POLICY ISSUE
(Information)

February 25, 1992 SECY-92-064

For: The Commissioners

From: James M. Taylor
Executive Director
for Operations

Subject: DISPOSITION OF THE WEAPONS GRADE NUCLEAR MATERIAL FROM DECOMMISSIONED NUCLEAR WEAPONS

Purpose: To advise the Commissioners of an issue with potential national policy implications concerning the disposition of large quantities of weapons grade special nuclear material (SNM) resulting from decommissioned nuclear weapons.

Background: Since the global nuclear threat was dramatically reduced with the end of the cold war, the two super power nations, the United States (U.S.) and the Russian Republic, have announced their intentions, based on a bilateral agreement, to dismantle large numbers of their existing nuclear weapons. The resultant large amount of reclaimed high enriched uranium (HEU) and plutonium (Pu) will create new handling, transportation, storage and safeguards challenges potentially impacting the Nuclear Regulatory Commission (NRC) and our licensees. This paper provides the following information: (1) current discussions in the disarmament context, (2) technologies and facilities available for conversion of SNM metals to light water reactor (LWR) fuel, (3) NRC's readiness to respond to the national initiative, and (4) potential alternatives in national policy formulation.

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Discussion: Current Discussions in the Disarmament Context

The on-going bilateral negotiations between the U.S. and the Russian Republic have already resulted in agreements to dismantle large numbers of nuclear weapons. The disposition of the nuclear materials from the dismantled weapons must follow.

Typically, the process of disarmament involves (1) separating the nuclear warhead from its delivery system, (2) extracting or separating the HEU or Pu from the warheads, and (3) changing the chemical/physical form of the SNM to remove the restricted data associated with the SNM, such as shapes, surface and thickness specifications, alloy composition and Pu isotopes. At this point, the SNM is in a form which is ready for either storage or the conversion process. The partial disarmaments made to date have apparently gone no further than the first step of this process.

In order to cooperate in mutually agreed upon general disarmament actions, several, as yet not agreed upon, options exist for the disposition of the weapons related SNM. One possibility would be for the U.S. to offer to store Pu and purchase HEU from Russia. Another possibility would be for the U.S. to build facilities in Russia, to be operated by the Russians with U.S. support, to convert the material into LWR fuel. Shipment to and conversion of the material in the U.S. is another possibility. The overall impact of the disarmament process may further result in policy decisions to: (1) convert only the U.S. generated HEU; (2) convert the U.S. generated HEU and Pu; (3) convert only the HEU generated by both the U.S. and Russia (and potentially other federation countries); or (4) convert both the HEU and Pu from all federation sources.

Any impact on the NRC and our licensees would depend upon decisions made by the respective governments on several options available, such as the few addressed above. Impact on NRC would also be contingent upon the direction of U.S. policy on whether the conversion process would be performed at Department of Energy (DOE) facilities or at NRC licensed facilities (B&W-Lynchburg and NFS-Erwin). A decision to have the HEU and Pu converted at B&W-Lynchburg and NFS-Erwin would have the maximum impact on NRC. NRC will obviously be least impacted if the decision is to convert the material in Russia. There will be little impact on NRC if the material is transported from Russia to the U.S. government-to-government (i.e., to DOE facilities, by DOE transport vehicles).

Several other issues must be addressed such as the quantities of SNM generated by this process, SNM transportation capabilities, and distribution of the final product (feed material) before the options can be explored in detail. The answers to several of those questions may lead to a better understanding of the impact on NRC.

Technologies and Facilities Available for Conversion of SNM Metals to LWR Fuel

The following information provides an overview of technologies currently available for conversion of weapons grade SNM.

1. Blending of HEU to form low-enriched uranium (LEU).

   (A) HEU and depleted or normal uranium (DU/NU) metals cut into appropriate sizes can be melted together and recast to form LEU ingots or rods.
   (B) HEU metal can be converted to uranium oxide powder and blended with DU/NU oxide.
   (C) HEU metal can be dissolved in nitric acid (HNO_3) and blended with DU/NU nitrate solutions.
   (D) HEU metal can be converted to hexafluoride (UF_6) gas and blended with DU/NU hexafluoride.

2. Conversion of HEU metal to commercial fuel facility feed (input) material.

   (A) Uranium metal can be burned in air to form uranus-uranic oxide (U_3O_8) followed with hydrogen (H_2) reduction to uranium dioxide (UO_2) or in steam (with H_2) to directly form UO_2.
   (B) Uranium metal can be dissolved in nitric acid and the resulting solution thermally denitrated to UO_3. (This product would be dissolved by the fuel fabricators at the head end to their process.) The UO_3 could be reduced to UO_2 by calcining in a hydrogen atmosphere.
   (C) Uranium metal can be dissolved in nitric acid and precipated with ammonia (NH_3) to form ammonium diuranate (ADU). ADU can be directly reduced to UO_2 by calcining in a H_2 atmosphere.

3. Conversion of uranium metal to UF_6.

   (A) Uranium metal can be burned to the oxide and subsequently burned in fluoride (F_2) to form UF_6. UF_6 is the standard input (feed) material for the uranium fuel fabricators.

4. Conversion of plutonium metal to mixed oxide fuel.

   (A) Plutonium metal readily burns in air to form PuO_2. Dissolution processes are also available.
   (B) The plutonium oxide would be mixed with UO_2 to form the mixed oxide. Mixed oxides containing 25% PuO_2 are required for fast reactors and 4% PuO_2 for light-water reactors.

The following DOE and commercial facilities are available for performing the conversion processes:

   (A) Facilities for HEU metal casting are available only at the Y-12 Plant (Oak Ridge, Tennessee) within the DOE complex. However, commercial facilities also may be made available at B&W-Lynchburg and NFS-Erwin with the addition of some new equipment. (Note: Y-12 is not licensed, NFS-Erwin and B&W-Lynchburg are licensed.)
   (B) HEU dissolution and conversion facilities are available at Savannah River Plant, Idaho Chemical Processing Plant and the Y-12 Plant of the DOE complex and at NRC licensed facilities, NFS-Erwin and B&W-Lynchburg.
   (C) Pu conversion facilities are available at Rocky Flats Plant, Los Alamos National Laboratory, Hanford Engineering Development Laboratory, and the Savannah River Plant of the DOE complex.

NRC's Readiness to Respond to the National Initiative

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, the commingling of HEU and LEU within the same facility will complicate the safeguards measures needed and the associated licensing considerations. Current rules outline clear distinctions in the material control and physical protection measures for each type of material. New safeguards rulemaking may be required.

There is current rulemaking underway for upgrading transportation requirements for Category I (HEU) and Category II Pu/HEU metals which will be applicable to the safeguarding of shipments that could potentially develop as a result of the disarmament program. Currently, the small amounts of commercial HEU being transported are being shipped by the existing DOE Safe Secure Transport (SST) system, since there are currently no commercial carriers licensed to ship HEU.

For licensing review of a facility for recycle Pu, the former Atomic Energy Commission, prompted by the concern for the potential production of large quantities of plutonium from nuclear generated commercial power reactors, published a draft Generic Environmental Statement on Use of Mixed Oxide Fuel in Light Water Reactors (GESMO), WASH-1327 in August 1974. The final GESMO Report was published by the NRC in August of 1976 (NUREG-0002). The purpose of the GESMO was to assess the impacts of the implementation of plutonium recycle in the LWR industry. The original draft GESMO only considered the issues of health, safety and environment. In May of 1978, the NRC published a supplemental report to GESMO to include safeguards (NUREG-0414, Safeguarding a Domestic Mixed Oxide Industry against a Hypothetical Sub-National Threat"). The GESMO project was terminated August 1, 1979, as a result of a national policy not to pursue the Pu recycling process.

However, the conversion of the reclaimed Pu from nuclear weapons to LWR fuel does not require reprocessing. Therefore, the regulatory process for licensing of a Pu conversion facility would be significantly less. The GESMO contains a wealth of information which can provide the needed technical basis for developing licensing review guidance and procedures. It should be noted, however, that for the previously licensed Pu facilities there were no requirements to design the facilities to resist the forces of natural phenomena such as earthquakes. The new Pu facilities would be subject to this requirement.

Since the conversion of HEU and Pu reclaimed from decommissioned nuclear weapons may be a major national undertaking, a comprehensive environmental impact statement (EIS) for the conversion operation and the use of the converted HEU and Pu as LWR fuel would be required. It is likely that DOE would be charged with the responsibility to prepare the EIS. NRC would probably be asked to assist DOE by providing technical input.

Alternatives in National Policy Formulation

The staff understands that several other federal agencies are also assessing and evaluating the current global and domestic need to address the disposition of the SNM recovered from dismantled nuclear weapons.

There is also public discussion of this issue. Enclosure 1 is an article by William Broad that appeared in the New York Times on December 17, 1991. Also, Enclosure 2 is an October 19, 1991 article written by Thomas Lippman appearing in the Washington Post.

Accordingly, the following are the possible options for the Commission as courses of action for addressing the current national environment concerning the issue of disposition of the SNM reclaimed from the decommissioned nuclear weapons. Unless otherwise directed by the Commission, the staff will pursue Option (3).

(1) NRC may pursue a passive role and react to specific calls for action from the President or the Congress.
(2) NRC may pursue a pro-active role and push for a national policy on the conversion issue which would involve the NRC.
(3) NRC may pursue a middle-of-the-road policy involving actively monitoring the activities related to the current issue which are taking place in other federal agencies, and interacting with them as appropriate.

Coordination: The Office of the General Counsel has reviewed this paper and has no legal objections.

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Nuclear Designers From East and West Plan Bomb Disposal

By WILLIAM J. BROAD

Special to The New York Times

MOSCOW, Dec. 16 -- In a first no less remarkable than others of late, nuclear bomb makers of East and West are sitting down together this week to seek ways to undo their handiwork and destroy their creations. The enterprise comes nearly a half century after the race to develop nuclear weapons began in an undertaking that for years commanded the best scientific and technical talents of both East and West.

The disabling of nuclear warheads is uncharted territory. Recent arms treaties have spelled out how delivery systems, like rockets and cruise missiles, should be crushed, burned, cut up or otherwise reduced to rubble. But none has addressed the most basic challenge of all, destroying the nuclear warheads that have kept the world on edge for so long.

"It's a wonderful opportunity to try to influence history," Dr. David W. Watkins, a nuclear arms designer at the Los Alamos National Laboratory in New Mexico, said of the meeting. Dr. Watkins is one of 14 American experts here to attend the gathering.

The aim of the week-long effort, which started today in Moscow, is to develop rules for counting, disabling and destroying thousands of nuclear warheads. It brings together top weapon designers and arms-control experts from East and West in an uneasy alliance.

For decades the two sides have vied for nuclear superiority and, because of that, to keep weapon secrets far from one another. Now, rather suddenly, they find themselves joining ranks to throw the nuclear arms race into reverse.

Viktor P. Karpov, a top official of the Soviet Foreign Ministry, told the American team today that its technology might "accelerate that process."

Dismantling Soviet nuclear arms has become a top priority of the Bush Administration and Congress as the Soviet Union has collapsed. Last week Secretary of State James A. Baker 3d pledged immediate aid for the effort, part of which could take till the year 2000 by some estimates. Last month, Congress allocated $400 million in emergency funds to help in the storage and destruction of Soviet nuclear arms.

The American delegation, organized by two private groups, includes arms designers and treaty experts from the Federal centers for warhead design at the Los Alamos lab and the Lawrence Livermore National Laboratory in California. The team also includes former directors of the Los Alamos lab and the Sandia National Laboratories in New Mexico, another such center.

The Soviet delegation includes nuclear bomb designers and officials from the Ministries of Defense, Foreign Affairs and Atomic Power and Industry, which oversees the building of Soviet nuclear arms.

One topic on the agenda is how to disable weapons as a first step to eventual destruction. "Soviet society is falling apart," Dr. Watkins said. "It's to our interest, in their interest, in everybody's interest, to get these stabilized as soon as possible. It would be a terrible thing, down the road, if we lost some of these weapons."

It remains to be seen whether ideas discussed here will be acted upon, and by whom. Many questions on control of the weapons have to be worked out between Moscow and the former republics.

A different issue is reciprocity with the United States. Moscow often wants the restrictive steps that it would adopt for its own weapons to apply to American ones as well, although the Bush Administration has just as often resisted such ideas.

The nuclear arms at issue include artillery shells, land mines, short-range missile warheads, air defense warheads and naval weapons.

Organizers of the American team are the Natural Resources Defense Council and the Federation of American Scientists, private arms-control groups that more than a year ago began exploring how to verify warhead dismantling, with little Federal encouragement.

"We busted our chops to try to get the Administration interested back then," said Dr. Thomas B. Cochran, a senior scientist at the resources council and a main organizer of the current meeting. "But there wasn't a flicker."

He said the Administration joined the effort at the last minute, apparently because of the sudden collapse of the Soviet Union and after the relatively recent East-West endorsement of warhead dismantling. Secretary Baker is here this week to press the same issues.

This fall President Bush and the Soviet President, Mikhail S. Gorbachev, announced dramatic cuts in short-range or tactical nuclear weapons and, for the first time, their planned destruction. Mr. Bush announced his initiative in September, and Mr. Gorbachev's position response came in October. The American concern was that these widely dispersed Soviet weapons, perhaps 13,000 of a total of 30,000 nuclear arms, might fall into unfriendly hands in distant republics amid growing turmoil, a prospect Secretary Baker has called "Yugoslavia with nukes."

After decades of secrecy, experts share ideas on how to undo the arms race.

A sealing system for weapons uses fiber-optic strands. If cut, the light pattern changes

The New York Times

Continued on Page C11

Continued From Page C1

Verification Is Crucial

So far, a central question that East and West have yet to address is how much of this promised dismantling can be verified and revealed to the other side. That is a main topic here. Other items on the agenda are finding better means of secure storage, outlining steps for destroying weapons and discussing the ultimate fate of nuclear materials, including plutonium and highly enriched uranium. Experts say the collapsing Soviet economy increases the risk that crucial weapons materials might be sold for hard currency.

Only delivery systems such as missiles were eliminated under the 1987 Intermediate-Range Nuclear Forces treaty and are slated for disposal under the Strategic Arms Reduction Treaty, known as Start, signed in July by Presidents Bush and Gorbachev.

The exemption of nuclear arms from these accords has been faulted by both liberals and conservatives since the weapons can be recycled and used again, giving new life to the arms race. "The only good treaty," Senator Jesse Helms, Republican of North Carolina, once said, "is one that actually reduces nuclear weapons."

The Bush Administration, and the Reagan Administration before it, have sought to reserve the right to do what they want with the leftover nuclear warheads and materials after delivery systems have been destroyed.

Today the delegation of American experts met with officials at the Foreign Ministry and the Russian Supreme Soviet in a round of preliminary talks. The hard technical work is expected to occur Wednesday and Thursday as American and Russian experts meet in Kiev with Ukrainian officials to discuss the estimated 4,800 Soviet arms on that country's soil and the issues in other former Soviet republics. The Ukrainian effort is expected to be a test case for the wider disarmament effort.

How Many Do They Have?

"We must work together with the new governments to insure a complete inventory, secure storage and

'It would be a terrible thing, down the road, if we lost some of these weapons.'

eventual dismantling of these warheads," said Christopher Paine, a senior researcher with the Natural Resources Defense Council.

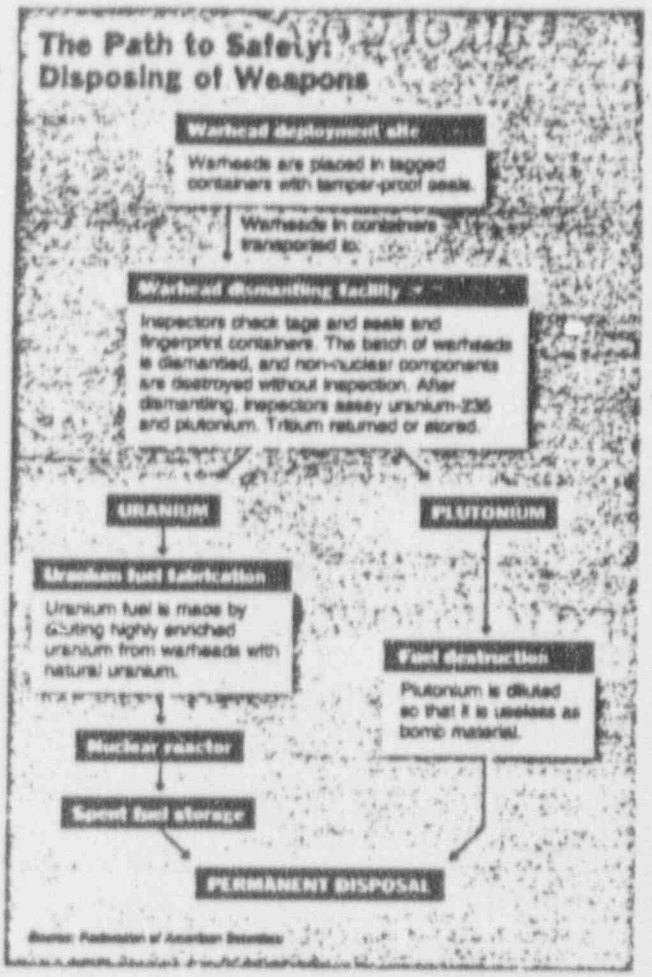
Remarkably, an important issue on the American side is simply to count the weapons. No one in the West knows the exact number of warheads that are deployed in Ukraine, or in Russia for that matter. Some experts suggest that even top Soviet officials may be in the dark as to the number of weapons, because competing military groups have custody of different kinds of nuclear arms. That vagueness is seen as raising the risk of arms sales or clandestine deployments by states that arise from the ashes of the Soviet Union.

At this week's meetings, Dr. Cochran of the American delegation said he plans to promote the idea of putting a unique "tag" for identification on each nuclear weapon as well as a "seal" that would reveal any tampering with storage containers. "These measures would insure a clear chain of custody for these weapons pending their destruction," he said. The Americans have brought sample tags and seals to the meeting and plan to discuss them with officials here.

One low-tech sealing system consists of a fiber-optic cable composed of either 16 or 64 fibers that would be wrapped around a weapon storage container and then illuminated at one end. The unique light "signature" visible at the other end would be photographed. Later, in a return visit, a comparison of old and new photographs would instantly reveal if the cable had been cut or violated in any way.

High on the agenda of American

Nuclear Experts From East and West Plan Bomb Disposal



The New York Times

arms designers is discussing with their Russian counterparts any safety systems that Soviet arms might have that would allow them to be disabled in place. In an interview, Dr. Watkins of Los Alamos said modern American weapons had several such systems, although he declined to discuss them. He added that an open discussion of design issues by Russian arms designers might be "very difficult" because of the secrecy that veils such programs.

How to Store Weapons

But today Mr. Karpov, of the Foreign Ministry, told the American team that it was possible to develop disabling methods that would leave design secrets intact.

Another focal issue here is how to safely store weapons that are awaiting dismantling. Officials of the Soviet Ministry of Atomic Power and Industry, while visiting Washington in October, said that because there was no money for building new central storage facilities, some short-range weapons might have to remain in dispersed areas until the turn of the century.

Such statements helped prompt the $400 million in American aid for arms storage, transport and destruction here.

A final issue is what to do with nuclear materials after warheads have been taken apart. In its current weapons and far-flung stockpiles, the former Soviet Union is estimated to have 700 to 1,800 tons of plutonium and highly enriched uranium, a vast amount of weapons material.

One plan would be simply to leave the material in well-guarded storage areas under international supervision.

Dr. Thomas L. Neff, a member of the American delegation and a physicist at the Center for International Studies of the Massachusetts Institute of Technology, has suggested that highly enriched uranium-235 could be diluted with natural uranium and processed for use in commercial nuclear power plants. Processing plutonium in such a manner is considered less attractive because most countries shun reactor fuels that contain plutonium.

Dr. Neff has also suggested that the United States should consider buying

> A Soviet official says American technology might speed the destruction of atomic warheads.

the uranium reactor fuel, which could cost billions of dollars. Otherwise, he says, former Soviet ministries might flood commercial nuclear fuel markets and destroy critical Western industries.

Problems of Uranium Sales

Already, the Soviets have been selling unusually large amounts of natural and enriched uranium in Western commercial markets. The sales have fed a downward price spiral that has driven some uranium producers out of business and threatened the uranium enrichment business of the Federal Energy Department, the world's largest supplier of commercial fuel.

In a final method of destruction, some Russian experts have suggested that retired arms be incinerated in nuclear blasts deep beneath the ground. A Moscow-based trading company, Chetek, which has ties to the Ministry of Atomic Power, has recently been set up to explore the commercial use of nuclear explosions for such purposes as eliminating toxic wastes.

At a reception Sunday night, Chetek officials told the American delegation that a single underground blast might destroy as many as 5,000 nuclear cores from retired warheads.

Disarmament's Fallout

50 Tons of Plutonium May Require Disposal

By Thomas W. Lippman
Washington Post Staff Writer

Even before President Bush announced a unilateral nuclear arms reduction last month, scientists, engineers and government officials were contemplating one of the most dangerous and expensive challenges of the post-Cold War era: disposal of the plutonium from dismantled warheads.

The United States must decide what to do with perhaps 50 tons of one of the most lethal substances on Earth. As the weapons stockpile shrinks, less and less plutonium is required for warheads. The rest of it must be stored, destroyed or put to some commercial use.

But no disposal method exists that would be safe, environmentally benign, economically feasible, legal and politically acceptable, according to scientists, Energy Department officials and congressional analysts.

A study published last December by scientists at the Energy Department's Pacific Northwest Laboratory in Richland, Wash., listed the known options for disposing of plutonium and found drawbacks to all of them. The "option of last resort," that paper noted, is "detonation"—exploding the warheads in a controlled setting, such as the Nevada Test Site.

Similarly, a less detailed analysis by the Congressional Research Service listed as many arguments against each option as for it.

On a purely technical level, "this is a solved problem," said Wolfgang K. H. Panofsky, chairman of the National Academy of Sciences Committee on International Security

See PLUTONIUM, A17, Col. 1

Washington Post

October 18, 1991

Disarmament Challenge: How to Dispose of One of Earth's Most Lethal Substances

PLUTONIUM, From A1

and Arms Control. Plutonium can be oxidized and mixed with uranium to make a fuel known as MOX that could be used in commercial nuclear power plants.

But commercial plants are not designed to use such a fuel, so there is no demand for it, Panofsky said. Furthermore, the use of military nuclear material for commercial purposes would violate long-standing U.S. policy.

Until recently the issue of plutonium disposal attracted little attention because arms-reduction agreements with the Soviet Union generally called for elimination of delivery systems—not of the explosive warheads, which were to be stored for possible redeployment. When obsolete warheads were retired, the plutonium was reused in new ones.

But now Bush has ordered destruction of 2,150 nuclear artillery shells and short-range ballistic missile warheads. With the weapons stockpile shrinking because of previous arms control agreements, the plutonium surplus is growing but a consensus on what to do with it is not.

James D. Werner, an environmental engineer with the Natural Resources Defense Council, has calculated that Bush's initiative and previous arms control pacts will yield more than 42 tons of plutonium for disposal. In addition, the Energy Department has what one congressional report called "several tons" of recoverable plutonium in wastes and residues at its weapons factories.

"Every known method of disposing of the plutonium surplus "will prove to be difficult, dangerous and expensive," a staff memorandum for the Senate Governmental Affairs Committee concluded.

Plutonium, a man-made radioactive element, is lethal when inhaled or swallowed in microscopic amounts.

Scientists at Pacific Northwest labs found that nearly 100 percent of beagle dogs that inhaled microscopic specks of plutonium weighing less than 0.0000015 gram developed lung cancer.

Plutonium has a half-life of 24,000 years, so the danger will not simply dissipate with time.

In the metal form used in nuclear warheads, it is pyrophoric—it can burn spontaneously if it comes in contact with air.

It must be stored in a way that would ensure against criticality, or the possibility of a spontaneous chain reaction, and ensure that the material cannot fall into the wrong hands.

Assistant Energy Secretary Richard A. Claytor, who runs the Energy Department's weapons complex, said the weapons to be destroyed will be disassembled at the department's Pantex plant in Amarillo, Tex., the same facility where they were put together.

After disassembly, the plutonium "pits," or warhead triggers, will be stored at Pantex and at military bases until a permanent disposal plan is developed, he said.

Kirtland Air Force Base, N.M., is expected to be a primary storage site.

"Our plan is to store these pits for the time being in a safe and secure form, in the form that it comes out of the weapons." This option is "the most economical in the near term," he said.

He said it would probably be "a matter of years" before a long-term disposal solution is chosen.

But long-term disposition of the plutonium presents difficult political questions. Should a verification program be negotiated with the Soviet Union, which also has a surplus of plutonium? And should the plutonium be classified as waste? If so, federal law requires that it be disposed of permanently in a facility licensed by the Nuclear Regulatory Commission—a facility for which a site would have to be found. If the plutonium is not classified as waste, why not? Does the administration contemplate a resumption of the nuclear arms race? Will the United States comply with International Atomic Energy Agency regulations requiring that "any excess" plutonium be turned over to IAEA control?

"I would advocate putting it in safeguarded storage while we talk about what we are going to do with it in the long term," said Frank von Hippel, a nuclear expert at Princeton University.

"Some of us are pressing to add verification [agreements] onto the dismantlement on both sides," American and Soviet, he said. "I would feel much better if I knew what was going to happen to the plutonium in the Soviet weapons and there was some kind of international or bilateral oversight."

For Werner, a longtime critic of the Energy Department's weapons complex, "The most important consideration is whether plutonium is regarded as an irretrievable waste or as a commodity to be husbanded."

"We're taking the first steps in a process that's important for the future," he said. "These decisions are being made by a closed circle of people. I think they consider this stuff an asset, but I think it's a liability."

Claytor, however, described it as "a valuable commodity."

Von Hippel said that "one possibility" for disposing of surplus plutonium "is the idea of actually shooting it into the sun."

That may sound farfetched, but deep space disposal is one of the options analyzed in the Pacific Northwest Laboratories and Congressional Research Service studies. Both concluded that it is technically feasible but politically and economically out of the question.

Besides detonation and deep space disposal—both unlikely because of public opposition—and conversion to MOX for eventual commercial use, the Pacific Northwest Laboratories and Congressional Research papers examined these options:

- Export to Europe, where several nations are planning to use MOX in commercial reactors. The problem with this is that the Europeans have plenty of plutonium of their own and do not need any from the United States. Export would also raise difficult issues of verification and control to ensure that none of the material was diverted to nations such as Iraq that seek nuclear weapons.
- Deep geologic disposal, or entombment in subterranean vaults such as the Waste Isolation Pilot Plant that the Energy Department is about to open in New Mexico or the proposed repository for civilian radioactive waste beneath Yucca Mountain, Nev. Even if these facilities eventually are developed and proved safe, neither would be permitted under current law to accept warhead plutonium.
- Indefinite storage of plutonium as an oxidized powder. This is the most likely short-term approach but it would cost money for construction of new storage buildings and for constant security, and the material could be recovered for weapons use. This option would "put off facing the question of what to do with these materials, which sooner or later must be answered," the Congressional Research Service paper said.

In addition to plutonium, the Energy Department must decide how to dispose of large quantities of highly enriched uranium, the other principal fissile material in nuclear weapons. Scientists and government officials agree, however, that decisions about this material are easier because it can be used as fuel in the reactors that power some Navy ships.