Savannah River tanks right now today.

So I think there is some prospect that would be a potential source for additional canisters that would be available once an immobilization plant came online. But there is no doubt that there are higher technical uncertainties on the immobilization front.

On the other hand, it is a somewhat simpler technology, because you are not trying to put it into a reactor which has the, you know, immense safety requirements of a nuclear reactor.

So you don't have to have, you know, as fine detail on exactly how that plutonium puck—you know, if there is a little chip off of it, it doesn't really make that much difference, whereas in terms of a pellet of MOX fuel, it makes a big difference, and you have got to make each one of them exactly right.

So I actually think that the balance between those options is fairly finely balanced in my mind, and that is why I recommended that Congress ask the Department for a number of analyses of the cost, benefit and risks of each of those approaches.

Mr. EVERETT. Mr. Barrett, it is your time now.

Mr. BARRETT. Thank you, Mr. Chairman. It was Mr. Schwarz's idea, too, by the way, to yield that time to me, Mr. Chairman, but I am——

Mr. EVERETT. You are not taking the credit for that.

Mr. BARRETT. Thank you so much.

Mr. Bunn, thank you for being here today. I see that you are a senior research associate and not associated with the DOE. How close do you work with these guys?

Mr. BUNN. Once upon a time, I worked much more closely with them than I do now. At one time, my program had a small grant from the disposition office, and at one time I consulted for Bechtel National on their efforts to get a contract for Russian plutonium disposition, but neither of those are active anymore, so I have no sort of financial dog in this fight.

Mr. BARRETT. Well, the reason I ask—because you made a statement, if we decide to go with MOX—if we decide the right—if we decide MOX is the right way to go, and I am taken aback by that, because we are $1 billion—$1 billion—into the MOX program.

And if you are speaking on the same sheet of music as DOE, we got a major problem here.

Mr. BUNN. No, no. I am an independent analyst sitting at Harvard University. I do think, though, that we need to look at the costs and risks and benefits of different options going forward. Some costs are sunk. We can't get them back.

Mr. BARRETT. Well, let's talk about that. You talk about immobilization versus MOX. And you are saying that they are very simi-

lar as far as the cost goes, and I don't know—and I am sure you have got facts and figures to back this up.

But the facts and figure that I have show just the opposite. In fact, the facts and figures that I show on MOX actually have the program laid out to show this is the overall cost, where, to the best of my knowledge, immobilization has not done that.

And I think when we are looking at the long term also, if we are talking about immobilization, sir, are we putting these immobilized canisters in Yucca Mountain? If we are, how much space is that taking up?

And if we are talking about interim storage, if we can't open one Yucca Mountain, I don't know how you think we are going to open up 31 or 32 interim storage sites throughout this nation, South Carolina being one of them.

Mr. BUNN. I for one am not talking about 32 interim spent fuel storage sites. I think you are confusing me with Senator Domenici and his——

Mr. BARRETT. But you have got to store this stuff somewhere if Yucca Mountain is not open, is that not correct, sir?

Mr. BUNN. That is exactly so, but what I am saying is that both the MOX option and the immobilization option result in massive, intensely radioactive objects, in one case plutonium in high-level waste glass canisters, in the other spent fuel from nuclear reactors, both of which are ultimately destined for Yucca Mountain. So I don't see a large distinction between the two options in that respect.

I defer to my DOE colleagues as to what their estimates of the respective costs are, but it is my belief that they are currently fairly similar for an all-immobilization option and——

Mr. BARRETT. Have you got——

Mr. BUNN [continuing]. Plus immobilization option. In the past the DOE's official studies have been that an all-immobilization option would be cheaper.

Mr. BARRETT. Have you got facts and figures to back that up? And I would certainly love to take a look at that.

Mr. BUNN. Sure. Take a look at the——

Mr. EVERETT. Let me say to my colleague that it would be a—Mr. Anderson will have some charts to show those facts and figures.

Mr. BUNN. Yes. As I say, that is the Department of Energy doing the real cost estimates. But you are absolutely right that the MOX estimates are much more detailed and are at—because we have made the investments we have in design and getting ready for construction and so on, we are at a point where we can make much more detailed cost estimates than are yet available for immobilization.

Mr. BARRETT. Let's turn toward fast reactors a little bit. I understand there may be some things that we can work with the Russians—if they are willing, as flush with cash as they are right now, to help pay for these fast reactors, if not fully fund them, wouldn't that make sense, if that is the only holdup, to kind of work with them through the MOX program to make the world safer and move toward—since we have already got $1 billion—if you are correct that they are very similar and we have already got $1 billion in-

vested in that, wouldn't it make sense to move ahead with the MOX?

Mr. BUNN. Well, it seems to me there is two questions there. One is moving ahead with the MOX and the other is moving ahead with the fast reactors in Russia.

My point about fast reactors in Russia was not that we should be against them but that we should be careful, because the fast reactors as originally designed are designed to make more weapon-grade plutonium than you put into them, so that wouldn't—I don't see any reason why the United States should spend money helping Russia make more weapon-grade plutonium than it started with.

However, I think there are potentially approaches where you could get them to take some of those breeder blankets off, convert them into net plutonium burners and do a number of other things that might potentially be enough to convince us that that, in fact, did serve our non-proliferation interests and move forward in supporting fast reactors in Russia.

We don't know yet how much of the cost of those reactors Russia is willing to pay. We know they say they are willing to pay some, and whether they want us to provide more or less the same amount we would have provided for the other reactors, or less, or more is still open to discussion.

Mr. BARRETT. I see my time is up.

Mr. EVERETT. Mr. Norwood.

Mr. BARRETT. Thank you, Mr. Chairman.

Mr. EVERETT. Let me mention to the members that we are probably going to have votes between 4:30 and 4:50, or between 4:30 and 5 o'clock. I would hope that we could get through the second panel.

Now, I am more than willing to come back and take as much time as we need, but I would hate to keep this room full of folks here for a series of votes. So I do intend to continue to enforce the five-minute rule.

Mr. Norwood.

Mr. NORWOOD. Thank you very much, Mr. Chairman, for allowing us to attend your hearing and ask a couple of questions.

Mr. Bunn, let's stay on cost just a minute if we may. You said earlier in your testimony that DOE knows more about waste than I do. Do you stand by that?

Mr. BUNN. I absolutely stand by that.

Mr. NORWOOD. DOE wants MOX. The White House wants MOX. The Senate wants MOX. Most of us in the House do, except one chairman. Well, he doesn't know anything about MOX, but he doesn't want it.

I happen to have a pretty good document that shows MOX is less expensive than the alternative of just immobilizing. And I also—on waste—you mentioned two or three times recently we have had an increase in cost for MOX. $1.1 billion? That is not an increase in cost. That is good management at DOE finally sticking its head above ground. That cost was always the cost. It was always the cost for a cold startup from day one. It was always a cost for contingency, unknown things that might happen.

That is in every program. We have just not had good enough management over the years to put that into programs. But that

$1.1 billion I think is unfair to say that oh, well, that is a new cost, because that same kind of cost applies to any program you have, once DOE determines it is going to start applying those figures to the cost of things.

So I think for the record, Mr. Chairman, I need to point out maybe MOX is less expensive—at least some people think so, and the $1.1 billion isn't necessarily an increase. It is a true factor.

Mr. BUNN. With respect, when we first made these decisions to move forward with MOX in the Clinton years, we were expecting that that MOX plant would cost about $700 million to $800 million, and now the estimate is about $3.5 billion. So in my book, that is a noticeable increase.

Mr. NORWOOD. Well, with respect, I would say to you if we hadn't studied it to damn death, we would have had it done before now.

Any time you have a program that takes that long to get off the board, of course there is going to be that kind of increase in it, just as is the program that is—you are suggesting maybe might be a better alternative, to immobilize everything.

That is going to cost a lot more than you think, too, if we go there, and it is going to take a lot longer.

You said in one of your statements that part of our purpose of getting rid of weapons-grade plutonium was to make sure Russia does, too. Now, that is probably right. I am sure we do want to get them to get rid of their weapons-grade plutonium.

If we don't get them to get rid of theirs, do you think we ought to just keep ours as it is now?

Mr. BUNN. I think given the estimated cost of moving forward that probably—if they are unwilling to disposition any of theirs, or we expect that that will be the case, that probably what we ought to do is pursue the least-cost alternative, which I believe would probably be to immobilize a portion of the plutonium and store the rest.

Mr. NORWOOD. So you think we ought to deal with it regardless of what Russia does.

Mr. BUNN. Absolutely.

Mr. NORWOOD. So do I, which means this really has—Russia has nothing to do with this conversation. We have weapons-grade plutonium in my backyard I want something done with. And I think most of the Nation feels the same way.

I also think most of people who have been looking at this for a long time—obviously, we have spent $1 billion down there trying to get ready for MOX. Somebody must think it is the right thing to do, and we ought to move forward and go ahead with it.

Mr. BUNN. To be fair, I was among those who decided that we should move forward with MOX in the first place when I was in the government.

Mr. NORWOOD. Well, that is all right. At least you are consistently wrong.

Let me just point out that you also mention that the energy reduced from MOX is not of any value. Now, that is government talk. That energy is worth $1 billion. Those of us down there in Georgia think that is a little bit of money. There is some value to that.

Mr. BUNN. Well, it is an interesting calculation to say that it is worth $1 billion. Getting it costs much more than $1 billion. So in

the net, it is—if you were to give a utility ten tons of plutonium today, it would go on the utility's liability list.

Mr. NORWOOD. I understand, but we have got to get rid of this product, and that is one of the ways we can at least get rid of about 90 percent of it.

Do you think it is a good idea to have two Yucca Mountains, or do you think we ought to have interim storage all over the country?

Mr. BUNN. Neither.

Mr. NORWOOD. Neither. Well, you are proposing two Yucca Mountains.

Mr. BUNN. I am not proposing——

Mr. NORWOOD. You are just not saying that.

Mr. BUNN. I am not proposing two Yucca Mountains.

Mr. NORWOOD. Well, you do that——

Mr. BUNN [continuing]. For the quantity of plutonium involved here is an extremely small percentage of the capacity of Yucca Mountain.

And what is more, the latest studies by the Electric Power Research Institute and others suggest that the technical capacity of Yucca Mountain is far greater than had previously been thought, almost certainly more than 250,000 tons heavy metal of spent fuel.

Mr. EVERETT. Well, I would tell my friend from Georgia, your time is expired.

Mr. NORWOOD. Mr. Chairman, I am grateful for every second. Thank you very much.

Mr. EVERETT. And I am grateful to have you here. I like your suit, by the way.

Mr. Bunn, listen, we have had you now in the hot seat for a while, and we do appreciate your testimony. It has been good. Members will probably have some questions for the record. I would ask you to not play by Washington time. I would ask you to respond within 30 days.

Mr. BUNN. Okay.

Mr. EVERETT. Thank you.

Mr. BUNN. Given the conversation so far, I am expecting questions for the record.

Mr. EVERETT. Okay. And thank you very much.

Mr. BUNN. Thank you for having me.

Mr. EVERETT. And now we will get started with the second panel.

And I would again remind members that I would—if we have to come back, we will come back, but I would prefer to not hold all these people here in the event that we have a series of votes, and I recognize that there will be questions, but we will hold to the 5-minute rule. And, Mr. Wilson, please don't ask 4.5-minute questions and expect answers.

Ambassador Brooks, good to see you again. I look forward to seeing you again on Sunday and Monday and Tuesday and Wednesday, and the floor is yours.

STATEMENT OF AMBASSADOR LINTON F. BROOKS, UNDER SECRETARY FOR NUCLEAR SECURITY AND ADMINISTRATOR, NATIONAL NUCLEAR SECURITY ADMINISTRATION, U.S. DEPARTMENT OF ENERGY

Ambassador BROOKS. Thank you, sir.

And I thank the members of the committee for the opportunity to discuss our plans to eliminate U.S. and Russian surplus weapons plutonium.

Mr. EVERETT. Ambassador, let me interrupt you one second and tell yourself and Mr. Anderson and Ambassador Guhin, please summarize your statement—your complete statements will be made a part of the record—because I am kind of serious about not——

Ambassador BROOKS. Yes, sir.

Mr. EVERETT [continuing]. Making you all wait here an hour while we have a series of votes.

Ambassador BROOKS. Yes, sir. I understand. The most important summary of my statement is the Administration remains firmly committed to the MOX program. Everything else is elaboration.

We spend a lot of money now to guard plutonium. We will always spend money to guard plutonium until we transform it into a form where it doesn't need to be guarded. And for us, burning it in reactors is the most effective way.

There is a lot changed since the year 2000. You have heard about the plutonium disposition agreement. But we believe the current approach remains in the national interest. The most compelling reason is non-proliferation and prevention of terrorism, because the only way you ultimately prevent this material from being at risk is to eliminate it.

As was made clear in the first panel, Russia agreed reluctantly in 2000 to allow us to immobilize one-third of this but has made it clear as recently as this month that they do not believe that immobilization of more than that would meet the intent of the agreement.

It is my judgment that if we were to shift to immobilization, which I believe is a bad idea for several reasons, that the Russians would almost certainly completely reconsider their approach.

Mr. Anderson will follow me and talk about how this fits into our overall domestic strategy, and Ambassador Guhin will talk about our diplomatic efforts with Russia. But I do want to point out that while it is clear the Russians are interested in a different technical approach, they remain committed to disposing of plutonium. This was reaffirmed by a statement by Secretary of Energy Bodman and Rosatom Director Kiriyenko, which I would like to submit formally a copy for the record.

Mr. EVERETT. Without objection.

[The information referred to can be found in the Appendix on page 95.]

Ambassador BROOKS. Russia does prefer to focus on advanced reactors, and so our experts are working together to identify specific technologies now. We hope to have a firm plan by the end of the year.

I would like to depart briefly from my written testimony to address the issue of cost. In a 2002 report the Department estimated it would cost $1.4 billion for the completion of the MOX facility through design and construction.

That was based on a 1997 conceptual design, and it made two assumptions. First, it assumed unconstrained funding—that is, we

would have the most optimum profile—and second, it assumed a four-year construction schedule beginning in 2004.

It did not include escalation. It did not include contingency. And it did not include a number of other things that under our procedures need to be included in a truly valid total cost.

The design of our facility is now 85 percent complete. We have completed an extensive bottom-up cost and schedule review. We have established a total cost for design, construct and startup of the MOX facility as $4.7 billion, of which about $800 million has already been spent.

This cost estimate has undergone external independent review and it is in the final stages of formal validation under our project management process.

Now, why is this big growth? About $850 million of it is due to the complexity of adapting the French technology to use weapons plutonium and to meet our safety and security requirements.

Contingency funding, which was not included in the original estimate, accounts for another $800 million of the cost increase.

$500 million is due to the funding profile that stretches out construction in an undesirable manner. And the rising cost of labor and construction materials accounts for another $500 million.

A couple of examples. The facility will require enough steel for 9,000 sport utility vehicles. The cost of steel has increased by 50 percent since 2003. The facility will use the same amount of concrete as 72 miles of highway. The cost of concrete increased by 15 percent last year.

The remainder of the cost increase is some costs that were erroneously not included in the 2002 report, construction management activities and some site infrastructure support which, as Mr. Norwood made clear, we were always going to spend. We just hadn't included them.

And we will be ready to move forward with an official cost report which, in our system, is a prerequisite for the formal start of construction. We are ready to move. Site preparation activities are under way.

We cleared 73 acres of land. We have excavated 80 percent of the site. The design, as I said, is 85 percent complete. We have authorization from the Nuclear Regulatory Commission to begin construction. And we plan to start this fall.

Implementing our plan is the right thing to do, sir. It makes it clear the United States will meet our international obligations. It enables us to keep engaging Russia to eliminate its own plutonium. It reduces U.S. storage, safeguards and security costs. It facilitates the modernization of the nuclear complex. And by providing a pathway out of the Savannah River for plutonium brought there, it meets our legal and our moral obligations to the state of South Carolina.

I urge the committee and the Congress to continue to support this important non-proliferation effort.

Mr. Chairman, this concludes my statement, and once you have heard from my colleagues I will look forward to your questions.

[The prepared statement of Ambassador Brooks can be found in the Appendix on page 76.]

Mr. EVERETT. Thank you, Mr. Ambassador. I heard every word of it, and I appreciate it.

Mr. Anderson.

STATEMENT OF CHARLES E. ANDERSON, PRINCIPAL DEPUTY ASSISTANT SECRETARY, OFFICE OF ENVIRONMENTAL MANAGEMENT, U.S. DEPARTMENT OF ENERGY

Mr. ANDERSON. Yes. Good afternoon, Chairman Everett and members of the subcommittee. I am a principal deputy assistant secretary for environmental management. And primarily for this hearing, I am also the chairman of the Nuclear Materials Disposition and Consolidation Coordination Committee for the Department.

I am pleased to be here today to discuss the Department's strategy for disposition. At this time, I would like to submit my full written statement for the record.

Mr. EVERETT. Without objection.

Mr. ANDERSON. As I have testified to in the past, the proper management and disposition of special nuclear materials is one of the biggest challenges facing the Department with respect to cost, security and the schedule of reducing the complex's nuclear materials footprint.

To provide perspective on the complexity of this situation, the Department's nuclear materials inventory includes over 500,000 separately inventoried items measuring up to thousands of tons of material.

Of primary interest today are the hundreds of tons of special nuclear material. While the challenge of reducing the special nuclear material storage footprint is complex—you can see from the chart here, it is spread across the country—it is far outweighed by the benefit provided to the Department and the taxpayer.

More importantly, the disposition of our surplus special nuclear material is needed to provide greater national security, and it is the right thing to do.

When I testified in front of this subcommittee in April, I explained why the disposition and consolidation of plutonium-239 was a top priority to the Department and the Nuclear Materials Disposition and Consolidation Coordination Committee—it would provide several important benefits to the Department and the taxpayers.

The Department has surplus plutonium–239 stored in highly secured facilities across the complex which require ultimate disposition, or else the Department and the taxpayer continues to bear the high cost of securing and protecting this material.

With disposition in mind as the final fate of this material, you can then see how premature decisions on consolidation would be inefficient without having a final disposition of surplus material identified.

Consolidation decisions must be informed by disposition plans to ensure efficient use of safeguards, storage and transportation resources and is why the Department's committee is evaluating an integrated disposition strategy.

We have identified approximately 76 metric tons of surplus special nuclear materials, plutonium–239 and highly enriched uranium, all of which ultimately need to be dispositioned.

Mr. Chairman, it is fundamental that these surplus materials not programmatically needed be dispositioned and not left to be stored indefinitely.

The Department has developed four primary alternatives on how to manage these special nuclear materials. The first would be to disposition using the mixed oxide fuel fabrication facility, pit disassembly and conversion facility, operation of a plutonium vitrification capability, and H-Canyon operations.

The second would be disposition using a mixed oxide fuel fab, pit disassembly, operational plutonium vitrification capability, but no H-Canyon operations.

The third would be disposition by immobilization, which will include stabilizing 50 metric tons of surplus plutonium in a ceramic matrix.

And the fourth would be continued storage in current locations—in essence, a no-action alternative—option the Department would continue to experience high annual operating and safeguards and security costs until some future decision were to be made on consolidation and/or disposition.

The Department's currently proposed approach, which includes the mixed oxide fuel fabrication and associated facilities, plutonium vitrification and H-Canyon operation, would enable the conversion of 34 metric tons of weapons plutonium into fuel for use in commercial nuclear power reactors.

It would vitrify up to 13 metric tons of non-MOXable plutonium for eventual disposal in the geological repository and a—of 26 metric tons of uranium and plutonium bearing materials with recovery of the uranium, which could be used again in the fuel cycle.

Let me further describe the key components of this integrated disposition strategy. Ambassador Brooks has already discussed the MOX program in great detail. The other two components are H-Canyon and plutonium vitrification.

First, H-Canyon is a large, heavily shielded aqueous chemical separations facility which dissolves spent nuclear fuel containing highly enriched uranium, other enriched uranium materials and plutonium-bearing materials and chemically separates their constituents.

The facility has been operating almost continuously since it was constructed in the early 1950's. H-Canyon is scheduled to complete its current processing mission in 2007.

This is, however, the only remaining production-size chemical separation facility in the United States, and as such is a valuable asset in the Department's nuclear materials disposition and risk reduction efforts.

Second, the Department is considering vitrification as the preferred technology to immobilize non-MOXable plutonium. The plutonium vitrification capability is proposed to be located in the basement of the former K Reactor facility at Savanna River Site where the majority of the non-MOXable plutonium material is currently located.

The facility would provide the capability to vitrify up to 13 metric tons of plutonium materials that were not—that are not suitable into fabrication into MOX fuel due to isotopic or other impurities.

The impure plutonium would be melted with glass frit, poured into small cans. The cans of vitrified plutonium would then be placed inside larger high-level waste canisters and subsequently shipped to the Defense Waste Processing Facility where they would be filled with glass containing high-level waste.

Remaining alternatives include variations of processing and disposition options, including immobilization of 50 metric tons. The Department's preliminary results indicate that cost is not a discriminating factor in choosing between these disposition options, as shown on this chart.

I want to emphasize these are preliminary results. They have not been thoroughly evaluated. We still have effort to do that, but they give an idea of the comparative cost for these options.

There are, however, other discriminating factors. The Department has higher confidence in the cost estimates for the disposition approach using MOX and associated facilities, plutonium vitrification and H-Canyon operation. Storage and operating cost of existing facilities are based on actual operating cost.

Furthermore, as mentioned before, the design of the MOX facility is 85 percent complete, and its cost estimate is based on a recent external independent review, whereas immobilization is an immature technology based on conceptual estimates and will require years of additional research and development.

The Department's integrated disposition strategy outlined herein provides the most cost-effective, timely means for dispositioning inventories and surplus materials that the Department maintains today.

I would point out that these costs are also to-go costs. They do not include sunk cost. We have not tried to capture that in total life cycle cost here.

And as a comparison, as we have talked about other cost here, the primary proposed alternative would be dispositioning 76 metric tons of material, both plutonium and uranium, and not just the 34 metric tons that is sometimes referred to as an alternative.

Mr. EVERETT. Mr. Anderson, let me ask you to summarize your statement.

Mr. ANDERSON. I am almost there.

Mr. EVERETT. Oh, good.

Mr. ANDERSON. Additionally, the integrated strategy maximizes the useful energy of this defense material, returning as much as possible to the nuclear fuel cycle.

This approach will enable the U.S. to achieve its non-proliferation objective of converting weapons material into a form that can no longer be used in a nuclear weapon.

The Department is making progress on finalizing the integrated disposition strategy and completing the necessary National Environmental Policy Act analysis to support this effort.

The cornerstone to this strategy is the MOX project. Without the MOX facility, the foundation for our disposition strategy erodes, setting the Department back years in its thinking, technology and

decision-making processes while eliminating the country's ability to meet non-proliferation objectives and eliminating any clear path for near-term consolidation.

This integrated disposition strategy, the three-prong approach, is a strategy in which we have the highest confidence in our cost estimate. It is a strategy which maximizes energy value and provides a clear disposition path for the surplus special nuclear materials discussed earlier.

I thank you for allowing me the opportunity to testify, and I am pleased to answer any questions at the completion.

[The prepared statement of Mr. Anderson can be found in the Appendix on page 81.]

Mr. EVERETT. Very welcome.

Mr. Guhin, again, if you can be as brief as possible. Your complete testimony will be made a part of the record. And while I am giving you a sense of urgency, I do want you to say whatever you need to say.

STATEMENT OF AMBASSADOR MICHAEL GUHIN, U.S. FISSILE MATERIALS NEGOTIATOR, U.S. DEPARTMENT OF STATE

Ambassador GUHIN. Thank you very much, Mr. Chairman, and thank you, distinguished members. It is an honor to be here. And thank you for accepting my testimony, and I will try to be brief.

I would preface my oral remarks with a bit of background that I have had the honor—and I stress the honor—of leading the negotiations of the 2000 agreement with Russia on plutonium disposition.

I have had the honor of leading the liability negotiations which we saw last July, and also the honor of such negotiations as extending the recent extension of the cooperative threat reduction agreement with Russia.

I would make just a few points, then, if I may, in summary. First, looking at this from the Department's but also from the government's entire perspective, we look at converting this most dangerous and most readily usable material as, first and foremost, a non-proliferation objective. And that is the criterion by which we judge it.

I would also note that other G–8 countries, several other G–8 countries, have supported this goal for over a decade, and that the contributions, the financial pledges, from other G–8 countries now exceed the $400 million pledged by the United States earlier.

Second, I agree with all those who have said negotiations with Russia have gone slower than we hoped, and we certainly do have some complicated negotiations ahead of us. But I would say that we are on a much more promising path than we have been in the past.

I say this for a few simple reasons. One, liability is resolved, and I won't go into that in detail, but it is resolved in substance, and it will be available by the time it is required.

Two, as has been noted, the sides have now agreed to explore paths that are more consistent with Russia's nuclear energy strategy. And I would stress that this does two things. It allows us to move this from mostly an assistance program to a partnership, to

much more of a real partnership. And it changes the entire negotiating paradigm.

We are no longer trying to convince Russia of an interest in a particular program, but are working with Russia for it to identify what is in its interest, and in which it will contribute financially, politically, and technically.

And I think those are very, very promising developments. The recent statements by Secretary Bodman and Mr. Kiriyenko have been noted. I would also note, however, that the fact that this was even referred to in the statement by President Bush and President Putin underlines the importance of the explorations and the talks that we now have going both in policy channels and in technical channels with Russia.

Finally, in this regard, I would note that our G–8 partners have also been impatient, but they have also expressed a continuing interest, and we have talked with almost all of them over the months, and we stay in dialogue.

Finally, I would like to address the second question that was in the—that I was asked to address, and I would summarize it this way, that while we keep our eye on the objective—that is, to get Russia—to get Russia to dispose of its excess weapon-grade plutonium under sound conditions, we are going to have to be flexible, and I say at times quite flexible, on Russian time frames.

To us, decoupling does not mean changing our commitment to get Russia in disposition. It does not mean changing our efforts to work with Russia. And it certainly doesn't mean any lessening of our commitment to the 2000 agreement. But it does mean decoupling the time frames and the time schedules for each side's program.

And I would say that from a negotiating standpoint, a long-term negotiating standpoint, that decoupling these time frames is not only highly desirable, I believe it is probably essential to achieve the goals that we want to achieve.

I say that because once these time schedules are coupled, it is counterproductive in that it gives Russia undue leverage in the entire negotiating process.

And I would also note in closing that the 2000 agreement, having led those negotiations, is deliberately flexible on this. It allows each side to adjust its program schedules.

The program schedules in the attachment to that agreement were recognized as not realistic by the negotiators when it was finalized, but you had to finalize something to get moving.

It recognized the time frames could be different between the two parties' programs. And it certainly never intended to make progress in one program hostage to progress in the other.

So I firmly believe that the wisdom of not coupling specific activities to time frames remains as valid today as it did then.

I believe that our negotiating hand will be made the strongest if the United States demonstrates its resolve by moving decisively ahead, at the same time that we work with Russia to seek to get it to move decisively ahead.

Mr. Chairman, that summarizes my—I would like to add two comments because they have come up very much in the discussion today.

One is I would like to stress the 2000 agreement and the 34 tons is very much seen as a first step. This was discussed in the negotiations as a first step. The 2000 agreement addresses the prospect and envisions the prospect that other material would be disposed of.

So I firmly agree with the idea that—and what the negotiators agreed—but you had to work out the first step before you could take a second step. And that is indeed, I think, envisioned. And second, just to clear the air here, since I think both DOE and the Department with DOE have talked and are exploring with Russia the future reactors it is talking about, I would like to make clear that Russia is very careful to refer to advanced reactors generally.

It has not made a commitment to fast reactors. It has not made a commitment to advanced light water reactors.

The idea is that both sides would explore various approaches to this and would explore both the technical but also very much the policy aspect and policy issues that would be associated, for example, with the fast reactor approach.

Thank you very much, Mr. Chairman.

[The prepared statement of Ambassador Guhin can be found in the Appendix on page 86.]

Mr. EVERETT. Mr. Ambassador, we thank you very much for your past service and your achievements along these lines and your most—congratulate you on the most recent one on liability, and I would make an observation that you are certainly an optimist.

I am at this time going to yield my time to Mr. Spratt.

Mr. SPRATT. Well, thank you very much, Mr. Chairman.

Just to cut to the essential questions, Mr. Brooks, does the Department of Energy still support the MOX fuel application plan?

Ambassador BROOKS. Yes, sir.

Mr. SPRATT. As the preferred alternative for disposing of excess plutonium?

Ambassador BROOKS. Yes, sir.

Mr. SPRATT. Are you satisfied that a parallel agreement can be struck with the Russians which will give you, in the end, the functional equivalent? That is, plutonium reduced to a non-weapons-grade status in essentially the same condition?

Ambassador BROOKS. Yes, with two caveats. One is he has got to do it, I don't have to, so it is always easier to—for me to say that Ambassador Guhin will do things.

And second, you know, the history of our dialogue with Russia in many areas is these things sometimes take longer, but I am absolutely convinced, because it is in their interest, too.

Mr. SPRATT. But technically are you satisfied that if they go for fast neutron reactor, they will not be actually producing more—breeding more plutonium than they are burning?

Ambassador BROOKS. I am absolutely convinced the United States wouldn't acquiesce to something that was counterproductive, and I think the Russians understand that.

Mr. SPRATT. Can we be assured of it, though?

Ambassador BROOKS. We can be assured at the time, because verifying whether a breeder—a breeding blanket is off is relatively straightforward. We are going to demonstrate this with a small step on an existing reactor called the BN–600.

I don't want to suggest that this is the solution for plutonium disposition, because it is only one-third of a ton a year, but it is provided for in the 2000 agreement. We are going to go forward with it.

And it will demonstrate both how we use fast reactor fuel, how we verify that there is no breeding, and so, yes, I think that is not an issue.

Mr. SPRATT. Do we lose our leverage if we go ahead with MOX?

Ambassador BROOKS. I don't think so. There was a time when we might have. I don't think we will lose leverage now.

Mr. SPRATT. Mr. Anderson, when you briefed me a few days ago on this, you mentioned another time frame instead of a 30-year time frame for comparing the cost of the various options. But since the cost of immobilization is rather constant over time, as you go from 30 years to 50 years, that cost recurs each year, whereas MOX fuel cost tapers off as the plutonium is eventually disposed of.

Let me show you the—this is 30 years, as I understand it, is that correct, 30-year time frame?

Mr. ANDERSON. This is the 2035. I actually also have a chart here that shows the 50-year, and a point that would be made there is that—you people have raised the question about well, you know, you are indicating the storage costs being very expensive by making it a much longer time period, and I would say that that is a range between the earlier chart at 2035, and then if we were going to keep it for 50 years or longer. So it gives a range, then, that the storage cost continues to go up the longer you keep that.

Mr. SPRATT. Whereas the MOX fuel cost continues to come down over time, so that at about 2030 it is basically——

Mr. ANDERSON. These are the life cycle costs. That would be the completed cost, then, before the 2035 time frame for the MOX—the two options of MOX or the cost for immobilization.

Mr. SPRATT. So if you run out the cost over a 50-year period of time, the cost of storage only is about 50 percent more than the cost of the MOX and H-Canyon——

Mr. ANDERSON. For these preliminary numbers, that would be correct.

Mr. SPRATT. All right. Thank you very much.

Mr. EVERETT. Mr. Reyes.

Mr. REYES. I have no questions.

Mr. EVERETT. No questions, good.

Mr. Larsen.

Mr. LARSEN. Just one question for Mr. Anderson—actually, two questions, but they are both very short.

The plans for disposition of plutonium currently stored at Hanford Site in Washington state is what?

Mr. ANDERSON. I am sorry, could you repeat the——

Mr. LARSEN. What are the plans for disposition of plutonium currently stored at the Hanford Site in Washington state?

Mr. ANDERSON. The up to 13 metric tons would be included in the disposition for that—I mean, it is part of that material.

Mr. LARSEN. The second question I have is given the experience in Washington state at Hanford with regards to the development and construction of everything there, but certainly the vitrification

plant, which I know is for high-level waste—it is not necessarily for the plutonium. Is there a lesson that we can learn from our experience in Washington state with the vit plant that is going to be applied if we move forward on immobilization as a part of the final disposition of plutonium?

Mr. ANDERSON. Actually, a series of those lessons have already been applied into the external independent review and the cost estimate that Ambassador Brooks referred to with the MOX, so that is factored in there from the lessons that we have learned from the waste treatment plant. They have not been factored into the immobilization project as it is a much earlier design at this point.

Mr. LARSEN. Okay. I may follow up with you on that, and I appreciate that.

Thank you.

Mr. EVERETT. Thank you.

Let me briefly recognize Mr. Spratt for another question.

Mr. SPRATT. Just two quick follow-up questions. Liquidated damages to the state of South Carolina if the project is terminated—what would the damages be?

And second, do you have any estimate of what the damages would be for termination for convenience of the government of the existing MOX contract with the contractor?

Ambassador BROOKS. The second question I will have to provide for the record because I simply don't remember. We will come to a point with South Carolina where we would be obligated to pay up to $100 million a year.

The law gives us an alternative which is to remove an amount of material equivalent to that which we brought in, and I suspect that is the approach we would take, although it is a stupid use of government money, to be blunt.

But if this project were canceled as a result of congressional action, then I think that we would look at what our alternatives were in terms of removing material, but that obviously—that moves the problem. It doesn't solve the problem.

But the damages to South Carolina under the law kick in in a little while, and they are up to $100 million, and I don't remember there is an end point to that.

[The information referred to can be found in the Appendix beginning on page 110.]

Mr. SPRATT. Mr. Chairman, I would ask unanimous consent to offer for the record a document entitled "Strategy for Disposing of the Surplus of Special Nuclear Materials", which is a good review of this prepared by the Department.

Mr. EVERETT. Without objection.

[The information referred to can be found in the Appendix on page 97.]

Mr. Norwood.

Mr. NORWOOD. Mr. Chairman, I will be very brief, just ask a couple of questions.

Could staff put the 30-year cost comparison chart back up, please?

Mr. Anderson, while they are doing that, let me ask you a couple of questions. We have already spent about $1 billion on MOX. Am I seeing that right?

Mr. ANDERSON. That is correct.

Mr. NORWOOD. Does that them come off the line up there?

Mr. ANDERSON. No, sir. That is not included in those costs. These are truly to-go costs from this point forward.

Mr. NORWOOD. So the $1 billion is already up there in that, then?

Mr. ANDERSON. Any of the costs—no.

Mr. NORWOOD. Will it come down—in other words, we have already spent that, so is that $1 billion less?

Mr. ANDERSON. No, sir.

Mr. NORWOOD. No, okay. All right. The cost of the storage and doing immobilization is going to take—if it works, would take much longer. That means there is going to be a lot more cost associated with that. Does that come off that line?

Mr. ANDERSON. All of the to-go costs are included in these charts here. None of the sunk costs, whether it is on immobilization or anything else—so it is——

Mr. NORWOOD. So in fact, the taxpayer would pay more if we went the other way than actually those charts indicate, because we would be spending a lot of money for storage and all that kind of thing.

Mr. ANDERSON. Well, the storage cost would, again, depend on how long—even though they are less per year, you know, in the near term, they are a lot longer. You still don't have a disposition path.

Mr. NORWOOD. I can't see the number of immobilization, but does that number actually include that amount of money that we would spend to the point where we could immobilize anything, if we ever could, storage costs too?

Mr. ANDERSON. Yes. Based on our current estimates that we have. And I would point out again—you know, in my testimony—these are very preliminary estimates, and they are for comparative purposes only at this point.

There are risks associated more with immobilization and those things that we have less design and engineering for than, for instance, either MOX, which we have 85 percent design for now, or for an H-Canyon operation where we actually have operating costs.

And in those cases, then, the numbers that are included there have a better certainty to them.

Mr. NORWOOD. Last, do you think that the energy value of MOX is zero?

Mr. ANDERSON. No, sir, and that is factored, you know, into these——

Mr. NORWOOD. That is also factored into that?

Mr. ANDERSON. That is correct.

Mr. NORWOOD. In other words, the $1 billion you could sell of the fuel is—reduces, then, in my mind what actually MOX would have cost otherwise?

Mr. ANDERSON. That is correct.

Mr. NORWOOD. Well, Mr. Ambassador Brooks, where is this immobilization coming from? I mean, the last time I was looking at this, we were standing on a site that we had cleared and paid for in order to get ready to build a MOX fuel plant. And then out of the blue, this immobilization comes up. What is going on with this?

Ambassador BROOKS. First off, it is not coming from us, sir. It is an idea that comes from some in Congress, the House Appropriations——

Mr. NORWOOD. Scientists in Congress have come up with this? Or is it engineers in Congress who have come up with this? We appreciate——

Ambassador BROOKS. I think I would just as soon not characterize it. This is——

Mr. NORWOOD. I am just trying to figure out—where did it come from, after we have spent $1 billion and we have cleared the ground to do what we need to do, something I have been interested in for at least ten years, and now all of a sudden somebody says woah, this immobilization is the greatest thing since snuff.

Ambassador BROOKS. I think that there was a time when it looked like immobilization was less expensive. Mr. Larsen asked about the lessons we have learned at Hanford. One lesson we learned at Hanford is when you do something you have never done before, with the very best will in the world, it often ends up costing more than you thought.

And so one of the concerns that I have is we are, to some extent, comparing apples and carburetors when we compare the MOX cost, which has been very heavily scrubbed and is based on a plant that exists, with large-scale immobilization, which hasn't.

That doesn't mean that those numbers are wrong. They are the best numbers we know. But we would be unwise, in my view, to assume vast savings to the taxpayer by going to immobilization, because somebody else will be sitting here in front of you all and going through all the cost increases that I went through on immobilization, not the least of which is simply the question of escalation, because it happens later.

Mr. EVERETT. I think that probably was the last question and also the last answer. I think we have got seven minutes to get to the floor, and I don't have a scooter, Charlie.

And first of all, Mr. Bunn, thank you for being here. I think we have actually had a very good hearing.

Ambassador Brooks, Ambassador Guhin, thank you.

Mr. Anderson, thank you.

Let me just, in closing, say that, Mr. Ambassador, best of luck. I still think you are a great optimist, and that has paid off, although it has taken several years to do so.

And I would hope that we very much look at de-linking at least moving on the Savannah River, rather than waiting till the Russians make up their mind, because they always find technical reasons why they can't move forward.

So thank you all for coming. The hearing is closed. Thank you.

[Whereupon, at 4:46 p.m., the subcommittee was adjourned.]

A P P E N D I X

JULY 26, 2006

PREPARED STATEMENTS SUBMITTED FOR THE RECORD

JULY 26, 2006

Opening Statement
The Honorable Terry Everett
Chairman, Strategic Forces Subcommittee

Hearing on plutonium disposition and the mixed oxide fuel fabrication facility

July 26, 2006

The hearing will come to order.

The Strategic Forces Subcommittee meets today to receive testimony on plutonium disposition and the mixed oxide fuel fabrication facility. Thank you all for coming.

I welcome -

- **Mr. Matthew Bunn, Senior Research Associate at the Belfer Center for Science and International Affairs of the John F. Kennedy School of Government,**

- **Ambassador Linton Brooks, Administrator of the National Nuclear Security Administration,**
- **Mr. Charles Anderson, Principal Deputy Assistant Secretary for Environmental Management at the Department of Energy, and**
- **Ambassador Michael Guhin, Fissile Materials Negotiator for the U.S. Department of State.**

I have read the written testimony of the witnesses that has been submitted for this hearing, and I am concerned that the statements do not fully address specific questions that were posed by the subcommittee.

The Administration's process for clearing testimony can be quite onerous, so hopefully, the oral statements will include more specifics. If not, I'm sure the questions from the Members will get right to the point, so we can have an informative hearing on this complicated topic.

We will have two panels for the hearing today:

In the first panel, Mr. Bunn will provide a scientific perspective on the costs and benefits of mixed oxide fuel as compared to alternative plutonium disposition pathways.

In the second panel:

- **Ambassador Brooks will discuss whether the Department of Energy's Mixed Oxide (MOX) Fuel Fabrication Facility is the most effective and appropriate means for managing and disposing of U.S. weapons-grade plutonium;**

- **Mr. Anderson has been asked to discuss the Department of Energy's recent analysis of options for plutonium disposition and present the Department's position on domestic plutonium disposition;**

- **Ambassador Guhin will provide testimony on the current status of negotiations with Russia over execution of the 2000 U.S.-Russia Plutonium Management and Disposition Agreement and the Department's perspective on current nonproliferation negotiations with Russia.**

This hearing is an important opportunity to discuss the disposition of surplus plutonium, including key issues such as:

- **The need to determine whether MOX is the most effective means, both from a cost and technical perspective, for managing and disposing of excess U.S. weapons-grade plutonium,**

- **Finding a means to move forward with plutonium disposition and avoid costs incurred by delays while preserving diplomatic relationships, and**
- **How to ensure that MOX, if continued, remains on-track with respect to cost, schedule, and technical challenges.**

These issues also bring to bear a provision in the Defense Authorization bill for 2007 (HR 5122). This subcommittee included language that directs the Department of Energy to report on its plans for the disposition of all surplus plutonium within the Department's inventory – this includes both weapons-grade plutonium as well as plutonium that is not suitable for conversion to mixed oxide fuel.

In addition, this subcommittee has directed the Department to do the following:

- **First, given the sunk costs to date for the U.S. MOX project and considering other alternatives for plutonium disposition, certify that U.S. MOX is the most effective means for managing and disposing of U.S. weapons-grade plutonium; and,**
- **Second, develop a corrective action plan for addressing the issues raised by the Inspector General concerning the management of the U.S. MOX project.**

This session is open under rule 9 of the Committee. I would ask members for their cooperation in keeping their line of questioning unclassified.

Let me now recognize my good friend and colleague, Mr. Reyes, the ranking member of the subcommittee. Mr Reyes…

[Following Mr. Reyes' remarks]

[Recognize Mr. Hunter and/or Mr Skelton if present]

Mr. Bunn, the floor is yours.

[Following Mr. Bunn's testimony]

Thank you Mr. Bunn.

[Proceed with Q&A for Mr. Bunn]

Thank you Mr. Bunn for taking the time to be here with us today. Your testimony will be helpful as we consider this complicated topic.

Would the second panel please come to the table?

[Change panels]

Ambassador Brooks, the floor is now yours.

[Following Ambassador Brook's testimony]

Thank you Ambassador Brooks. Mr. Anderson, the floor is yours.

[Following Mr. Anderson's testimony]

Thank you Mr. Anderson. Ambassador Guhin, the floor is now yours.

[Following Ambassador Guhin's testimony].

[Proceed with Q&A].

Thank you all for taking the time to be with us today. Your statements and comments are important as we consider the complicated issue of disposition of excess plutonium.

The hearing stands adjourned.

Opening Statement
Honorable Silvestre Reyes

Hearing on the Department Of Energy's Plutonium Disposition Program and Plans for a Mixed Oxide Fuel Fabrication Facility

Subcommittee on Strategic Forces
House Armed Services Committee
July 26, 2006

Thank you, Mr. Chairman, and I join you in welcoming our distinguished witnesses: Mr. Matthew Bunn (who is a Senior Research Associate at Harvard's John F. Kennedy School of Government); Ambassador Linton Brooks (the Administrator of DOE's National Nuclear Security Administration); Mr. Charles Anderson (Principal Deputy Assistant Secretary for DOE's Environmental Management group); and Ambassador Michael Guhin (the U.S. Department of State's Fissile Materials Negotiator).

I want to thank each of our witnesses for taking time from their busy schedules to be with us today. But I also want to echo the concerns raised by my friend, Chairman Everett, about the quality of the written statements we received from the Administration. They clearly did not answer the questions the Chairman posed in his hearing invitation letters.

Hopefully, the Administration witnesses can address these in their oral statements here today.

Mr. Chairman, my comments will be brief. Almost 15 years have passed since the collapse of the old Soviet Union. Much has changed since that time; however, the *legacy* of our nuclear weapons competition with the former Soviet Union lives on in the weapons, facilities and materials that remain.

This hearing gives us a chance to examine what the United States is doing to consolidate and dispose of surplus fissile materials that can be used for nuclear weapons – in both Russia and our own backyard. Specifically, we have asked our witnesses to discuss plans for disposing of excess plutonium.

In June 2000, the United States and Russia agreed to dispose of at least 34 metric tons of plutonium each, beginning next year – in 2007. However, this program has been stalled for years over the issue of liability and, more recently, by uncertainty about the technical means by which the Russians would render their plutonium unusable for weapons.

The hearing today allows the subcommittee to reflect on the initial reasons for pursuing a vigorous plutonium disposition program, and to explore the Administration's current plans for disposing of domestic plutonium given the uncertainties surrounding the Russian program.

Mr. Chairman, thank you again for calling this hearing and I look forward to the testimony of our witnesses. At this time, however, I would like to yield the balance of my time to Mr. Spratt from South Carolina, who is probably the most knowledgeable member of the committee on this subject.

Opening Statement by Rep. John Spratt
House Armed Services Committee, Strategic Subcommittee Hearing on Plutonium Disposition

July 26, 2006

Thank you, Mr. Reyes, for yielding your time, and thank you, Mr. Chairman, for holding this hearing on an issue of importance to the nation and to South Carolina.

For almost five years, the Department of Energy has proposed to build a Mixed Oxide, or MOX, fuel plant at Savannah River Site. The plant's purpose is to convert weapons-grade plutonium into fuel that can be "burned" in light-water reactors. There are two benefits from this process. First, it degrades plutonium into elements that are no longer fissile or usable as warhead material, and second, it extracts the energy potential from surplus plutonium.

Until recently, DOE's plan to build a MOX fuel plant at Savannah River Site was to be matched on a parallel track in Russia. The Russian Federation, with foreign financial assistance, was to build a similar plant. Each plant would process at least 34 metric tons of weapons-grade plutonium into mixed oxide fuel, which would then be burned in a nuclear reactor.

The House Energy and Water Appropriators have now decided to zero out funding for the MOX fuel program, citing mainly the Russians' renunciation of DOE's proposal, but also cost growth and technical hurdles. The purpose of our hearing today is to take a thorough look at the MOX program, assess its progress, and compare it with other options for the disposal of plutonium.

To set the stage for our discussion, a little history might be helpful. In 2002, the State of South Carolina, in an arrangement with the Department of Energy and Congress, agreed to accept 34 tons of weapons grade plutonium for MOX processing. In exchange, the State of South Carolina received assurances that the MOX fuel plant would be completed on schedule, and those assurances were backed by penalty payments, or liquidated damages, to which the Department of Energy agreed, if the MOX fuel plant's construction was delayed beyond 2011.

In parallel with this effort, the United States agreed to help fund a MOX fuel facility in Russia, where the Russians would likewise convert 34 tons of weapons grade plutonium into MOX fuel. To most, this seemed to be a fair deal. In the U.S., we would eliminate the expense and risk of safeguarding weapons-grade nuclear materials. In Russia, we would diminish the risk that weapons-grade materials might fall into terrorists' hands. And for the nuclear power industry, we would provide a new source of reactor fuel.

For the last four years, we have been told by the Department of Energy that liability concerns for U.S. contractors in Russia were holding up the MOX fuel facility. We thought that problem was finally resolved last summer, but early this year, a more fundamental disagreement came to light. In February, the Russians informed U.S. officials that they would move forward only (1) if the plutonium fuel could be burned in new so-called fast neutron reactors (which could raise proliferation concerns), or (2) if the international community paid for the whole MOX project. This development called into question the nonproliferation benefits that the U.S. expected from MOX. However, in a joint statement with the U.S., Russia has recommitted to dispose of 34 tons of plutonium.

I understand the appropriators' concerns about changes to the MOX fuel program. They are major changes. But without a MOX fuel fabrication plant, South Carolina will be stuck with tons of weapons-grade plutonium with no clear pathway for disposal. When South Carolina agreed to take the nation's plutonium, we did not do so to become plutonium's final burial place. We took the plutonium on the strength of DOE's promise that a fabrication facility was coming. The penalty payments imposed on the Department of Energy were our assurance that this would happen.

In the Defense Authorization bill this year, we took what I consider sensible steps to account for the new circumstances. The committee reaffirmed our

conclusion that the MOX facility is worth pursuing, separate of the Russian facility if need be. The committee also reaffirmed our commitment to construction of a Russian MOX facility in parallel, if possible. And the committee fenced off a portion of the MOX fuel funds, pending a report from the Department of Energy that reaffirms MOX as the preferred technology and most cost-effective means for disposing of weapons-grade plutonium.

The decision by the Energy and Water appropriators to zero out the MOX program has accelerated the timeline for this report, but it has not changed the issues surrounding the MOX program. I am not dogmatic about MOX; if other options are available and are cost effective, I am open to those options. But sunk cost carries some weight. Over half a billion dollars has been invested in the MOX facility already, an EIS has been approved, design work on the facility has been completed, and plutonium is piling up in the K Reactor, a facility not designed for that purpose. This should make all of us wary of scrapping the whole idea and starting over.

Mr. Chairman, I hope that the testimony today will give us an opportunity to weigh carefully again the pros and cons of the MOX program, particularly as it compares to other options like immobilization. To name just a few questions, I would like for our witnesses to address these questions:

- What is the life cycle cost of the MOX facility as compared to immobilization?
- What technical challenges remain in the construction of a MOX fuel plant and immobilization?
- What is the effect of a decision to delay or discontinue MOX on the schedule for plutonium disposition?
- What is the status of negotiations with Russia regarding MOX? Is the burning of plutonium fuel in fast neutron reactors an acceptable alternative, with comparable end results?
- What alternatives other than MOX and immobilization are available for plutonium disposition and what are their costs and benefits?

Chairman Everett and Ranking Member Reyes, let me thank you again for agreeing to hold this hearing. This is a matter of great importance, and I look forward to our witnesses' testimony and our discussion about plutonium disposition.

Disposition of Excess Plutonium: Rethinking Security Objectives and Technological Approaches

Matthew Bunn

Project on Managing the Atom
Belfer Center for Science and International Affairs
John F. Kennedy School of Government
Harvard University

Testimony before the Subcommittee on Strategic Forces,
Committee on Armed Services, U.S. House of Representatives
July 26, 2006

Washington, DC

Mr Chairman, members of the committee, it is an honor to be here to discuss a subject that has important implications for U.S. national security – what the United States and Russia should do with the tens of tons of plutonium no longer needed for their nuclear weapons programs. I will briefly summarize my full statement, which, with your permission, I would like to submit for the record.

I was the study director for the National Academy of Sciences study *Management and Disposition of Excess Weapons Plutonium,* issued in two volumes in 1994 and 1995, which provided the foundation for many of the policies that have been pursued since then.[1] I then spent several years at the Office of Science and Technology Policy, where I was the principal staffer for the interagency plutonium disposition working group and for the U.S. delegation in the U.S.-Russian discussions of plutonium disposition. I was the U.S. staff director for the U.S.-Russia Independent Scientific Commission on Disposition of Excess Weapons Plutonium, which delivered its unanimous report to President Clinton and President Yeltsin in 1997.[2] After leaving the government, I have continued to pay close attention to this program and its many trials and tribulations. While in the past my program at Harvard had a small grant from the disposition office, and at one time I

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[1] U.S. National Academy of Sciences, Committee on International Security and Arms Control, *Management and Disposition of Excess Weapons Plutonium* (Washington, D.C.: National Academy Press, 1994; available at http://books.nap.edu/html/plutonium/0309050421.pdf as of 20 March 2005); U.S. National Academy of Sciences, Panel on Reactor-Related Options, *Management and Disposition of Excess Weapons Plutonium: Reactor-Related Options* (Washington, D.C.: National Academy Press, 1995; available at http://books.nap.edu/html/plutonium/0309051452.pdf as of 20 March 2005).

[2] John P. Holdren and Evgeniy P. Velikhov, co-chairs, *Final Report of the US-Russia Independent Scientific Commission on Disposition of Excess Weapons Plutonium* (Washington, D.C.: Office of Science and Technology Policy, 1997; available at http://bcsia.ksg.harvard.edu/BCSIA_content/documents/fnlrpt.pdf as of 23 July 2006).

consulted for Bechtel National on its efforts in this area, at present I have no financial interest in any side of this debate.

As you know, the plutonium disposition program has suffered years of delays, shifting approaches, and skyrocketing costs, raising questions about whether and how to move forward from here. In this testimony, I will make four basic points:

(1) Plutonium disposition is not among the top priorities for reducing the risk of nuclear theft and terrorism, and can actually *increase* that risk unless very high standards of security are maintained throughout the process.

(2) Disposition of U.S. and Russian excess plutonium can nevertheless offer security benefits that are worth the effort *if and only if* the 34 tons of weapons plutonium on each side covered by the U.S.-Russian Plutonium Management and Disposition Agreement (PMDA) is the first step toward disposition of much larger quantities of plutonium.

(3) Congress should support moving forward with disposition of excess weapons plutonium, under appropriate conditions.

(4) But before providing the billions of dollars necessary to build and operate major facilities for producing uranium-plutonium mixed-oxide (MOX) fuels in the United States, or to help build new reactors and plutonium fuel facilities in Russia, Congress should ensure that (a) a policy context is put in place that will make it possible for plutonium disposition to offer benefits worth its costs; and (b) important technological alternatives to current approaches are fully considered.

In short, we should move forward, but only if there is agreement on a set of policies that will make doing so worthwhile.

Objectives of Plutonium Disposition

It is important to be clear about what investing in plutonium disposition can and cannot buy us, and under what circumstances. Disposition of excess weapons plutonium – by which I mean physically transforming the plutonium into forms that would be difficult and costly to recover for use in nuclear weapons – can, under the right circumstances, make an important contribution to two national security objectives: (1) reducing the risk of nuclear theft and terrorism, and (2) ensuring that nuclear arms reductions will be difficult and costly to reverse and thereby strengthening political support for international nonproliferation efforts. In addition, disposition of U.S. excess plutonium can serve what I would call a "good housekeeping" function, reducing the number of sites in the U.S. complex where directly weapons-usable plutonium is stored and the costs, risks, and political liabilities of storing it.

I have deliberately not included supporting the U.S. nuclear industry on this list of objectives. As desirable as that objective may be, plutonium disposition will do little to achieve it. The U.S. nuclear industry is doing very well with low-enriched uranium fuel and has no need for MOX fuel. While the use of such fuel made from weapons plutonium might be seen as a step in the direction of reprocessing and recycling, I believe that making a transition to reprocessing U.S. nuclear fuel any time in the next few decades would do more to undermine than to support the future of nuclear energy in the

United States.[3] That, however, is a subject for another hearing on another day. In any case, as the NAS studies pointed out, the plutonium that has been declared excess, while a large amount in terms of the number of nuclear weapons that could be made from it, is small in terms of global energy needs: even if it were all used as nuclear fuel, it would provide only a few months of the fuel for the existing global reactor fleet.

The key question, then, is under what circumstances can plutonium disposition provide benefits in these areas that are worth the substantial costs of moving forward – not only in money, but in high-level political attention and diplomatic capital expended? Let me consider each of these benefits in turn.

Plutonium Disposition and the Risk of Nuclear Theft

As currently planned, disposition of excess plutonium will have only minor benefits for reducing the risk of nuclear theft. The 34 tons of Russian weapons plutonium slated for disposition under the 2000 U.S.-Russian Plutonium Management and Disposition Agreement (PMDA)[4] will be some of the most secure plutonium in all of Russia: Russia plans to load some 25 tons of it into the Mayak Fissile Material Storage Facility – a highly secure fortress built with U.S. funds – and the remainder will come from plutonium oxide stored in secure vaults at Seversk and Zheleznogorsk, the latter of which is deep underground. Similarly, the risk that any of the 34 tons of U.S. weapon-grade plutonium covered by the PMDA will be stolen is quite far down the list of potential nuclear security vulnerabilities around the world.

The biggest risks of nuclear theft are at small, vulnerable facilities with plutonium or highly enriched uranium (HEU), and disposition of 34 tons of excess plutonium in Russia and 34 more in the United States is not likely to reduce the vulnerabilities at these sites. Even the modest nuclear theft risks posed by the large, heavily secured sites where the plutonium slated for disposition is stored will not be much reduced by disposition of 34 tons of this material, as disposition will apply to only a portion of the plutonium at these sites, leaving substantial amounts still at these sites and still vulnerable to whatever modest risks of theft may exist there. As the Department of Energy has pointed out, "a building with 1 ton of nuclear material in storage is as great a threat as a building with 10 tons."[5]

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[3] Matthew Bunn, "Assessing the Benefits, Costs, and Risks of near-Term Reprocessing and Alternatives," in *Proceedings of the 47th Annual Meeting of the Institute for Nuclear Materials Management, Nashville, Tenn., 16-20 July* (Northbrook, Ill.: INMM, 2006; available at http://bcsia.ksg.harvard.edu/BCSIA_content/documents/INMM_Assessing_the_Benefits_Costs_Risks_NearTerm_Reprocessing_Alternatives_2006.pdf as of 22 July 2006).

[4] U.S. Department of Energy, *Agreement between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation* (Washington, D.C.: DOE, 2000; available at http://www.nnsa.doe.gov/na-20/docs/2000_Agreement.pdf as of 30 March 2005).

[5] U.S. Department of Energy, *FY 2007 Congressional Budget Request: National Nuclear Security Administration--Defense Nuclear Nonproliferation*, vol. 1, DOE/CF-002 (Washington, D.C.: DOE, 2006; available at http://www.cfo.doe.gov/budget/07budget/Content/Volumes/Vol_1_NNSA.pdf as of 24 February 2006), p. 514.

The 34 tons of weapons plutonium covered under the PMDA represents less than a quarter of the roughly 145 tons of weapon-grade plutonium in Russia's stockpile.[6] Russia's more than 40 tons of separated reactor-grade plutonium are also weapons-usable and pose a risk of nuclear theft and terrorism; the total stockpile of potentially dangerous separated plutonium in Russia is in the range of 185 tons.[7] The 34 tons of weapons plutonium covered by the PMDA, mixed with up to four tons of reactor-grade plutonium as Russia is permitted to do under the agreement, represents only one-fifth of this total stockpile.

As the NAS studies pointed out, unless stringent security measures are taken throughout the process, removing plutonium from storage in secure vaults, processing it in bulk forms, and shipping it from place to place can *increase* rather than decrease the risk of nuclear theft. To avoid this risk, and because acquiring the needed nuclear material is by far the most difficult part of making a nuclear bomb, the NAS committee recommended that "an agreed and stringent standard of security and accounting must be maintained throughout the disposition process, approximating as closely as practicable the security and accounting applied to intact nuclear weapons."[8] We called that the "stored weapon standard."

With respect to nuclear theft and terrorism, HEU poses a somewhat greater threat than plutonium, as only HEU can be used to achieve substantial nuclear yields in the very simplest gun-type devices. Nevertheless, the possibility that terrorists could make a crude nuclear bomb from stolen plutonium cannot be ruled out.

In short, in a comprehensive, prioritized plan to reduce the risks of nuclear theft and terrorism, focused on addressing the greatest risks first, disposition of excess plutonium would be on the list of actions to take, but it would be far from the top – and it would only be on the action plan at all if stringent security measures were to be taken throughout the process, and if 34 tons were only a first step toward disposition of much larger quantities of material.

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[6] Russia has never declared how much weapon-grade plutonium it has. Both unclassified estimates and U.S. intelligence estimates of the total amount of plutonium in Russia's stockpiles are subject to uncertainties of tens of tons. The 145-ton estimate, as of the end of 2003, is from David Albright and Kimberly Kramer, *Global Stocks of Nuclear Explosive Materials* (Washington, D.C.: Institute for Science and International Security, 2005; available at http://www.isis-online.org/global_stocks/end2003/tableofcontents.html as of 22 February 2006).

[7] Russia has officially declared that as of the end of 2005, it possessed 41.2 tons of separated civilian plutonium. See International Atomic Energy Agency, *Communication Received from the Russian Federation Concerning Its Policies Regarding the Management of Plutonium*, INFCIRC/549/Add.9/8 (Vienna: IAEA, 2006; available at http://www.iaea.org/Publications/Documents/Infcircs/2006/infcirc549a9-8.pdf as of 9 June 2006). The most detailed unclassified U.S. government statement on the weapon-usability of reactor-grade plutonium is in U.S. Department of Energy, Office of Arms Control and Nonproliferation, *Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Excess Plutonium Disposition Alternatives*, DOE/NN-0007 (Washington, D.C.: DOE, 1997; available at http://www.osti.gov/bridge/servlets/purl/425259-CXr7Qn/webviewable/425259.pdf as of 12 December 2005), pp. 37-39.

[8] U.S. National Academy of Sciences, *Management and Disposition of Excess Weapons Plutonium*, p. 12.

Plutonium Disposition and the Irreversibility of Nuclear Arms Reductions

A world in which Russia had far smaller stockpiles of nuclear weapons and weapons-usable nuclear materials – and in which those reductions would be difficult and costly to reverse – would be very much in the U.S. national security interest, reducing the danger that Russia would ever return to a Cold War-scale nuclear arsenal. Moreover, similar difficult-to-reverse reductions in the U.S. stockpiles of nuclear warheads and materials would make it clear to the world that we were committed to our Nonproliferation Treaty (NPT) obligation to negotiate in good faith toward nuclear disarmament. That would strengthen worldwide political support for the NPT and help win the votes needed to shore up the global nonproliferation with stronger export controls, more stringent inspections, and tougher enforcement. All of those measures will mean additional constraints on other states, and we are unlikely to get the support we need for them if we are unwilling to accept constraints on our own nuclear posture. Disposition of excess plutonium could make a substantial contribution to the irreversibility of nuclear arms reductions. Indeed, the "13 Steps" toward disarmament agreed to by the United States and the other nuclear weapon states at the 2000 NPT review conference included placing excess nuclear material under IAEA monitoring and then carrying out disposition, "to ensure that such material remains permanently outside of military programmes."[9]

Today, however, the U.S. government is not pursuing irreversible nuclear arms reductions. The Moscow Treaty was designed to be readily reversible should circumstances change. The current administration plan is to maintain large numbers of warheads beyond those that will be actively deployed and large numbers of additional primaries and secondaries so that more warheads could be assembled. That plan also includes a "responsive infrastructure" designed to have the capability to build significant numbers of new weapons should world circumstances require. There would be little point spending billions of dollars on a program whose primary benefit is to increase the irreversibility of nuclear arms reductions as long as it remains the policy of the U.S. government to ensure that nuclear arms reductions *are* reversible.

Moreover, plutonium disposition can only make a serious contribution to the irreversibility of nuclear arms reductions if it is applied to far more than 34 tons of plutonium on each side. Following disposition of 34 tons of excess weapons plutonium, Russia would still have well over 100 tons of weapon-grade plutonium remaining, enough to support a stockpile of over 20,000 nuclear weapons. The United States would still have over 50 tons of weapon-grade plutonium remaining, enough to support a stockpile of over 10,000 nuclear weapons. If irreversible nuclear arms reductions are the goal, then the United States and Russia should reduce their stockpiles of nuclear weapons to low, agreed levels, and reduce their stockpiles of plutonium and HEU to the minimum levels needed to support those agreed warhead stockpiles, as the NAS committee recommended.

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[9] "2000 Non-Proliferation Treaty Review Conference Final Document" (New York, NY: United Nations, 2000; available at http://www.armscontrol.org/act/2000_06/docjun.asp as of 22 July 2006).

Plutonium Disposition and "Good Housekeeping" in the U.S. Complex

The current situation, in which plutonium that is no longer needed is stored in a wide variety of stable and unstable forms at several sites scattered throughout the Department of Energy (DOE) complex, is needlessly expensive and dangerous. The Defense Nuclear Facilities Safety Board has recommended that DOE move aggressively to consolidate all of its excess plutonium at a single site, and DOE ultimately hopes to consolidate all operations involving plutonium still in use for weapons at a single site.[10]

Disposition of some excess plutonium could help overcome the political obstacles to consolidating plutonium storage. South Carolina, in particular, has strongly objected to moving all of the excess plutonium there unless there is a clear path forward for what will be done with it, which ends with it being removed from the state. Disposition can also reduce the ongoing costs of storage. Indeed, in recent analyses, DOE has argued that simply storing all the excess plutonium at its current locations would cost even more than its proposed disposition program.[11]

If "good housekeeping" becomes the primary motivation for plutonium disposition, however, clear distinctions should be made between plutonium whose storage is costly and plutonium whose storage is cheap. The cost of storing various impure forms of plutonium ultimately slated for immobilization, at a large number of sites, is substantial. By contrast, the net additional cost of storing the excess plutonium that is in pits at Pantex , which represents the majority of the material slated for MOX disposition, is very modest, since large numbers of reserve pits will remain in storage there in any case.

Other Rationales for Proceeding with Plutonium Disposition

For better or for worse, the United States has been negotiating with other governments to move plutonium disposition forward for more than a decade now. As far back as the Group of Eight (G8) Nuclear Safety and Security Summit in Moscow in 1996, the G8 have endorsed moving forward with plutonium disposition as an important common nonproliferation and arms reduction objective. The centerpiece of the resulting efforts is the 2000 PMDA. For years, the United States has been in discussions with Russia and a variety of other states to pull together a multilateral agreement to finance and manage disposition of excess plutonium in Russia, and that accord is nearly complete. U.S.-Russian negotiations on liability measures for plutonium disposition have dragged on for years, but are now essentially resolved.

A U.S. decision now to abandon plutonium disposition, leaving all or most of the U.S. excess plutonium in indefinite storage, would require walking away from these agreements and negotiations. This could affect the credibility of U.S. pledges and

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[10] Defense Nuclear Facilities Safety Board, *Plutonium Storage at the Department of Energy's Savannah River Site: Third Annual Report to Congress* (Washington, D.C.: DNFSB, 2006; available at http://www.deprep.org/2006/fb06112b.pdf as of 23 July 2006). For a review of DOE's complex-wide problems with plutonium consolidation, see U.S. Congress, General Accounting Office, *Securing U.S. Nuclear Materials: DOE Needs to Take Action to Safely Consolidate Plutonium*, GAO-05-665 (Washington, D.C.: GAO, 2005; available at http://www.gao.gov/new.items/d05665.pdf as of 23 July 2006).

[11] Data provided by DOE, July 2007.

agreements across a broad spectrum of threat reduction cooperation stretching well beyond the specific subject of disposition of excess plutonium. Moreover, in a context in which the United States has already rejected many of the steps toward arms reductions it agreed to at the 2000 NPT review conference, rejecting yet another of these steps could give at least a modest amount of additional ammunition to those in non-nuclear-weapon states who argue that the United States is not fulfilling its legal obligation to move toward disarmament. These potential risks should be factored into decision-making about whether to move forward with plutonium disposition.

At the same time, it is not necessary to be constrained to the specific approaches identified in the PMDA six years ago. It is clear the PMDA will have to be modified: its schedules can no longer be achieved, and Russia appears to be leaning heavily toward reactor approaches other than those agreed to in the PMDA.

Similarly, the fact that the United States has already made substantial investments in one option or another should *not* be a major factor in how to proceed from here. Those costs are sunk already, and no decision we make now can bring them back. Rather, decision-making should be based on considering the costs, risks, and benefits of different options as we go forward from where we are today.

Technologies for Meeting the Objectives

The NAS studies recommended that, as a first priority, urgent steps be taken to ensure that all stocks of separated plutonium and HEU worldwide were effectively secured and accounted for. It is clear that secure storage is an essential first step for all disposition options for excess plutonium. For long-term disposition, the NAS studies recommended that options be chosen which:

(1) Would make the plutonium "roughly as inaccessible for weapons use as the much larger and growing quantity of plutonium in spent fuel from commercial nuclear-power reactors" – which we called "the spent fuel standard";

(2) Would maintain security approximating the "stored weapon standard" for the plutonium until it met the spent fuel standard;

(3) Would meet all applicable environment, safety, and health (ES&H) rules and agreements, and would not add significantly to the ES&H risks that would exist if plutonium disposition were not moving forward; and

(4) Within those constraints, would get the plutonium disposition job done rapidly and cost-effectively.

The NAS committee concluded that the most promising approaches to accomplishing these objectives were the use of plutonium as fuel in existing reactors or immobilization of the plutonium with high-level wastes. Advanced reactors and fuel cycles are not needed to accomplish these objectives, and hence the committee recommended that plutonium disposition programs should not wait for, or pay for, advanced reactors or fuel cycles to be developed and deployed. If, on the other hand, advanced reactors are built because of their benefit for the future of nuclear energy, their use should be considered for disposition of whatever excess plutonium remains when they become available.

While many things have changed in the intervening decade – including, in particular, much improved economic circumstances and nuclear security arrangements in Russia – I believe this fundamental framework remains valid. With the passage of more than a decade and with Russia's stabilization, however, the importance of getting the job done rapidly now seems somewhat less than it did when the NAS committee made its recommendations. In addition, as disposition will only have substantial security benefits if it is applied to far more than 34 tons of plutonium on each side, a disposition option that could address 34 tons of plutonium but was not expandable to cover more material would not be the right way to go. With the passage of time, and investments in particular options, important implementation specifics such as estimates of the cost and schedule of different technologies have changed, which may change the answers that result from applying this framework, but the framework itself has not changed.

As one analyst sitting at Harvard University, I obviously have not had the resources to perform complete analyses of the detailed costs, security risks, ES&H risks, and other factors that should be considered for all the possible options for U.S. and Russian weapons plutonium. The following discussions are therefore summary judgments, based on previous work by the NAS committees, by DOE, in joint U.S.-Russian analyses, and by independent experts.

Technologies for Disposition of Russian Excess Plutonium

Until recently, the plan for disposition of Russia's excess plutonium, as outlined in the PMDA, called for using a small portion of it as fuel in the existing BN-600 fast-neutron reactor, while using the rest of it as MOX fuel in existing light-water reactors (LWRs). As you know, Russia has recently re-emphasized that rather than implementing this plan, it would much prefer to use the excess plutonium as fuel in new reactors it plans to build, such as the BN-800 fast neutron reactor now under construction or high-temperature gas reactors it is considering building in the future. Russia has taken the view, in effect, that since MOX in LWRs does not otherwise fit into its vision of the future of nuclear energy, Russia would only proceed on that course if the international community paid every penny of the cost, whereas for options that do fit into its plans, Russia would be willing to pay a substantial portion of the cost itself. Some in Congress have seen this as a major reversal of the Russian position; in my judgment, however, it is more a reemphasis of Russia's long-standing preferences. Whatever U.S. officials may have told Congress about positive Russian hints they had received, Russia was never committed to paying any of the costs of the plan laid out in the PMDA. The recent Russian shifts may, in the long run, have some positive effect: if a plutonium disposition approach can be agreed that Russian officials are genuinely enthusiastic about, success will be more likely than it would be dragging along on a course that Russian officials saw as pointless or marginal.

The total cost of building and operating these new reactors and plutonium fuel facilities for them would be far higher than the total cost of using MOX in existing LWRs. Depending on the outcome of negotiations, however, the international community's share of that cost might be the same or less. The schedule for these advanced reactors is highly uncertain as well, particularly as Russia has yet to determine where the money to pay for its ambitious reactor construction plans will come from. In 2005, for instance, the Russian government reportedly requested some $200 million for

BN-800 construction, but the Duma provided just over $30 million.[12] At that level of funding, completing the roughly $1.5 billion in work remaining would take some 50 years.

Fast-neutron reactors. Before the United States agrees to support construction and operation of the BN-800 fast-neutron reactor for plutonium disposition, a range of policy issues would have to be addressed. First, as originally designed, the BN-800 is a plutonium breeder reactor, producing more weapon-grade plutonium than it consumes; under traditional plans, this plutonium would be reprocessed using PUREX, separating pure weapon-grade plutonium. Supporting Russia to use weapon-grade plutonium to make more weapon-grade plutonium would do more to undermine than to support U.S. nonproliferation objectives. Russia might be willing to remove some of the breeder blankets, converting the reactor into a net plutonium burner, and under the PMDA, it is obligated not to reprocess irradiated fuel from plutonium disposition reactors until after disposition of the plutonium covered by the agreement is complete. But what happens after the disposition program? Should the United States seek agreement that Russia would not add breeder blankets to the reactor the international community had helped build after the disposition program, and would not process the fuel from this reactor in a way that would separate weapons-usable plutonium? Would Russia be willing to make such commitments? How much does it matter that the spent fuel from such a reactor would be in smaller fuel assemblies with lower radiation fields, higher plutonium concentrations, and better isotopics than if it had been used as MOX in an LWR?

High-temperature gas reactors. Advocates of high-temperature gas reactors often point out that such systems offer high burnup, creating the potential to fission a large fraction of the plutonium loaded. As we pointed out in the NAS studies, however, once the excess weapons plutonium has reached a point where it poses no more security risk than the enormously larger quantity of plutonium in spent fuel around the world, further burnup has little security benefit. Nevertheless, high-temperature gas reactors, with their difficult-to-reprocess fuel, do not pose the same kinds of policy issues that the BN-800 poses.

MOX in LWRs. It remains possible that after U.S. and Russian experts have considered the various options available, they will return to the use of MOX in existing (or planned) LWRs as the best approach. For that approach, much of the relevant design, site preparation, and regulatory work is already well advanced. Russia's existing LWRs are not sufficient, without substantial modifications, to reach the four ton per year disposition rate envisioned in the PMDA – but Russia plans to bring a substantial number of additional LWRs on-line over the next decade. If Russia remained unenthusiastic, however, it is likely that this approach would continue to advance slowly and encounter one bureaucratic obstacle after another.

Reactors outside of Russia. Technically, it would be straightforward to burn MOX from excess Russian weapons plutonium outside of Russia as well as inside Russia – but politically and institutionally, this might be difficult. Europe's reactors already licensed to burn plutonium fuel already have more civilian plutonium than they can handle. Nonetheless, for some years there have been quiet international discussions of

[12] Interview with DOE officials, April 2006.

possibilities for burning some of Russia's excess weapons plutonium in reactors in other countries, and there are at least a few reactors that could be possibilities – particularly if their incentive to use this fuel was increased by having the fresh fuel service packaged with the service of taking the spent fuel back to Russia, in a fuel "leasing" arrangement. In addition to Western Europe, there is Ukraine, where 11 VVER-1000s, the most modern Soviet reactor design, are already operating, and already receive their fuel from Russia. There is also Canada, whose CANDU reactors have also been explored as possibilities for burning excess weapons plutonium. The United States and Russia should continue discussions with these other countries, in pursuit of ways to accelerate the disposition of Russia's excess weapons plutonium.

Immobilization. Russia has always rejected immobilization for any substantial quantity of its own plutonium – though in the negotiation of the PMDA, Russia identified roughly a ton of plutonium in sludges appropriate for immobilization. Given the priority on production over safety in the Russian complex during the Cold War years, and the huge quantities of plutonium in the U.S. complex that is not suitable for use in MOX fuel, it would be quite surprising if Russia really has only one ton of plutonium in forms unsuitable for MOX. I believe the United States should re-start the joint U.S.-Russian research and development on immobilization approaches that was pursued in the past, while exploring with Russia whether massive plutonium facilities such as Mayak and Seversk may have additional stockpiles only suitable for immobilization and disposal as waste. Immobilization is unlikely, however, to gain Russian acceptance for the bulk of its excess plutonium.

Plutonium swaps. As a backup and complement to other approaches, the United States should consider the possibility of "plutonium swaps." Today, some 10 tons of reactor-grade civilian plutonium is already being burned as fuel for civilian power reactors each year. By far the fastest and cheapest approach to reducing stockpiles of excess weapons plutonium, if agreement could be reached on it, would be to substitute excess weapons plutonium for this civilian plutonium, thereby burning some 10 tons a year of excess weapons plutonium while using existing fuel fabrication facilities and contract arrangements.[13] The excess weapons plutonium would be converted to oxides suitable for fuel fabrication in Russia and the United States, and shipped to existing European fuel fabrication facilities under heavy guard. Modest license modifications for those facilities and for the reactors that use fuel from them would likely be needed in order for them to use weapon-grade rather than reactor-grade plutonium. The civilian plutonium that would have been burned at a rate of 10 tons per year would be displaced and would build up in storage, adding to the large quantities of civilian separated

[13] This approach was outlined in Thomas L. Neff, "Perspectives on Actions Necessary to Move the Plutonium Disposition Program Forward" (paper presented at the International Policy Forum: Management and Disposition of Nuclear Weapons Materials, Bethesda, Maryland, March 23–26, 1998). Senator Pete Domenici (R-NM) championed the idea briefly, but dropped it after finding little European interest (see, for example, Dave Airozo, "Finding Europeans Disinterested, Domenici Shelves `Global Burn'," *Nuclear Fuel*, July 27, 1998). If appropriately presented and packaged with reasonable incentives for all concerned, however, this approach could be designed so that it would *not* interfere with European fuel-cycle choices, but, indeed, would effectively lock in use of plutonium fuel for a decade or more as part of a nuclear arms reduction initiative. A similar approach was also discussed in U.S. National Academy of Sciences, *Management and Disposition of Excess Weapons Plutonium,* op. cit., pp. 176–181.

plutonium that are already in storage. In effect, this would transform a problem of excess weapon-grade plutonium in Russia and the United States, under no international safeguards, to a problem of excess reactor-grade plutonium stored in secure facilities in Europe under international safeguards. While that transformation would not reduce the total amount of separated plutonium in the world, it would be a substantial benefit in reducing the risk of nuclear theft and improving the irreversibility of nuclear arms reductions. These stockpiles of displaced civilian plutonium could be "swapped" for the excess weapons plutonium, so that the United States and Russia would retain title to the same amount of fissile plutonium they each sent to Europe (potentially important for Russia, which focuses more on the potential future value of plutonium than on its present liabilities). Indeed, given the costs and difficulties for utilities in managing plutonium, the European and Japanese utilities that own the huge stocks of separated civilian plutonium now in storage would likely be happy to have Russia take title to two tons of civilian plutonium for every one ton of weapons plutonium sent to Europe.

Performance-based financing approaches. As the United States and Russia, with their other contributing partners, explore different technological approaches for disposition of Russia's excess weapons plutonium, they might also consider revised approaches to structuring the financing the international community might provide. Rather than agreeing, for example, to pay all of the capital cost for a particular fuel facility – which gives Russia little incentive to keep that cost low – the international community might agree with Russia on a particular amount to be paid per ton of plutonium whose disposition Russia completed, with a portion of those funds to be paid up-front (allowing Russia to finance some of the needed investments), and a portion to be paid when disposition was complete. This would give Russia an incentive to find ways to reduce total costs, and to find ways to get the job done expeditiously, so that it could receive the final payments. Since security measures are inevitably an extra cost that managers are tempted to cut, it would make sense for the international community to contribute to stringent security measures as a separate item.

Plutonium purchase options. The ultimate in performance-based financing approaches would be to actually buy Russia's excess weapons plutonium. If Russia were willing to sell (senior Russian officials have expressed contradictory views on this point at different times) the cost would likely not be astronomical. If the buyer – the United States or other countries participating in the G-8 Global Partnership – were willing to pay the same amount per ton as the United States is now paying for HEU, then 50 tons of plutonium (enough for over 10,000 nuclear weapons) would cost just over $1 billion.[14] This would be a generous offer, since in the current commercial market the plutonium's actual commercial value is negative (the costs of securing it and making fuel from it are much higher than the value of the fuel). Once the plutonium had been purchased, the buyer would presumably then have the right to remove the material from Russia for immobilization or use as fuel elsewhere, or to pay for it to be immobilized or used as fuel within Russia. In the case of a U.S. purchase, for example, it might be possible to build only one plutonium fuel fabrication plant, rather than one in the United States and one in Russia. There are a wide range of difficult political and legal questions that would have to be addressed – along with some technical and economic questions – before such a

[14] The original estimated price for 500 tons of HEU was $12 billion.

purchase could become a reality, but it remains something that should be considered. The option may be particularly valuable if the current plan to use plutonium as fuel runs into serious obstacles or cost overruns, while Russia continues to resist throwing its plutonium away through immobilization. In that case, the option of purchasing Russia's plutonium (thereby allowing Russia to monetize it immediately), and then paying for it to be immobilized, might provide a plausible back-up approach. As with the "swap" concept, however, considerable care must be used to explore these concepts without undermining the main thrust of the plutonium disposition program, which remains focused on using the material as fuel while it remains under the control of its original owners, Russia and the United States.

Technologies for Disposition of U.S. Excess Plutonium

The establishment of the Nuclear Materials Disposition and Consolidation Coordination Committee last year has the potential to be a major step forward in organizing DOE's thinking about storage and disposition of nuclear material throughout the DOE complex. In particular, it is important to think about all the plutonium at the same time, whether it happens to belong to the Office of Materials Disposition, to Environmental Management, or to other entities; one way or another, the taxpayer is going to end up paying for managing it, and therefore whatever opportunities there are for synergies in managing these different plutonium stocks should be aggressively pursued.

Several options can be considered for long-term disposition of DOE's excess plutonium stockpiles.

Indefinite storage: the no-action alternative. DOE believes that simply continuing to store all the different forms of excess plutonium that now exist in the U.S. complex would be the most costly option (though the annual storage could be greatly reduced if all of the excess plutonium could be stabilized and consolidated at one or two sites).[15] Moreover, this option would not accomplish any of the security objectives of plutonium disposition, and would require walking away from the 2000 PMDA and related negotiations. This option appears to be the least desirable of the available choices.

Partial immobilization: the least-cost alternative. While no complete and recent study has been done, it seems likely that that the lowest-cost alternative would be to immobilize that portion of the excess plutonium that would otherwise be costly to store for the long term, and store the rest, consolidated at one or two sites.[16] The life-cycle savings compared to a mixed MOX-and-immobilization plan for all 50 tons of excess plutonium might be several billion dollars, though this requires detailed examination. The excess plutonium most relevant to possible reversal of nuclear arms reductions – the pits at Pantex and other clean metal and oxide – would likely remain in storage

[15] Data provided by DOE, July 2006.

[16] While DOE's 2002 disposition study was looking only at 34 tons of plutonium, not the full stock of excess material, for the stock they examined, this partial immobilization approach clearly involved the lowest costs (at least over the period they examined). See U.S. Department of Energy, *Report to Congress: Disposition of Surplus Defense Plutonium at the Savannah River Site* (Washington, D.C.: DOE, 2002; available at http://www.nci.org/pdf/doe-pu-2152002.pdf as of 23 July 2006).

indefinitely, and thus in this case, too, few of the security objectives of plutonium disposition would be accomplished. This option would also require abandoning the 2000 PMDA. This option would only be the best choice if the United States was not interested in going beyond the 34 tons of plutonium covered in the PMDA, or was absolutely convinced that Russia would never agree to go further; in that case, the benefits of disposition of 34 tons of weapon-grade plutonium under the PMDA might well be smaller than the additional costs of moving forward beyond this least-cost approach.

The all-MOX option. An all-MOX option is not realistic, as the MOX approaches cannot handle the large quantities of highly impure plutonium in the DOE complex, unless this impure plutonium were reprocessed to purify it; some of this material may even be difficult to reprocess without large investments in specialized processes.

The all-immobilization option. An all-immobilization option is a real possibility that should be seriously considered. In a "ceramic can-in-canister" approach, the plutonium would be immobilized in ceramic pucks, which would be loaded into metal cans that would be placed inside the large canisters into which molten high-level-waste glass is poured. This would put the plutonium into a massive, intensely radioactive waste form that roughly meets the spent fuel standard. While immobilization is less technologically mature than use of plutonium as MOX, it would involve fewer difficult-to-safeguard steps, handling of plutonium at fewer sites that would have to be guarded, and less potentially vulnerable transportation. Unfortunately, the immobilization research and development program was terminated in 2001 and only recently restarted in Environmental Management (now with a focus on immobilizing only a fraction of the total amount of excess plutonium); as a result, if this option is chosen, there will inevitably be some additional difficulties and costs in getting the effort going again.

In the past, DOE has rejected all-immobilization approaches on the grounds that Russia might not move forward with disposition of its own plutonium if the United States relied only on immobilization, which Russia considers simply another form of storage. This Russian view of immobilization is clearly wrong: immobilization would drastically increase the cost and difficulty of recovering plutonium for weapons use, and if the United States had any intention whatever of ever recovering this material for use in weapons, it would surely not spend billions of dollars to put it into forms from which it cost additional billions to recover it. It is becoming increasingly clear that the specific technologies of the U.S. and Russian programs will be delinked, and Russia is now re-opening the agreed approaches in the PMDA for its own disposition effort. I believe that there is at least a reasonable chance that if the United States agrees to support a disposition approach in Russia that fits with Russia's long-term energy plans, Russia might accept an all-immobilization approach for U.S. excess plutonium – though that might be more genuinely problematic from the Russian perspective if the two sides really were agreeing to apply disposition to all but a small portion of their plutonium stockpiles. If, based on other criteria, an all-immobilization approach was considered attractive, this possibility should at least be explored.

DOE has recently raised a number of concerns about the all-immobilization option, arguing that (1) it would cost just as much as options combining MOX and immobilization, and (2) if immobilization of high-level wastes at the Savannah River Site

(SRS) proceeds at the pace currently planned, and a large-scale plutonium immobilization facility takes until 2019 to get operating, there may no longer be enough waste canisters still to be produced to contain all the excess plutonium.[17] Both of these issues require further examination. Previous DOE analyses, by contrast, concluded that all-immobilization approaches would be significantly cheaper than hybrid MOX and immobilization approaches, even before the recent dramatic escalation of the estimated cost of MOX options.[18] Congress should require DOE to provide a detailed analysis of the factors that have reversed its previous conclusion, and then submit these cost analyses to independent review, perhaps by the National Academy of Sciences.

Similarly, with respect to the availability of waste canisters, Congress should require DOE to provide an in-depth (and independently reviewed) examination of approaches for providing sufficient waste canisters for plutonium immobilization, including, but not necessarily limited to: (1) modest delays in high-level waste immobilization at SRS (as might occur in any case, given the past delays in high-level waste processing and the need to bring the high-activity salt waste processing facility on line);[19] (2) a faster schedule for bringing the plutonium immobilization facility into operation (as projected in previous DOE reports);[20] (3) possible additional wastes whose processing may lead to additional canisters being produced (such as the return of U.S.-origin research reactor fuel, now extended until 2019, whose processing will require the management of millions of curies of radioactive waste beyond what is currently in the SRS tanks);[21] or (4) immobilizing some or all of the plutonium at Hanford, whose waste

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[17] Data provided by DOE, July 2006. DOE expects that it can put 28 kilograms of plutonium in each canister, so 50 tons of plutonium would require over 17,000 canisters; if the DWPF immobilization of high-level waste and the high-activity salt waste processing facility both move forward with no further delays, and it takes until 2019 to bring plutonium immobilization on-line, as DOE now expects, then by the time plutonium was being immobilized there might only be two-thirds as many canisters remaining as required for immobilization of 50 tons of plutonium.

[18] See, for example, U.S. Department of Energy, *Disposition of Surplus Defense Plutonium*.

[19] DOE currently projects that a plutonium immobilization facility for 50 tons of excess plutonium would take more than a decade to bring on-line, and that if the Defense Waste Processing Facility at SRS worked well in the intervening time, there might not then be enough canisters of waste glass yet to be produced to hold 50 tons of plutonium. (Data provided by DOE, July 2006.) A delay of only a few years, however, would be sufficient to ensure that sufficient waste canisters were still available at SRS to immobilize 50 tons of plutonium. Such a delay might occur in any case, or Congress could consider instructing DOE to operate its facilities to achieve an appropriate balance among different objectives, rather than maintaining an inflexible schedule for high-level waste immobilization that was unable to accommodate plutonium immobilization.

[20] The 2002 report on cost analysis, for example, projected that an immobilization facility for 50 tons of plutonium would complete operations shortly after DOE now projects it could begin operations. See U.S. Department of Energy, *Disposition of Surplus Defense Plutonium*. Previously, DOE had projected it would take eight years to design, build, and begin to operate an immobilization facility, compared to the 13 years now projected.

[21] Reprocessing of this fuel, if that is the option chosen, would result in large quantities of liquid waste containing tens of millions of curies of radioactivity that would have to be immobilized. Use of a "melt and dilute" approach would result in large quantities of radioactivity being captured in the off-gas system, and the off-gas filters would then become high-level radioactive waste that would require immobilization as well. See, for example, Edwin S. Lyman, "The Future of Immobilization under the U.S.-Russian Plutonium Disposition Agreement," in *Proceedings of the 42nd Annual Meeting of the Institute for Nuclear Materials Management, Indian Wells, Calif., 15-19 July 2001* (Northbrook, Ill.: INMM, 2001; available at http://www.nci.org/new/el-inmm2001.htm as of 23 July 2006).

immobilization program is moving more slowly, rather than at Savannah River. Congress should direct to DOE to examine not only whether enough canisters can reasonably be made available to immobilize 50 tons of plutonium, but also whether enough could be made available to immobilize even larger quantities if additional material were declared excess. Potential impacts on how much canister storage will be required at the immobilization sites, pending the shipment of the canisters to Yucca Mountain, should also be examined.

Mixed MOX-and-immobilization options. DOE currently proposes to pursue a mixed strategy that involves using roughly 34 tons of its excess plutonium as MOX fuel in existing LWRs and immobilizing the remainder (in some cases after dissolution in the H-Canyon). Cost estimates for this approach are now much higher than they were six to seven years ago.[22] Unfortunately, while the investments over the intervening period have led to significant progress in designing, getting regulatory approval for, and preparing to build a MOX plant, the cost escalation for the MOX option has been more rapid than the progress, so that the estimates of remaining cost are bigger, rather than smaller, than they were years ago; and the plant is still not expected to be able to come on line until 2015 at best (whereas six years ago it was expected to be going into start-up operations about now). DOE believes that with only a portion of the plutonium being immobilized rather than all of it, immobilization can make greater use of existing facilities rather than green field construction and hence can come on-line sooner, be less expensive, and have plenty of waste canisters available for the job. Moreover, since the material to be used in reactors under the PMDA would still be used in reactors, this option would offer Russia no rationale for backing out of its disposition obligations. If additional plutonium were declared excess, it would largely be additional clean metal and could be used as MOX by extending the operations of the proposed MOX plant.

This hybrid approach may in fact be the most effective available strategy, but it is certainly costly. Congress should require DOE to consider a number of options for cost reduction, such as combining some of the four proposed major facilities into one or two buildings.

Advanced reactors and fuel cycles. Despite the large increases in the projected cost of MOX options and the extended delays in implementing them, it remains highly likely that developing and deploying any advanced reactor or fuel cycle approach would cost more and take longer, without delivering commensurate benefits. As in Russia's case, however, if advanced reactors are built for other purposes and some excess plutonium is still available when they come on-line, their use for plutonium disposition should also be considered.

Plutonium swaps and transfers. The "plutonium swap" approach described above could also be applied to U.S. excess plutonium. Indeed, it is highly unlikely that it would be acceptable to Russia unless pursued in parallel. More broadly, a variety of options for transferring plutonium to Europe for fabrication, irradiation, or both could be considered. I have long advocated, only partly in jest, that we should offer France and Britain 50 tons of plutonium (or however much we could provide in pure forms) and $100 million to take it off our hands: if they said "yes," this would be by far the lowest

[22] Data provided by DOE, July 2006.

cost of the available options, while if they said "no," that would firmly put the lie to the oft-repeated notion that plutonium has great value rather than being a dangerous liability.

Recommendations

(1) As a first priority, the United States should do everything in its power to ensure that all stockpiles of nuclear weapons and weapons-usable nuclear materials worldwide are secure and accounted for, to standards sufficient to defeat the threats that terrorists and thieves have shown they can pose. This effort should be prioritized, focusing on addressing the highest risks of nuclear theft first. A variety of U.S. programs are making significant progress toward this objective, but much more remains to be done.[23] The global initiative announced by President Bush and President Putin in St. Petersburg may turn out to be a dramatic step forward in this global effort.

(2) DOE should move aggressively to consolidate its plutonium and HEU in a smaller number of highly secure locations, achieving higher security at lower cost – and should work with Russia and other countries to encourage them to do the same.

(3) The United States should adopt a policy of seeking deep, transparent, and irreversible nuclear arms reductions. In that context, it should seek agreement with Russia to reduce each country's total stockpile of assembled nuclear weapons to 1,000-2,000, and to take a range of steps to make these reductions difficult to reverse. This should include, but not be limited to, reducing stockpiles of separated plutonium and HEU to the minimum required to support the reduced warhead stockpiles. While such a policy is not without some risks, those risks are more than outweighed by the nonproliferation and arms reduction benefits.[24]

(4) The United States should maintain both a domestic plutonium disposition program and a program to support disposition of Russian excess plutonium. Funding for the U.S. MOX program should not be cut to zero, as proposed in the House Energy and Water appropriation bill.

(5) The United States, however, should only be prepared to invest billions in construction and operation of relevant facilities if:

    a. For disposition of U.S. plutonium:

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[23] We provide a detailed assessment of progress to date and a far-reaching set of recommendations for next steps in Matthew Bunn and Anthony Wier, *Securing the Bomb 2006* (Cambridge, Mass.: Project on Managing the Atom, Harvard University, and Nuclear Threat Initiative, 2006; available at http://www.nti.org/securingthebomb as of 23 July 2006).

[24] For a discussion of the case for such reductions, see, for example, U.S. National Academy of Sciences, Committee on International Security and Arms Control, *The Future of U.S. Nuclear Weapons Policy* (Washington, D.C.: National Academy Press, 1997; available at http://newton.nap.edu/html/fun/ as of 24 July 2006). For discussions of the controls over nuclear materials that might be part of such a regime, see U.S. National Academy of Sciences, *Management and Disposition of Excess Weapons Plutonium*; U.S. National Academy of Sciences, Committee on International Security and Arms Control, *Monitoring Nuclear Weapons and Nuclear-Explosive Materials* (Washington, D.C.: National Academy Press, 2005; available at http://books.nap.edu/catalog/11265.html as of 8 August 2005).

i. The United States has adopted a policy of seeking irreversible nuclear arms reductions, in which which disposition of 34 tons is seen as only a first step toward disposition of enough plutonium so that the remainder would no longer be sufficient to construct a Cold War-scale nuclear arsenal; or

ii. The costs and risks of disposition are less than the costs and risks of continued storage, in the context of an overall assessment of the best approaches to managing *all* plutonium under U.S. government control. That assessment should include not only technical but political realities, including the feasibility of moving forward with a consolidation effort in the absence of a disposition path forward.

b. For disposition of Russian plutonium:

i. The United States has adopted a policy of seeking irreversible nuclear arms reductions, and is seeking to convince Russia to adopt a similar policy, in which disposition of 34 tons would be only a first step toward disposition of enough plutonium so that the remainder would no longer be sufficient to construct a Cold War scale nuclear arsenal.

There need not be an ironclad commitment to go far beyond 34 tons to justify moving forward major construction, but there should at least be a policy that clearly identifies going well beyond 34 tons as a goal, and discussions of going further should not be left for the indefinite future; otherwise, there is too great a risk that political leaders in the United States, Russia, and elsewhere will put in place measures to address the 34 tons covered in the PMDA and then wipe their hands and walk away, thinking, wrongly, that they have solved the plutonium problem.

(6) The United States should re-examine the technical options for plutonium disposition, and choose options that achieve the spent fuel standard; maintain security as close as practicable to the stored weapon standard throughout the process; meet applicable ES&H standards, and do not create significant new ES&H risks that would not exist in the absence of plutonium disposition; are scalable to larger quantities of plutonium than 34 tons; and, within those constraints, provide the best balance of timing, security advantages, and reasonable costs.

(7) For disposition of U.S. excess plutonium, both a hybrid MOX-and-immobilization option and an all-immobilization option should be seriously considered. To help make the choice, Congress should direct that DOE provide detailed analyses of the costs, benefits, and risks of each option, and Congress should direct that in-depth independent peer reviews of these analyses be carried out. These analyses should include, but not be limited to:

a. Why DOE's cost estimates for these options are now less favorable to immobilization than DOE's earlier studies, despite the large escalation in projected costs of the MOX approach.

b. What options may exist for ensuring that sufficient high-level waste canisters would be available for immobilizing 50 tons of excess plutonium, and whether

these options could be scaled to provide sufficient canisters for immobilizing even larger quantities of U.S. excess plutonium.

(8) For Russian excess plutonium, the United States:

a. Should continue to seek a degree of linkage – that is, to ensure that Russia will carry out disposition of quantities of plutonium comparable to or larger than those slated for disposition in the United States, on a comparable time scale. This is important since, at least from the U.S. point of view, most of the national security benefit of disposition of U.S. excess plutonium comes from its effect of enabling disposition of Russia's excess plutonium. The specific technologies and the specific times at which facilities would begin construction and operation need not be the same in the United States and Russia, however.

b. Should begin discussions with Russia now on declaring additional material excess to their military needs, and should structure plans for the disposition program to ensure that the program, once underway, could handle much larger quantities of plutonium than are covered under the initial agreement.

c. Should seek an agreed decision with Russia concerning which long-term disposition options will be implemented as rapidly as practicable. The criteria for choice should be the same as those in point (6) above.

d. Should seek to complete an international financing and management agreement for disposition of Russia's excess plutonium as rapidly as practicable.

e. Should be willing to support reliance on new reactors for plutonium disposition only if options are developed that offer a better mix of costs to the United States, risks, and timing than does the use of existing reactors.

f. Should not support construction and operation of new fast-neutron reactors for disposition of excess plutonium until it is convinced that arrangements are in place that will ensure that doing so will contribute to, and not undermine, U.S. nonproliferation objectives.

g. Should restart joint immobilization research and development with Russia.

(9) As a complement and backup to other approaches, "plutonium swaps" and other options for transfers or purchases of plutonium should continue to be considered.

(10) For both U.S. and Russian excess plutonium, the United States should take steps to build in stringent standards of security and accounting, approximating the stored weapon standard as closely as possible, for the beginning; tacking on security measures as an afterthought later is likely to lead to higher cost and lower effectiveness. In the United States, the Nuclear Regulatory Commission decision that reactors using MOX fuel should not have to prove that they have security measures in place capable of defeating the Category I design basis threat for theft should be reversed. In Russia, detailed planning for security measures throughout the process – possibly going beyond the measures that Russian regulations currently require – should be integrated into the effort from the outset.

(11) Given the delays in disposition of excess plutonium, and the desirability of sending a message internationally that this material will never be returned to weapons, the United States and Russia should implement the PMDA commitment to placing their excess plutonium stocks under International Atomic Energy Agency monitoring as soon as practicable.

(12) The United States should support efforts to avoid accumulation of additional stockpiles of separated plutonium. In particular, the United States should continue to support the shut-down of Russia's plutonium production reactors (if the quantity of plutonium whose production would be avoided is judged to justify the cost of the effort); should resume the negotiation of a 20-year U.S.-Russian moratorium on plutonium separation, which was almost complete at the end of the Clinton administration; and should support negotiation of a verifiable fissile cutoff treaty.

In short, the United States should adopt policies that will make it possible for plutonium disposition to make a substantial contribution to U.S. national security, and then move forward with disposition of a substantial fraction of the U.S. and Russian plutonium stockpiles.

Statement of Ambassador Linton F. Brooks
Under Secretary for Nuclear Security and Administrator,
National Nuclear Security Administration
U.S. Department of Energy
Before the
House Armed Services Committee
Subcommittee on Strategic Forces

July 26, 2006

INTRODUCTION

Mr. Chairman and other Members of the Committee, thank you for the opportunity to discuss the surplus weapons plutonium disposition program on behalf of the Department of Energy. I will address the Department's plans to dispose of U.S. surplus weapons plutonium and to assist Russia in disposing of its surplus weapons plutonium as part of a bilateral nonproliferation agreement. This program falls under my responsibility as the head of the National Nuclear Security Administration. Following my statement, Charlie Anderson, Principal Assistant Deputy Secretary of Energy for Environmental Management, will address the Department's plans for disposing of its larger inventory of special nuclear material, and how U.S.-Russian plutonium disposition program fits into this overall strategy. Lastly, my colleague from the Department of State, Ambassador Michael Guhin, will discuss in greater detail the status of diplomatic efforts to support disposition of Russia's plutonium.

The Department of Energy currently has approximately 50 metric tons of surplus weapons and non-weapons plutonium. In addition, the Department has approximately 26 metric tons of surplus highly enriched uranium (HEU) that does not currently have a disposition path. This highly enriched uranium is part of a larger inventory of surplus HEU that will either be blended down for disposition in light water reactors or retained for use in Navy nuclear propulsion plants. Although this hearing does not cover uranium directly, finding a disposition path for that HEU is a necessary component of an overall materials disposition strategy, as Mr. Anderson will describe.

These surplus materials, which are no longer required for national defense or programmatic purposes, are stored at multiple locations, including the Savannah River Site, Hanford, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, the Pantex Plant, and the Y-12 National Security Complex. Since these materials could be used to make a nuclear weapon or a dirty bomb, the Department spends hundreds of millions of dollars each year to ensure that these materials are stored safely and securely.

U.S.-RUSSIAN PLUTONIUM DISPOSITION PROGRAM

One way in which DOE will dispose of a large amount of its surplus special nuclear material is through the U.S.-Russian plutonium disposition program – the U.S. Government's largest nonproliferation program. As part of the Plutonium Management and Disposition Agreement signed by the United States and Russia in 2000, both countries committed to dispose of 34 metric tons each of their surplus weapons plutonium. Disposing of 34 metric tons of Russian plutonium, which is enough material for thousands of nuclear weapons, will permanently reduce

the threat that this material can be stolen or diverted. The United States and Russia will both dispose of their plutonium by irradiating it as fuel in nuclear reactors to produce electricity. Once the plutonium has been irradiated in a reactor, it has been converted to a form that can no longer be used in a nuclear weapon. The agreement also envisions both countries disposing of additional plutonium beyond the initial 34 metric tons.

To dispose of our plutonium in the United States, the Department will construct three facilities at the Savannah River Site in South Carolina to fabricate the plutonium into mixed uranium-plutonium oxide fuel, or MOX fuel: a MOX Fuel Fabrication Facility, a Pit Disassembly and Conversion Facility, and a Waste Solidification Building. The Pit Disassembly and Conversion Facility will disassemble the plutonium cores of surplus nuclear weapons, also known as pits, and convert the resulting plutonium metal to an oxide form. The plutonium oxide will then be transferred to the MOX Facility for fabrication into nuclear reactor fuel. The Waste Solidification Building will process liquid waste streams from both the MOX Facility and the Pit Disassembly and Conversion Facility that cannot be handled by the existing site infrastructure.

MOX fuel technology is well established and mature. The design of the U.S. MOX Facility is based on proven processes used in Europe since the 1960s – specifically French technology currently in use at the MELOX and LaHague facilities. MOX fuel is currently being used in more than 30 reactors worldwide.

ROLE OF MOX IN NONPROLIFERATION

There are many reasons why the current MOX fuel approach is the most effective and appropriate means for disposing of surplus weapons plutonium. However, I believe the most compelling reason is the nonproliferation objective of the program. We are disposing of our plutonium by fabricating it into fuel because we want Russia to do the same.

One of the objectives of U.S. nonproliferation and threat reduction programs is to help Russia secure or dispose of as much weapons material as possible, as swiftly as possible, to prevent any of this material from falling into the hands of those who wish us, or our allies, harm. Because of the quantity and locations of this material, our strategy to prevent theft or diversion is multi-tiered. There are complementary efforts that serve different purposes at different stages: 1) accounting and securing nuclear material in Russia and the former Soviet Union; 2) detecting and preventing the movement or trafficking of nuclear materials; 3) stopping the production of new fissile material in Russia; and 4) eliminating nuclear material that currently exists.

The U.S.-Russian plutonium disposition program focuses on the last goal – permanently eliminating existing plutonium. While our activities to account for and secure weapons material in Russia are certainly important to our national security, in the long run the only way to permanently prevent the theft or diversion of this material is to dispose of it. If this material is not disposed of, the threat that terrorists could steal or divert enough material to cause devastating harm to the United States or our allies remains real.

This is why the current bilateral approach to disposing of U.S. and Russian plutonium by using it as nuclear fuel is important. First and foremost, proceeding with the current strategy engages the Russian Government to honor its commitment to dispose of its plutonium. As part of a previous U.S. disposition strategy, Russia reluctantly agreed to the United States immobilizing a third of its 34 metric tons of surplus U.S plutonium in a ceramic material surrounded by high-level

radioactive waste. However, Russia opposed immobilization of more than this amount because the plutonium would not be degraded and the Russians fear it could be retrieved subsequently for weapons use. In fact, earlier this month senior Russian officials reiterated their opposition to the U.S. proceeding with an immobilization-only approach. Therefore, if the United States were to abandon its current strategy of disposing of its plutonium in nuclear reactors, it would probably lead Russia to reconsider its commitment to dispose of its plutonium, jeopardizing the conversion of these materials into forms unusable for weapons.

When the Department submitted a 2002 report to Congress on options for U.S. plutonium disposition, we concluded that immobilizing plutonium would be less expensive than using the plutonium as MOX fuel. With the continued delay in the Russian program, we recently re-evaluated a range of disposition options, including immobilization. Based on this assessment, I believe shifting to a disposition path based on immobilization would be unwise for three reasons:

- First, although we are still evaluating the data, our preliminary analysis of disposition options indicates that the cost difference between immobilization and MOX is well within the normal uncertainty in cost estimation for large projects. This is primarily due to the longer time required to store materials since an immobilization facility could not begin operations for approximately thirteen years. Thus there is no cost savings from shifting paths.

- Second, as I have already noted, if the United States were to shift to immobilization it could lead Russia to reconsider its commitment to dispose of its plutonium. We would thus lose the non-proliferation benefits of plutonium disposition.

- Finally, immobilization of weapons plutonium has never been done before and is still in the research and development stage, whereas MOX is a mature technology now in use throughout the world. Thus our current path has far less technical risk.

I should note that the proposed Pit Disassembly and Conversion Facility is needed to convert plutonium metal to a powder form regardless of whether the plutonium is immobilized or used as MOX fuel.

ROLE OF MOX IN DOMESTIC RESPONSIBILITIES

In addition to the benefits of disposing of surplus plutonium, proceeding with the current plutonium disposition strategy is important for many other reasons. It reduces safeguards and security and storage costs at U.S. facilities and facilitates the modernization of DOE's remaining nuclear complex. These objectives have been outlined to Congress as part of NNSA's "Complex 2030" plan to establish a smaller, more efficient Nuclear Weapons Complex.

The current plutonium disposition strategy also provides a pathway out of the Savannah River Site for plutonium previously brought there for disposition. This will facilitate DOE's ability to meet commitments to South Carolina as set forth in existing law and decrease the potential for the Department to have to pay penalties or take other actions. It also demonstrates to the international community that the United States is committed to meeting its international nonproliferation obligations. Moreover, irradiating MOX fuel in commercial nuclear reactors serves as an important stepping-stone for demonstrating this technology in the United States, thereby facilitating efforts to develop the advanced fuel fabrication techniques needed to support

the Global Nuclear Energy Partnership. Lastly, this disposition strategy utilizes the energy value of the plutonium, which is estimated at nearly one billion dollars.

STATUS OF RUSSIAN PROGRAM

Despite some delays in the Russian program, the Russian Government remains committed to disposing of its plutonium, and we fully expect Russia to meet its obligations under the 2000 Plutonium Management and Disposition Agreement. In fact, earlier this month Secretary Samuel Bodman and Russian Federal Atomic Energy Agency Director Sergei Kiriyenko reaffirmed their commitment to implement the 2000 Agreement to dispose of their surplus weapons plutonium by irradiating it as nuclear reactor fuel. I have attached a copy of their statement for the record. In addition, President Bush and President Putin noted in their recent Joint Statement at the G-8 Summit that both sides are continuing discussions on how best to implement the commitment to dispose of 34 tons of weapons plutonium each. Moreover, the United States and Russian Governments completed negotiations of a liability protocol for the plutonium disposition program last year and the protocol will be signed by both sides in the near future pending final conforming of the English and Russian texts.

Although the Russian Government remains committed to reactor-based plutonium disposition, it has indicated it would prefer to focus its efforts on using advanced reactors, rather than using existing light water reactors as originally planned. Our experts are working together this summer to identify the specific technologies that Russia will use to dispose of all 34 metric tons and are aiming to develop a detailed plan for Russia's plutonium disposition program by the end of this year.

Using advanced reactors in Russia could have some advantages. First of all, Russia has indicated a willingness to contribute its own funds for this approach because it fits with its overall energy strategy. Secondly, Russia has already committed to explore the use of its one existing fast reactor to begin disposing of approximately a third of a metric ton of plutonium per year by about 2010 – which is five years before the U.S. plans to begin disposing of our own plutonium. In addition to being a clear indication of the Russian continued commitment to plutonium disposition, this could provide valuable technical information depending on the specific advanced reactor disposition path ultimately chosen. A bilateral meeting is currently scheduled for August to review programmatic issues of initiating "early disposition."

While we and the Russians have not yet made a final determination of how the Russian program will ultimately be structured, key Russian Government officials have told us, told members of Congress, and told the international community that Russia remains committed to disposing of 34 metric tons of plutonium. We fully expect them to keep this commitment and will work with them to achieve it. I will defer to Ambassador Guhin to discuss in more detail current diplomatic efforts with Russia.

STATUS OF U.S. MOX FACILITY

While we have made limited progress on the Russian program, we have made significantly more progress on the U.S. program. Site preparation activities for the plutonium disposition facilities at the Savannah River Site began last year and are fully underway – we have cleared 73 acres of land, excavated 80% of the site of the planned plutonium disposition facilities, and relocated power lines. We have also completed installation of telecommunications and electric services

for a batch plant that will supply the concrete necessary to build the MOX facility. The overall design of the U.S. MOX facility is 85% complete and we have received authorization from the Nuclear Regulatory Commission to begin construction. In addition, we have fabricated MOX fuel lead assemblies and are currently irradiating those assemblies at the Catawba Nuclear Power Station in South Carolina. This is the first time that U.S. weapons plutonium has been irradiated in a commercial reactor to produce electricity.

The U.S. program is now ready to begin construction of the MOX facility this fall. To prepare for the start of construction, we have begun increasing our staff at the site and selected a new Federal Project Director. In addition, our contractor has begun transitioning employees to the site, including the President and the Construction Manager, and is starting to staff up in the Aiken area. The Administration's budget request is essential for continuing construction activities in FY 2007, which will be a peak construction year. Without adequate funding, the MOX Facility cannot be constructed on schedule and the effect over time would be to greatly increase the total construction costs. Once construction is completed, operations of the MOX facility are planned to commence in 2016 and continue for approximately 14 years.

There would be certain contract costs associated with terminating the program. However, the real cost of terminating the program or changing the disposition strategy now in favor of another method would be delaying disposing of surplus weapons plutonium by many years, wasting the nearly $1 billion that has already been invested in the plutonium disposition program, and forcing the Department to continue to pay costly safeguards and security and storage costs for this material.

RECOMMENDATION

In conclusion, I am confident that continuing the Department's plan to dispose of our surplus plutonium by irradiating it as MOX fuel is the right thing to do. This strategy enables us to continue to engage Russia in this program, which will in time permanently reduce the threat that this plutonium could be stolen or diverted. It demonstrates to the international community that the United States is committed to meeting its international nonproliferation obligations. On the domestic side, it reduces safeguards and security and storage costs and facilitates the modernization of the DOE's remaining nuclear complex. Lastly, it provides a pathway out of the Savannah River Site for plutonium previously brought there for disposition.

Mr. Chairman, this concludes my statement. I would be pleased to answer any questions you may have on the plutonium disposition program.

STATEMENT OF CHARLES E. ANDERSON

PRINCIPAL DEPUTY ASSISTANT SECRETARY

OFFICE OF ENVIRONMENTAL MANAGEMENT

DEPARTMENT OF ENERGY

BEFORE THE

SUBCOMMITTEE ON STRATEGIC FORCES

COMMITTEE ON ARMED SERVICES

U.S. HOUSE OF REPRESENTATIVES

JULY 26, 2006

Good afternoon, Chairman Everett and Members of the Subcommittee. My name is Charlie Anderson and I am the Principal Deputy Assistant Secretary for Environmental Management, as well as the Chairman of the Department of Energy's Nuclear Materials Disposition and Consolidation Coordination Committee (NMDCCC). I am pleased to be here today to address the Department's plans for disposing of its special nuclear materials. I will also provide an update to you on the Department's efforts to consolidate its surplus weapons-usable plutonium since my April 5, 2006, hearing. I want to thank you and the Subcommittee for your interest in this complex challenge as it is vital to the security of our country. Just to place into perspective how complex this issue is, as NMDCCC Chair, I have initiated an evaluation of all the various types of nuclear material that the Department has in inventory – thousands of tons of nuclear material – over half a million separately inventoried items. Of primary interest are the hundreds of tons of special nuclear material, requiring the highest level security.

The Department currently has approximately 50 metric tons (MT) of surplus plutonium-239 (both weapons-grade and non-weapons-grade). Attached you will find an illustration showing the locations and unclassified quantities of the Department's surplus weapons-usable plutonium. As noted, these surplus plutonium materials are stored at

multiple Department locations: the Savannah River Site (SRS), the Hanford Site, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and the Pantex Plant. The majority of this plutonium is in surplus pits while most of the remainder is in the form of plutonium metal and oxides (i.e., non-pit forms) currently stored or planned to be stored in 3013 containers. DOE-STD-3013 is the Department's standard for long-term storage of plutonium, and each 3013 container has a maximum capacity of 4.4 kilograms of plutonium. However, few containers have the maximum amount of plutonium. In addition to its plutonium, the Department has approximately 26 MT of surplus highly enriched uranium requiring a disposition path. The disposition strategy I will outline here today also addresses this material.

The Department is developing an integrated approach to address the disposition of surplus fissile nuclear materials, including the surplus weapons-usable plutonium that is not suitable for the Mixed-Oxide (MOX) Fuel Fabrication Facility, as well as material which would have been dispositioned through the previously cancelled Plutonium Immobilization Project. This disposition approach will enable the Department to proceed with a decision relative to consolidating surplus plutonium-239 at one location.

The Department is currently considering, subject to review under the National Environmental Policy Act (NEPA), the following three capabilities for the processing and disposition of surplus plutonium and highly enriched uranium at SRS:

- the construction and operation of the MOX Fuel Fabrication Facility planned to be constructed at the Savannah River Site, including the Pit Disassembly and Conversion Facility (PDCF) and the Waste Solidification Building (WSB) to convert at least 34 MT of weapons plutonium into MOX fuel to be burned in commercial nuclear power generating reactors;
- the continued operation of the existing H-Canyon and HB-Line facilities at Savannah River Site (SRS) to recover highly enriched uranium that would be down blended, and to process very impure plutonium which does not meet the specifications for commercial-grade MOX fuel; and,
- the construction and operation of a new vitrification capability is proposed to be located at the K-Reactor facility that will immobilize surplus weapons-grade plutonium which does not meet the specifications for commercial-grade MOX fuel.

Ambassador Linton Brooks has already discussed the status of constructing and operating the MOX Fuel Fabrication Facility, the Pit Disassembly Conversation Facility, and the Waste Solidification Building to dispose of 34 MT of surplus weapons plutonium and the Department is pursuing these facilities. I will now describe the other two capabilities the Department is considering for processing other surplus material and preparing it for ultimate disposition. These are:

1. Construct and operate a plutonium vitrification capability to dispose of up to 13 MT of "non-MOX-able" plutonium; and

2. Operate the H-Canyon/HB-Line to dissolve 26 MT of uranium and plutonium-bearing materials which does not meet the specifications for commercial-grade MOX fuel, as well as process some spent nuclear fuel (aluminum-clad) containing uranium.

1. Proposed Plutonium Vitrification Project: The Department, following an analysis of the potential disposition alternatives for non-MOXable plutonium currently located at SRS, is considering pursuit of vitrification as the preferred technology to immobilize this material. The plutonium vitrification capability is proposed to be located in the basement of the former K-Reactor facility at SRS. The facility would provide the capability to vitrify up to 13 MT of plutonium materials that are not suitable for fabrication into MOX fuel due to isotopic or other impurities. The impure plutonium would be melted with glass frit and poured into small cans. The cans of vitrified plutonium would then be placed inside larger high-level waste canisters and subsequently shipped to the Defense Waste Processing Facility at SRS where they would be filled with glass containing high-level waste. The filled canisters would be stored at SRS for an interim period of time while awaiting shipment to the geological repository for final disposal upon qualification for waste acceptance. Additional analyses under NEPA would be required before the Department could finalize a decision on the disposition strategy.

2. H-Canyon/HB-Line Facilities: H-Canyon/HB-Line are large heavily shielded aqueous chemical separation facilities at SRS. The facilities have been operating almost continuously since they were constructed in the early 1950s. The facilities dissolve spent nuclear fuel containing highly enriched uranium, other enriched uranium materials, and plutonium-bearing materials, and chemically separate their constituents. The planned strategy would be to continue activities already underway to recover highly enriched uranium from aluminum-clad spent nuclear fuel and to down blend it to low-enriched uranium. In addition, H-Canyon/HB-Line could be used to process approximately 2 MT of impure plutonium, which would then be vitrified in the Defense Waste Processing Facility for eventual disposal in the geological repository. The H-Canyon facilities are scheduled to complete their current processing missions in 2007.

The Department is currently analyzing the costs for this three-pronged approach and various other disposition alternatives.

This past April, I informed you about the progress the Department has made on consolidation of its nuclear materials. I also briefed you on the activities of the NMDCCC, including the development of a strategic plan and individual implementation plans. The Committee concluded that the top priority facing it was to identify a path forward for plutonium-239 at the Hanford Site. Since then, the Committee has been developing an implementation plan for consolidation of plutonium-239. This implementation plan includes an evaluation of three alternatives (i.e., continued storage at a current sites, consolidation and storage at an interim site, and consolidation and storage at the disposition site), and the advantages and disadvantages of storage at different sites. The Department is currently evaluating the implementation plan for Pu-239, to assure the necessary NEPA and legal requirements are satisfied before making a consolidation

decision. The NMDCCC continues to act in support of the integrated disposition strategy, with future consolidations decisions being informed by the appropriate disposition strategy.

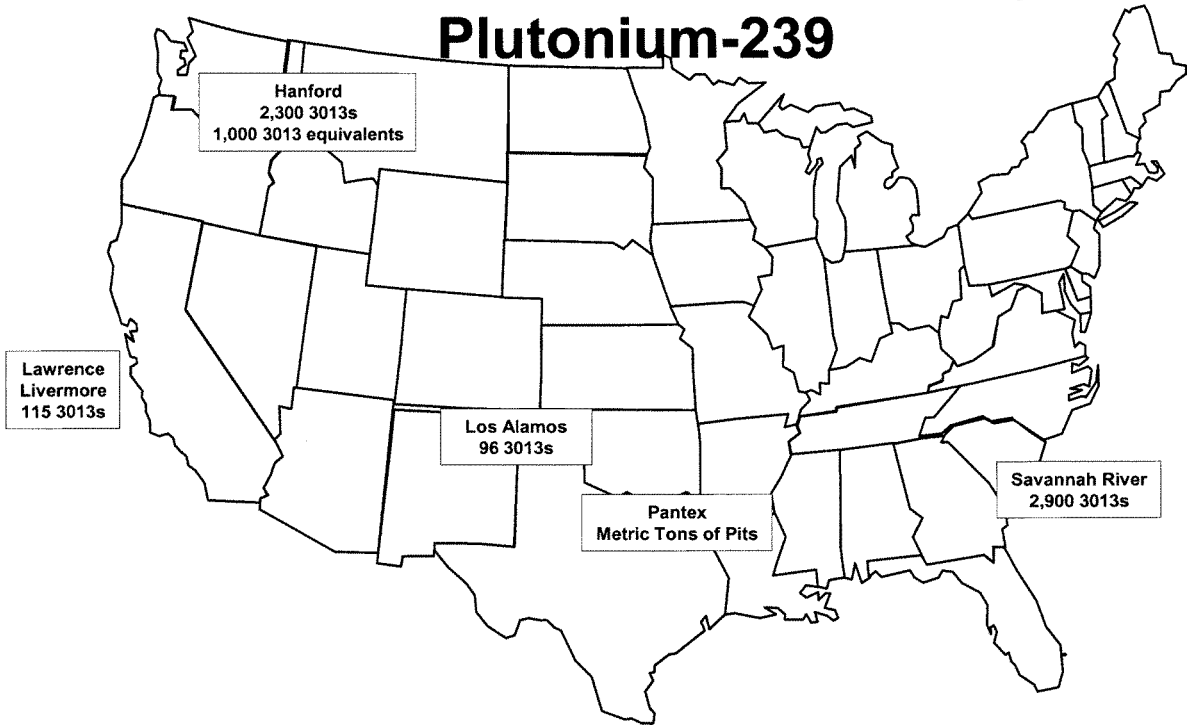
To date, complex-wide, we have identified four regulatory and legal challenges that affect the movement of materials: NEPA, Public Law 107-107, Public Law 107-314, and the Aiken County Lawsuit.

Section 3155 of the National Defense Authorization Act for Fiscal Year 2002 (Public Law 107-107) currently prohibits the Department from shipping surplus weapons-usable plutonium to SRS until preparation and submittal to Congress of a plan that identifies a disposition path for all plutonium that would have been disposed of at the Plutonium Immobilization Plant that was cancelled in 2002. Additionally, Public Law 107-314, as amended, includes a MOX production objective of 1 MT of mixed-oxide fuel by the end of 2012. Lastly, there is a pending lawsuit brought by Aiken County, SC, alleging the Department has failed to comply with reporting and other requirements of section 3182 of the National Defense Authorization Act for Fiscal Year 2003 (Public Law 107-314, as amended) for the MOX Fuel Fabrication Facility.

The next steps for the Department are to proceed with the MOX Fuel Fabrication Facility, and complete cost analyses and finalize the integrated disposition strategy for the materials aforementioned. For the remaining materials not included in the proposed strategy that I have just outlined, I have requested that each site office provide a listing of all materials and their anticipated disposition pathways. The NMDCCC will be validating these results by the end of Fiscal Year 2007.

Mr. Chairman and Members of the Subcommittee, thank you for allowing me the opportunity to testify. This concludes my formal statement for the record.

DOE Complex
Locations and Quantities of Surplus Plutonium-239



Testimony of Amb. Michael Guhin
U.S. Fissile Material Negotiator
Before The
Strategic Forces Subcommittee Of The
House Committee on Armed Services
July 26, 2006

Mr. Chairman and distinguished Members, it's a pleasure to join this panel and appear before you to address the diplomatic agreements and related efforts between the United States and the Russian Federation concerning plutonium disposition.

I would stress, at the outset, that transparently, effectively and safely converting Russian excess weapon-grade plutonium into forms that are not usable for nuclear weapons remains a critical nonproliferation, threat reduction goal. It is as important today, if not more so, as it was when the initiative was launched in the mid-1990's.

This priority was reaffirmed by President Bush's review in 2001. The goal has been strongly backed by G-8 countries, including by financial pledges from nearly all other partners. Many of them judge Russian and U.S. disposition as **both** a key nonproliferation measure **and** a key step for making arms control irreversible.

As President Bush highlighted in 2001, keeping weapons and materials of mass destruction out of terrorist and other proliferators' hands presents one of the greatest security challenges of our time. Having worked in the nuclear nonproliferation field for nearly three decades, I could not agree more.

Nonproliferation has always been a complex, multifaceted challenge, ranging from the headline and high-visibility issues (for example, Iran and North Korea today) to a number of less conspicuous, but no less vital efforts (for example, export controls, safeguards, the proliferation security initiative, and securing and reducing weapons and materials of mass destruction). The spread of information, technology, expertise and materials today and into the future only increases the complexity and urgency of meeting these nonproliferation challenges.

At the 2002 G-8 Summit, in Kananaskis, Canada, G-8 leaders joined in a "Global Partnership Against the Spread of Weapons and Materials of Mass Destruction." The United States took a leading role in this initiative. Among the four priority concerns listed in their statement was, I quote, "disposition of fissile materials." The July 16, 2006 G-8 leaders' statement on non-proliferation reaffirmed support for the priority areas.

U.S. plutonium disposition efforts with Russia represent a key component for keeping weapons and materials of mass destruction out of terrorist or other proliferators' hands. Separated plutonium, particularly weapon-grade, represents one of the most dangerous and readily usable materials for weapons of mass destruction. This is a most compelling reason for converting it into forms that are not usable for such weapons and doing so under conditions of safety, security, accountability and transparency.

The 2000 U.S.-Russian plutonium disposition agreement establishes a sound set of nonproliferation and other conditions for disposition programs in Russia and the United States. Progress in executing that Agreement has been slower than we hoped, sometimes frustratingly so. But, today, it's critical to look forward, not backward. In doing so, we should heed some clear lessons from past experience.

Status of Disposition Negotiations with Russia

We are now engaged in a new phase in our negotiations with Russia on plutonium disposition. I believe this stage offers better opportunities for success than we have had over the past five years.

First, disagreement over longstanding liability issues between the United States and Russia is no longer a barrier to cooperation in plutonium disposition or, for that matter, in other nonproliferation or cooperative programs where these issues have frequently been an impediment. Liability formulations were resolved for plutonium disposition in negotiations last July. They have been approved for signature by both sides pending final conforming of the Russian and English versions.

We expect liability protections to be applied by the time they are required for cooperative disposition activities supported by U.S. assistance. Russia informed us in early 2005 that it was not prepared to

proceed with any substantial program activities pending high-level decision on its internal governmental review and agreement with the United States on a path forward. That review was not completed until early this year, 2006.

Second, and perhaps most important, in the wake of Russia's governmental decision, both sides agreed to begin exploring ways of meshing Russia's program and related cooperation more effectively with Russia's interests and nuclear energy strategy. This means structuring cooperation as a more durable partnership, rather than simply an assistance program.

Conversely, it means that both sides are no longer pressing for positions that were going nowhere. To wit: Since 1999, Russia has maintained that it would only utilize its existing light water reactors for disposition if other countries covered all costs because such use was inconsistent with Russia's nuclear energy strategy. The United States -- backed by other G-8 contributing countries -- made clear all along that contributors would not cover all costs and that Russia needed to put more political commitment and some resources behind its program.

We hoped and believed that Russia's interest would grow and its position would become more flexible as pledges for cooperation and prospects for technology transfer increased and as the program took on more definition. Pledges for cooperation did increase some fourfold since 2000. They now total $800 million - with roughly half from other G-8 partners and half from the United States. DOE and others put considerable work into defining a technical program. Our belief, however, proved wrong; Russian interest in consistency with its broader energy strategy was stronger.

Looking forward, we have learned from and have now overcome the 2004-2005 rough patch. As a result of meetings in February and March this year, both sides are now actively exploring in diplomatic and other channels alternative potential disposition paths that, as noted, could mesh with Russia's nuclear energy strategy. That strategy, formulated at the highest levels of the Russian Government, envisions a much expanded role for nuclear energy and related initiatives.

More recently and more importantly, the joint statement by Secretary Bodman and Rosatom Head Kiriyenko signaled continuing commitment to

the disposition goals of the 2000 U.S.-Russian Agreement and the importance of exploring alternative paths for decisions by both governments. The Summit statement by President Bush and President Putin also referred to the commitment of both sides, highlighting the importance of discussions on how best to fulfill those commitments.

Two basic aspects are being explored in policy and technical channels. One would be disposition of limited quantities of excess weapon-grade plutonium in Russia's existing fast reactor, the BN-600, appropriately modified so that it does not operate as a breeder of new weapon-grade plutonium. This was envisioned in the 2000 Agreement itself and could begin well before the United States actually started disposing of its plutonium. The second would be large-scale disposition for the bulk of the 34 tons using reactors that Russia itself plans to bring online.

From the beginning of this exploratory process, we have stressed that Russia needs to identify a 34-ton program in which it has an interest and will invest politically, financially and technically. This offers a key opportunity, as noted, to move from basically an assistance program to a type of partnership, with Russia being the prime partner.

The ball is in Russia's court and we, with DOE, are working actively with Russia to move it forward. We hope to see some positive progress and direction by the end of this year and especially early next year. Some complicated negotiations no doubt lie ahead. But the key is that Russia has to decide what approach fits with its interests. We cannot force that even if we wanted.

We have other positive indicators today. While G-8 contributing countries have expressed disappointment with Russia's failure to move more quickly, they have also reaffirmed that disposition of Russian excess weapon-grade plutonium remains a priority.

Based on several diplomatic consultations since February, contributing partners seem open to the United States exploring with Russia other disposition approaches. They, too, hope for progress this year or early next, at least in terms of defining a direction and playing field. In short, though their patience may be running thin, they remain interested and involved.

We have also made some progress toward meeting a second requirement of the 2000 Agreement, namely, developing monitoring and inspection procedures for both sides' 34-ton programs. A few key issues remain. They should be resolvable next year as well, assuming Russia identifies its disposition program and the two sides agree on areas for cooperation with it.

Finally, we are engaged in a new negotiating paradigm. We have moved from trying to "sell" Russia a program, in which it proved to have insufficient self-interest, to offering to cooperate in a program that Russia defines to coincide with its interests.

Russia has said for almost a decade that it indeed will dispose of this plutonium, and will do so by utilizing and degrading it as reactor fuel. Again, the statement by Secretary Bodman and Rosatom Head Kiriyenko includes Rosatom's reaffirmation of its intention to stand by its commitment to dispose of no less than 34 tons of this plutonium.

I cannot predict the precise outcome or timing of the negotiations on which we are now embarked. But I can predict that we will have no positive result if we lose heart in the process.

The 2000 U.S.-Russian Agreement has sound conditions and such conditions would be reflected in any multilateral cooperative arrangements. To achieve Russian disposition under sound conditions, it is clear to me that we need to be steadfast on the objective but flexible on the time frame for Russia's program.

Effects on Negotiations of "Decoupling" U.S. Disposition Activities

This is a critical aspect, and we should be absolutely clear about what is meant by "decoupling." Both the United States and Russia have long committed to the nonproliferation objectives of plutonium disposition; these mutual objectives should not be "de-coupled." We have no intention of walking away from the 2000 Agreement. Indeed, Russia has said it does not intend to walk away from that Agreement.

So, "de-couple" does not mean changing our overall objectives. Nor does it mean changing our efforts to work with Russia on these mutual undertakings.

De-coupling with reference to the **schedules and time frames** for each side's program is an entirely different matter. From a negotiating standpoint, such de-coupling is highly desirable and most likely essential to achieve the outcomes the United States has been seeking.

Having led the negotiations on the 2000 Agreement, I would note that its text throws important light on this aspect. It stipulates that the Parties shall cooperate to implement "their respective disposition programs in parallel to the extent practicable." While the concept of some parallelism was to encourage Russia to move positively, it was not intended to make progress in one program contingent on equivalent progress in the other.

Quite the contrary, "**to the extent practicable**" was a carefully chosen, deliberate phrase. The negotiating teams actually envisioned that neither program should be held hostage to the other in any way that impeded it or adversely affected program costs. They also envisioned that the two side's programs could, in practice, be some years apart. The agreement, for example, allows each side to notify the other of adjustments to its own schedules and milestones.

I believe the wisdom underlying the insertion of that qualifying phrase is apparent today. To hold the U.S. program hostage to progress or milestones in Russia's program would be expensive and inconsistent with the spirit of the 2000 negotiations.

Even more to the point, "coupling" the program activities and schedules would be as counterproductive today as it has proved to be in the past **and** would hurt U.S. negotiating efforts with Russia. It would increase Russian leverage in the negotiations, effectively giving it a say or even a veto over the U.S. program and related activities, and could correspondingly produce exaggerated Russian impressions of what it might expect to achieve. Conversely, "de-coupling" the program activities and schedules would give the U.S. the strongest negotiating hand.

As noted, since 1999, we told Russia that the United States and other donors would contribute only a fair share for the previously defined Russian program and that Russia had to commit some substantial resources. I don't know whether Russia might have thought that the United States would in the end agree to substantially increase its pledge, if only to save the U.S.

program. I do know, however, that it demonstrated no flexibility in its position and that its inflexibility was endorsed earlier this year at its highest levels.

Before closing, Mr. Chairman, I would like to inform the Subcommittee of a number of useful discussions I have had since the fall of 2005 with other countries that have pledged support for Russia's program.

In these cases, I would characterize other partners' responses as disappointment with the results of Russia's high-level review: namely, that Russia would utilize its existing light-water reactors for disposition, but only if others paid essentially all costs. Nonetheless, these partners also indicated a continued interest in cooperating if Russia took more responsibility and gave greater commitment and resources to its own program.

In consultations, some partners also welcomed the U.S. initiative to proceed to break ground at the Savannah River Site on the MOX facility last fall, despite the existing and expected future delays in Russia's program. To their way of thinking, the best way to secure Russian fulfillment of this critical nonproliferation objective is to demonstrate that the United States is on the high road by proceeding with measures necessary to fulfill its obligations.

As a negotiator, that coincides with my way of thinking on this matter. This is not a situation that calls for Cold War-type thinking and logic. In negotiating terms, we have nothing to lose and potentially much to gain by proceeding to move forward on the U.S. disposition program on its merits as we continue to work with Russia on its own program.

Thank you, Mr. Chairman.

DOCUMENTS SUBMITTED FOR THE RECORD

JULY 26, 2006

Joint Statement
On the
U.S. - Russian Excess Weapon-grade Plutonium Disposition Program

The U.S. Department of Energy (DOE) and the Federal Atomic Energy Agency, Russian Federation (Rosatom), as the Executive Agents for the implementation of the 2000 Plutonium Management and Disposition Agreement, hereby reaffirm their commitment to implementing the 2000 Agreement and effective and transparent disposition of 34 metric tons each of weapon-grade plutonium designated as no longer required for defense purposes. They confirm that the preferred disposition method for such plutonium to implement the 2000 Agreement is irradiation of nuclear fuel in reactors. Their expert groups are directed to:

- Provide for the performance of technical analysis that will contribute to both governments' decision making on cooperation regarding Russia's program to implement the 2000 Agreement. This effort will include key technical and programmatic principles and Russia's plans for disposing of 34 metric tons of weapon-grade plutonium as required by the 2000 Agreement.

- Review programmatic issues of initiating, not later than in the 2010-2012 timeframe, the "early disposition" of a portion of Russian weapon-grade plutonium as mixed oxide fuel in the BN-600 fast reactor, including agreement on monitoring arrangements.

- Prepare assessments of the cost and schedule for "early disposition" and describe plans for the long-term implementation of the Russian technical program for disposition of excess weapon-grade plutonium. Present to the Secretary of Energy and Director of Rosatom by December 25, 2006 a report containing discussion of these assessments and plans, as well as proposals on further action.

Samuel Bodman

U.S. Secretary of Energy

July 7, 2006

Sergey Kiriyenko, Director, Federal Atomic Energy Agency, Russian Federation

Проект
Совместного заявления
по
российско-американской программе утилизации
избыточного плутония оружейного качества

Министерство энергетики (МЭ) США и Федеральное агентство по атомной энергии (Росатом), как исполнительные органы по реализации Соглашения 2000 г. об утилизации плутония и обращению с ним, настоящим вновь подтверждают свою приверженность выполнению Соглашения 2000 г. и утилизации действенным и транспарентным образом по 34 тонны с каждой стороны плутония оружейного качества, заявленного как плутоний, не являюшийся более необходимым для целей обороны. Они констатируют, что при реализации Соглашения 2000 г. предпочтение в выборе метода утилизации такого плутония отдается облучению ядерного топлива в реакторах. Группам экспертов поручается:

- Обеспечить проведение технического анализа, который будет способствовать принятию решений обоими правительствами в отношении сотрудничества в части российской программы реализации Соглашения 2000 г. Эта работа включает ключевые технические и программные принципы и российские планы утилизации 34 тонн плутония оружейного качества как это предусмотрено Соглашением 2000 г.
- Рассмотреть программные вопросы начала не позднее 2010 – 2012 годов «ранней утилизации» части российского плутония оружейного качества в виде смешанного оксидного топлива на быстром реакторе БН-600, включая согласование мер мониторинга.
- Подготовить оценки затрат и сроков по «ранней утилизации» и сформулировать планы в отношении долгосрочной реализации российской технической программы утилизации избыточного плутония оружейного качества. Представить Министру энергетики США и Руководителю Росатома к 25 декабря 2006 г. отчет, содержащий изложение этих оценок и планов, а также предложения по дальнейшим действиям.

Samuel W Bodman

July 7, 2006

Strategy for Disposing of Surplus Special Nuclear Materials

DOE currently has approximately 76 metric tons (MT) of surplus special nuclear materials, i.e., approximately 50 MT of plutonium (both weapon-grade and non-weapon-grade) and approximately 26 MT of highly enriched uranium (HEU), including some aluminum clad spent nuclear fuel. These materials are stored at multiple locations, including the Savannah River Site (SRS), Hanford, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, the Pantex Plant, and the Y-12 National Security Complex. Storing these materials currently costs DOE approximately $500 million per year.

The following three-pronged approach is being considered by DOE for disposing of these materials:

1. Construct and operate a Mixed Oxide (MOX) Fuel Fabrication Facility, a Pit Disassembly and Conversion Facility (PDCF), and a Waste Solidification Building (WSB) to dispose of 34 MT of weapon-grade plutonium (MOX program);

2. Construct and operate a plutonium vitrification capability to dispose of 6-13 MT of "non-MOX-able" plutonium; and

3. Operate the H-Canyon/HB-Line to dissolve 26 MT of uranium and plutonium bearing materials as well as some uranium spent nuclear fuel (Aluminum Clad).

The construction and operation of the above referenced facilities are subject to compliance with all applicable laws, including the National Environmental Policy Act (NEPA). In addition, new outyear budget authority will be required.

MOX Program (MOX, PDCF & WSB): In 2000 the United States and Russia signed an agreement that commits each country to dispose of 34 MT of surplus weapon-grade plutonium. Disposing of 34 MT of Russian plutonium, which is enough material for thousands of nuclear weapons, will permanently reduce the threat that it can be stolen or diverted. The agreement also allows both countries to dispose of additional plutonium beyond the initial 34 MT. This is the U.S. Government's largest nonproliferation program.

Both countries will dispose of their plutonium by irradiating it as fuel in nuclear reactors. Once irradiated, the plutonium can no longer be used in nuclear weapons. To implement this approach in the United States, DOE will construct and operate three plutonium disposition facilities at the SRS: a Pit Disassembly and Conversion Facility, a MOX Fuel Fabrication Facility, and a Waste Solidification Facility.

One of the primary reasons DOE decided to dispose of plutonium by irradiating it as MOX fuel is that Russia has consistently represented it would not support an immobilization-only disposition approach because: (1) the plutonium can be retrieved for weapons use, and (2) immobilization fails to utilize the energy value of the plutonium. Therefore, if the United States were to abandon its current approach of disposing of its plutonium in nuclear reactors, Russia would likely discontinue its disposition program and continue to store its surplus weapon-grade plutonium in vulnerable storage facilities, increasing the risk that the material could be diverted by insiders or stolen by terrorist groups and used against the United States or our allies.

In addition to the obvious benefits of disposing of surplus Russian plutonium, proceeding with construction of the U.S. MOX facility in South Carolina is important for many other reasons. It demonstrates to the international community that the United States is committed to meeting its international obligations. It also reduces the safeguards and security and storage costs and facilitates the modernization of DOE's remaining nuclear complex. In addition, it provides a pathway out of the Savannah River Site (SRS) for plutonium previously brought there for disposition, thereby facilitating DOE's ability to meet commitments to South Carolina as set forth in existing law and decreasing the potential that DOE would have to pay penalties or take other actions under the existing law (e.g., transfer plutonium out of the state). Moreover, irradiating MOX fuel in commercial nuclear reactors serves as an important stepping-stone for demonstrating this technology in the United States and utilizes the energy value of the plutonium estimated at nearly one billion dollars.

While the U.S. plutonium disposition program has progressed significantly, Russia has been slow to proceed with plutonium disposition. However, Russia has represented that it remains committed to fulfilling the terms of the 2000 agreement. In this regard, both countries have recently developed a two-pillared approach for Russian plutonium disposition. First, Russia has agreed to begin early disposition of one third of a metric ton of plutonium per year in its existing fast reactor — as much as five years before plutonium disposition begins in the United States. Second, experts from the United States and Russia are meeting to discuss the use of other advanced reactors for disposing of the balance of the 34 metric tons of Russian plutonium.

Under current plans, construction of the U.S. MOX Facility will begin in the fall of 2006, with operations scheduled to commence in 2015 and continue for approximately 14 years. The PDCF will disassemble the plutonium cores of surplus nuclear weapons, i.e., pits, and convert the resulting plutonium metal to oxide, which will subsequently be transferred to the MOX Facility for fabrication into reactor fuel. Construction of the PDCF is expected to start in 2011, with operations scheduled to begin in 2017. The facility will continue to operate for approximately eight years. The WSB will process liquid waste streams from both the MOX Facility and the PDCF that cannot be handled by the existing SRS infrastructure.

Plutonium Vitrification Facility: The DOE Savannah River Site Operations office, following an analysis of the potential disposition alternatives for non-MOXable plutonium currently located at the SRS, has recommended that the Department pursue a vitrification technology to immobilize this material. The Plutonium Vitrification Facility would be located in the basement of the former K Reactor facility at SRS. The facility would provide the capability to vitrify 6-13 MT of plutonium materials that are not suitable for fabrication into MOX fuel due to isotopic or other impurities. The impure plutonium would be melted with glass frit and poured into small cans. The cans of vitrified plutonium would then be placed inside larger high level waste canisters and subsequently shipped to the Defense Waste Processing Facility (DWPF) at SRS where they would be filled with glass containing high-activity waste. The filled canisters would be stored at SRS for an interim period of time while awaiting shipment to the geological repository for final disposal upon qualification for acceptance. Additional analyses under NEPA would be required before the Department could finalize a decision on the disposition technology. Subject to completion of that NEPA review and compliance with other applicable law, construction would be planned to commence in 2009 with the facility becoming operational in 2013. The facility would operate until 2019 to dispose of "non-MOXable" surplus plutonium.

H Canyon/HB-Line Facilities: H-Canyon/HB-Line are large heavily shielded aqueous fuel reprocessing facilities at SRS. The facilities have been operating continuously since they were constructed in the early 1950s. The facilities dissolve enriched uranium spent nuclear fuel, other enriched uranium materials, and plutonium-bearing materials, and chemically separate their constituents. The planned strategy would continue activities already underway to recover enriched uranium from spent nuclear fuel and to down blend it to low enriched uranium for use as feed material to fabricate fuel for reactors. In addition, H-Canyon/HB-Line Facilities could be used to process 2 MT of highly impure plutonium, which could be sent directly to the SRS liquid waste system to be vitrified for disposal in the geological repository. Additional NEPA analyses will be necessary before the Department could finalize a decision on this process.

H-Canyon facilities are scheduled to complete their current processing missions in 2007. However, these are the only remaining production-size chemical separation facilities in the United States and, as such, are valuable assets in DOE's nuclear materials disposition and risk reduction efforts. Therefore, DOE is currently evaluating operations of the H-Canyon facilities beyond 2007, and has identified several materials at various sites that could be processed for disposal in these facilities. DOE also has a large inventory of aluminum clad spent nuclear fuel that could be processed for disposal in the H-Canyon facilities and the resulting uranium could be used in commercial nuclear reactor fuel.

Without additional funding or a specified mission for H-Canyon, the facilities would be placed in a cold shutdown status causing DOE to be unable to meet the apparent objective of Public Law 108-136, which requires DOE to "continue operations and maintain a high state of readiness."

Why Not Vitrify All 50 MT Of Plutonium?

If MOX were no longer an option, DOE would not proceed with consideration of the plutonium vitrification (glass) project as it is currently scoped nor pursue a large-scale plutonium vitrification (glass) facility. DOE would likely pursue immobilizing the plutonium in a ceramic form to prepare the entire 50 MT of plutonium for disposal as waste. This decision is based on the higher concentration of plutonium-bearing material that could be added to ceramic (and hence the need for only half the high level waste canisters) and the lower radiation exposure to workers involved with ceramic immobilization. Regardless of the ultimate decision on glass or ceramic, disposing of all 50 MT of plutonium would still require the PDCF to disassemble the cores of nuclear weapons and convert the resulting plutonium metal into an oxide form suitable for vitrification/immobilization.

Immobilization of weapon-grade plutonium has never been done before and is still in the research and development stage. In addition, the resulting immobilized plutonium waste form has yet to be qualified for acceptance in the planned geologic repository. MOX, on the other hand, is a mature, accepted technology used in over thirty reactors worldwide. Abandoning MOX at this time and shifting to a new plutonium disposition strategy would entail considerable time to perform the necessary research and development, design and construct new facilities and conduct the appropriate environmental impact analysis in accordance with the National Environmental Policy Act. Even in an optimistic scenario, DOE would not be able to begin construction of a ceramic immobilization facility for at least ten years.

Immobilizing the entire 50 MT of plutonium, regardless of whether glass or ceramic is used, would require significantly more high-activity waste canisters and waste than currently remain at DWPF. This

would force consideration of the option, not currently under consideration, of shipping most of DOE's surplus plutonium to the State of Washington and performing some, if not all, of the can-in-canister operations at the Waste Treatment Plant currently being constructed at Hanford. This decision would not only affect the preferred location of an immobilization facility, but the location of the planned PDCF as well.

Cost and Schedule of DOE's Strategy for Disposing of Special Nuclear Materials

The total cost of DOE's disposition strategy is approximately $13.7 billion (2007 –2028). This includes the following:

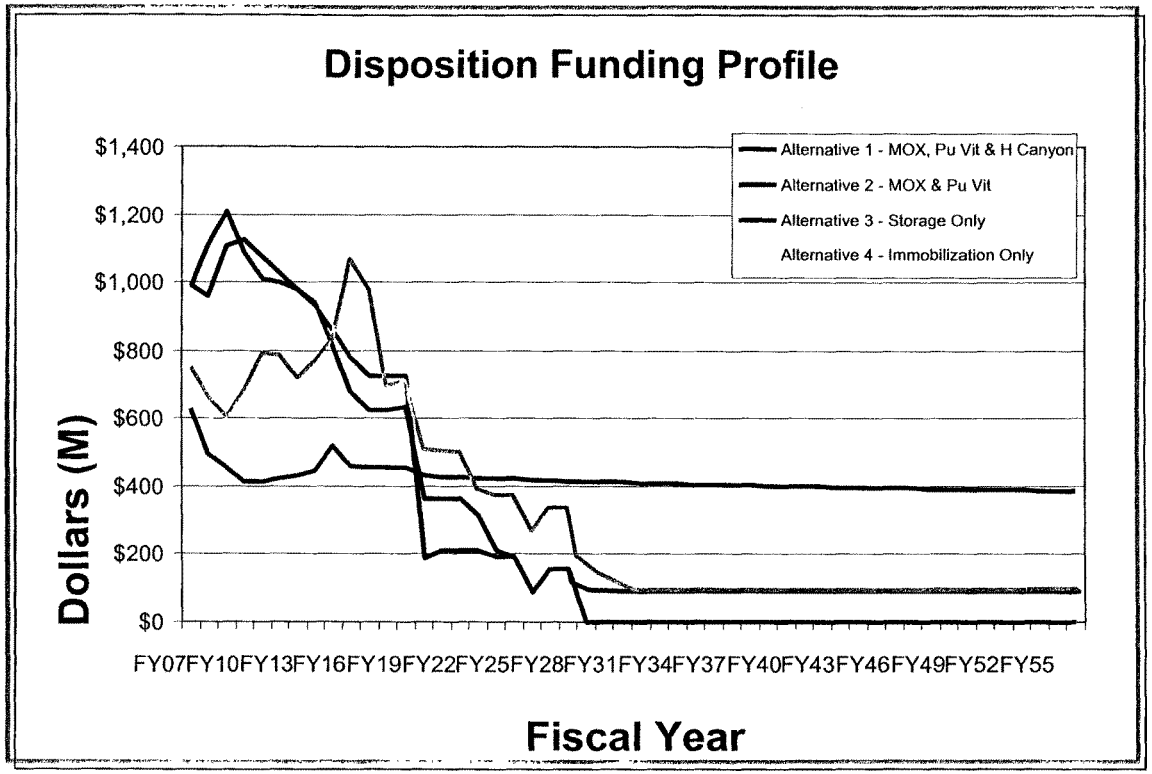
- Remaining design, construction and operating costs for MOX, PDCF and WSB including the revenue offsets resulting from the energy value of the plutonium and uranium. Approximately $3.9 billion is currently estimated for the MOX Facility which is in the final stages of independent validation[1];
- Design, construction and operations of a plutonium vitrification capability (currently estimated to be approximately $1.1 billion);
- H-Canyon operations;
- Special nuclear materials storage and security costs;
- Payments to the state of South Carolina.

This approach enables the conversion of 34 MT of weapon-grade plutonium into fuel for use in commercial nuclear power reactors by 2028; vitrification of 6-13 MT of "non-MOXable" plutonium by 2019; and processing of 26 MT of uranium and plutonium bearing materials also by 2019.

DOE is currently analyzing the costs for various other disposition alternatives other than the approach outlined above. Storage-only, which is estimated to be approximately $500 million per year, is the highest cost alternative in the long-term. This annual cost would continue indefinitely until a disposition pathway is developed. Remaining alternatives include variations of processing and disposition options, including immobilization of 50 MT of plutonium. DOE's preliminary results indicate that the total costs of all options are within 3% of one another, which is well within the amount of contingency for uncertainty that is normally associated with projects of this type (25%).

DOE has a high degree of confidence in the cost estimates for the three pronged disposition approach outlined above. Storage and operations costs of existing facilities are based on actual costs. Furthermore, the design of the MOX Facility is 85% complete and its cost estimate is based on a recent external independent review. Moreover, the Nuclear Regulatory Commission has reviewed the design of the MOX Facility and authorized the start of construction. Conversely, DOE has extremely low confidence in the estimates for the immobilization-only alternative since the estimate is based on data developed when the design was in its infancy more than six years ago. This estimate has been adjusted based on current design standards and cost data and takes into consideration DOE's recent experience with first-of-a-kind large projects, which greatly increases the error margin of the estimate.

Summary Cost Analysis of **Alternatives**
for Disposing of Special Nuclear Materials



Alternative	Results
Alternative 1: MOX, PDCF, WSB, Plutonium Vitrification and continued H Canyon/HB-Line Operations	- 34 MT weapons usable plutonium converted into commercial fuel - 6-13 MT non-MOXable plutonium vitrified for geologic disposal - Recovery of uranium from stored DOE SNF, surplus uranium materials, and pits for reuse in commercial fuel cycle - Near term disposition of plutonium though H-Canyon/HB-Line facilities - Results in fewest number of safeguards Category I storage facilities
Alternative 2: MOX, PDCF, WSB, and Plutonium Vitrification	- 34 MT weapons usable plutonium converted into commercial fuel - 6-13 MT non-MOXable plutonium vitrified for geologic disposal - Provide disposition path for high enriched uranium materials (non-SNF) through vitrification process - Recovery of uranium only from pits in PDCF for reuse in commercial fuel cycle - Establishes the capability to package all SNF for shipment to geologic repository
Alternative 3: Storage Only	- Material left stored in its current locations - Establishes the capability to package all SNF for shipment to geologic repository
Alternative 4: Plutonium Immobilization and PDCF	- Immobilizes all 50 MT plutonium and high enriched uranium materials (non-SNF) in ceramic matrix for geologic disposal - Establishes the capability to package all SNF for shipment to geologic repository

Alternative	Pros	Cons	Other Considerations
Alternative 1: MOX, PDCF, WSB, Plutonium Vitrification and continued H Canyon/HB-Line Operations	- Provides disposition path for all DOE SNM - Provides near term disposition of plutonium through H-Canyon/HB-Line facilities - Supports consolidation of SNM - Results in fewest number of safeguards category I storage facilities - Highest confidence in cost		- Meets the object of the statutory language for disposition/removal of materials in SC - Meets the objective of the statutory language to maintain H Canyon in an operable state
Alternative 2: MOX, PDCF, WSB, and Plutonium Vitrification	- Supports consolidation on SNM - Results in fewest number of safeguards category I storage facilities	- Does not maximize recovery of energy value of material - Requires capability to disposition SNF to geologic repository - Start of disposition on SNM does not occur until 2013	- Does not meet the objective of the statutory language to maintain H Canyon in an operable state
Alternative 3: Storage Only	- High confidence in cost	- Recovers no energy value from material - Does not support consolidation on SNM - Results in highest number of safeguards Category I storage facilities - May result in the State of SC seeking fines or other action	- Does not meet the objective of the statutory language for disposition/removal of materials in SC - May have to consider moving material out of SC - Does not meet the objective of the statutory language to maintain H Canyon in an operable state
Alternative 4: Plutonium Immobilization and PDCF	- Provides a disposition path for all 50 MT Pu and non-SNF HEU	- Essentially takes disposition program back to infancy stage - Reverts to immature technology requiring significant research and design - Does not recover energy value from the material - Does not support consolidation of SNM - Could result in the State of SC seeking fines or other action - Requires capability to disposition immobilized plutonium to geologic repository - Results in DBT upgrades needed for current storage facilities - Lowest confidence in cost	- Does not meet the objective of the statutory language for disposition/removal of materials in SC - May have to consider moving material out of SC - Does not meet the objective of the statutory language to maintain H Canyon in an operable state - Does not align with DWPF operations schedule at SRS, other alternatives (e.g., Hanford Waste Treatment Plant) would have to be considered - Does not take into consideration additional national repository costs associated with increase in materials

QUESTIONS AND ANSWERS SUBMITTED FOR THE RECORD

JULY 26, 2006

QUESTIONS SUBMITTED BY MR. EVERETT

Mr. EVERETT. According to the 1994 National Academy of Sciences study, the disposition method of immobilization was still in need of substantial research and development.

a. Has any progress been made since the 1994 study in the area of R&D for immobilization of plutonium?

Mr. BUNN. Yes. DOE made substantial progress in immobilization R&D before the Office of Fissile Materials Disposition terminated their effort. A variety of potential immobilization forms were considered, ending with the principal focus on the "can-in-canister" concept. In that concept, plutonium would be immobilized in ceramic pucks, which would be placed in cans, with the cans arrayed inside a canister that would be filled with high-level waste (HLW) glass, so that the final form would be an intensely radioactive HLW canister with immobilized plutonium embedded within it. Processes for carrying out this immobilization were designed and demonstrated, and conceptual designs and cost estimates were developed. The Office of Environmental Management has started some work of its own on immobilization, to address the impure plutonium for which it has responsibility, focusing on homogeneous immobilization of both plutonium and HLW in glass waste forms. Immobilization of plutonium remains somewhat less technologically mature than the MOX approach, but the difficulties of immobilization are more modest, since the immobilized forms do not require the kind of exactness and performance needed for nuclear reactor fuel.

Mr. EVERETT. b. How much R&D would be required today to implement vitrification as a primary method for U.S. domestic stores of plutonium?

Mr. BUNN. When the immobilization R&D program was terminated, an immobilization process had been developed and a conceptual design of an immobilization plant had been done. "Hot" testing combining both plutonium and HLW remained to be done. As of the FY 2001 budget request, DOE expected that physical construction of an immobilization plant at Savannah River could begin in the last quarter of FY 2003, and be completed in FY 2007—only one year behind the expectations at that time for the MOX facility. This suggests that DOE assessed at that time that only a modest amount of R&D work remained to be done. Arguably, however, the cost growth and delays that tend to occur as a program moves from conceptual design to full design and construction have already largely occurred for the MOX program, but have not yet occurred for immobilization; it may well be that the estimated cost and schedule for immobilization would increase if the program were reinstated and moved toward full construction.

Mr. EVERETT. c. What are the biggest technical challenges remaining in the development of immobilization technology?

Mr. BUNN. As noted above, for the can-in-canister approach, most of the fundamental technical issues have been addressed, though further testing is still required and might surface additional issues. The biggest technical challenges are in the real engineering and construction of full-scale facilities. Homogeneous approaches may be somewhat less mature. A National Academy of Sciences review did raise questions about how difficult it would be for adversaries to recover plutonium from the can-in-canister form; resolving these questions, if judged essential, would require a modest amount of additional testing.

There is a significant practical challenge that faces both options, if they are to be applied to the entire U.S. stockpile of excess plutonium, and that is the availability of sufficient HLW to be immobilized with the plutonium. If immobilization of HLW proceeds at Savannah River as DOE hopes, and immobilization of plutonium takes as long to begin as DOE expects, there will not be enough HLW remaining at Savannah River for immobilization of the entire stockpile of U.S. plutonium. This could be addressed in a variety of ways. DOE could examine options including a modest delay of HLW immobilization at Savannah River; building plutonium immobilization facilities at Hanford rather than Savannah River, to take advantage of the HLW immobilization planned there; and whether Cs–137 capsules in storage could be made available safely and in sufficient quantity to supplement the available radiation barrier for immobilization. In addition, if DOE decides to reprocess the re-

search reactor fuels now being returned from abroad, this will result in a significant additional amount of HLW which could be immobilized with the plutonium.

Mr. EVERETT. Were there any options besides immobilization and MOX that were considered? Why were they rejected as less promising by the NAS?

Mr. BUNN. The NAS report *Management and Disposition of Excess Weapons Plutonium* considered a wide array of options for disposition of excess weapons plutonium, including a variety of advanced reactors and a wide range of disposal options, from launching the material into space to burying it in deep boreholes to diluting it in the ocean. The committee recommended that options be pursued which could transform the plutonium into forms that posed no more security risk than the much larger quantity of plutonium that already exists in spent fuel from commercial power reactors; could do so while meeting very high standards of security, complying with all applicable environment, safety, and health regulations, and without imposing substantial additional environmental burdens; could do so reasonably quickly and with reasonably high confidence; and, within those constraints, could do so at the lowest cost. All of the options examined raised issues and potential difficulties. The committee concluded that the options with the least substantial drawbacks were use of the plutonium as MOX in reactors that already exist, and immobilization of the plutonium with high-level wastes.

Mr. EVERETT. The disposition method of immobilization might take many different forms. How does vitrification compare with other forms of immobilization, both technically (such as use of a ceramic rather than glass matrix) and practically (such as quantities and forms of plutonium to which it could be applied)?

Mr. BUNN. DOE has examined a variety of forms of immobilization, including (a) homogeneous vitrification, with both plutonium and HLW mixed together in a glass matrix; (b) homogeneous immobilization in ceramic, with both plutonium and HLW mixed together in a ceramic matrix; (c) ceramic "can-in-canister," in which the plutonium would be immobilized in ceramic pucks, which would be placed in cans inside large canisters of glass containing HLW; and (d) glass can-in-canister, in which the plutonium is immobilized in glass cans, which are arrayed inside the HLW canisters. Ceramic can-in-canister approaches have significant advantages if all of the excess plutonium is to be immobilized, as the ceramic forms are projected to have excellent long-term repository performance; the immobilization process can be designed specifically for plutonium, without the complication of having to also be applicable to a wide range of fission products in HLW; and the process need not significantly interfere with ongoing immobilization of HLW. As noted earlier, however, questions have been raised about whether adversaries might be able to remove the cans from the canisters and then recover the plutonium from the HLW-free pucks somewhat more easily than they could recover plutonium from spent fuel (though in general the chemical process for recovery of plutonium from the ceramic forms would be somewhat more challenging for adversaries than the process for recovering plutonium from glass). Vitrification may have some advantages for immobilizing a modest portion of the total plutonium in the DOE inventory, as it is conceivable that existing facilities at Savannah River could be used for this moderate-scale immobilization. Homogeneous immobilization of plutonium with HLW, however, is somewhat less technically mature than the can-in-canister approach. In my judgment, it is likely that any of these approaches could be developed into an acceptable approach for disposition of excess plutonium.

Mr. EVERETT. The disposition method of immobilization might take many different forms. How does vitrification compare with other forms of immobilization, both technically (such as use of ceramic rather than glass matrix) and practically (such as quantities and forms of plutonium which it could be applied)?

Mr. ANDERSON. Ceramic and glass are both material forms that can be used to stabilize, or "immobilize" plutonium to make it into a form suitable for disposal in a geologic repository. Both immobilization methods have technical advantages and disadvantages. To immobilize smaller quantities (6–13MT) of highly impure, non-MOXable plutonium, glass vitrification is the more suitable option. Correspondingly, ceramic immobilization would most likely be the more suitable option for the disposition of the entire inventory (approximately 50 MT) of surplus plutonium for disposal as waste.

Vitrification using a lanthanide borosilicate glass has recently been identified as the preferred technology to immobilize 6–13MT of plutonium not suitable for use as MOX fuel. Vitrification is more tolerant of variations in feed material when compared to the ceramic process. During ceramic processing, consistency would be achieved by controlling feed material inventory and pre-blending pure and impure plutonium. Given the uncertainties with how much pure and impure plutonium will be processed and the quality of the existing material characterization data, vitrification technology is preferred. The principal technical risk identified with vitrification

ten years ago when ceramic immobilization was favored was design and operation of a reliable melter. Subsequent follow-on development efforts for vitrification have mitigated that risk. Furthermore, the infrastructure supporting the ceramic technology for plutonium disposition was dismantled following cancellation in 2002 of the ceramic immobilization disposition strategy, while the DOE infrastructure for glass vitrification technology continues today (for example, Defense Waste Processing Facility, Waste Treatment Plant).

Conversely, if the Department chose to immobilize the entire inventory of surplus plutonium (approximately 50 metric tons), there would be sufficient inventory of pure plutonium to enable achievement of the appropriate consistency through the blending process. Ceramic immobilization could contain as much as twice the amount of plutonium per unit volume as glass, and therefore result in fewer containers of immobilized waste. In addition, if the Department were to proceed with immobilization of the entire inventory of surplus plutonium, the infrastructure associated with developing the ceramic technology would need to be reinstated, and research and development would be reinitiated.

Mr. EVERETT. The Department is currently pursuing a three-pronged approach to plutonium disposition: MOX for 34 metric tons, H Canyon processing for 2 metric tons, and vitrification for the remaining 6–13 metric tons of non-MOXable plutonium. Could vitrification as planned be used to immobilize all of the Departments' excess plutonium? Would it be a more cost-effective approach to pursue a single disposition method such as vitrification for all excess plutonium?

Mr. ANDERSON. If the Department were directed to divert from its current plan and immobilize the entire inventory of surplus plutonium, glass vitrification would most likely not be the preferred technology. Additionally, the Pit Disassembly and Conversion Facility would be needed to convert plutonium from pits into an oxide to prepare it for immobilization, regardless of the technology chosen. The Department is developing a cost comparison of special nuclear materials (Pu and HEU) disposition alternatives whose preliminary results indicate immobilization using ceramic is comparable in cost to the currently planned three-pronged approach. The Department has a higher confidence in the estimate for the three-pronged approach versus immobilization, which is based on an updated estimate of the Plutonium Immobilization Plant that was cancelled in 2002 upon completion of conceptual design only. Conversely, the currently planned three-prong approach is based on historical operating costs for H Canyon, and design that is almost completed for the MOX facility.

Mr. EVERETT. Liability issues that had stalled Russian action towards plutonium disposition were resolved in negotiations in July 2005, but as of August 2006 a final liability resolution had yet to be signed. What has delayed signing of the final liability agreement for the past year? When do you expect the final liability agreement will be signed?

Ambassador GUHIN. I am pleased to confirm, as announced by the Departments of State and Energy, that the liability protocol for plutonium disposition was signed by the United States and Russia on September 15. A number of factors appear to have prolonged Russian consideration of the text negotiated in July 2005. It required wide interagency and highest-level review in the Russian Government, and the meticulously crafted formulations required additional time to conform precisely into Russian. Moreover, Russia had suggested that it saw no programmatic urgency pending definition of its program and U.S.-Russian agreement on areas of cooperation. Talks on these are actively underway.

Mr. EVERETT. Today, how are Russia's views on the acceptability of vitrification as a disposition method for plutonium similar to or different from those of the U.S.? How should consideration of Russia's views affect U.S. decisions on domestic plutonium disposition pathways? Would you anticipate any potential diplomatic drawbacks should the U.S. change the domestic plutonium disposition path from MOX to immobilization?

Ambassador GUHIN. Russia has consistently, since the mid-1990's, opposed vitrification as a disposition method for any Russian plutonium to be disposed under its program. Also, in negotiations of the 2000 Agreement, the Russian side opposed the United States utilizing vitrification for more than a quarter of its obligation since the weapon-grade plutonium itself would not be degraded. We do not believe Russia has changed its positions on these matters.

As a general rule, each country should make decisions on what disposition course is best for it to pursue on their own merits. However, such decisions should take into account the broad picture, including especially in this instance the non-proliferation benefits of converting Russian excess weapons plutonium into proliferation-resistant forms.

Having pursued a plutonium disposition approach based largely on MOX for more than half a decade, a shift in the U.S. position from MOX to all immobilization would likely have significant diplomatic drawbacks. It would present a new set of problems for Russia, putting at risk this critical non-proliferation project itself. It could also signal to other G–8 supporters a lack of U.S. resolve and determination. I would defer to DOE for the technical and programmatic issues associated with immobilization.

QUESTIONS SUBMITTED BY MR. SPRATT

Mr. SPRATT. How much money has been spent to date on the MOX program? (i.e. what are the sunk costs?)

Ambassador BROOKS. The Department has spent approximately $700 million on the design of the U.S. MOX facility and site preparation activities as of July 31, 2006.

Mr. SPRATT. How much money is available unexpended in the MOX account currently?

Ambassador BROOKS. As of July 31, 2006, approximately $500 million is unobligated, and we expect to obligate an additional $215 million by the end of FY 2006. However, to support starting construction of the MOX facility in 2006 and to continue the construction effort we will need all of the FY 2006 unobligated balances as well as the requested FY 2007 construction funding. We expect to obligate all prior year funding in FY 2007 and do not expect to carry over any unobligated balances into FY 2008.

Mr. SPRATT. (a) What would the termination costs be if the MOX program were discontinued?

Ambassador BROOKS. Both the prime contract between the Department and the MOX contractor, Duke Cogema Stone & Webster (DCS), and the subcontract between DCS and Duke Power contain the mandatory Federal Acquisition Regulation clause on Termination for Convenience (FAR 52.249–6). The clause provides for payment of all allowable and allocable costs incurred by the contractor and subcontractor as a result of the termination, up to the date of termination. These may include severance costs, subcontract termination costs, and associated administrative costs. Termination of the prime contract between the Department and DCS would likely result in substantial termination costs, due to the large number of employees working on the contract; however, termination of the subcontract would not likely result in substantial costs.

Although the standard termination clause does not provide for liquidated damages, the subcontract between DCS and Duke Power does provide for liquidated damages to be paid by DCS if delivery of the MOX fuel is delayed beyond 2007. The amount to be paid to Duke Power is based on the value of lost fuel savings, because Duke would need to procure other fuel under contracts with shorter-than-usual lead times or on the spot market.

Mr. SPRATT. (b) It is my understanding that Russia prefers to dispose of its 34 tons of plutonium using so-called "fast reactors." Are there any proliferation concerns associated with these fast reactors? What drawbacks are there from Russia's use of fast reactors to dispose of plutonium as compared with light water reactors as was originally planned?

Ambassador BROOKS. The Russian Government has not yet made a final decision on the types of reactors it will use for its plutonium disposition program. However, if the Russian Government chooses to use fast reactors rather than light water reactors for plutonium disposition, we do not see any proliferation concerns as long as these reactors are configured as burners rather than breeders of plutonium. In fact, fast reactors (configured as burners) are capable of consuming more plutonium more quickly than light water reactors, therefore achieving a greater non-proliferation benefit. We are working with Russia to convert the BN–600 fast reactor from a breeder to a burner of plutonium, which will allow it to be used to begin disposing of a small quantity of Russia's plutonium several years ahead of the U.S. program.

Mr. SPRATT. What is the expected date for completion of all processing of MOX fuel at Savannah River Site?

Ambassador BROOKS. If Congress approves the Department's funding request for fissile materials disposition in FY 2007 and the out years, the MOX facility will complete fabricating 34 metric tons of surplus weapon-grade plutonium into MOX fuel by approximately 2039. However, it is possible that the MOX facility could be operated longer to dispose of additional amounts of weapon-grade plutonium that may be declared surplus in the future.

Mr. SPRATT. How much plutonium is currently stored at Savannah River Site?

Mr. ANDERSON. The Department has plutonium stored in approximately 2,800 DOE Standard 3013 (DOE–STD–3013) containers at Savannah River Site. DOE–STD–3013 is DOE's standard for long-term storage of plutonium, and each 3013 container has a maximum capacity of 4.4 kilograms of plutonium, although very few containers actually have the maximum amount of plutonium.

Mr. SPRATT. It is my understanding that immobilization uses vitrified high level waste to encase plutonium in glass for long term storage. If all the plutonium at Savannah River Site is slated for immobilization, is there enough high level waste to do the job?

Mr. ANDERSON. In immobilization, whether using a glass or ceramic matrix to first immobilize plutonium in small containers, high activity radioactive liquid waste is then used to encase the smaller containers of plutonium. There is sufficient liquid waste at the Savannah River Site to immobilize the current inventory of plutonium. There is also sufficient liquid waste inventory at Savannah River Site to immobilize the inventory of non-pit surplus plutonium, estimated at 13 MT located at DOE sites across the complex. However, it is expected that some of this plutonium can be used in the MOX program (the exact amount is not known at this time due to lack of chemical data).

If immobilization were chosen to dispose of the entire inventory of surplus plutonium (approximately 50 metric tons), there is not sufficient inventory of radioactive liquid waste at Savannah River Site to continue operation of the Defense Waste Processing Facility to immobilize the entire amount. Thus, subject to appropriate review under the National Environmental Policy Act and compliance with other applicable laws, it would be necessary to consider siting of a "whole surplus inventory" immobilization facility at Hanford, where the Waste Treatment Facility is currently under construction and expected to operate during the relevant timeframe, and with sufficient quantities of high activity waste, to immobilize the entire surplus inventory of plutonium.

Mr. SPRATT. If the MOX program were to be terminated today, when can we expect processing of plutonium at Savannah River Site through immobilization or another disposition path to begin?

Mr. ANDERSON. If the Department were directed to terminate the MOX project and initiate a new project to immobilize the entire inventory of surplus plutonium, it is estimated that a plutonium immobilization facility could be operational by 2019, based on a reasonable project schedule and a project start in FY 2007. This estimated schedule is speculative at this point in time and is based on the knowledge gained during conceptual design of the previous immobilization project, which was terminated in 2002.

Mr. SPRATT. If we use immobilization only, when could we expect all processing of plutonium to be completed?

Mr. ANDERSON. The Department projects that operation of an immobilization facility to immobilize the entire surplus plutonium inventory would take approximately ten years, and be completed in approximately 2028 based on a reasonable project schedule and a project start in FY 2007.

Mr. SPRATT. Do we expect that Russia would pursue fast reactor technology separate of international assistance?

Ambassador GUHIN. Russia has asserted in its nuclear energy statements and plans that it will continue to pursue fast reactor technology on its own, and this interest is manifested in its budget statements.

Mr. SPRATT. If Russia will pursue fast reactors with or without international funding, what benefits would the international community derive from investment in developing such a facility?

Ambassador GUHIN. The United States and other potential donors have consistently opposed utilization of any reactors for disposition if they are operated as breeders and have stressed that disposition cooperation as such will not extend to assistance in construction of any new Russian power reactors. From the disposition perspective, namely reducing the production of and eliminating excess separated weapon-grade plutonium, benefits could accrue from using such reactors only if Russia were to agree that its new fast reactors would be operated as burners—and not net breeders—of such plutonium and be subject to the pertinent conditions of the 2000 U.S.-Russian Agreement. Disposition cooperation between the two countries has for years included consideration of modifying Russia's existing fast reactor to be a net burner of plutonium as part of Russia's disposition program, but Russia has not indicated similar intentions with respect to fast reactors that it intends to bring on line in the future.

Mr. SPRATT. What safeguards (i.e. monitoring and inspections) has Russia agreed to regarding its plutonium disposition facilities? What can be done to encourage more progress in this area?

Ambassador GUHIN. The 2000 U.S.-Russian Agreement codifies a number of agreed and important monitoring and inspection principles and conditions. As stipulated in that agreement, we have been working with Russia on translating those principles into an agreed set of monitoring and inspection procedures. Such procedures must be completed prior to any assistance being used for the actual construction of any industrial-scale facility in Russia. We have made good progress in identifying key elements of a framework for a monitoring regime, including involvement of the International Atomic Energy Agency, but have yet to resolve a central monitoring issue related to confirming Russia's disposition of plutonium. We are continuing to work with Russia on this matter and expect to make progress when the two sides reach agreement on the broader issues concerning a modified Russian program and international cooperation with it.

Mr. SPRATT. How much funding has Russia committed to its own plutonium disposition program to date?

Ambassador GUHIN. To date, Russia has not committed or identified any significant Russian funding for a Russian disposition program, and this has been a paramount area of contention between Russia and potential donors, including the United States. The United States and others have for years insisted that a viable long-term program requires substantial Russian investment (political, financial and technical). We are continuing to work with Russia on reasonable burden-sharing principles and approaches for a modified Russian program.

QUESTIONS SUBMITTED BY MR. TURNER

Mr. TURNER. Cost estimates have grown from $1B in 2001 to $4.7B in summer of 2006, and that is before construction has ever started. This is only the estimate for construction up through cold start—it does not include the costs of hot commissioning, the cost of operations, the cost to decontaminate and decommission the plant, and the cost to subsidize Duke Power to burn MOX fuel. What is the total cost estimate for the MOX program goal of disposing of 34 metric tons of U.S. surplus plutonium?

Ambassador BROOKS. The plutonium disposition program involves three facilities at the Savannah River Site: a MOX Fuel Fabrication Facility, a Pit Disassembly and Conversion Facility (PDCF) and a Waste Solidification Building (WSB). The total lifecycle cost estimate for all three facilities is approximately $11 billion (including sunk costs). This includes a total project cost for the MOX facility (design, construction, and cold start-up) of $4.7 billion, which has been independently reviewed but cannot be validated until uncertainty with regard to DOE's FY 2007 budget request for fissile materials disposition is resolved. This cost estimate is comparable with immobilization and is less than the cost of storage, which is estimated to cost between $400–$500 million per year and still requires disposition facilities to be built and operated.

With regards to arrangements for Duke Power to irradiate the MOX fuel, Duke Cogema Stone & Webster (DCS) has negotiated a subcontract with Duke Power which, based on the current price of uranium fuel, would require the utility to pay approximately $1 billion over the life of the plutonium disposition program. These payments would be made to the U.S. treasury, and have not been used to offset the cost of operating the MOX facility.

Mr. TURNER. The most optimistic DOE scheduling case for beginning MOX production is an operational plant in 2015. The State of South Carolina has stated that it will not accept additional plutonium coming into the State until MOX is operational and MOX fuel begins to leave the State.

Is it your position that South Carolina should block any shipments of special nuclear materials into the Savannah River Site until the MOX plant is operational?

Ambassador BROOKS. No. Given current funding limitations, the MOX facility is not expected to begin operations until 2016. Nevertheless, DOE believes that it should retain the ability to transfer special nuclear materials to the Savannah River Site, as necessary, consistent with its commitment to surplus special nuclear material consolidation and disposition, its obligations to the State of South Carolina, and applicable law.

Mr. TURNER. Is the Federal government willing to bring cleanup, material consolidation efforts at other sites (e.g., Hanford) to a standstill until 2015?

Ambassador BROOKS. As stated above, the Department remains committed to the consolidation of surplus special nuclear material. This commitment will enable the continued cleanup at sites such as Hanford.

Mr. TURNER. The Government will not have MOX operational until 2015 at the earliest, yet the statutory provision (even with the amended dates) begins to levy

fines totaling $100,000,000 a year against the Federal government in 2012 if the MOX production goal is not achieved by 2014. How does the Administration plan to deal with these pending fines—seek legislative relief from the fine provision, or pay the fines to the State?

Ambassador BROOKS. In addition to resetting the schedule in Public Law 107–314, the FY 2006 Energy and Water Appropriations Act directed the Department to prepare and submit to Congress a new baseline schedule for the MOX facility by the end of this year. This new baseline will take into account all relevant factors, including the FY 2007 funding level approved by Congress. This baseline will permit Congress and the Administration to consider what, if any, additional changes should be made to the statutory framework for the MOX facility.

Mr. TURNER. Without Yucca Mountain, there is no path out of South Carolina for plutonium (either in MOX fuel form or vitrified form). Under the latest DOE schedule, the Yucca Mountain repository will not become operational in 2017 at the earliest. Does South Carolina contend that it should be able to fine the federal government, even if we built the MOX plant, because the resulting MOX fuel would still remain in the State?

Ambassador BROOKS. We are unable to speculate about the position of the State of South Carolina. Public Law 107–314, as amended, however, does not impose any fines on DOE if the production objective is met, even if the MOX fuel remains in the State.

Mr. TURNER. The MOX plant is presently designed only to handle weapons-origin plutonium. In the original incarnation of the Global Nuclear Energy Partnership (GNEP), DOE had concluded (as had the Russian government) that MOX was an obsolete and ineffective technology. Under the latest version of GNEP, the Department is now recommending that we implement existing technology to begin recycling spent fuel in the near future (i.e.,. separation using PUREX or UREX+, MOX plant, and burning MOX fuel in existing U.S. light water reactors). For a price tag that will certainly be excess of $5B, should we be designing a MOX plant that will be dual-use and could also process commercial spent fuel?

Ambassador BROOKS. Without significant study we are unable to estimate what it would cost to convert the MOX facility to handle commercial reactor-grade fuel. However, if a decision were made prior to start of MOX construction, we estimate it would take several years to modify the design and relicense the facility with the Nuclear Regulatory Commission, and cost hundreds of millions of dollars. If a decision were made to convert the MOX facility after completing the 34 MT mission, the impacts would be more significant.

With respect to the latest version of GNEP, the Department plans to recycle spent fuel using an Advanced Burner Reactor and a Consolidated Fuel Treatment Facility. The baseline strategy for GNEP does not include a MOX plant or burning MOX in existing light water reactors.

Mr. TURNER. Scale of plant—$5B plus for a plant that will only process 34 metric tons is excessive when the 34 metric tons of plutonium represents only a fraction of the total inventory of surplus plutonium. This large an investment only makes sense if the MOX plant processes additional weapons plutonium or serves as a dual-use facility for civilian fuel as well. Is the Administration considering additional plutonium that could be dispositioned through a MOX plant?

Ambassador BROOKS. The U.S. MOX facility is nominally designed for a 20-year life but this could be extended to process additional quantities of weapon-grade plutonium expected to result from future weapons dismantlements. As noted previously, processing plutonium from commercial SNF would significantly increase the cost of the MOX facility.

Mr. TURNER. Several factors have changed significantly in recent months—the costs for MOX have grown dramatically, the Russian government has abandoned MOX as a strategy for disposing of excess Russia plutonium, and the U.S. has launched its GNEP initiative. All of these developments call into question the wisdom of building a MOX plant, as originally envisioned solely for processing 34 metric tons of excess U.S. plutonium, without some analysis that supports the change in program strategy. Is the Department going to submit to Congress any documentation that provides the cost analysis that demonstrates this is the most efficient path forward for material disposition?

Ambassador BROOKS. DOE has evaluated a range of alternatives to determine if changes or redirection should be made in its planned disposition approach. This evaluation includes alternatives for disposing of about 50 metric tons of both weapon-grade and non-weapon-grade plutonium and about 25 metric tons of surplus highly enriched uranium (HEU) that currently lacks a disposition path (including spent nuclear fuel). Preliminary results of this analysis suggest that costs and other considerations of the current approach to plutonium disposition compare favorably

with other alternatives. A report on this analysis has been provided to the committees of jurisdiction.

Mr. TURNER. Have the costs, dangers, and community concerns of the need to transport radioactive materials to the Savannah River Site (SRS) for disposition been considered? What precautions are being made to ensure transfer safe from both potential accidents and terrorist plots?

Ambassador BROOKS. As a matter of routine, the National Nuclear Security Administration's Office of Secure Transportation (OST) conducts in-depth safety analyses, vulnerability analyses, threat assessments, and security analyses of the Transportation Safeguards System (TSS). These analyses provide high confidence in the TSS's ability to successfully perform its mission. Extensive training is provided to the federal agents assigned the responsibility of transporting nuclear material. Routine route surveys are conducted for both safety and security. The TSS is independently validated annually to ensure it can defend shipments from terrorist attacks. The TSS has operated over 100 million miles without the loss of a nuclear weapon or dispersal of nuclear material. Additionally, OST's liaison program routinely meets with personnel in law enforcement and emergency management as identified by the governors of the states where OST travels.

Mr. TURNER. The international community, including the U.S., was to share in the cost to build the Russian MOX plant. Now that Russia has abandoned MOX for light water reactors and intend to pursue a fast reactor strategy, do we know whether any international partners will provide financial support for fuel fabrication for Russian fast reactors (which many European countries equate to breeder reactors which produce more plutonium)?

Ambassador BROOKS. The United States and its international partners would not support Russia's use of fast reactors unless the reactors were reconfigured as "burners." Unlike "breeders," these reactors consume more plutonium than they produce. DOE and Rosatom technical experts are currently evaluating how best to make this modification to Russia's existing BN–600 fast reactor. Reconfiguring the BN–600 reactor in this manner has long been a part of Russia's plutonium disposition program and is specifically allowed in the 2000 Plutonium Disposition Agreement. As a result, our G–8 partners remain committed to providing funds for fuel fabrication for Russian fast reactors configured as burners and no international pledges have been withdrawn.

Mr. TURNER. Even with the new fast reactor strategy, Russia will still need to build a plant to fabricate fuel to burn in the fast reactors. Given that the cost of the U.S. MOX has increased to nearly $5B, is the same true of the Russia fuel fabrication plant? If so, what share will the U.S. have to pay for the Russian fuel plant?

Ambassador BROOKS. There are no plans to increase the current U.S. pledge of $400 million. The cost of a Russian fuel fabrication facility cannot be estimated until Russia determines the reactors and fuel fabrication technology it plans to use for its disposition program.

Mr. TURNER. Considering that the U.S. is further along than Russia in implementing the Plutonium Management and Disposition Agreement (PMDA) signed by the U.S. and Russia in 2000, what specific actions can we look to for assurance that Russia is committed to plutonium disposition besides the joint statement affirming commitment signed by both countries on July 12, 2006? What are you doing to ensure that Russia is financially committed to providing the resources needed to complete plutonium disposition? What can be done to ensure that Russia follows through on its commitments?

Ambassador BROOKS. In addition to recent statements by President Bush and President Putin, and by Secretary Bodman and Rosatom Director Kiriyenko, Russia has committed to explore the use of its one existing fast reactor to begin disposing of approximately a third of a metric ton of plutonium per year several years before the U.S. plans to begin disposing of our own plutonium. Russia is developing a technical plan for its full 34 metric ton plutonium disposition program, which we expect the Russian Government to submit in December. We anticipate the Russian scenario to be consistent with its long-term nuclear strategy and therefore we fully expect Russia to support implementation both politically and financially.

Mr. TURNER. In your testimony you addressed Russia's desire to use advanced reactors (BN–800 fast-neutron reactors) as opposed to existing light water reactors to disposition plutonium. Mr. Bunn testified that BN–800 reactors, as traditionally designed, produce more weapons-grade plutonium than they consume. Considering this fact, would that not raise serious concerns for you as the U.S. plans to continue discussions with Russia about this possibility in August? Should the U.S. not focus on methods that render plutonium useless for weapons purposes?

Ambassador BROOKS. We are unable to speculate about plans for Russia's yet-to-be completed BN–800 reactor. However, the United States and our international partners would not support Russia's use of a Russian fast reactor configured as a breeder for plutonium disposition purposes.

Mr. TURNER. DOE, per Congressional direction, will be conducting a competition to host one or more integrated recycling centers to process spent commercial fuel. Interim storage, or process storage, of spent fuel will be an essential first step for any site that hopes to host the integrated recycling facility. Does South Carolina intend to compete for the integrated recycling facility and is it willing to accept interim storage of spent fuel as part of the package deal?

Mr. ANDERSON. DOE does not know whether South Carolina intends to compete for the integrated recycling facility or if it is willing to accept interim storage of spent fuel as part of a package deal.

Mr. TURNER. In his testimony, Mr. Matthew Bunn proposed consideration of the all-immobilization option for plutonium disposition. Would you please expand on DOE's decision to focus on MOX efforts? Would you please also address in more detail the cost analysis of this decision?

Mr. ANDERSON. DOE is evaluating a range of alternatives to determine if changes or redirection should be made in its planned disposition approach. This evaluation includes alternatives for disposing of about 50 metric tons of both weapon-grade and non-weapon-grade plutonium and about 26 metric tons of surplus highly enriched uranium (HEU) that lacked a disposition path (including certain spent nuclear fuel). Preliminary results of this analysis suggest that costs and other considerations of the current approach to plutonium disposition are comparable with other alternatives.

The Department's commitment to the current approach and plan for disposing of plutonium, which includes the MOX facility, the operation of H Canyon and the vitrification of non-MOXable plutonium is based on several factors: it provides a disposition path for all known inventories of surplus plutonium and uranium; it meets the objectives of the U.S. non-proliferation policy, including meeting the objectives and commitments in the 2000 U.S.-Russia Plutonium Management and Disposition Agreement; it provides a beneficial reuse of weapons grade plutonium (and highly enriched uranium) through its fabrication into fuel for irradiation in commercial nuclear reactors; it supports and enables proposed materials consolidation and Complex 2030 objectives; and provides the highest confidence in the cost estimates.

An immobilization only option has the highest uncertainty in terms of cost. DOE would likely choose ceramic immobilization if it were decided not to pursue MOX and instead prepare the entire inventory (approximately 50 MT) of surplus plutonium for disposal as waste. The timeframe needed to complete research and development, design, construction and startup of an immobilization facility would result in the facility operating past the projected completion of the Defense Waste Processing Facility at Savannah River Site. Thus, subject to appropriate review under the National Environmental Policy Act and compliance with other applicable law, it would be necessary to consider siting of the "whole surplus inventory" immobilization facility at Hanford, where the Waste Treatment Facility, the only other facility that will vitrify radioactive liquid waste. Additionally, the Pit Disassembly and Conversion Facility would be needed to support the disposition of special nuclear materials.

Mr. TURNER. The international community, including the U.S., was to share in the cost to build the Russian MOX plant. Now that Russia has abandoned MOX for light water reactors and intends to pursue a fast reactor strategy, do we know whether any international partners will provide financial support for fuel fabrication for Russian fast reactors (which many European countries equate to breeder reactors which produce more plutonium)?

Ambassador GUHIN. The United States and other potential donors have consistently opposed utilization of any reactors for disposition if they are operated as breeders of weapon-grade plutonium, but have supported their utilization if they are modified to operate as net burners of such plutonium. Other potential donors have stressed over the years, as has the United States, that the key goal is the transparent, effective and safe disposition of excess Russian weapon-grade plutonium under appropriate conditions. For most, if not all donors, I believe reactor and technology choices are secondary considerations, as long as those choices define a viable program and do not include disposition cooperation for any reactor operated as a net breeder. I would add that, based on several indications, we do not believe Russia has abandoned consideration of MOX for light water reactors, and it appears to have some potential interest in that approach.

Mr. TURNER. Even with the new fast reactor strategy, Russia will still need to build a plant to fabricate fuel to burn in the fast reactors. Given that the cost of

the U.S. MOX has increased to nearly $5B, is the same true of the Russia fuel fabrication plant? If so, what share will the U.S. have to pay for the Russian fuel plant?

Ambassador GUHIN. U.S. contributions for support of a Russian disposition program are capped at $400 million, the amount previously pledged. Also, we do not expect any significant increase in other G–8 pledges, totaling about another $400 million. Russia would have responsibility for covering all costs of its program that are not included in the agreed and capped areas for donor support. The United States and other G–8 partners have stressed that for any program to be viable, substantial Russian investment is required and discussions are proceeding with Russia on these key matters.

Mr. TURNER. Considering that the U.S. is further along than Russia in implementing the Plutonium Management and Disposition Agreement (PMDA) signed by the U.S. and Russia in 2000, what specific actions can we look to for assurance that Russia is committed to plutonium disposition besides the joint statement affirming commitment signed by both countries on July 12, 2006? What are you doing to ensure that Russia is financially committed to providing the resources needed to complete plutonium disposition? What can be done to ensure that Russia follows through on its commitments?

Ambassador GUHIN. The Liability Protocol for Plutonium Disposition was signed on September 15th. The key next actions will be reaching agreement and decisions by the governments on a modified Russian program and cooperation with it, including resolution of outstanding financial and monitoring issues, and application of the liability protocol. To these ends, State and DOE have been engaged with Rosatom and other potential donors on related policy, program, legal and technical considerations.

Since early this year, we have been seeking to ensure Russia's investment by working with it to identify its own preferred program that is more consistent with its nuclear energy strategy and goals. We can have reasonable confidence that Russia will follow through when it defines a program that meshes with its strategies and interests (political, energy and technical) and commits politically and financially to it. U.S. leverage in this regard is at best limited, and linkages of U.S. program schedules to Russian program schedules has been and, if continued, surely will be counterproductive to U.S. interest in converting this most readily usable, nuclear-weapon material.

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