[redacted]

POLICY ISSUE
(Notation Vote)

July 14, 1992 SECY-92-244

For: The Commissioners

From: James M. Taylor
Executive Director
for Operations

Subject: UPDATE ON DISPOSITION OF THE WEAPONS GRADE NUCLEAR MATERIAL FROM DECOMMISSIONED NUCLEAR WEAPONS (U)

Purpose: To advise the Commissioners of additional staff analysis and provide a recommendation on an issue with potential national policy implications concerning the disposition of large quantities of weapons grade special nuclear material (SNM) resulting from dismantlement of nuclear weapons.

Background: Prompted by United States and Russian announcements of their intentions to dismantle part of their existing nuclear warhead inventories, the staff prepared an information paper for the Commission, dated February 25, 1992, concerning the disposition of the excess SNM reclaimed from the disarmament program (SECY-92-064, "Disposition of the Weapons Grade Nuclear Material From Decommissioned Nuclear Weapons").

Contact:
Philip Ting, NMSS
504-3379

NATIONAL SECURITY INFORMATION

Unauthorized disclosure subject to Administrative and Criminal sanctions.

Classified By SSD Program
( ) Declassify on _____ **(date or event)**
(X) Originating Agency's Determination Required
Derivative Classifier: Elizabeth Q. Ten Eyck
Elizabeth Q. Ten Eyck
Deputy Director
Division of Safeguards &
Transportation, NMSS

[redacted]

SECY-92-064 provided information on:

(1) interagency discussions in the disarmament context,

(2) technologies and facilities available for conversion of SNM metals to light water reactor (LWR) fuel,

(3) the Nuclear Regulatory Commission's readiness to respond to the national initiative to dismantle existing nuclear weapons, and

(4) possible alternatives in national policy formulation.

Also, the staff presented three options for Commission consideration and recommended a moderate option of staff actively monitoring the pertinent activities taking place in other Federal agencies and interacting with them as appropriate.

A memorandum dated April 1, 1992, from Samuel Chilk to James Taylor (COMKR-92-001) stated that, as further internal and external discussions clarify the issues and options, the Commission has requested that SECY-92-064 be reviewed and resubmitted as a notation vote so that the Commission can act on more specific recommendations.

Accordingly, this paper provides an update of the subject issue, as well as further staff analysis of possible options and a more specific recommendation.

Summary: A U.S.-Russian cooperative effort is underway to address the issue of disposition of large quantities of weapons grade SNM reclaimed from dismantled nuclear warheads. Under the auspices of the Nuclear Weapons Safe and Secure Dismantlement (SSD) initiative, an interagency working group has considered various aspects of the disposition issue and analyzed different options for use as the basis for formulating a national policy.

Several options are addressed for ultimate disposition of high enriched uranium (HEU). The options for plutonium (Pu) are not discussed in detail.

In order to develop a joint action plan to deal with the disposition issue, experts from U.S. and Russia have already met twice this year in Moscow to exchange technical information and discuss approaches to the resolution of the issue. At the conclusion of the second U.S.-Russian meeting it was agreed that further technical information would be exchanged and that both countries will seek to explore commercial sales opportunities for the disposition of excess Russian HEU in the U.S. and elsewhere.

A national policy to recycle the Russian or U.S. weapons grade nuclear material would impact the NRC if NRC licensed facilities are involved. However, the staff has the capacity to readily respond to the national initiative if called for.

Accordingly, it is recommended that the staff continue to actively monitor interagency activities in this area and periodically provide the Commission with updated information for consideration in initiating appropriate regulatory programs to support the national policy.

Discussion:

1. Possibilities for the Processing of Material from Dismantled Weapons

After the dramatic announcements by the U.S. and Russia to dismantle a significant percentage of their existing inventories of nuclear warheads, a grave concern now shared among the world-wide community is the question of how quickly, safely, and securely can disposition of the large quantities of reclaimed SNM in the form of HEU and Pu be accomplished, especially as it relates to the Russian dismantlement.

Addressing these concerns is a national priority for the U.S. government and for many other governments. In general, the preferred process for the excess Russian SNM reclaimed from the dismantled warheads would be the transfer of the material from the military to the civilian sector. This material would then be converted to a form unsuitable for further weapons use. (Technical processes involved in prospective conversion of weapons grade SNM to commercial use or disposition as waste were discussed in SECY-92-064.)

Since the disarmament announcements were made, the U.S. agencies (Department of State (DOS), Arms Control and Disarmament Agency, and Department of Energy (DOE)) have been addressing this issue as part of the U.S. support-to-Russia activities under the SSD initiative under the Nunn-Lugar Act.[1] However, it is quite possible that Russia may expect the U.S. to pursue a similar track for the disposition of U.S. material.

In the context of the combined U.S. and Russian dismantlement activities, the primary possibilities under consideration for the processing of material are:

(1) Under a U.S.-Russian arrangement, the U.S. would process, in the U.S., the SNM from the decommissioned Russian and U.S. nuclear weapons into LWR fuel.

(2) The U.S. would pursue the option to recycle only U.S. SNM, and Russia would either pursue similar activities with its material or place unprocessed material in storage.

(3) All the SNM generated from decommissioned nuclear weapons in both countries would be put into long-term secure storage and not processed.

---

[1]The Safe and Secure Dismantlement initiative and the current status of dismantlement bilateral discussions are described in Enclosure 1.

The primary possibilities for the facilities involved in the processing are:

(1) Conversion of all U.S. and Russian SNM would be performed at facilities within the DOE complex.

(2) Conversion of all U.S. and Russian SNM would be performed at DOE facilities and NRC licensed facilities.[2]

(3) Conversion of all U.S. and Russian SNM would be performed at NRC licensed facilities.

(4) Conversion of Russian SNM would be performed at the U.S. built and operated facilities in Russia, and conversion of U.S. SNM at DOE or NRC licensed facilities, or some combination.

From the possibilities listed above, it is clear that some would impact the NRC; these impacts are discussed in Section 3 below.

2. Issues Under Consideration

Near-term issues addressed by the SSD Disposition Subgroup are: (1) whether materials from dismantled weapons should remain in Russia or be brought out as soon as possible, (2) the arrangements for ownership and financial responsibility, and the associated effects on world market price, and (3) whether the materials should be monitored under International Atomic Energy Agency (IAEA) safeguards or under some other international arrangements.

Pros and cons concerning these issues have been outlined by the SSD Disposition Subgroup in two draft option papers.[3] Copies of these papers

---

[2]Commercial nuclear facilities available for conversion of weapons grade SNM include NFS-Erwin and B&W-Lynchburg.

[3]The draft option papers are being revised. The final versions will not include the detailed discussions of the options.

are provided in Enclosures 2 and 3. (Enclosure 2, "Enriched Uranium Options," and Enclosure 3, "Options for the Disposition of Russian Plutonium from Dismantled Weapons.") These option papers, as revised, will be used as a basis for formulating a national policy on the disposition of SNM recovered from the dismantled Russian warheads.

Several options have been addressed for ultimate disposition of HEU. In the case of Pu, the long-term options are not discussed in detail. (The paper merely notes that decisions about U.S. preferences for the long-term do not need to be made at this time; that the options would include long-term storage, geologic disposal, and burning Pu in reactors; and that it is unclear which of these options is the most economical in the long-term.)

In each of the two papers, options for the issues are discussed along with advantages and disadvantages. However, neither paper presents specific recommendations.

The HEU paper discusses the following issues and options:

Issue (1) - Location of the facility for conversion of HEU into LEU.

Options: (a) Russia

(b) U.S.

(c) Acceptable third country

Issue (2) - While the HEU is in Russia, whether international monitoring is required.

Options: (a) no monitoring

(b) monitoring

Issue (3) - Who assures financial responsibility for the ownership, control, and marketing of the blended Russian HEU?

Options: (a) U.S. purchases Russia's excess HEU.

(b) An international financial institution (IFI) uses former Soviet Union fissile material as collateral for loan placements.

(c) U.S. private sector firm assumes responsibility for financing purchases of Russian HEU.

(d) Inter-government consortium of U.S., Japan, and two European countries finance purchases of Russian HEU.

(e) Russia retains title to HEU, blends dcmestically and markets LEU.

Each option is discussed in detail in the draft HEU paper (Enclosure 2) with pros and cons, but no single option for any of the three issues stands out with overall advantages. The ultimate decision will undoubtedly have to consider other related U.S., national, and international issues; e.g., national budgetary and importation[4] constraints, domestic regulatory requirements[5], and international political forces.

The Pu paper addresses the following issues and options concerning near-term and long-term disposition:

Near-Term Disposition

Issue (1) - Location of storage.

Options: (a) In the U.S.

---

[4]One particular aspect of interest is the financial implications of the Department of Commerce's anti-dumping ruling. This ruling applies to natural uranium and LEU but might be extended to HEU imported to replace LEU.

[5]An example is the physical protection requirements associated with the transportation of HEU.

(b) In a "safe" third country, probably France.

(c) In Russia.

Issue (2) - Type of controls.

Options: (a) Place excess Russian Pu under Russian voluntary safeguards agreement with the IAEA.

(b) Formulate a new agreement under which Russia would make a commitment against military or nuclear explosive use and agree to continuous inspector presence.

(c) Place excess Russian Pu under international custody.

Long-Term Disposition

Issue (1) - Transport Russian Pu to the U.S.

Options: (a) Long-term storage.

(b) Geologic disposal.

(c) Burning Pu in reactors.

Issue (2) - Pu remains in Russia.

Options: (a) Long-term storage

(b) Burning Pu in existing Russian reactors.

(c) Burning Pu in new dedicated reactors.

(d) Dispose of the Pu as waste.

The near-term options for disposition of Pu are discussed in detail in Enclosure 3. However, similar to the HEU paper, no near-term options stand out with distinct advantages.

The long-term options for disposition of Pu are only briefly discussed. The Pu paper does state that decisions about U.S. preferences for the long-term need not be made at this time. Also, if the Russian Pu was brought to the U.S., the ultimate disposition of the Russian Pu would presumably depend upon decisions regarding the disposition of U.S. Pu.

3. Impact on the NRC and Our Licensees

Any significant impact on the NRC and our licensees would become reality only if the processing and recycling of the Russian or U.S. material involve NRC licensed facilities, or if the Russian or U.S. material is recycled at some designated DOE facilities and those facilities are required by Congress to be subject to NRC licensing.

The readiness of the NRC, in terms of applicable regulations, guidance, and licensing review criteria, to respond to the national initiative for disposition of SNM reclaimed from the dismantled warheads was addressed in SECY 92-064. This status has not changed since SECY 92-064 was prepared. In summary, NRC's current safety and safeguards regulations cover the types of operations needed to convert weapons grade material to LWR fuel. However, the existing Category I fuel facility licensees will have to obtain license amendments for this activity. Also, new safeguards rulemaking and a comprehensive environmental impact statement for the conversion operation and the use of the converted HEU and Pu as LWR fuel would be required.

For NRC licensees, the two Category I facilities, Babcock and Wilcox (B&W-Lynchburg) and Nuclear Fuel Services, Inc., (NFS-Erwin), are likely sites for recycling the material if it is required by national policy. The staff understands that representatives from the Office of Management and Budget have recently visited B&W-Lynchburg and met with the facility management to discuss the possibility of using the B&W-Lynchburg facility for such purposes. In

addition, we understand that NFS-Erwin is currently participating in a task force in Russia dealing with this matter. Cost estimates for the project were also explored, but no conclusive results were obtained. The staff's preliminary analysis shows that with some modifications to the facilities; e.g., new storage vaults and additional process equipment, B&W-Lynchburg and NFS-Erwin would be suitable facilities and available to start the project within 12 months notice. Incidentally, NFS-Erwin may be more prepared than B&W-Lynchburg for the project since, after February 1994, its existing naval contract expires.

If conversion of the material is performed at the U.S. commercial facilities, transport of the material would have to be addressed. At the present time, there are no commercial carriers licensed to transport Category I quantities of HEU.[6]

Recognizing the importance and urgency of a timely resolution of the issue of disposition of both U.S. and Russian weapons grade SNM by the Executive Branch, the staff has been monitoring the activities taking place in the involved Federal agencies to ensure that the development of any national policy that would potentially affect the NRC will be known to the Commission well in advance. In this regard, the Commission has requested the views of the Executive Branch (letters to Secretary of State Baker and Secretary of Energy Watkins) and indicated that the Commission would like to be involved in identifying and developing the policy options under consideration.

---

[6]Rulemaking is currently underway to upgrade the NRC's regulations for transport of Category I material. These new rules would be comparable to measures used by DOE. This will reduce reliance on DOE's Safe Secure Trailer (SST) program for secure shipments of Category I material if a commercial carrier is available and approved.

In anticipation of the NRC's involvement in the regulatory aspect of a national endeavor concerning the disposition of material from dismantled weapons, the Office of Nuclear Material Safety and Safeguards (NMSS) has assigned two FTE per year in the area of safeguards for FY93-97 to address the disposition of nuclear weapons grade material and uranium enrichment with the assumption that one of the following will occur:

(1) The LES's Claiborne Enrichment Center will be constructed; or

(2) The NRC will be required to license or advise on the licensability of an Atomic Vapor Laser Isotope Separation (AVLIS) facility; or

(3) Material from dismantled nuclear weapons will be converted into reactor fuel at current NRC-licensed facilities.

The resources budgeted in this area are interchangeable; that is, they will be used to fund whichever of the above occurs.

In the area of safety, NMSS' program did not include resources during the formulation process of the FY94 budget; i.e., FY93-97, to cover activities which may involve disposition of weapons grade nuclear material. However, during this process, significant resources were planned for a licensability review of AVLIS in the safeguards area. Therefore, in case of an immediate need to respond to a national policy requirement for NRC involvement in disposition of material reclaimed from dismantlement of nuclear weapons, resources allocated to AVLIS could be redirected. However, resources for safety are unbudgeted and possibly would require shifting of other programmatic activities.

In summary, if called upon by the President or the Congress, the NRC will be expected to readily respond to the national requirement for participating in the disposition of SNM

recovered from the dismantled warheads. However, there is not enough information available at this time for the staff to develop a specific action plan and associated resource requirements.

Recommendation: In view of the current national level effort to develop a U.S. policy for the subject issue and other international activities in this area, it is recommended that:

(1) staff continue to actively monitor interagency activities related to the disposition issue and work with the other Federal agencies as appropriate;

(2) staff periodically provide the Commission with updated information; and

(3) as decisions concerning the various options are made, the staff identify for Commission consideration any changes in regulations and guidance that may be necessary to support the U.S. government's efforts for the disposition of material from dismantled weapons.

Coordination: The Offices of the General Counsel and International Programs have reviewed this paper and have no objections.

NOTE: Provided as enclosure 4 is information recently received concerning a protocol between NFS-Erwin and the Russian Academy of Sciences and MINATOM. This describes a commercial venture which would

involve the conversion of HEU to LEU and the subsequent sale on the world market. Copies of this information have been forwarded to the pertinent SSD subcommittee and the Department of Energy.

James M. Taylor
Executive Director
for Operations

Enclosures:
1. The SSD Initiative
2. Enriched Uranium Options
3. Options for the Disposition of Russian Plutonium from Dismantled Weapons
4. Facsimile from C. R. Johnson to H. L. Thompson, dated July 7, 1992, regarding protocol between NFS and Russian organizations

Removed to allow public release of the rest of this paper

Commissioners' comments or consent should be provided directly to the Office of the Secretary by COB Thursday, July 30, 1992.

Commission Staff Office comments, if any, should be submitted to the Commissioners NLT Thursday, July 23, 1992, with an information copy to the Office of the Secretary. If the paper is of such a nature that it requires additional review and comment, the Commissioners and the Secretariat should be apprised of when comments may be expected.

DISTRIBUTION:
Commissioners
OGC
IP
OPP
EDO
SECY

The Safe and Secure Dismantlement (SSD) Initiative

As a result of a meeting between President Bush and President Yeltsin in January 1992 at Camp David and a subsequent meeting between Secretary of State Baker and President Yeltsin in February 1992 in Moscow, a U.S.-Russia Cooperative effort, the SSD program, was initiated. The SSD program is a U.S.-Russia cooperative effort to seek solutions to and assure the safe and secure dismantling of the Russian nuclear warheads and the adequate protection of the SNM recovered from the Russian dismantlement program. The SSD Initiative includes seven technical subgroups. Each consists of experts from both countries.

The seven subgroups are:

1. Dismantlement Subgroup
2. Disposition Subgroup
3. Containers Subgroup
4. Railcar Subgroup
5. Storage Subgroup
6. Material Control and Accounting and Physical Protection Subgroup
7. Accident Response Subgroup

On March 12-13, 1992, lead by General W. Burns of the Department of State, seven U.S. teams were assembled and met with their Russian counterparts in Moscow to exchange technical information and to plan for future cooperative activities. The NRC is involved in the technical area of the material control and accounting and physical protection subgroup.

Upon return from the Moscow trip, the SSD Steering Group, Chaired by General J. Gordon, Special Assistant to the President and Senior Director for Defense Policy and Arms Control, requested that two option papers, one on HEU and one on Pu, be developed by the SSD Disposition Subgroup.

On June 2 through 4, 1992, as a followup to the initial discussions on March 12-13, 1992, the U.S.-Russian Disposition Subgroup met and reached agreement to continue discussions on a government-to-government basis regarding disposition of excess Russian HEU and Pu reclaimed from decommissioning of nuclear weapons. It was agreed that further technical information would be exchanged and that both countries will seek to explore commercial sales

[redacted]

ENRICHED URANIUM OPTIONS - REV. 9

This paper follows from Secretary Baker's February 17, 1992 proposal to Russian President Yeltsin: "The U.S. proposes that discussions between U.S. and Russian technical experts commence promptly on the disposition of excess Russian highly enriched uranium (HEU) and plutonium (PU) in ways that are consistent with the stated nonproliferation and disarmament objective of each country and which would be economically beneficial to both governments. To this end, the U.S. and Russia would seek a government-to-government agreement on the uses of excess Russian weapons HEU and PU, including controls that should be placed on the use of such material by non-government entities and third countries."

There is general agreement that:

- For security and non-proliferation reasons, material derived from Soviet weapons should be converted to LEU at the earliest feasible point.
- Careful consideration should be given to the economic impact of the disposition of this material for the U.S. and Russia.
- The funding associated with all U.S. Government actions will be proposed in a manner consistent with existing budgetary laws, including the Budget Enforcement Act of 1990.

There are three issues that need resolution. The first decision is where the HEU should be converted into LEU. Second, while the HEU is in Russia, a decision needs to be made on how best to ensure that it is not diverted. The third issue is who assumes financial responsibility for and marketing of the blended Russian HEU.

This paper deals only with HEU in Russia, recognizing that the disposition of HEU from weapons originally deployed outside Russia may be subject to agreement between Russia, Ukraine and others.

Issue A: <u>Where should interim storage/blending facility for HEU be located?</u>

Option 1: In Russia
Option 2: In U.S.
Option 3: In safe 3rd country

[redacted]

ANALYSIS:

The HEU will be generated from the dismantled weapons over a period estimated to be 10-15 years. From a practical standpoint, some interim storage capability inside Russia will need to be maintained, because of the time it will take to construct a blending facility of suitable size to process efficiently the HEU (est. 2-5 years). Assuming the Russians upgrade their Materials Controls and Physical Protection programs, the risk of diversion during interim storage would be considered manageable. However, risk of diversion is highest for shipment of material within and among the States and Republics of the former Soviet Union, principally due to subnational terrorism.

If HEU is shipped into the U.S., additional safeguards and physical protection requirements might need to be implemented, particularly at NRC-licensed facilities that process HEU. The logistical support required to ship HEU in large quantities have not been defined at this time. In addition, the U.S. currently has insufficient blending capability to handle such large quantities (approx. 500 MT) of HEU.

COSTS

All Options

The cost estimate for constructing a blending facility is about $200 million and for an interm storage facility $50 million. Nunn-Lugar funds can legally be used for these purposes: a decision would have to be made on the relative priority of this project compared to other needs for Nunn-Lugar funds.

Option A1: Construction of interim storage/blending facility in Russia.

Pros:

-- Minimizes costs and risks of international transportation of HEU.

-- Low US budget impact.

Cons:

-- Even with stringent international controls, Russia could reuse HEU for weapons purposes.

-- Potential for diversion to subnational groups or third parties.

Option A2: Construction of interim storage/blending facility outside of Russia.

Pros:

-- Eliminates risk that HEU could be reused for Russian weapons.

-- Minimizes risk of use in weapons by third parties or subnational groups.

-- DOE believes shipment of HEU from Russia to U.S. using transport as soon as possible under U.S. physical protection preferable from a national security and nonproliferation standpoint.

Cons:

-- Diversion risk associated with international transport of HEU.

-- Could involve U.S. budget impact.

Option A3: Construction of interim storage/blending facility in a "safe" third country.

Pros:

-- Eliminates risk of HEU reuse in Russian weapons.

-- Minimizes risk of subnational diversion in Russia.

Cons:

-- Diversion risk associated with international transport.

-- Could run counter to U.S. nonproliferation objective of discouraging the spread of HEU.

Issue B: What type of monitoring system should be used for protection against diversion in Russia?

Option 1: IAEA Monitoring System.

Option 2: Monitoring under new Bilateral or Multilateral Agreement.

ANALYSIS

The HEU will require some kind of monitoring during the period of construction of blending facility (est. 2-5 years).

Option B1: Place excess Russian HEU under Russian voluntary safeguards agreement with the IAEA

As a nuclear weapon state (NWS) party to the NPT, Russia is not obliged to place its nuclear materials under safeguards, but like other NWS, has made a so-called "voluntary offer" with the Agency. Under the terms of the offer, Russia provides a list of facilities eligible for safeguards. However, Russia may at any time remove facilities or materials from the eligible list and reintroduce them into the military sphere, including for weapons use. If Russia included an HEU storage facility on its eligible list, it is assumed that the IAEA would choose to safeguard that facility , although the IAEA would be under no obligation to do so. Routine practice for safeguarding an HEU storage facility would involve monthly or bi-monthly inspector visits. However, a permanent inspector presence would not be inconsistent with this option.

Pros:

-- Requires least change and would be most easily palatable to Russians.

-- Provides political barrier to Russia's re-use of plutonium in weapons.

Cons:

-- No legal obligation not to re-use material in weapons.

-- If inspector presence on site is not continuous, the risks of "insider" diversion scenarios are magnified.

Option B2: New agreement under which Russia would make a commitment against military or nuclear explosive use and agree to continuous inspector presence

Under this option, inspections could be carried out by the U.S., the IAEA, or some other multinational body.

Pros:

-- Russia could not legally reuse the HEU in weapons.

-- Continuous inspector presence at storage facility provides added protection against insider diversion scenarios.

[redacted]

Cons:

-- If applied reciprocally to U.S., this option would be more difficult for the U.S. to accept than would option A.

-- If the verification system were bilateral, rather than IAEA, the pressure for reciprocal U.S. steps could be greater.

Issue C: Who should have responsibility for financing/marketing of HEU?

Taking into account the nonproliferation and the national security considerations assessed under Issues A and B, and the criteria set forth below which have been developed for evaluating possible options for financing and/or marketing of the Russian HEU, the interagency working group narrowed a rather wide range of financing/marketing possibilities to five major options which merit further consideration. From the non-proliferation/national security standpoint Options C1 through C4 are considered to be essentially the same, and, therefore the choice of a preferred financing/marketing option from among these four can be made independently of the issues of the preferred location for the blending facility and preferred international monitoring approach. Option C5 is the least desirable from the non-proliferation and national security standpoint since there is little opportunity for international control of the HEU. OMB budget estimates are presented in Tab A.

Definition of Options

Option 1	DOE would begin to negotiate with the Russians for the purchase of their excess HEU.
Option 2	An international financial institution (IFI) uses former Soviet Union fissile material as collateral for loan placements.
Option 3	Private sector firm assumes responsibility for financing, purchase, storage and marketing of Russian HEU.

[redacted]

6

Option 4	Inter-governmental consortium of U.S., Japan, and two European countries finance purchase of HEU.
Option 5	Russia retains title to HEU, blends domestically, markets LEU product through commercial channels.

Criteria for evaluating options

In addition to non-proliferation and other security factors, the following criteria are taken into account: Financial benefits to Russia, U.S. budgetary impact, U.S. economic impact, congressional actions and impact on allied interests.

Discussion of Options

Option C1: DOE would initiate negotiations with the Russians for the purchase of their excess blended HEU.

The initial goal would be to reach an agreement in principle (but not sign a contract). Later a contract to purchase the Russian HEU would be signed by either a new uranium enrichment corporation (UEC)[1] or by DOE.

Pros:

-- The UEC would be able to provide a substantial total compensation payment to the Russians (up to $2.1 billion), including large advanced payments.

-- By purchasing the HEU, the UEC would not have to compete against this inventory in the market. DOE believes that the UEC will thereby avoid the loss of 47 million SWU sales, $4 billion in revenues, $1 billion in net cash flow, and the closure of one of the existing plants with the loss of 2000 DOE contractor jobs associated with the operation of DOE's enrichment plants.

---

[1] During 1992, the Congress has been considering legislation to restructure the DOE uranium enrichment program by creating a U.S. Government Corporation to produce and market enrichment services.

-- DOE believes the enrichment market is competitive and will remain so under this option.

-- DOE believes that the UEC or DOE can use the forward sales commitments ($12 billion) as a means of securing financing from non-USG sources. DOE believes that funding from these sources would avoid any impact on the U.S. budget.

-- Gives maximum protection to DOE's existing marketing arrangements and price structure. Would reduce prices less than the other options since DOE is the only supplier large enough to use this inventory in lieu of production and thereby minimize enriched uranium supplies in the world markets.

Cons:

-- OMB believes that this option could be seen by other countries as a U.S. attempt to corner the world uranium market. It could be perceived as inconsistent with the free market approach taken in other areas.

-- None of the congressional bills mandate that the Corporation purchase the Russia uranium. In the absence of such a provision, it is not possible to commit the Directors of the Corporation.

-- OMB believes that in the Senate bill creating a U.S. Government Enrichment Corporation, an additional $0.5 - 1.5 billion of contract authority would be required for the purchase of Russian enriched uranium. OMB further believes that $3 - 5 billion of new contract authority would be required in the pending House bills.

-- OMB also believes that under the Budget Enforcement Act these additional contracting authorities would require budget offsets. Without such additional authorities, OMB believes the Corporation could not play the role outlined in this option.

-- Should legislation not be enacted, there is no guarantee that DOE's customers would be willing to make advance payments. OMB believes that in the absence of firm offers for prepayments, it is not possible for the U.S. to offer to buy the uranium without an appropriation and subsequent impact on the budget.

Option C2. An international financial institution (IFI) uses former Soviet Union fissile material as collateral for lump sum loan.

An international financial institution (IFI) uses the fissile material owned by Russia as collateral for providing loan to Russia. Russia would retain title to the uranium, irrespective of whether the material is being stored or processed within their borders or in another sovereign country. The capital for the loans would be raised by the IFI issuing bonds, which would be secured by enrichment contracts signed by Russia with Western customers. The loan to Russia would be for a dedicated purpose, agreed upon by the IFI and the Russian Government.

Enrichers are selected through periodic sealed bid auctions as a means of determining price. IFI bonds are paid off by proceeds from enrichment contracts.

Pros:

-- Has the potential to raise substantial lump sum or advance payment with significantly less potential USG budget impact than Options C1 and C4.

-- Provides a mechanism for participation by key West European governments and Japan.

Cons:

-- Issuing bonds based on commodity contracts would constitute an entirely new undertaking on the part of IFIs.

-- Could be difficult to gain approval by the Board of Governors, given that various members would have different views.

-- DOE believes there would be some significant negative impact on the stability of DOE's business and its competitivesness. The amount will depend on the disposition of the enriched uranium which is unknown at this time.

-- DOE believes Russia would have difficulty securing needed enrichment contracts to make this a viable option.

[redacted]

Option C3: Private sector firm takes ownership of the uranium and thereby assumes responsibility for securing the needed financing to be able to purchase, process, store, and market the material.

The firm raises non-USG financing for paying the Russians for the material as well as for other costs incurred by the firm. The firm would need to secure firm contracts from worldwide customers of LEU to secure the financing. Because of the inherent riskiness of this investment (both the Russian stability factor and the future of worldwide nuclear power), it likely several different financial entities would need to be involved to provide financing in order to spread the risk.

Pros:

-- It would have a minimal impact on the U.S. budget.

-- It would maximize Russian opportunities for private sector investments in this sector of its economy.

-- It provides best opportunity for a free trade environment in the marketing of uranium enrichment services.

-- It would eliminate any perception that the U.S. Government was using an arms control pretext in order to serve their own enrichment interests.

-- Provides U.S. maximum control over HEU and therefore maximum leverage to achieve our nonproliferation and security objectives.

Cons:

-- Payment to Russia would be significantly lower than Option C1, C2, or C4 because a private firm would have to pay market interest rates to raise the capital for paying the Russians.

-- DOE believes that a private firm may have difficulty obtaining contracts with utilities as it would be a new entry in market; DOE further believes this would mean that a private firm will be less likely than the UEC under Option C1 to be able to raise non-USG financing.

-- Decisions by private sector will be driven by need to realize profits. A private purchaser may be unwilling to meet the timetable or scope of purchase contemplated by the USG or Russian Government.

Option C4: Inter-governmental Consortium of U.S., Japan, and two West European Countries Finance Purchase of HEU:

An intergovernmental consortium could be configured along various lines and have a range of participants. For purpose of this analysis, there are four governmental members, each of which has 25 percent ownership. Risk and title to blended material shared among members. The consortium could also finance the blending facility; alternatively, the blending facility could be financed by the International Finance Corporation under a joint venture arrangement. A governmental consortium could buy its share on behalf of a domestic entity - e.g., a U.S. public enrichment corporation; e.g., COGEMA; e.g., group of Japanese utilities.

Pros:

-- Would provide a mechanism for allied participation.

-- Would involve potentially lower U.S. budget impact than Option C1.

Cons:

-- Could still involve a U.S. budget impact.

-- Could become an enrichment cartel with increased costs for consumers.

-- Would take years to negotiate.

Option C5: Russia retains title to HEU, blends domestically, markets LEU product through commercial channels.

This option is, in effect, what results if none of the other options succeeds or is selected. It requires no specific action on the part of the USG. A key uncertainty in this option is whether Russia would continue its present practice of placing LEU on the market in a measured fashion, or whether Russia would flood the market with LEU.

Pros:

-- No U.S. budgetary impact.

-- No Congressional action required.

-- If Russia decides to sell large quantities of LEU in a short time frame, could produce a significant drop in the world market price for enriched uranium which would benefit electricity customers.

[redacted]

Cons:

-- Since there is no international financial involvement, this option provides the U.S. with little or no additional leverage to extract commitments from Russia relevant to our non-proliferation and security objectives (i.e. commitments for rapid blending of HEU to LEU and safeguards on HEU in the interim).

-- If Russia decides to sell large quantities of LEU in a short time frame, could produce a significant drop in the world market price of enriched uranium which would damage DOE (or its successor UEC) and other uranium enrichers.

[redacted]

[redacted]

OPTIONS FOR THE DISPOSITION OF RUSSIAN PLUTONIUM FROM DISMANTLED WEAPONS

I. ISSUES FOR DECISION

Regardless of its long-term disposition, excess Russian plutonium will have to be stored in the near-term. Hence, there are two issues facing the U.S. in defining its near-term preferences: 1) whether it is in the U.S. interest for excess Russian plutonium to be permanently removed from Russia; 2) if plutonium is to remain in Russia, what types of controls do we wish to see placed on that material.

II. BACKGROUND

Russian officials have said they expect about 50 tonnes of Pu from dismantled weapons will be excess to their weapons program. Approximately another 50-100 tonnes of Pu will remain in the weapons program under current arms control agreements. U.S. arms control objectives could result in additional weapons Pu being declared excess by the Russians. About 25 tonnes of separated Pu now exists in the Russian civil program; additional Pu is being produced in both the military and civil programs but it is not clear how long this will continue. This paper addresses only Pu from dismantled weapons which will be declared excess to the weapons program.

Russia has committed itself not to reuse excess Pu for military purposes. Russia's intention is to place excess Pu in storage for the foreseeable future. Beyond this, there appears to be no agreement within the Russian government about long-term plans. Some officials from the Ministry of Atomic Power have expressed an interest in using Pu as fuel in the Russian nuclear fuel cycle. A facility for fabricating Pu into fuel is under construction, but there are substantial domestic obstacles to its completion. Russia has no plans to export this plutonium.

At present and for the foreseeable future, there is no commercial market for plutonium. Any country assuming responsibility for this plutonium would incur substantial financial costs.

III. NEAR-TERM OPTIONS

The central U.S. objective in the near-term is to ensure that excess Russian Pu is not re-used in nuclear weapons, either by the Russians or a proliferant state. The options addressed below seek to accomplish this objective either by removing Pu from Russia, or by placing it under controls. It is technically possible to denature the Pu by mixing it with reactor grade Pu or with fission products, steps which would

[redacted]

significantly increase the cost and time to reconvert the Pu to weapons but would not prevent it. However, these steps would also increase the cost and time of converting the Pu into reactor fuel, a long-term option some in Russia would like to preserve. Hence, denaturing of Pu or mixing it with waste in the near-term is not considered realistic because of likely Russian opposition.

In the longer term, plutonium must either be buried, used in reactors, or stored indefinitely. It is unclear which of these options is the most economical in the long-term. If it is used in reactors, the spent fuel must either be buried or stored. (Long-term options are discussed in more detail at the end of this paper.) While there is no requirement to decide now about long-term disposition of Russian plutonium, decisions about near-term issues should bear in mind the following:

-- If Russian Pu is moved to the U.S., decisions about eventual burial, burning or storage may be linked to decisions about the long-term disposition of U.S. Pu, a subject of some political controversy.

-- Those who favor the near-term option of moving Pu to an acceptable third country believe this makes sense only if there is an intention to burn the Pu in that country's reactors. There are sharp disagreements among U.S.G. agencies about whether a third-country burn option is consistent with U.S. nonproliferation and national security interests; U.S. policy is not to oppose Pu use in Japan and EURATOM.

-- If Russian Pu remains in Russia, U.S. influence over the long-term choice among burial, burning and storage will likely be quite limited.

ISSUE ONE: LOCATION OF STORAGE

Option 1. Move the plutonium to the U.S. for storage

This would have to be accomplished by DOE and DoD as military Pu. While any effort to move Pu to the U.S. would face significant public acceptance problems, the problems are even greater with civilian Pu, due to NRC licensing and NEPA requirements. Public acceptance problems could be mitigated somewhat by the fact that this effort would help curb the Russian nuclear threat.

The cost of this option over the next ten years could be about 1.6 billion dollars (note: all cost estimates in this paper are very rough). It is assumed that the U.S. government would bear the entire cost although some international cost sharing might be achieved. Funding would be from the defense budget.

The total includes an estimated one billion dollars to provide Russia a financial incentive to relinquish control of the Pu; 10 million dollars to transport the Pu to the U.S. (this includes only fuel and operating costs; the opportunity cost of diverting ships and personnel from other missions is higher); $160 million for transport and storage containers and vehicles; $30-60 million for a modified storage facility; and an annual cost of $30-50 million for storage. If plutonium remains in storage for more than five years, the annual storage costs will continue. If it is removed from storage for geologic disposal or for use in reactors, there will be additional costs.

Pros:

-- Eliminates risk that Pu could be used in Russian weapons (once it is removed from Russia).

-- Minimizes risk of use in third party weapons or by subnational groups.

-- DOE has facilities that could be modified to store about 50 Mt of additional Pu.

Cons:

-- Some do not regard this option as realistic due to expected Russian opposition and budget impact for the U.S. share of costs for transport, handling, storage, and likely need to provide Russia with financial incentive to release Pu to U.S.

-- Public and Congressional acceptance problems.

-- Diversion risk associated with transport of Pu.

Option 2. Move the plutonium to a "safe" third country, probably France.

Proponents of this option believe that the only scenario under which it might be in the U.S. interest to support moving Russian Pu to a third country would be if that country intended to burn the Russian Pu in its civilian power reactors. (Others note that the near-term option of moving Pu to a third country is also compatible with longer-term options of burial or storage.) France appears to be the only country with a major program for civil plutonium use who might be willing to accept Russian Pu and whom the U.S. would deem an acceptable recipient. (Japan is another potential candidate, but the Japanese have indicated that it would probably not be politically feasible for them to accept plutonium from Russian weapons, although they have indicated an interest in supporting, perhaps financially, an appropriate solution.

[redacted]

Also, Japan has sufficient Pu to meet its domestic needs. Finally, some in the U.S.G. would oppose transfer to Japan on nonproliferation grounds, since Japan is not a nuclear weapon state.) It is estimated that if France built a new Pu fuel fabrication facility and committed 13 additional reactors to burning Pu from dismantled Russian weapons, France could burn up 50 tons of Russian Pu over 10 years at a cost penalty estimated to be $700 million. (The cost penalty is the cost of using plutonium fuel versus uranium fuel.)

In addition to the $700 million cost penalty, the following costs are assumed to be the same as option one: providing a financial incentive to Russia (one billion dollars); procuring containers and vehicles for transport and storage of Pu ($160 million); and arranging for international transport ($10 million). It is assumed that France would share some of the costs with the U.S., thus lowering the U.S. budget impact relative to option one. Other contributions to the cost might be found (e.g., Japan, UK, etc.). U.S. funding would be from the defense budget.

Pros:

-- Eliminates risk that Pu could be re-used in Russian weapons (once it is removed from Russia).

-- Minimizes risk of subnational theft or sabotage or diversion to a third country.

-- This is quickest way to achieve burn-up of Russian Pu. Some believe that burn-up provides best long-term protection against diversion to weapons.

Cons:

-- Highest total cost over ten years.

-- Potentially large U.S. budget impact since U.S. would probably need to subsidize a portion of the cost for this option to make it acceptable to France and Russia.

-- May not be politically feasible. Some Russian officials have indicated Russia does not want to export Pu. Unclear whether France would accept Russian Pu.

-- Some believe that a U.S. subsidy for civil plutonium use in France would undermine U.S. nonproliferation objective of discouraging civil plutonium use elsewhere.

-- Risk of diversion associated with international transport.

Option 3. Storage in Russia

The costs associated with this option are: $50-150 million to construct a long-term storage facility (the lower figure is a U.S. estimate for Pu storage only; the higher figure is a Russian estimate for both Pu and HEU storage); and costs associated with international monitoring (which are discussed below). It is assumed that the U.S. would pay for the storage facility using Nunn-Lugar funds. U.S. could be asked to pay some or all of the costs of operating a storage facility in Russia. It is assumed that these costs would be roughly comparable to the cost of operating a storage facility in the U.S. ($30-50 million per year).

Pros:

-- Some believe this is the only politically viable option in the near-term.

-- Avoids financial costs and diversion risks associated with international Pu transport.

-- Lower U.S. budget impact than other options.

Cons:

-- Even assuming stringent international controls, Russia could later decide to abrogate controls and re-use Pu in weapons.

-- If continued economic and political decay undermines the loyalty of those responsible for physical protection of the plutonium, there is a risk of Pu diversion for use in third party weapons.

Option 4. Storage in Russia - No U.S. Support

This option is essentially "do nothing" so far as the U.S. is concerned. Russia would store and dispose of its Pu as it saw fit and could afford to do.

Pros:

-- No direct cost to the U.S.

Cons:

-- Would not entail any international controls.

-- Would not preclude re-use in Russian or other warheads.

-- Proliferation risks could prove costly in the long run.

ISSUE TWO: WHAT TYPES OF CONTROLS?

Under the Alma Ata agreement, Russia agreed to verification of the dismantling of nuclear warheads and pledged not to reuse the nuclear material for nuclear weapons. However, Russia has made no commitment to the subsequent verification of nuclear material.

Storage of Pu in Russia without any form of international control would be undesirable. The U.S., the CIS, and other states as well as some in Russia itself, will place a high value on verifying that the plutonium removed from dismantled weapons is not recycled or diverted into weapons. Finally it should be stressed that international controls could apply regardless of whether Pu remains in storage, is used in reactors, or is buried as waste.

In discussing options for international controls, it is assumed that the U.S. would prefer controls to apply only to Russian Pu, not to U.S. Pu. A major consideration in evaluating the various options is whether and to what extent the U.S. might come under similar pressure to take comparable steps and whether we would be willing to do so. In considering this issue, it should be borne in mind that even if the U.S. did agree to reciprocal controls on U.S. excess material it is uncertain what those controls might be.

Option A: Place excess Russian Pu under Russian voluntary safeguards agreement with the IAEA

As a nuclear weapon state (NWS) party to the NPT, Russia is not obliged to place its nuclear materials under safeguards, but like other NWS, has made a so called "voluntary offer" with the Agency. Under the terms of the offer, Russia provides a list of facilities eligible for safeguards. However, Russia may at any time remove facilites or materials from the eligible list and reintroduce them into the military sphere, including for weapons use. If Russia included a Pu storage facility on its eligible list, it is assumed that the IAEA would choose to safeguard that facility, although the IAEA would be under no obligation to do so. Routine practice for safeguarding of Pu storage facilities involves monthly or bi-monthly inspector visits. However, a permanent inspector presence would not be inconsistent with this option.

Under this option, it is assumed that all excess Russian Pu would be placed in a single storage facility that would be declared eligible for safeguards. The annual cost of safeguarding that storage facility would depend upon whether inspector presence is intermittent or continuous. Regardless, the annual cost would be no more than 2-3 million dollars. Initial start-up costs would probably be less than one million dollars. If this option were funded from the regular IAEA

budget, the U.S. would pay twenty-five percent of the total costs. If funded outside the regular budget, the U.S. might bear the full cost.

Pros:

-- Requires least change and would be most easily palatable to Russians.

-- Would be least onerous of verification options for U.S. to accept, if we are pressed to do the same, since we already have a voluntary safeguards offer and have the option of withdrawing the material when needed for national security reasons.

-- Provides political barrier to Russia's re-use of plutonium in weapons.

Cons:

-- No legal obligation not to re-use material in weapons.

-- If inspector presence on site is not continuous, the risks of "insider" diversion scenarios are magnified.

Option B: New agreement under which Russia would make a commitment against military or nuclear explosive use and agree to continuous inspector presence

Under this option, inspections could be carried out by the IAEA, the U.S., some other body, or a combination. As with option one, it is assumed that all excess Russian Pu would be placed in a single storage facility. However, Pu removed from that storage facility for peaceful use would remain subject to safeguards.

As long as Pu remains in storage, the overall costs of this option are essentially the same as maintaining a continuous presence under option one. However, if this were done under a bilateral arrangement the U.S. may have to assume the full cost of verification. Moreover, if Pu is removed from storage for peaceful use there would be additional costs associated with safeguarding that material. These additional costs would likely be less than one million dollars per year.

Pros:

-- Russia could not legally reuse the Pu in weapons.

-- Continuous inspector presence at storage facility provides added protection against insider diversion scenarios.

Cons:

-- If applied reciprocally to U.S., this option would be more difficult for the U.S. to accept than would option A.

-- If the verification system were bilateral, rather than IAEA, the pressure for reciprocal U.S. steps could be greater.

Option C. Place Excess Russian Pu under international custody

Under Article XII A.5 of the IAEA statute, the Agency has the right to require the deposit with the Agency of any excess of special fissionable materials over what is needed for specified peaceful purposes in order to prevent stockpiling of those materials. Deposited materials must be returned promptly to the parties concerned for peaceful purposes. Under this scheme, Russia would continue to own its excess Pu, but it would be placed under IAEA custody and returned to Russia only when released by the IAEA for a specific peaceful purpose. The Pu would be safeguarded while under IAEA custody. An alternative would be to provide for custody by some international body other than the IAEA.

The financial costs of this option are essentially the same as option B.

Pros:

-- Would add further political barriers to military use.

-- Would enhance confidence building measures and would give international community greater oversight over Russian Pu.

Cons:

-- Would encounter Russian opposition.

-- U.S. may be pressed to give reciprocal rights to Russia.

Option D. U.S. consent rights

This option would include the same verification arrangements as option B, but would additionally require Russia to obtain U.S. consent for: 1) any export of plutonium from a safeguarded storage facility; and 2) safeguards and security arrangements for any proposed domestic use of plutonium to be removed from a safeguarded storage facility. The financial costs are as discussed above.

[redacted]

Pros:

-- Provides added assurance that safeguarded plutonium will not subsequently be used in a manner inconsistent with U.S. nonproliferation and national security interests.

Cons:

-- Would encounter Russian opposition.

-- U.S. may be pressed to give reciprocal rights to Russia.

IV. LONG-TERM OPTIONS

Decisions about U.S. preferences for the long-term need not be made at this time. However, the following is a brief description of the various possibilities.

If the Russian Pu were removed to the U.S., the ultimate disposition of this Pu would presumably depend upon decisions about the disposition of U.S. Pu. Options would include long-term storage, geologic disposal, and burning Pu in reactors. It is unclear which of these options is the most economical in the long-term. If the Pu is moved to a third country these same options are all theoretically possible.

If the Pu remains in Russia, in the long-term the Russians may decide to:

a) keep it in storage for the indefinite future. This option is the same as the near-term storage option.

b) use it in some or all existing Russian reactors. This would be undesirable on economic grounds (Pu is far more costly as a fuel than uranium). Also the greater the number of reactors involved, the greater the security risk, since widespread use of Pu increases the risk of theft and sabotage. It would also require safety modifications of existing reactors to be used.

c) use in new dedicated reactors designed to optimize the consumption of Pu. This has the advantage of eliminating large quantitiies of Pu but would entail substantial costs ($3-5 billion) for 3 such reactors. Assuming a small number of reactors at one site, this option poses fewer security risks than widespread use in existing reactors.

d) dispose of the Pu as waste. This would minimize security risks but would likely encounter public acceptance problems and would preclude possible future peaceful use. The cost and time to develop an acceptable repository for disposal are expected to be large.

Estimated Cost for Pu Disposition, 1993-2002

TABLE OF COSTS, 1993-2002
(in millions of dollars)

	1993		Annual Cost, 1994 - 2002		Total 10-year cost*	
	US	Total	US	Total	US	Total
Option 1	170	170	155	155	1575	1575
Option 2	50	215	45	205	465	2070
Option 3	50	50	20	40	230	410
Option 4	0	25	0	20	0	205

*Note: Option 2 entails no cost beyond 10 years; for Options 1, 3, and 4 annual storage costs continue indefinitely.

In obtaining the above figures:

1. Purchase price for Pu, $1 billion, is spread evenly over ten years (Options 1 and 2).

2. Cost for containers and handling vehicles, $160 million, is divided into $25 million the first year, $15 million each remaining year (Options 1 and 2).

3. Cost for transport, $10 million, is spread evenly over ten years (includes only fuel and operating costs, does not count opportunity cost of assigning ships and sailors to new mission; the same transport cost is used in Options 1 and 2).

4. Apportioning costs in Option 2. Receiving country pays the full cost to expand and operate the storage facility. U.S. pays 25 percent of other costs. Other countries share the remaining 75 percent. Included in Option 2 cost is the estimated $700 cost penalty associated with Pu fuel.

5. Under all options, full cost to upgrade or to build a new storage facility falls in the first year. Upgrading is assumed to cost $45 million in Option 1; $20 million in Option 2 (which entails a smaller storage facility); $50 million in Option 3 (paid by U.S.); and $25 million in Option 4 (paid by Russia).

[redacted]

6. Annual operating cost for storage facility is assumed to be $40 million in Options 1 and 3 and $20 million in Options 2 and 4. Operating costs begin the second year and remain constant. The U.S. pays full operating cost in Option 1, half the cost in Option 3, and none of the cost in Options 2 and 4.

7. Figures are rounded to nearest $5 million, so slight mismatch occurs in some totals.

8. U.S. funding for Options 1, 2, or 3. It is assumed that funds for the first year could be money made available under the Nunn-Lugar bill. In subsequent years, funds could come out of the defense budget under an arrangement similar to that in the Nunn-Lugar legislation.