Department of Energy
Washington, DC 20585

February 8, 1996

Dear Interested Party:

I am enclosing a copy of the Summary of the final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel. The Department of Energy, in cooperation with the State Department, prepared the final Environmental Impact Statement.

This study analyzes the potential environmental impacts of adopting a policy to manage foreign research reactor spent fuel containing uranium enriched in the United States. In particular, the study examines the comparative impacts of several alternative approaches to managing the spent fuel. The analyses demonstrate that the impacts on the environment, workers and the general public of implementing any of the alternative management approaches would be small and within applicable Federal and state regulatory limits.

The Department's preferred approach to managing the spent fuel, referred to in the study as the "preferred alternative," is for the Department to receive the spent fuel into the United States, and to manage it at the Department's Savannah River Site in South Carolina and the Idaho National Engineering Laboratory. The spent fuel would be shipped to the United States over 13 years through two military ports. The Charleston Naval Weapons Station in South Carolina would receive about one to two shipments every month beginning in 1996. The Concord Naval Weapons Station in California would receive far fewer shipments (as few as five shipments over a 13-year period) beginning in 1997.

The final Environmental Impact Statement is a three-volume document, approximately 4000 pages in length. Volume 1 (494 pages) describes the policy considerations of adopting a policy to manage foreign research reactor spent fuel, and the potential environmental impacts. Volume 2 (1111 pages) contains eight appendices relating to the technical analyses. Volume 3 (2230 pages) contains the public's comments on the draft Environmental Impact Statement, the Department's responses to those comments, and summaries of the 17 public hearings held throughout the United States during the 90-day comment period on the draft.

Our experience has taught us that many people who are interested in the Department's proposed activities do not necessarily want to receive a lengthy, multi-volume document to review. For this reason, we are sending you the Summary alone at this time. If, however, you would like a copy of the entire study, a particular volume, or an additional copy of the Summary, we would be pleased to send it to you. Please let us know by calling the Department's

Center for Environmental Management Information at 1-800-736-3282 (toll-free). The entire document will be placed in the public reading rooms and information locations listed in the Summary.

The Department will not make a final decision on whether to adopt the proposed policy until late March 1996. Thank you for your interest in this proposed action.

Sincerely,

Thomas P. Grumbly
Assistant Secretary for
Environmental Management

Enclosure

DOE/EIS-0218F
February 1996

Summary

FINAL ENVIRONMENTAL IMPACT STATEMENT

on a

Proposed Nuclear Weapons Nonproliferation

Policy Concerning Foreign Research Reactor Spent Nuclear Fuel

Cover Sheet

Responsible Agencies: Lead Agency: United States Department of Energy
Cooperating Agency: United States Department of State

Title: Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel

Contact: For further information, concerning this Final Environmental Impact Statement, contact:

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For general information on the United States Department of Energy's National Environmental Policy Act process, call 1-800-472-2756 to leave a message, or contact:

Carol Borgstrom, Director
Office of NEPA Policy and Assistance (EH-42)
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585
202-586-4600

Abstract: The United States Department of Energy and United States Department of State are jointly proposing to adopt a policy to manage spent nuclear fuel from foreign research reactors. Only spent nuclear fuel containing uranium enriched in the United States would be covered by the proposed policy. The purpose of the proposed policy is to promote U.S. nuclear weapons nonproliferation policy objectives, by seeking to reduce and eventually eliminate highly-enriched (weapons-grade) uranium from civilian commerce worldwide. Environmental effects and policy considerations of three Management Alternative approaches for implementation of the proposed policy are assessed. The three Management Alternatives analyzed are: (1) acceptance and management of the spent nuclear fuel by the Department of Energy in the United States, (2) facilitate the management of the spent nuclear fuel at one or more foreign facilities (under conditions that satisfy United States nuclear weapons nonproliferation policy objectives), and (3) a combination of elements from one or both of Management Alternatives 1 and 2 (Hybrid Alternative). A No Action Alternative is also analyzed.

For each Management Alternative, there are a number of implementation alternatives. For Management Alternative 1, this document addresses the environmental effects of various implementation alternatives, such as varied policy durations, management of various quantities of spent nuclear fuel, chemical separation, developmental treatment and/or packaging technologies, and differing financing arrangements. Environmental impacts are also examined at various potential ports of entry, along truck and rail transportation routes, at candidate management sites, and for alternate storage technologies. For Management Alternative 2, this document addresses the environmental effects of two implementation alternatives: (1) assisting foreign nations with storage; and (2) assisting foreign nations with reprocessing

of the spent nuclear fuel. With respect to Management Alternative 3, an example Hybrid Alternative is analyzed wherein a portion of the spent nuclear fuel would be processed at overseas facilities and the remaining portion would be managed in the United States.

The United States Department of Energy and United States Department of State, in consultation with other government agencies, designate the acceptance and management of the foreign research reactor spent nuclear fuel in the United States (i.e., Management Alternative 1 with modifications to several basic implementation elements) as the preferred alternative.

Public Comments: The public comment period on the Draft EIS was conducted from April 21, 1995 to July 20, 1995. During this period, DOE held 17 public hearings in the locations most likely to be directly affected by the EIS alternatives, including the 10 candidate ports of entry and 5 candidate spent nuclear fuel management sites. In addition, a public hearing was held in Washington, D.C. The Draft EIS was made available to the public through mailings, requests to DOE's Environmental Management Information Center, and at DOE Public Reading Rooms and other designated information locations.

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Summary

S.1 Introduction

Reducing the threat of the proliferation of nuclear weapons is one of the foremost goals of the United States. Proper management of spent nuclear fuel from foreign research reactors supports this goal, since much of this spent nuclear fuel contains highly-enriched uranium (HEU) which can be directly used in simple nuclear weapons.

The proposed action is for the U.S. Department of Energy (DOE) and the Department of State to jointly adopt a policy to manage spent nuclear fuel from foreign research reactors. Only spent nuclear fuel containing uranium enriched in the United States would be covered by the proposed action. The purpose of the proposed policy is to promote U.S. nuclear weapons nonproliferation policy objectives, specifically by seeking to reduce, and eventually eliminate, HEU from civilian commerce.

DOE and the Department of State have evaluated various Management Alternatives for implementing this policy. A key element of DOE and Department of State decisionmaking is a thorough understanding of the policy considerations and environmental impacts that may be associated with implementation of the proposed action. The National Environmental Policy Act of 1969 (NEPA), as amended, provides Federal agency decisionmakers with a process to use in considering potential environmental impacts (both positive and negative) of proposed actions before agencies make decisions.

National Environmental Policy Act

National Environmental Policy Act of 1969: A law that requires Federal agencies to consider in their decisionmaking processes the potential environmental effects of proposed actions and analyses of alternatives and measures to avoid or minimize any adverse effects of a proposed action.

Alternatives: The range of reasonable options, including not taking any action (the No Action alternative), considered in selecting an approach to meeting the need for agency action.

Environmental Impact Statement: A detailed environmental analysis for a proposed major Federal action that could significantly affect the quality of the human environment. A tool to assist in decisionmaking, it describes the positive and negative environmental effects of the proposed undertaking and alternatives.

Record of Decision: A concise public record of DOE's decision, which discusses the decision, identifies the alternatives (specifying which ones were considered environmentally preferable), and indicates whether all practicable means to avoid or minimize environmental harm from the selected alternative were adopted (and if not, why not).

In following this process, DOE and the Department of State prepared a draft Environmental Impact Statement (EIS) for public comment. The Draft EIS was issued in April 1995. Following consideration of public comments, DOE and the Department of State have prepared this *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (Final EIS). DOE's and the Department of State's decisions will be presented in a Record of Decision to be issued not less than 30 days after issuance of the Final EIS.

S.1.1 Policy Background

Since the 1950's, as part of the "Atoms for Peace" program, the United States has provided peaceful nuclear technology to foreign nations in exchange for their promise to forego development of nuclear weapons. A major element of this program was the provision of research reactor technology and the HEU necessary to fuel the research reactors. Research reactors play a vital role in important medical, agricultural, and industrial applications. For example, research reactors are a vital tool in cancer therapy and radioimmunoassay blood testing. There are about 30,000 medical procedures per day in North America using medical isotopes produced in research reactors in other countries. There are also about 8,000 to 10,000 such procedures per day in Europe and a similar number on other continents. Figure S-1 provides examples of the uses and benefits of research reactors.

In the past, after irradiation in the research reactor, the used fuel (known as "spent") was transported to the United States, where it was reprocessed to extract the uranium still remaining in the spent nuclear fuel. In this way, the United States maintained complete control over the HEU that it provided to other nations. The United States began accepting HEU spent nuclear fuel from foreign research reactors in 1958.

The provision of enriched uranium from the United States to other nations was usually supported by a bilateral research agreement for each research reactor. Before 1964, these agreements provided for the lease of the enriched uranium, with explicit provision for the return of the spent nuclear fuel to the United States. After 1964, most agreements provided for the sale of this material to the foreign nation, and the United States began operating under a policy known as the "Off-Site Fuels Policy," under which the United States continued to accept, temporarily store, and reprocess the spent nuclear fuel.

What is Spent Nuclear Fuel?

Spent nuclear fuel is fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated. When it is removed from a reactor, spent nuclear fuel contains some unused enriched uranium and radioactive fission products. Because of its radioactivity (primarily from gamma rays), it must be properly shielded. Nuclear fuel consists of fuel elements which can come in many configurations. Generally, a fuel element is covered by a metal called cladding and is shaped like long rods, flat plates or cylinders.

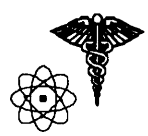
What is Enriched Uranium?

Uranium ore occurs naturally in a state that cannot be used in most reactors or to make nuclear weapons. Enriching the uranium makes it easier to use in reactors. The enrichment process increases the amount of the fissionable uranium-235 (^{235}U) isotope. Uranium enriched to contain less than 20 percent ^{235}U is called low enriched uranium. Uranium enriched to contain 20 percent or greater ^{235}U is highly-enriched uranium that can be directly used to make nuclear weapons.

Uses and Benefits of Research Reactors

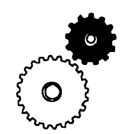
The United States has participated in cooperative international actions to expand peaceful uses of nuclear energy since the early days of the nuclear era. The foreign research reactors program has produced far-reaching benefits for medicine, science, industry, and the environment.

Advances in Nuclear Medicine



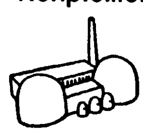
Cancer therapy, medical isotope production, clarification of the biological effects of radiation, development of improved drugs, and blood testing.

Benefits to Industry



Neutron radiography allows diagnosis of defects in metals and engines, research on new and improved materials, and leak detection.

Nonproliferation



Training of international inspectors of nuclear facilities worldwide to prevent diversion of nuclear materials.

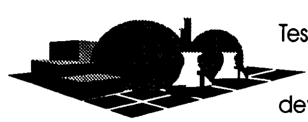
Environmental, Agricultural, and Climate Studies

Development of tracer elements for studies of pollution, waste migration, toxic waste management, mine drainage, water chemistry, sediment transport, contamination of freshwater ecosystems, atmospheric dispersion and fallout product measurements, and soil erosion.

Advancement of Basic Scientific Research

Neutron scattering experiments produce insights into elementary particle physics, clarification of the biostructure of organic substances, and development of new magnetic materials and superconducting materials.

Materials and Advanced Fuels Testing



Testing of materials and fuel forms, including safety experimentation, is being conducted to support advance fuel design and waste management development for use in the power industry.

Figure S-1 Uses and Benefits of Research Reactors

To further reduce the danger of nuclear weapons proliferation, the United States in 1978 initiated the Reduced Enrichment for Research and Test Reactors (RERTR) program, which was aimed at reducing the use of HEU in civilian programs by promoting the conversion of foreign research reactors from HEU fuel to low enriched uranium (LEU) fuel. Research reactor fuel has become the major civilian use of HEU. As part of the RERTR program, DOE developed LEU fuel and worked with foreign research reactor operators to convert their reactors to run on such fuel.

The foreign research reactor operators who converted to LEU fuel did so in support of nuclear weapons nonproliferation objectives, even though such conversions were expensive and generally resulted in reduced capabilities of the reactors and increased operating costs. From the beginning of the RERTR program, foreign research reactor operators made it clear that their willingness to convert their research reactors to LEU fuel was contingent upon the continued acceptance by DOE of their spent nuclear fuel for disposition in the United States.

In 1986, to further encourage foreign research reactor operators to convert to LEU fuel, the DOE "Off-Site Fuels Policy" was extended to include the acceptance of spent nuclear fuel containing LEU enriched in the United States. The RERTR program has been highly successful and many foreign research reactors have been modified to operate, or have been designed to operate, with the high-density LEU fuels developed by the RERTR program. Of the 42 foreign research reactors with power levels equal to or above one million watts that use U.S. enriched fuel, 37 could operate with the currently available high-density LEU fuels. Of these, 25 are either operating on LEU fuel, or have ordered LEU fuel, and DOE anticipates that an additional eight reactors will convert to LEU fuel by 2001. Work is underway to develop improved high-density LEU fuels that would enable the remaining HEU-fueled reactors to convert as well. Thus, the RERTR program has contributed to a significant reduction in the level of HEU fuel usage in foreign research reactors.

The United States accepted foreign research reactor spent nuclear fuel until the program expired (in 1988 for HEU fuels and 1992 for LEU fuels). At that time, DOE committed to prepare an environmental review of the impacts of extending the program for accepting foreign research reactor spent nuclear fuel. In 1991, DOE issued an environmental assessment of the potential environmental impacts of the proposed extension. DOE received numerous comments from the public stating that any long-term policy should not be implemented until an EIS was prepared. DOE decided in mid-1993 to prepare an EIS to evaluate the impacts of implementing a new foreign research reactor spent nuclear fuel acceptance policy.

On April 21, 1995, DOE published a Notice of Availability (60 FR 19899) of the *Draft Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (Draft EIS). Only spent nuclear fuel containing uranium enriched in the United States would be covered under the proposed action. The Draft EIS analyzed three Management Alternatives for implementing the proposed action: Management Alternative 1, accept and manage foreign research reactor spent nuclear fuel in the United States; Management Alternative 2, facilitate the management of foreign research reactor spent nuclear fuel overseas; and Management Alternative 3, a hybrid, or combination, of elements from the first two Management Alternatives. In Management Alternative 1, the Draft EIS assesses the impacts of managing the spent nuclear fuel at five DOE sites and using ten candidate ports of entry.

During the 90-day public comment period (April 21, 1995 to July 20, 1995), about 900 individuals attended the 17 public hearings held in or near candidate ports, management sites, and in Washington, DC. In addition to oral comments, DOE received approximately 5,040 written comments contained within approximately 1,250 comment documents on a wide range of policy, economic, and technical issues. Many commentors supported the U.S. nuclear weapons nonproliferation policy objective of seeking to reduce the use of HEU in civilian commerce. However, comments reflected a wide range of views as to which management alternative should be adopted. Some commentors supported management of the spent nuclear fuel in the United States. Other commentors questioned the need to accept spent nuclear fuel from allies and those countries that can manage their spent nuclear fuel abroad. These commentors generally believed that such spent nuclear fuel should be managed overseas. With regard to the implementation of the policy in the United States, some commentors preferred the use of military ports. Risks

The failure of the United States to manage foreign research reactor spent nuclear fuel could have a number of adverse consequences. Foreign governments and research reactor operators participated in the RERTR program in part because the United States accepted the spent nuclear fuel from their research reactors. The United States has not accepted HEU spent nuclear fuel for more than six years, with the exception of recent shipments of 252 spent nuclear fuel elements (153 elements from Austria, The Netherlands, Sweden, and Denmark, and 99 elements from Switzerland and Greece) under the *Environmental Assessment of Urgent Relief Acceptance of Foreign Research Reactor Spent Nuclear Fuel, April 1994*. As a result, some foreign research reactor operators have run out of space to store their spent nuclear fuel and others soon will. Under such conditions, the foreign research reactor operators must either shut down their reactors, construct new storage facilities, or ship the spent nuclear fuel offsite for storage or reprocessing. Currently, overseas reprocessing results in separated HEU that is placed back into commerce for use as new reactor fuel. The overseas reprocessing facilities (e.g., Dounreay in the United Kingdom) currently do not have the special equipment to reprocess the high-density LEU fuels that the United States is encouraging foreign research reactors to use to replace the HEU fuels. Thus, in the absence of action to resolve the question of the disposition of spent nuclear fuel, any foreign research reactor operator who reprocesses spent nuclear fuel to control a spent fuel inventory must continue to use, or convert back to, fuel containing HEU. Some nations, such as Belgium and Germany, have already begun shipments for reprocessing. For most foreign research reactor operators, construction of a new storage facility would not be practical due to the very high cost of storing small amounts of spent nuclear fuel and the long time required to design, license, and construct facilities. The most realistic near-term option for these reactor operators (particularly those in countries without power reactor programs) is to ship their spent nuclear fuel offsite for reprocessing. In such a case, foreign research reactor operators would have little incentive to convert their reactors to LEU fuels.

A crucial consideration in making the proposal to manage foreign research reactor spent nuclear fuel was the then upcoming 1995 international conference on the *Treaty on the Non-Proliferation of Nuclear Weapons*. At that conference, a major United States foreign policy objective was reached when the parties agreed by consensus to make the Treaty a permanent part of the international nuclear nonproliferation regime. One key to the success of the conference was the ability of the United States to convince other Treaty parties that the nuclear weapons States had complied with their obligations

The Treaty on the Non-Proliferation of Nuclear Weapons

The 1968 *Treaty on the Non-Proliferation of Nuclear Weapons* is the basis for the world's nuclear weapons nonproliferation regime. The purpose of the Treaty is to keep the number of countries with nuclear weapons to the five countries that possessed such weapons before 1967: the United States, Russia, the United Kingdom, France, and China. In addition to the five nuclear weapons States, 175 other countries are members of the Treaty. On May 12, 1995, the Review and Extension Conference of the Parties to the Treaty agreed by consensus to extend the Treaty for an indefinite period. This accomplishment achieved a major goal of United States foreign policy. The obligations for compliance with the *Treaty on the Non-Proliferation of Nuclear Weapons* apply to both nuclear weapons States and nonnuclear weapons States. While nonnuclear weapons States agree not to pursue development or acquisition of nuclear weapons or other nuclear explosive devices, the nuclear weapons States commit themselves to work toward the ultimate elimination of their nuclear arsenals. All States are thus bound to help reduce the global threat of nuclear weapons, but must do so without prejudice to a nation's ability to pursue the benefits of peaceful uses of nuclear energy.

under Article IV of the Treaty and had shared with nonnuclear weapons States the benefits of peaceful nuclear cooperation.

The parties also agreed to review the Treaty every five years to ensure that all parties are in compliance. Any country which has been compelled to shut down its research reactors, or has been forced to seek reprocessing, could accuse the United States of not having complied with its Treaty obligations. This accusation, however ill-founded, could be made not only by the affected countries, but by any country opposed to U.S. interests.

To illustrate the level of concern that exists, DOE has received letters from the U.S. Department of State, the Nuclear Regulatory Commission (NRC), the Arms Control and Disarmament Agency, and the International Atomic Energy Agency, all urging DOE to implement a new policy to manage the foreign research reactor spent nuclear fuel. (See Appendix G of the Final EIS.)

By proposing a policy for management of certain foreign research reactor spent nuclear fuel, DOE and the Department of State do not seek to indefinitely accept or otherwise manage spent nuclear fuel from foreign research reactors. Rather, the purpose of the proposed new policy is to remove as much U.S.-origin HEU as possible from international commerce while giving the foreign research reactor operators and their host countries time to convert to operation with LEU fuel and to make their own arrangements for disposition of subsequently generated LEU spent nuclear fuel. Should the proposed policy be adopted, the foreign research reactor operators and countries in which the research reactors are operating must be prepared to implement their own arrangements for disposition of their spent nuclear fuel after the policy expires.

S.1.3 Decisions to be Made Based on this EIS

The principal policy decision for which this EIS will provide a basis is whether the United States should adopt a policy for the management of foreign research reactor spent nuclear fuel containing uranium enriched in the United States. The countries which host foreign research reactors covered under this EIS are identified in Figure S-2.

Should a decision be made to manage this foreign research reactor spent nuclear fuel in the United States, decisions also would have to be made on the duration of the policy, amount of fuel to be accepted, transportation modes, ports of entry, and method of spent nuclear fuel management (storage, chemical separation, or use of a new treatment and/or packaging technology). Should the decision be made to facilitate management of foreign research reactor spent nuclear fuel overseas, decisions would need to be made on what assistance the United States would provide to foreign nations for storage or reprocessing of the spent nuclear fuel overseas. The decisions of DOE and the Department of State will be announced in the Record of Decision for this EIS, which will be available no less than 30 days after the Environmental Protection Agency publishes a Notice of Availability for the Final EIS.

ther than High-Income Economies (World Bank, 1994)

ries which Host the Research Reactors

S.1.4 Relationship of This EIS to Other NEPA Documentation and Reports Relating to Spent Nuclear Fuel Management

Certain potential actions discussed in this EIS would depend on decisions to be made under other NEPA analyses. For example, the site(s) at which foreign research reactor spent nuclear fuel would be managed (if the spent nuclear fuel were to be accepted in the United States) were considered in Volume 1 of the *DOE Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement*, or "Programmatic SNF&INEL Final EIS," issued in April 1995. The five management sites considered were: the Savannah River Site, the Idaho National Engineering Laboratory, the Oak Ridge Reservation, the Hanford Site, and the Nevada Test Site. The Record of Decision, issued on May 30, 1995, indicated that DOE aluminum clad spent nuclear fuel will be managed at the Savannah River Site and other DOE spent nuclear fuel will be managed at the Idaho National Engineering Laboratory. Accordingly, the Comment Response Document (Volume 3) for this EIS focuses on the Savannah River Site and the Idaho National Engineering Laboratory, although to maintain maximum consistency with the analysis provided in the Programmatic SNF&INEL Final EIS, this EIS analyzes the impacts of the proposed action at all five sites.

Potential chemical separation activities for nuclear materials already in inventory at the Savannah River Site are addressed in the *Interim Management of Nuclear Materials Final Environmental Impact Statement.* A Record of Decision and Notice of Preferred Alternative was published in December 1995 in the *Federal Register* (60 FR 65300). Decisions were made in the Record of Decision for the majority of materials covered by the EIS and processing Mark-16 and Mark-22 fuels and blending down the resulting HEU to LEU was identified as the preferred alternative. These fuels are similar to the aluminum-based foreign research reactor spent nuclear fuel, although significant corrosion has been identified. An amended Record of Decision is expected soon regarding the Mark-16 and Mark-22 spent nuclear fuel. DOE has taken into consideration the Record of Decision on the *Interim Management of Nuclear Materials Final EIS* in preparation of this EIS and in reaching a decision on how to implement the proposed policy, if adopted.

The relationship of this EIS to other DOE NEPA reviews, either completed or currently under preparation, and other DOE analyses related to the EIS, is discussed in Volume 1, Section 1.5 of the EIS.

S.2 Proposed Action and Alternatives

The proposed action is for DOE and the Department of State to jointly adopt a policy to manage spent nuclear fuel from foreign research reactors. Only spent nuclear fuel containing uranium enriched in the United States would be covered by the proposed action. The purpose of the proposed policy is to promote U.S. nuclear weapons nonproliferation policy objectives, specifically by seeking to reduce, and eventually eliminate, HEU from civilian commerce. The proposed policy applies solely to aluminum-based and Training, Research, Isotope, General Atomic (TRIGA) foreign research reactor spent fuels and target material containing HEU and LEU of U.S. origin.

To implement the proposed action, the EIS analyzes three "Management Alternatives," which are:

Management Alternative 1: Accept and manage foreign research reactor spent nuclear fuel in the United States. This could be implemented by accepting foreign research reactor spent nuclear fuel (containing HEU or LEU enriched in the United States) for management in the United States.

Management Alternative 2: Facilitate the management of foreign research reactor spent nuclear fuel overseas. This could be implemented by U.S. assistance in spent nuclear fuel storage or reprocessing.

Management Alternative 3: A hybrid, or combination, of elements from the above two Management Alternatives.

Each management alternative has further implementation components and alternatives, as identified in Figure S-3. These are addressed in succeeding sections.

The EIS also evaluates the "No Action" alternative, in which case the United States would take no action concerning such a policy.

DOE did not identify a preferred alternative for the management of foreign research reactor spent nuclear fuel in the Draft EIS. After careful consideration of public comments on the Draft EIS and other factors, DOE and the Department of State have designated Management Alternative 1, with modifications to several basic implementation

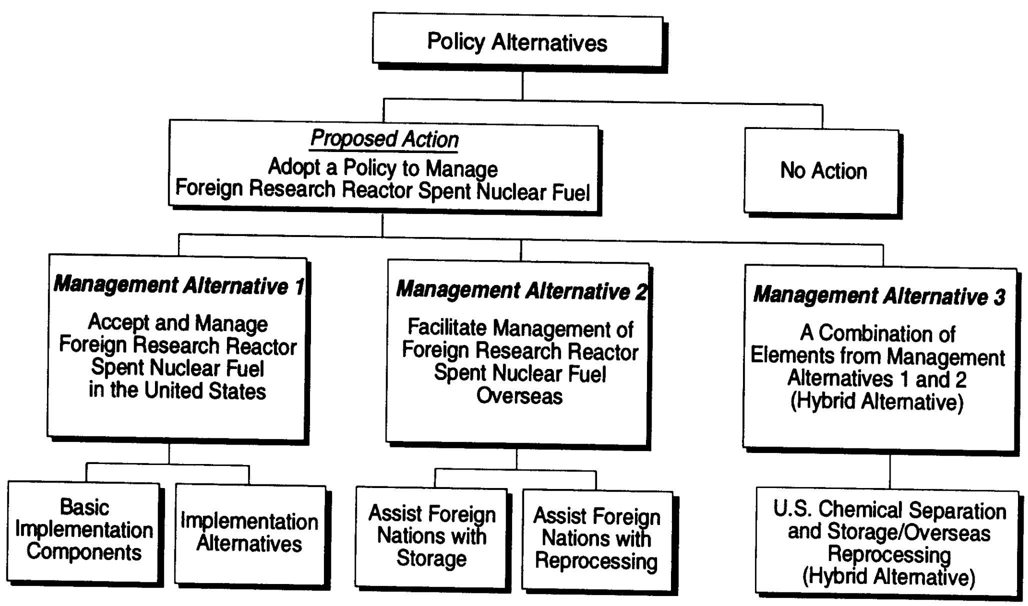


Figure S-3 Management Alternatives of the Proposed Action elements, as the preferred alternative for the implementation of the proposed policy. This preferred alternative is to accept and manage in the United States up to 22,700 elements of foreign research reactor spent nuclear fuel containing uranium enriched in the United States and target material. The preferred alternative is described in Section S.2.3 of this Summary.

S.2.1 Overview of Management Alternatives to Implement the Proposed Action

The three Management Alternatives are summarized below.

[illegible]

Management Alternative 1: Manage Foreign Research Reactor Spent Nuclear Fuel in the United States

Under Management Alternative 1, foreign research reactor spent nuclear fuel, which contains uranium enriched in the United States, would be transported to the United States in casks designed on the basis of international regulations that are essentially identical to those promulgated by the NRC and certified by the U.S. Department of Transportation. In accordance with the Record of Decision for the Programmatic SNF&INEL Final EIS, all of the aluminum clad foreign research reactor spent nuclear fuel accepted by DOE would be managed at the Savannah River Site in South Carolina, and any other foreign research reactor spent nuclear fuel, such as the TRIGA elements, to be accepted by DOE would be managed at the Idaho National Engineering Laboratory, pending ultimate disposition. Nevertheless, all five of the spent nuclear fuel management sites originally considered in the Draft EIS have been kept in this Final EIS to maintain maximum consistency with the analyses provided in the Programmatic SNF&INEL Final EIS. The components of the basic implementation of Management Alternative 1 are identified in Figure S-4.

The EIS also evaluates several different options for implementing Management Alternative 1. (Indeed, the preferred alternative incorporates a combination of various implementation alternatives that were analyzed.) The implementation alternatives are identified in Figure S-5. They include, for example, different time periods for the policy duration, different storage technologies, and a chemical separation alternative to storing the fuel.

Management Alternative 2: Facilitate the Management of Foreign Research Reactor Spent Nuclear Fuel Overseas

This Management Alternative would require bilateral agreements between the United States and one or more foreign governments in order to ensure consistency with U.S. nuclear weapons nonproliferation policy. Under this Management Alternative there are two subalternatives: one is to provide assistance to foreign nations that are able to store their spent nuclear fuel in facilities in their own countries, and a second is to provide

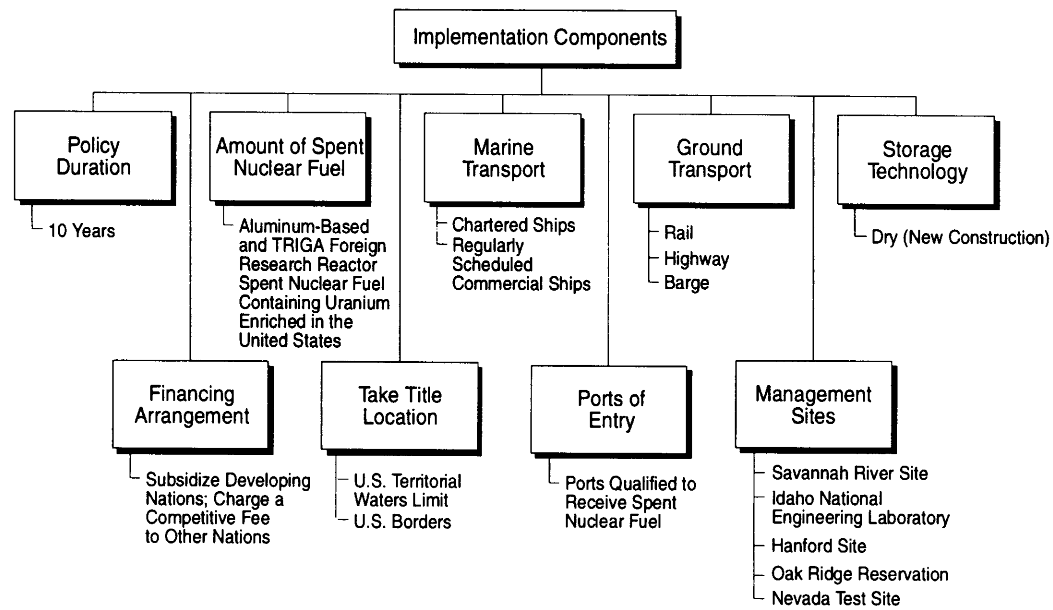


Figure S-4 Basic Implementation Components of Management Alternative 1

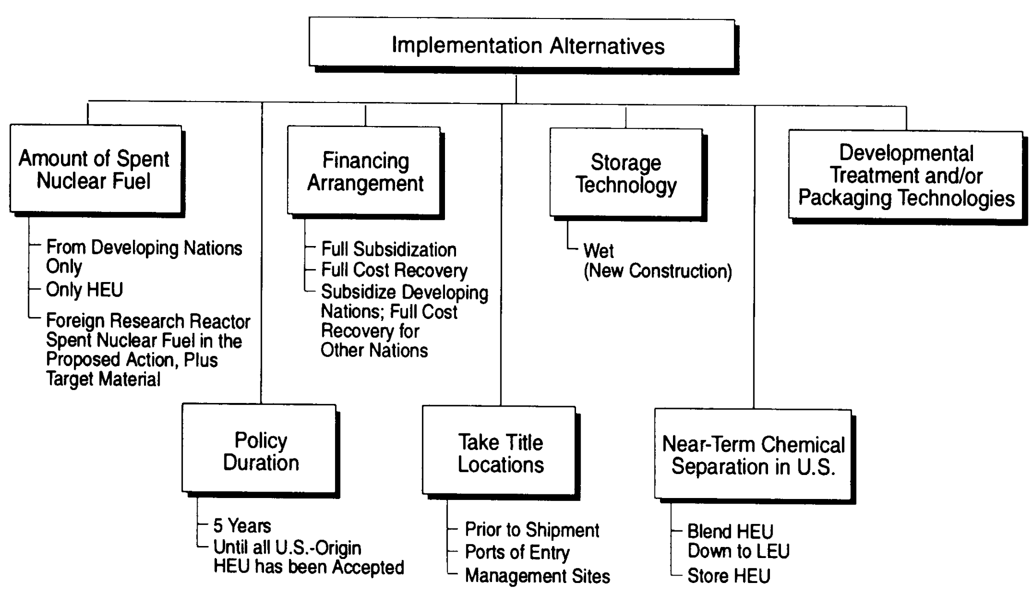


Figure S-5 Implementation Alternatives subalternative, DOE and the Department of State would provide nontechnical assistance, incentives, and coordination to foreign research reactor operators and reprocessors to facilitate reprocessing of spent nuclear fuel overseas in facilities operated under international inspections and safeguards. Facilities operated by the United Kingdom Atomic Energy Authority at Dounreay, United Kingdom, and by Cogema at Marcoule, France might be used for this purpose. After reprocessing, the recovered HEU would be blended down to LEU at these same facilities for reuse as either LEU research reactor fuel or commercial power reactor fuel. The high-level wastes resulting from this reprocessing would be sent to the country in which the spent nuclear fuel was irradiated. If the reprocessing wastes could not be sent to the country in which the spent nuclear fuel was irradiated, such wastes would be accepted by the United States for storage and ultimate geologic disposal.

Management Alternative 3: A Combination of Elements From Management Alternatives 1 and 2 (Hybrid Alternative)

Under Management Alternative 3, DOE and the Department of State would combine elements from Management Alternatives 1 and 2 to develop new alternatives for management of foreign research reactor spent nuclear fuel in the United States or abroad. For example, DOE and the Department of State could combine partial storage or reprocessing overseas with partial storage or chemical separation in the United States.

The following sections discuss in more detail the implementation of each Management Alternative.

S.2.2 Management Alternative 1 - Manage Foreign Research Reactor Spent Nuclear Fuel in the United States

This section provides a more detailed summary of Management Alternative 1 and identifies components of its basic implementation and components of various implementation alternatives.

S.2.2.1 Basic Implementation Components

The components of the basic implementation of Management Alternative 1 (see Figure S-4) provide the foundation for the analyses of impacts presented in the EIS. They are:

- Policy Duration
- Financing Arrangement
- Amount of Foreign Research Reactor Spent Nuclear Fuel
- Location for Taking Title to Foreign Research Reactor Spent Nuclear Fuel
- Marine Transport
- Port(s) of Entry
- Ground Transport

- Foreign Research Reactor Spent Nuclear Fuel Management Sites
- Storage Technologies.

S.2.2.1.1 Policy Duration

The policy duration would be the 10-year period beginning on the date when the policy takes effect. Spent nuclear fuel containing HEU and LEU of U.S. origin that is currently being stored or is to be generated during the 10-year policy period would be accepted. Actual shipments of spent nuclear fuel to the United States could be made for a period of 13 years starting from the effective date of the policy implementation, as long as spent nuclear fuel was generated within the 10-year policy period. The additional three years would allow for a cooling time for fuel discharged from a reactor late in the policy period, logistics in arranging for shipment of this fuel, and other unplanned for delays.

S.2.2.1.2 Financing Arrangement

The United States would bear the full cost of transporting and managing the foreign research reactor spent nuclear fuel received from countries with other-than-high-income-economies. For high-income economy countries, the United States would charge a competitive fee for all spent nuclear fuel management activities conducted by the United States.

S.2.2.1.3 Amount of Foreign Research Reactor Spent Nuclear Fuel

The amount of foreign research reactor spent nuclear fuel that would be accepted under the basic implementation of Management Alternative 1 is up to about 19.2 MTHM from up to approximately 22,700 individual spent nuclear fuel elements (1 MTHM equals about 2,200 pounds).

S.2.2.1.4 Location for Taking Title to Foreign Research Reactor Spent Nuclear Fuel

DOE would take title to the foreign research reactor

As a comparison:

- *During the last 5 decades, DOE and its predecessor agencies have produced, transported, received, stored, and processed more than 100,000 metric tons of heavy metal (MTHM) of spent nuclear fuel.*
- *Currently about 2,700 MTHM of DOE spent nuclear fuel are being stored at various DOE facilities.*
- *Currently about 30,000 MTHM*

S.2.2.1.6 Port(s) of Entry

The receipt of the foreign research reactor spent nuclear fuel could occur at any of the following candidate ports of entry:

- Charleston, SC (includes Naval Weapons Station and Wando Terminal, Mt. Pleasant)
- Galveston, TX
- Hampton Roads, VA (includes Terminals at Newport News, Norfolk, and Portsmouth, VA)
- Jacksonville, FL
- Military Ocean Terminal Sunny Point, NC
- Naval Weapons Station Concord, CA
- Portland, OR
- Savannah, GA
- Tacoma, WA
- Wilmington, NC

The locations of these ports in relation to the five candidate management sites are depicted on the map in Figure S-6.

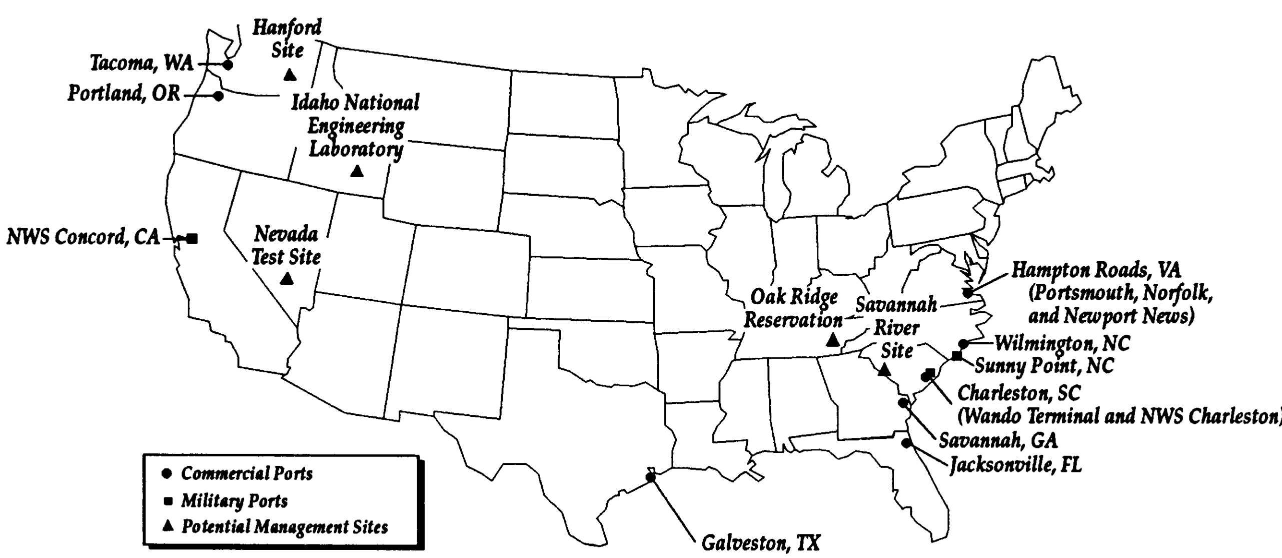


Figure S-6 Location of Potential Ports of Entry and Management Sites

The potential ports of entry were identified using screening criteria that included appropriate experience, safe transit, adequate facilities, and population around the ports and along routes to potential management sites. Screening criteria were based on input from the public (during the EIS scoping process), a U.S. Merchant Marine Academy panel of maritime safety experts, and factors identified in Section 3151 of the National Defense Authorization Act for Fiscal Year 1994.

S.2.2.1.7 Ground Transport

The basic implementation of Management Alternative 1 would involve transporting casks containing foreign research reactor spent nuclear fuel by truck, rail, or barge from the ports of entry or Canadian border crossings to potential management sites. It could also involve later transport of the spent nuclear fuel between the management sites.

All spent nuclear fuel shipments must comply with both NRC and Department of Transportation regulatory requirements. Specific highway routing of the cask shipments would follow a systematic process in accordance with Department of Transportation regulations. Shipments must also comply with NRC regulations covering physical security and notification.

Rail routing is not covered by specific Department of Transportation and NRC regulations. Therefore, shippers would generally select the most direct available rail route, which would serve to reduce travel time and radiation exposure consistent with track class and other rail service requirements.

S.2.2.1.8 Foreign Research Reactor Spent Nuclear Fuel Management Sites

Potential sites for the receipt and management of foreign research reactor spent nuclear fuel have been specified by DOE in the Record of Decision for the Programmatic SNF&INEL Final EIS, which is concerned with the environmental impacts of management of spent nuclear fuel. In accordance with this Record of Decision, all of the aluminum clad foreign research reactor spent nuclear fuel accepted by DOE would be managed at the Savannah River Site in South Carolina, and any other foreign research reactor spent nuclear fuel, such as the TRIGA elements, to be accepted by DOE would be managed at the Idaho National Engineering Laboratory, pending ultimate disposition. Notwithstanding the Record of Decision of the Programmatic SNF&INEL Final EIS, full analyses of all five sites are included in the EIS to maintain analytical consistency with the programmatic analyses.

In the analyses considering use of potential management sites other than the Savannah River Site and the Idaho National Engineering Laboratory, the near-term unavailability of the other three candidate management sites to accept foreign research reactor spent nuclear fuel at the beginning of the implementation period (due to lack of existing storage capacity) would necessitate temporary receipt and storage of the spent nuclear fuel at either the Savannah River Site or the Idaho National Engineering Laboratory. The other three sites — the Oak Ridge Reservation, the Hanford Site, and the Nevada Test Site — would not have facilities available for approximately 10 years. The Nevada Test Site could receive the spent nuclear fuel in approximately five years if a decision were made to refurbish the Engine Maintenance and Disassembly (E-MAD) facility rather than construct a new facility.

S.2.2.1.9 Storage Technologies

Under the basic implementation of Management Alternative 1, DOE would manage foreign research reactor spent nuclear fuel for a period starting in 1996, and continuing for 40 years, or until ultimate disposition. The technology for safely storing spent nuclear fuel has been in use for over 40 years in the nuclear industry. Spent nuclear fuel storage is generally characterized as either "wet" or "dry." Wet storage means that the spent nuclear fuel elements reside in a water-filled pool. Dry storage means that the fuel is

S.2.2.1.10 Ultimate Disposition

Ultimate disposition of DOE's spent nuclear fuel, including foreign research reactor spent nuclear fuel, is a high priority. For planning purposes, DOE has determined that its spent nuclear fuel that is not otherwise managed (e.g., chemically separated, with the high-level waste being converted into a vitrified glass for repository disposal) is authorized for disposal in a geologic repository. The Nuclear Waste Policy Act of 1982 (as amended) authorizes disposal of the foreign research reactor spent nuclear fuel in a geologic repository (if DOE takes title to such spent nuclear fuel). However, since the repository characterization program is in its early stages, the waste acceptance criteria for disposal of DOE's spent nuclear fuel in a repository have not been developed. Thus, a determination cannot be made at this time as to the requirements that must be met to allow emplacement of the foreign research reactor spent nuclear fuel in the repository. As a result, the EIS analysis for the time period beyond 40 years is qualitative rather than quantitative. The qualitative assessment includes consideration of disposal of intact foreign research reactor spent nuclear fuel, disposal of vitrified high-level waste resulting from chemical separation, as well as utilization of various potential new technologies to process the spent nuclear fuel into a more stable form prior to its ultimate disposition. In the event that the availability of a geologic repository were to be delayed beyond the 40-year program period, DOE assumed for purposes of this analysis that it would continue to manage the foreign research reactor spent nuclear fuel, or the high-level radioactive waste resulting from the chemical separation or other processing of such spent nuclear fuel, at the management sites until a geologic repository becomes available. Decisions regarding the actual disposition of DOE's spent nuclear fuel will follow appropriate review under NEPA.

S.2.2.2 Implementation Alternatives for Management Alternative 1

This EIS also evaluates a range of implementation alternatives that modify one of the basic implementation components of Management Alternative 1 (see Figure S-5). The implementation alternatives (and implementation subalternatives) include the following:

1. Alternative amount of foreign research reactor spent nuclear fuel to be accepted:
   a. Only from countries with other-than-high-income-economies (up to 1.9 MTHM; 5,000 elements)
   b. HEU only (up to 4.6 MTHM; 11,200 elements)
   c. Target material in addition to spent nuclear fuel (up to 0.6 MTHM; equivalent to 620 elements)

2. Alternative policy durations:
   a. Five-year policy (up to 13 MTHM; 18,800 elements)
   b. Indefinite HEU/10-year LEU policy (same amount as basic implementation; different timing)

3. Alternative financing arrangements:
   a. Subsidize all countries

b. Charge all countries full cost of accepting and managing foreign research reactor spent nuclear fuel
c. Subsidize other-than-high-income economy countries; charge high-income economy countries full-cost recovery fee

4. Alternative locations for taking title:

    a. Prior to shipment
    b. Port(s) of entry
    c. Management sites

5. Wet storage technology for new construction

6. Near-term conventional chemical separation in the United States[1]

    a. Extent of chemical separation: dedicated to foreign research reactor spent nuclear fuel only, or part of larger-scale DOE chemical separation activities
    b. Uranium disposition: blend HEU down to LEU or process HEU to oxide for interim storage

7. Developmental treatment and/or packaging technologies (Conduct a development program leading to a decision on whether to construct and operate a cost-effective new treatment and/or packaging facility. The objective of this technical strategy is to treat, package, and store spent nuclear fuel in a manner suitable for placement into a geologic repository.

S.2.3 Preferred Alternative

In selecting a preferred alternative for the management of foreign research reactor spent nuclear fuel, DOE and the Department of State took several factors into consideration, including the following:

1. U.S. Government nuclear weapons nonproliferation policies and objectives;

2. DOE responsibilities (e.g., safe handling of hazardous materials, safety/health risks to workers, compatibility with other ongoing missions, etc.);

3. Potential environmental impacts (e.g., public safety, etc.);

4. Public comments received and concerns expressed following issuance of the Draft EIS;

5. Analysis of impacts and alternatives in the Programmatic SNF&INEL Final EIS (DOE, 1995c), as well as the Record of Decision for that EIS;

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1 *Chemical separation of foreign research reactor spent nuclear fuel in existing facilities is not preferred by DOE as a technology for* [illegible]

6. Estimated costs of alternatives for management of foreign research reactor spent nuclear fuel;

7. Public issues/concerns/perceptions (e.g., fairness/equity to affected States and populations, etc.); and

8. Uncertainties (e.g., future budget priorities and continuity of funding, technology development, repository timing and waste form acceptance criteria, regulatory change, etc.).

Based on consideration of these factors, DOE and the Department of State, in consultation with other Government agencies, designate the alternative described below as the preferred alternative. This preferred alternative is the same as Management Alternative 1 (Manage Foreign Research Reactor Spent Nuclear Fuel in the United States, discussed in Section 2.2 of the EIS and S.2.2 of the Summary), with the modifications discussed below. The basic components of Management Alternative 1 have been modified to incorporate various implementation alternatives discussed in Section 2.2.2 of the EIS and S.2.2.2 of the Summary.

The amount of foreign research reactor spent nuclear fuel that would be accepted and managed, as specified in Section 2.2.1.3 of the EIS, could total approximately 19.2 MTHM, with a volume of approximately 110 m^3 (4,100 ft^3), representing approximately 22,700 individual spent nuclear fuel elements. The target material that would be accepted and managed, as specified in Section 2.2.2.1 of the EIS, contains an additional 0.6 MTHM representing the uranium content of approximately 620 additional typical foreign research reactor spent nuclear fuel elements. The following stipulations on qualifying spent nuclear fuel types would apply:

- Spent nuclear fuel (HEU and/or LEU) would be accepted from research reactors operating on LEU fuel or in the process of converting to LEU fuel when the policy becomes effective.

- Spent nuclear fuel (HEU and/or LEU) would be accepted from research reactors which operate on HEU fuel when the policy

Preferred Alternative Elements

Policy: Adopt a policy to accept and manage foreign research reactor spent nuclear fuel and target material in the United States.

Amount of Fuel to be Accepted: Up to 19.2 metric tons of heavy metal in 22,700 fuel elements, and 0.6 metric tons of heavy metal of target material.

Policy Duration: Ten years. Shipment to United States could occur for 13 years.

Financing Arrangements: United States would bear the full cost for transporting and managing the spent nuclear fuel accepted from countries with other-than-high-income economies, and would charge high-income economy countries a fee.

Marine Transport: Either chartered or commercial ships.

Ports of Entry: Military ports of Charleston Naval Weapons Station, SC, and Naval Weapons Station Concord, CA.

Location for Taking Title: Upon unloading the spent nuclear fuel at U.S. ports of entry and at the U.S.-Canadian border.

Ground Transport: Truck or rail.

Management Sites: Aluminum-based foreign research reactor spent nuclear fuel and target material at the Savannah River Site. TRIGA foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory.

Management Technologies: Management of the TRIGA foreign research reactor spent nuclear fuel at the Idaho National Engineering Laboratory would be based on the use of existing storage facilities with the possible use of a new treatment and/or packaging technology.

Management of the aluminum-based foreign research reactor spent nuclear fuel at the Savannah River Site would be based on the use of existing storage facilities, development and implementation of a new treatment and/or packaging technology, and chemical separation if necessary.

DOE would conduct an independent study of the nonproliferation and other implications of reprocessing a portion of the foreign research reactor spent nuclear fuel at F-Canyon prior to committing to the use of reprocessing for other than health or safety reasons.

becomes effective and which agree to convert to LEU fuel. Spent nuclear fuel would not be accepted from research reactors that could convert to LEU fuel but refuse to do so.

- Spent nuclear fuel (HEU) would be accepted from research reactors having lifetime cores, from research reactors planning to shut down by a specific date while the policy is in effect, and from research reactors for which a suitable LEU fuel is not available.

- Spent nuclear fuel (HEU and/or LEU) would be accepted from research reactors that are already shut down.

- Unirradiated fuel (HEU and/or LEU) from eligible research reactors would be accepted as spent nuclear fuel.

- For research reactors with both HEU and LEU spent nuclear fuel available for shipment, LEU spent nuclear fuel would not be accepted until the HEU spent nuclear fuel is exhausted, unless there are extenuating circumstances (e.g., deterioration of one or more LEU elements sufficient to cause a safety problem).

- Spent nuclear fuel (HEU and/or LEU) would not be accepted from new research reactors starting operation after the date of implementation of the policy.

The policy duration under this preferred alternative would be 10 years, beginning on the date when the management policy would become effective, as discussed in Section 2.2.1.1 of the EIS. Shipments of spent nuclear fuel to the United States could be made for a [illegible]

Station Concord). Under this preferred alternative, a maximum of 38 casks of TRIGA foreign research reactor spent nuclear fuel (estimated to require about 5 shipments) could be accepted at a western port, with 150 to 300 shipments being accepted via an eastern port.

The foreign research reactor spent nuclear fuel and target material would be shipped by either chartered or regularly scheduled commercial ships from the foreign ports to the United States, as specified in Section 2.2.1.5 of the EIS.

DOE would take title to the foreign research reactor spent nuclear fuel and target material that is shipped by sea after it is offloaded at the port of entry, and to the spent nuclear fuel and target material shipped solely overland (i.e., from Canada) at the border crossing between Canada and the United States.

The foreign research reactor spent nuclear fuel and target material would be transported from the United States ports to the management sites by truck and rail as specified in Section 2.2.1.7 and S.2.2.1.7 of the Summary.

The financing arrangement under this preferred alternative would be for the United States to bear the full cost for transporting and managing the foreign research reactor spent nuclear fuel and target material accepted from countries with other-than-high-income economies, and to charge high-income economy countries a competitive fee. The fee would be established in a *Federal Register* Notice (as opposed to being published in this Final EIS), to allow DOE flexibility to adjust the fee to account for inflation, or changes in spent nuclear fuel management practices in the United States.

For the aluminum-based foreign research reactor spent nuclear fuel, a three point strategy is proposed, as follows:

1. DOE would embark immediately on an accelerated program at the Savannah River Site to identify, develop, and demonstrate one or more non-reprocessing, cost-effective treatment and/or packaging technologies to address potential health and safety issues that may develop and to prepare the foreign research reactor spent nuclear fuel for ultimate disposal. The purpose of any new facilities that might be constructed to implement these technologies would be to change the foreign

Developmental Treatment and/or Packaging Technology Options for Spent Nuclear Fuel

Direct Disposal in Small Packages: Place fuel into small waste packages with neutron poison to control criticality.

Dissolve and Vitrify: Dissolve and mix fuel with depleted uranium to produce LEU and vitrify the mixture.

Melt and Dilute/Poison: Melt and dilute or mix fuel with a neutron poison.

Chop and Dilute/Poison: Chop fuel and dilute with depleted uranium or mix with a neutron poison.

Plasma Arc Treatment: Place fuel into plasma centrifugal furnace with other material to melt and convert into a ceramic material.

Electrometallurgical Treatment: Melt fuel in an electrolytic cell to remove the bulk of the aluminum (for disposal as low-level waste); vitrify the residual aluminum, actinides and fission products; recover pure uranium if required.

Glass Material Oxidation and Dissolution System: Melt fuel with glass-forming-materials in a glass melt furnace to form glass.

Can-in-Canister: Place fuel, with a critically safe quantity of uranium, in a can and place that can into a canister and surround with high-level waste glass from the Defense Waste Processing Facility.

Chloride Volatility: React fuel with chlorine gas to convert all materials into a volatile gas. Separate uranium, actinides, and fission products by cooling and distillation.

research reactor spent nuclear fuel into a form that is suitable for geologic disposal, without necessarily separating the fissile materials, while meeting or exceeding all applicable safety and environmental requirements. Examples of technologies that would be considered include: *can-in-canister, chop and dilute/poison, melt and dilute/poison, plasma arc treatment, electrometallurgical treatment, glass material oxidation and dissolution, chloride volatility, dissolve and vitrify, direct disposal in small packages*, etc. In conjunction with the examination of new technologies, variations of conventional direct disposal methods would also be explored. After treatment and/or packaging, the foreign research reactor spent nuclear fuel would be managed on site in "road ready" dry storage until transported off-site for continued storage or disposal. DOE would select, develop, and implement, if possible, one or more of these treatment and/or packaging technologies by the year 2000. DOE is committed to avoiding indefinite storage of this spent nuclear fuel in a form that is unsuitable for disposal.

2. Despite DOE's best efforts, it is possible that a new treatment and/or packaging technology may not be ready for implementation by the year 2000. It may become necessary, therefore, for DOE to use the F-Canyon to reprocess some foreign research reactor spent nuclear fuel elements, while the F-Canyon is operating to stabilize at-risk materials as recommended by the Defense Nuclear Facilities Safety Board. (For example, under current schedules this activity could take place between the years 2000 and 2002.) In that event, the foreign research reactor spent nuclear fuel would be converted into LEU and wastes generated during reprocessing. Certain wastes would be vitrified in the Defense Waste Processing Facility, while others would be solidified in the Saltstone facility. In order to provide a sound policy basis for making a determination on whether and how to utilize the F-Canyon for processing tasks that are not driven by health and safety considerations, DOE will commission or conduct an independent study of the nonproliferation and other (e.g., cost and timing) implications of reprocessing spent nuclear fuel from foreign research reactors. The study will be initiated in mid-1996 and will be completed in a timely fashion to allow a subsequent decision about possible use of the F-Canyon for foreign research reactor spent nuclear fuel reprocessing to be fully considered by the public, the Congress and the Executive Branch agencies. Pending disposition of the foreign research reactor spent nuclear fuel by either a new treatment and/or packaging technology or reprocessing in the F-Canyon, the spent nuclear fuel would be placed in existing wet storage at the Savannah River Site.

3. DOE would conduct a program of close monitoring of any foreign research reactor spent nuclear fuel and target material that would be accepted for storage in existing wet storage facilities. DOE is presently unaware of any technical basis for believing that this spent nuclear fuel cannot be safely stored until one or more of the treatment and/or packaging technologies becomes available. Nevertheless, if health and safety concerns involving any of the foreign research reactor spent nuclear fuel elements are identified prior to development of an appropriate treatment and/or packaging technology, DOE would use the F-Canyon to reprocess the affected spent nuclear fuel elements, if it is still operating to stabilize at-risk materials.

> Because of criticality constraints stemming from the configuration of the F-Canyon, under no circumstances would it be possible to produce separated HEU that is suitable for a nuclear weapon. Instead, depleted uranium would be added to the foreign research reactor spent nuclear fuel near the beginning of the reprocessing process, so that only LEU would be produced when the uranium is separated from the fission products. The trace quantities of plutonium in the spent nuclear fuel would be left in and solidified along with the high-level radioactive reprocessing wastes. This would further the President's policy to discourage the accumulation of excess weapons-grade fissile materials, to strengthen controls and constraints on these materials and, over time, to reduce worldwide stocks.

The TRIGA foreign research reactor spent nuclear fuel would be stored at the Idaho National Engineering Laboratory in the Fluorinel Dissolution and Fuel Storage (FAST) facility (wet storage) or preferably the dry storage Irradiated Fuel Storage Facility (IFSF) and the CPP-749 dry storage area. After 2003, all foreign research reactor spent nuclear fuel would be managed in accordance with the provisions of the settlement agreement between DOE and the State of Idaho, until transported off-site for ultimate disposition. Depending on the nature of any new treatment and/or packaging technology that might be developed, the TRIGA spent nuclear fuel would also be processed using such a new technology, if necessary for disposal.

A critical result of implementing this preferred alternative would be the continued viability and vitality of the Reduced Enrichment for Research and Test Reactors (RERTR) Program, whose goal is minimizing and eventually eliminating the use of HEU in civil nuclear programs, by providing foreign research reactor operators with a continued incentive to participate. Similarly, the successful development of alternative fuels for research reactors and the expansion of the program to Russia, the other Newly Independent States, China, South Africa, and other countries, and the establishment of a world-wide norm discouraging the use of HEU, are dependent on the United States' commitment to action such as that embodied in this preferred alternative.

DOE is aware that the inclusion of chemical separation within the preferred alternative could be interpreted by some nations, organizations and

Policy considerations and environmental impacts associated with implementation of this preferred alternative are presented in Section 4.7 of the EIS and S.4.4.1 and S.4.4.2 of the Summary. Cost considerations are included in Section 4.9 of the EIS and S.4.9 of the Summary.

Basis for the Preferred Alternative - The elements of the preferred alternative discussed above have been selected based on the following considerations:

1. ***Management Alternative*** - The various management alternatives considered are discussed in Sections 2.2 through 2.4 of the EIS and S.2.2, S.2.4 and S.2.5 of the Summary. The analyses in Sections 4.2 through 4.5 of the EIS and S.4.2, S.4.3, S.4.5 and S.4.6 of the Summary demonstrate that the impacts on the environment, involved workers, or the citizens of the United States from implementation of any of the management alternatives or implementation alternatives analyzed (other than beneficial impacts associated with support for United States nuclear weapons nonproliferation policy) would be small and completely within the applicable regulatory limits, and would not provide a basis for discrimination among the alternatives. As a result, the process for selection of the elements of the preferred alternative focused on programmatic considerations:

   a. DOE and the Department of State concluded that the No Action Alternative and Management Alternative 2, Implementation Alternative 1a (Overseas Storage) would be unacceptable since these alternatives are not consistent with United States nuclear weapons nonproliferation policy objectives.

   b. DOE and the Department of State believe that the basic implementation of Management Alternative 1 would be undesirable to the extent that it would involve indefinite storage of foreign research reactor spent nuclear fuel in a form that is not suitable for disposal. Management Alternative 1 modified to rely solely on Implementation Alternative 6 (Near Term Conventional Chemical Separation in the United States) would raise nuclear weapons nonproliferation policy questions. Management Alternative 1 modified to rely solely on Implementation Alternative 7 (Developmental Treatment and/or Packaging Technologies) could not be selected at this time because no decision has been made on which technology will be pursued.

   c. DOE and the Department of State also believe that Management Alternative 2, Implementation Alternative 1b (Overseas Reprocessing) would be technically complex and potentially extremely expensive because it would require the United States to accept reprocessing wastes from the overseas reprocessing operations. This is due to the fact that both of the countries in which the overseas reprocessing might be accomplished require the reprocessing wastes to leave their countries, and many of the countries that would be covered by the proposed policy cannot accept the return of such reprocessing wastes. The intermediate-level radioactive wastes produced in Europe during reprocessing of research reactor spent nuclear fuel are often in a concreted waste form, unlike any high-level radioactive waste form in the United States. This concreted waste form has not been evaluated for disposal in a United States geologic repository. Accordingly, acceptance of such waste in the United

States likely could require expensive, currently unproven treatment and/or packaging technologies to transform it into a form that would be acceptable for disposal.

d. The sample hybrid alternative (Management Alternative 3) analyzed in the Draft EIS involved partial reprocessing overseas coupled with partial management in the United States. In order for this alternative to be consistent with United States nuclear weapons nonproliferation policy objectives, certain conditions would have to be met by either the reprocessor (e.g., Dounreay) or the research reactor operators. Staff from both DOE and the Department of State have addressed this issue with representatives of the United Kingdom Department of Trade and Industry and reactor operators, and have determined that it would not be possible to ensure compliance with the United States nuclear weapons nonproliferation policy objectives. The primary concern was the inability to ensure that any separated HEU would be blended down to LEU. Obtaining the reactor operators' agreement to such a policy would likely require significant financial subsidies. The potential cost of achieving agreement to blend down the uranium, plus uncertainties regarding Dounreay's long-term availability, led DOE and the Department of State to conclude that successful implementation of this alternative could not be relied on.

None of the alternatives analyzed in the Draft EIS could be implemented without some degree of difficulty. However, a modification of Management Alternative 1 (Manage Foreign Research Reactor Spent Nuclear Fuel in the United States), incorporating a combination of alternatives to the basic implementation components balances policy, technical, cost and schedule requirements. DOE and the Department of State consider that this approach provides the highest assurance that programmatic requirements could be met. This combination also provides the strongest support for United States nuclear weapons nonproliferation policy objectives as all aspects of the alternative would be under the control of DOE, either directly or through the spent nuclear fuel acceptance contracts with the reactor operators.

2. ***Management Technology*** - The alternative spent nuclear fuel management technologies considered are discussed in Sections 2.2.2.7 and 2.6.5 of the EIS and S.2.2.1.9 and S.2.2.2 of the Summary. The approaches fall into four broad categories, as follows:

Wet Storage - Wet storage is a proven technology, the impacts of which would be small, and completely within the applicable regulatory limits, if it were used to implement the proposed action. Furthermore, DOE currently has wet storage facilities in operation at the Savannah River Site and the Idaho National Engineering Laboratory that could be used for storage of foreign research reactor spent nuclear fuel. However, wet storage requires attention to ensure that the storage conditions do not foster slow degradation of the spent nuclear fuel through corrosion.

Dry Storage - Dry storage is also a proven technology, that would also have no more than small impacts, completely within the applicable regulatory limits, if used to implement the proposed action. It is the storage medium that is being selected at all commercial power reactor sites where additional storage capacity is being built. However, it has not been used for research reactor spent nuclear fuel in the United States. Dry storage capacity could be provided at the management sites in time to meet the program's projected needs, if initial spent nuclear fuel receipts were placed into the available wet storage.

Chemical Separation - Chemical separation is also a proven technology, the impacts of which would be small, and completely within the applicable regulatory limits, if used to implement the proposed action. However, DOE is phasing out its chemical separation activities and is currently reprocessing only at the Savannah River Site to stabilize materials for health and safety reasons. Because these chemical separations facilities could be used to treat the foreign research reactor spent nuclear fuel, they provide a contingency to be considered pending availability of an alternate means of treating and/or packaging the spent nuclear fuel prior to ultimate disposition.

New Technologies - Due to concerns regarding geologic disposal of intact spent fuel containing HEU (i.e., the possibility of uncontrolled criticality incidents), some form of treatment of this spent nuclear fuel may be required. While several concepts have been proposed for new treatment and/or packaging technologies, none of them are ready for implementation at this time. Prior to a decision leading to their implementation, additional development work would be required to determine whether and how they could be implemented, based on technical and cost considerations.

In order to effectively implement the preferred alternative of accepting and managing the foreign research reactor spent nuclear fuel in the United States, DOE and the Department of State developed the three point strategy for management of aluminum-based spent nuclear fuel discussed earlier in this Section. This strategy draws on the strengths of each of the spent nuclear fuel management technologies discussed above, while avoiding sole reliance on any of them. Due to the relatively more robust nature of the TRIGA spent nuclear fuel, DOE believes that minimal additional development may be needed to prepare it for storage and final disposition. Accordingly, the preferred alternative specifies that the TRIGA spent nuclear fuel would be placed in existing dry storage facilities at the Idaho National Engineering Laboratory. However, the program to qualify the final geologic disposal form for the TRIGA spent nuclear fuel will continue and the appropriate treatment, if any, would be identified and implemented.

3. ***Policy Duration*** - The alternative policy durations considered are defined in Sections 2.2.2.1 and 2.2.2.2 of the EIS and S.2.2.2 of the Summary. Analysis of these alternatives concluded that the 5-year option is likely to provide insufficient time for the reactor operators to arrange for alternative spent nuclear fuel disposal mechanisms, and thus might result in some reactor operators refusing to cooperate fully with United States nuclear weapons nonproliferation programs. This, in turn, could undermine international cooperation with other nuclear weapons nonproliferation programs the United States might seek to implement.

On the other hand, the analysis determined that there was insufficient benefit to be gained from indefinite acceptance of all the spent nuclear fuel containing HEU because such an approach likely would provide insufficient incentive for other countries to proceed expeditiously with arrangements for alternative disposal mechanisms not involving the United States.

The approach incorporated into the preferred alternative allows sufficient incentive to the reactor operators to ensure their cooperation, while specifying a definite cut-off point. This alternative provides sufficient lead time to allow the reactor operators to make other arrangements for disposition of their spent nuclear fuel, and provides sufficient time to accept all spent nuclear fuel containing HEU enriched in the United States.

4. ***Amount of Material to Manage*** - The alternative amounts of material that might be covered by the proposed policy are defined in Sections 2.2.1.3 and 2.2.2.1 of the EIS and S.2.2.2 of the Summary. DOE and the Department of State concluded that management of spent nuclear fuel only from other-than-high-income economy countries would strongly encourage the resurgence of the use of HEU in the high-income economy countries, as well as opening the United States, fairly or unfairly, to charges that we are not living up to our commitments under the *Treaty on the Non-Proliferation of Nuclear Weapons*. Management of only spent nuclear fuel containing HEU would penalize those reactors that have already converted to the use of LEU fuel, and would provide an incentive for reactors to continue to use HEU fuel, or switch back to its use. The impacts that would result from management of any of these different amounts of material would be small, and within the applicable regulatory limits.

   DOE and the Department of State concluded that management of all of the aluminum-based and TRIGA foreign research reactor spent nuclear fuel currently in storage or projected to be discharged during the policy period, and target material containing uranium enriched in the United States, would provide the best support for the objectives of the proposed policy. Implementation of this preferred alternative would provide an opportunity for removal of the maximum amount of HEU from civil commerce and would provide an incentive for the continued conversion to and use of LEU as fuel for foreign research reactors, in place of highly-enriched (weapons-grade) uranium.

5. ***Marine Transport*** - The alternative approaches to marine transport of foreign research reactor spent nuclear fuel are discussed in Section 2.2.1.5 of the EIS. The analysis in the EIS demonstrates that the impacts to the environment, workers, or the public from transport of the spent nuclear fuel using any of these types of ships would be small, and within the regulatory limits. The analyses do not identify any difference in the small impacts that would result from the use of purpose-built vs. general purpose ships. Since "military transports" are in fact the same type of ship as the chartered commercial cargo ships and are crewed by civilians, use of "military transports" would not actually result in any difference in impacts. DOE and the Department of State believe that use of actual warships would be both unnecessary from a security standpoint and could entail additional risk to the environment and the public, since such ships do not routinely carry cargo.

The approach selected by DOE and the Department of State for the preferred

The approach incorporated into the preferred alternative ensures that liability for accidents during the transportation process outside the United States would remain with the reactor operators while reinforcing in the minds of the public that the United States Government would be accountable in the unlikely event of an accident within United States territory.

8. ***Ports of Entry*** - The alternative ports of entry considered are discussed in Sections 2.2.1.6 and 3.2 of the EIS and S.2.2.1.6 of the Summary. The analyses in the EIS demonstrate that the impacts on either the environment, workers, or the public due to use of any of the potential ports of entry analyzed would be small and within applicable regulatory limits.

   Although any one or all of the ten ports of entry described in Sections 2.2.1.6 and 3.2 of the EIS would be acceptable ports of entry, DOE and the Department of State concluded that foreign research reactor spent nuclear fuel marine shipments to the United States should be made via the military ports (selected from among those analyzed in the EIS and found acceptable) in close proximity to the spent nuclear fuel management sites. DOE would seek to transport multiple casks per ship to keep the total number of shipments as low as possible, as well as to reduce risks. The exact number of shipments that might be made would be determined by several factors that are unknown at this time, such as the times at which the reactor operators need to make shipments over the 13 year shipping period, the geographic distribution of the reactors, and the availability of suitable ships that would stop at the required ports to pick up and drop off the spent nuclear fuel and target material.

   Use of military ports would provide additional confidence in the safety of the shipments due to the increased security associated with the military ports. It could also require much of the spent nuclear fuel to be shipped via chartered ships since commercial ships would not have stops scheduled at military ports, increasing the cost of spent nuclear fuel shipping. This additional cost would be borne by the reactor operators for shipments from high-income economy countries, and by the United States for shipments from other-than-high-income economy countries. Additional costs would be kept to a minimum by shipping as many casks as possible on each ship (up to a maximum of eight per ship).

9. ***Management Sites*** - The question of which sites should be used for management of all of DOE's spent nuclear fuel was addressed in the Programmatic SNF&INEL Final EIS (DOE, 1995c). That EIS included consideration of the potential receipt of the foreign research reactor spent nuclear fuel. The Record of Decision for that EIS, issued on May 30, 1995, specifies that any aluminum-based foreign research reactor spent nuclear fuel accepted in the United States shall be managed at the Savannah River Site; and that the remaining foreign research reactor spent nuclear fuel shall be managed at the Idaho National Engineering Laboratory. The site for management of the target material was left to be decided under this EIS. All of the target material currently in DOE's possession is managed at the Savannah River Site. The approach incorporated into the preferred alternative is in compliance with the decision specified in the Record of Decision for the Programmatic

The analyses in the EIS demonstrate that the impacts to either the environment or the public through use of any of the sites for management of the foreign research reactor spent nuclear fuel and target material would be small, and within the applicable regulatory limits.

10. ***Financing Arrangement*** - The alternative financing arrangements are discussed in Sections 2.2.1.2 and 2.2.2.3 of the EIS and S.2.2.2 of the Summary. The financing arrangement used for the proposed action would have no effect on the physical processes that would take place, and thus would not have any effect on the potential impacts on the environment, or on the public. However, it could affect how many foreign research reactor operators elect to ship spent nuclear fuel to the United States. For instance, if DOE and the Department of State chose to charge a full cost recovery fee to all reactors, many, if not all, of the reactors in other-than-high-income economy countries would not have the financial resources to participate. On the other hand, if the United States subsidized all of the reactors, the United States would bear the full financial burden, even for reactors which can afford to pay their fair share.

    DOE and the Department of State concluded that, to ensure that reactor operators in other-than-high-income economy countries would participate in the program, the United States should subsidize receipt of their spent nuclear fuel. DOE and the Department of State also concluded that DOE should strive to recover as much of the cost of managing the spent nuclear fuel as possible from high-income economy countries. DOE concluded that it would announce the fee in a *Federal Register* notice, so that the fee may be changed from time to time as necessary to reflect inflation or improvements in DOE's knowledge concerning the costs of the activities to be carried out.

    Such an approach would encourage participation by as many other-than-high-income economy countries as possible, would recover as much as possible of the United States' expenses for management of spent nuclear fuel from high-income economy countries without encouraging any of them to resort to reprocessing of their spent nuclear fuel, and would provide a mechanism through which to account for inflation and future definition of program details.

S.2.4 Management Alternative 2 - Facilitate the Management of Foreign Research Reactor Spent Nuclear Fuel Overseas

Under this Management Alternative, DOE and the Department of State would seek to facilitate the management of foreign research reactor spent nuclear fuel overseas in a manner that would be consistent with U.S. nuclear weapons nonproliferation policy. DOE

1b. Overseas Reprocessing

The United States would facilitate and provide nontechnical (financial and/or logistical) assistance to foreign research reactors and reprocessors to facilitate reprocessing of spent nuclear fuel overseas in facilities operated under international safeguards consistent with U.S. nuclear weapons nonproliferation concerns.

The overseas reprocessing option was evaluated in light of the U.S. nuclear weapons nonproliferation policy on HEU minimization. For example, factors such as the following were considered:

- A commitment that HEU separated during reprocessing would be blended down to LEU for research reactors which are converting to LEU.
- The foreign reprocessors would provide the capability to reprocess LEU as well as HEU.
- Research reactors would be encouraged to convert to LEU if a LEU fuel exists or is developed that will allow such operation.

Arrangements would have to be worked out with foreign reprocessors that would be consistent with U.S. nuclear weapons nonproliferation objectives to minimize the civil use of HEU worldwide.

S.2.5 Management Alternative 3 - Combination of Elements From Management Alternatives 1 and 2 (Hybrid Alternative)

In implementing the proposed action, DOE and the Department of State could combine implementation elements from Management Alternatives 1 and 2, such as partial storage or reprocessing overseas with partial storage or chemical separation in the United States.

To demonstrate the kind of hybrid alternatives that could be developed, this EIS considers the following hybrid alternative example: DOE and the Department of State would facilitate the reprocessing of foreign research reactor spent nuclear fuel at Western European reprocessing facilities (e.g., Dounreay or Marcoule) for research reactors in countries that could accept the waste from reprocessing, and DOE would accept and manage in the United States the rest of the foreign research reactor spent nuclear fuel from countries that could not accept the waste from reprocessing. Of the foreign research reactor spent nuclear fuel to be accepted in the United States, the aluminum-based portion would be chemically separated at the Savannah River Site and the TRIGA portion would be stored in existing facilities at the Idaho National Engineering Laboratory.

The impacts to the U.S. environment from hybrid alternatives would be covered by the analyses presented in the EIS for Management Alternative 1, because the analyses for Management Alternative 1 consider the maximum amount of foreign research reactor spent nuclear fuel that could be accepted, stored, and/or chemically separated in the United States.

S.2.6 No Action

In the No Action Alternative, the United States would neither manage foreign research reactor spent nuclear fuel containing uranium enriched in the United States, nor provide technical assistance or financial incentives for overseas storage or reprocessing. In this case, there would be no foreign research reactor spent nuclear fuel shipments to the United States and no assistance to foreign countries for managing foreign research reactor spent nuclear fuel overseas.

[illegible] of Spent Nuclear Fuel Management

[illegible]

This section briefly summarizes information on the characteristics of the spent nuclear fuel to be managed, the types of transportation casks considered, management site storage facilities, chemical separation facilities in the United States, and foreign reprocessing facilities.

S.2.7.1 Characteristics of Foreign Research Reactor Spent Nuclear Fuel

Spent nuclear fuel is fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated. Spent nuclear fuel is radioactive because of the presence of the radioactive isotopes, products of the fission process. The radiation of most concern from spent nuclear fuel is gamma rays. Although the radiation levels can be very high, the gamma ray intensities are readily reduced by shielding the fuel elements with such materials as steel, lead, concrete, and water during the various phases of handling, transporting, or storing the spent nuclear fuel elements.

An issue associated with the management of spent nuclear fuel containing significant amounts of fissionable material is the potential for a self-sustaining nuclear fission process called criticality. Prevention of criticality conditions enters in the design of the spent nuclear fuel transportation casks, the spent nuclear fuel storage and processing facilities, and the spent nuclear fuel packaging for ultimate disposition. In general, criticality prevention is accomplished by either controlling the amount of fissionable material present within a certain volume (dilution or spatial separation techniques) or by introducing neutron absorbing materials that reduce the number of neutrons available to the fission process (poisoning technique).

Two types of foreign research reactor spent nuclear fuel are covered under the proposed policy. They are the aluminum-based fuel and TRIGA-type reactor fuel. In addition to the two types of spent nuclear fuel described above, target material is also covered under [illegible]

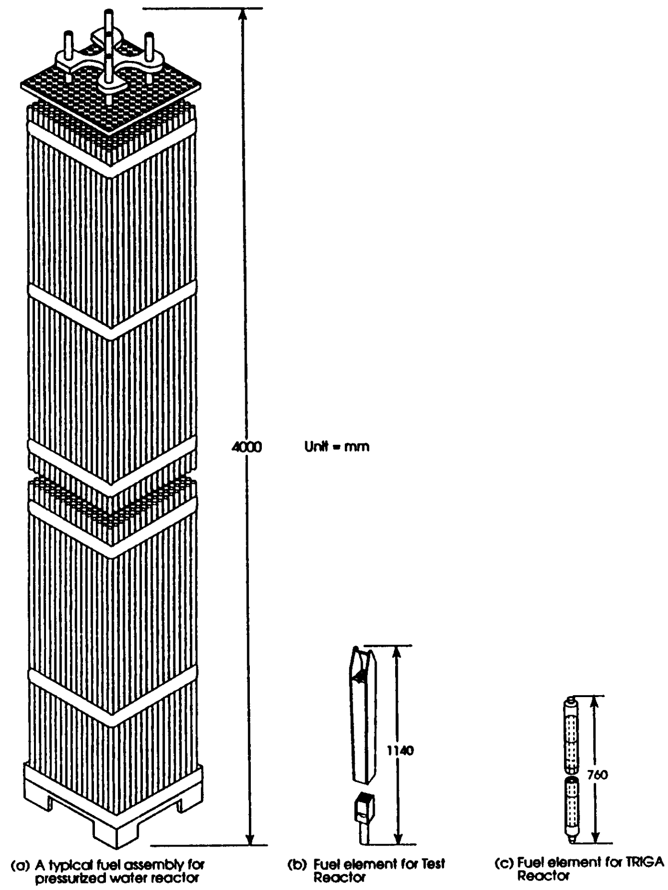

Figure S-8 Typical Spent Nuclear Fuel Elements

S.2.7.2 Transportation Casks

Spent nuclear fuel elements are transported in stainless steel packages, usually weighing several tons, called transportation casks. A typical cask for the transportation of foreign research reactor spent nuclear fuel elements is shown in Figure S-9.

The casks are designed to provide shielding from radiation. However, a low radiation field is present outside the cask — frequently less than one millirem (mrem) per hour at one meter (3.3 ft) away from the cask. A full cask can carry from 13 to 120 spent nuclear fuel elements from foreign research reactors, depending on fuel element design, size, and cask capacity. The casks that would be used to transport foreign research reactor spent nuclear fuel to the United States are "Type B" casks designed on the basis of international regulations essentially identical to those promulgated by the NRC and certified by the Department of Transportation. "Type B" casks have been used for years to transport spent nuclear fuel elements within the United States and around the world. In more than

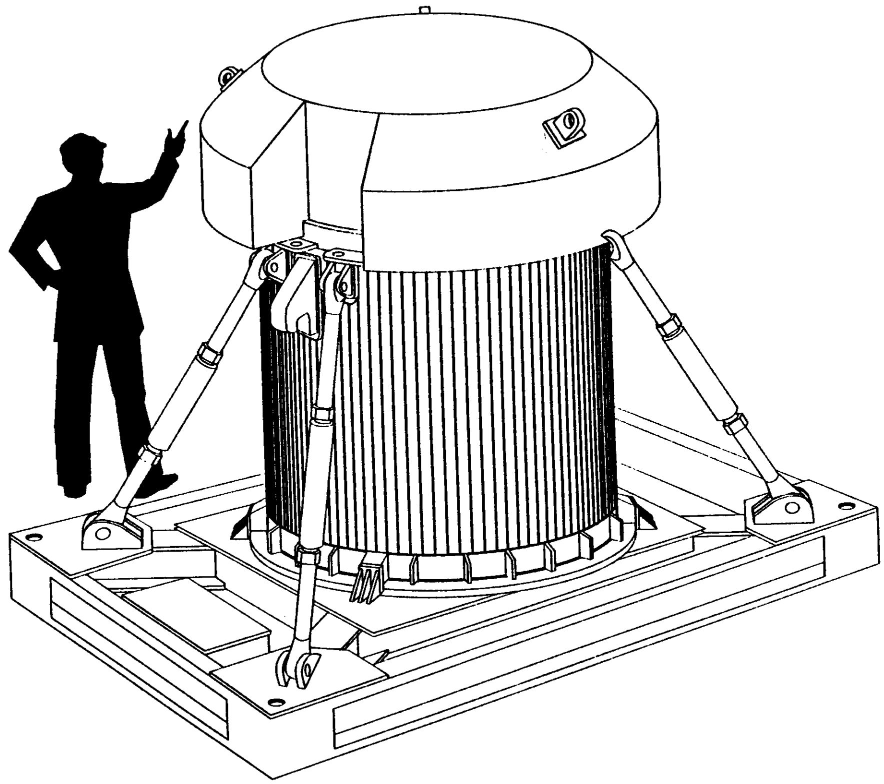

Figure S-9 Typical Spent Nuclear Fuel Transportation Cask

four decades of transporting spent nuclear fuel within the United States, no accident has ever occurred in which a "Type B" spent nuclear fuel transportation cask was punctured or spent nuclear fuel contents released, even in actual highway accidents.

S.2.7.3 Spent Nuclear Fuel Storage Facilities in the United States

The EIS analyzes a variety of scenarios in which each site could manage foreign research reactor spent nuclear fuel. However, as noted in S.2.2.1.8, in accordance with the Record of Decision for the Programmatic SNF&INEL Final EIS, all of the aluminum clad foreign research reactor spent nuclear fuel accepted by DOE would be managed at the Savannah River Site in South Carolina, and any other foreign research reactor spent nuclear fuel to be accepted by DOE would be managed at the Idaho National Engineering Laboratory, pending ultimate disposition. Of the five management sites considered in the Draft EIS, only the Savannah River Site and the Idaho National Engineering Laboratory have facilities that could be available in 1996. The other three could become available as management sites at a later date after construction or refurbishment of appropriate facilities could be completed. This constraint has resulted in a two-phased approach to the implementation of the policy. For the purpose of site impact analysis, the implementation of the policy was divided into two functional periods -- the period during which receipt and management of foreign research reactor spent nuclear fuel would be accomplished by using existing facilities (Phase 1), and the period during which new or refurbished facilities could be used (Phase 2). The following discussion summarizes key points concerning facility capabilities and assumptions at each site, which drive the analysis of environmental impacts in the EIS.

S.2.7.3.1 Savannah River Site

As a potential Phase 1 storage site under Management Alternative 1, the Savannah River Site would receive and manage foreign research reactor spent nuclear fuel at its existing wet storage facilities. The Receiving Basin for Offsite Fuels and the L-Reactor Disassembly Basin are considered for this purpose.

As a potential Phase 2 storage site, the Savannah River Site could continue to receive foreign research reactor spent nuclear fuel in a new dry storage facility or a new wet storage facility that would be constructed in the H-Area of the site or a refurbished Barnwell Nuclear Fuels Plant which would have to be acquired by DOE. The spent nuclear fuel would be managed at the new storage facility until ultimate disposition.

S.2.7.3.2 Idaho National Engineering Laboratory

As a potential Phase 1 storage site under Management Alternative 1, the Idaho National Engineering Laboratory would receive and manage foreign research reactor spent nuclear fuel at existing dry and/or wet storage facilities. The existing facilities identified for this purpose would be the Fluorinel Dissolution and Fuel Storage Facility in CPP-666, the Irradiated Fuel Storage Facility in CPP-603, and the CPP-749 storage area.

As a potential Phase 2 storage site, the Idaho National Engineering Laboratory could continue to receive and manage foreign research reactor spent nuclear fuel at a new dry storage or wet storage facility to be constructed at the site.

S.2.7.3.3 The Hanford Site, Oak Ridge Reservation, and Nevada Test Site

The Hanford Site, the Oak Ridge Reservation, and the Nevada Test Site could only be Phase 2 storage sites (under Management Alternative 1) if they had been selected as management sites under the Programmatic SNF&INEL Final EIS Record of Decision. As noted in Summary Section S.1.4, these three sites are no longer candidates for management of the foreign research reactor spent nuclear fuel under the Record of Decision in the Programmatic SNF&INEL Final EIS, but are considered in this EIS in order to maintain consistency with the analyses provided in the Programmatic SNF&INEL Final EIS.

S.2.7.4 Chemical Separation Technology and Facilities in the United States

The EIS evaluates near-term conventional chemical separation in the United States as an alternative method of managing foreign research reactor spent nuclear fuel. Chemical separation involves separating the uranium in the spent nuclear fuel from the other material (i.e., cladding material, fission products, etc.). Aluminum would be the predominant cladding material. Waste materials would mainly be fission products, and consist of radioactive species such as cesium and strontium. The separated uranium could be placed into commerce as new fuel (as LEU fuel) or could require further disposition steps. Vitrification (conversion into a solid glass form) of the high-level waste would be the preferred waste management approach.

An aqueous chemical method is the only processing method applied on a large scale. All existing chemical separation plants use an extraction process that has been in use for some 40 years. Under the chemical separation implementation alternative of Management Alternative 1, foreign research reactor spent nuclear fuel would be chemically separated at the Savannah River Site or the Idaho National Engineering Laboratory. For purposes of analysis, this EIS assumes that the Savannah River Site would chemically separate aluminum-based spent nuclear fuel in the F-Canyon and the Idaho National Engineering Laboratory would chemically separate both aluminum-based and TRIGA spent nuclear fuel. Near-term conventional chemical separation of foreign research reactor spent nuclear fuel at the other three proposed foreign research reactor spent nuclear fuel management sites would not be considered since the Oak Ridge Reservation and the Nevada Test Site do not have facilities in which such chemical separation could be conducted, and the facilities at the Hanford Site are no longer operable. Figure S-10 provides an overview of chemical separation.

S.2.7.5 Foreign Reprocessing Facilities

Both France and the United Kingdom have modern fuel cycle facilities and offer reprocessing services to international customers. These facilities are capable of reprocessing spent nuclear fuel and preparing the waste products for disposal. Both France and the United Kingdom would require the country operating the reactor to accept the waste from reprocessing.

S.2.8 Emergency Management and Response

An emergency management and response infrastructure exists to support the implementation of those Management Alternatives that would be carried out in the United States, including ports of entry, ground transport routes, and management sites. In the United States, State and local governments are required to have emergency management and response programs. These programs must be capable of managing all hazards, ranging from natural disasters to hazardous material incidents on a day-to-day basis. These programs include support from special emergency response teams and emergency operations centers.

S.2.9 Security Measures

Domestic transportation of foreign research reactor spent nuclear fuel would be under the regulatory jurisdiction of the Department of Transportation and the NRC. In the event that foreign research reactor spent nuclear fuel was transported through a military port of entry, applicable requirements would be established in advance by the U.S. Department of Defense, DOE, and NRC to provide the appropriate level of security.

The objectives of the security measures during transportation of spent nuclear fuel are to minimize the possibilities for sabotage of spent nuclear fuel shipments, and facilitate the location and recovery of spent nuclear fuel shipments in the unlikely event that a shipment came under the control of unauthorized persons. Specific elements of the security

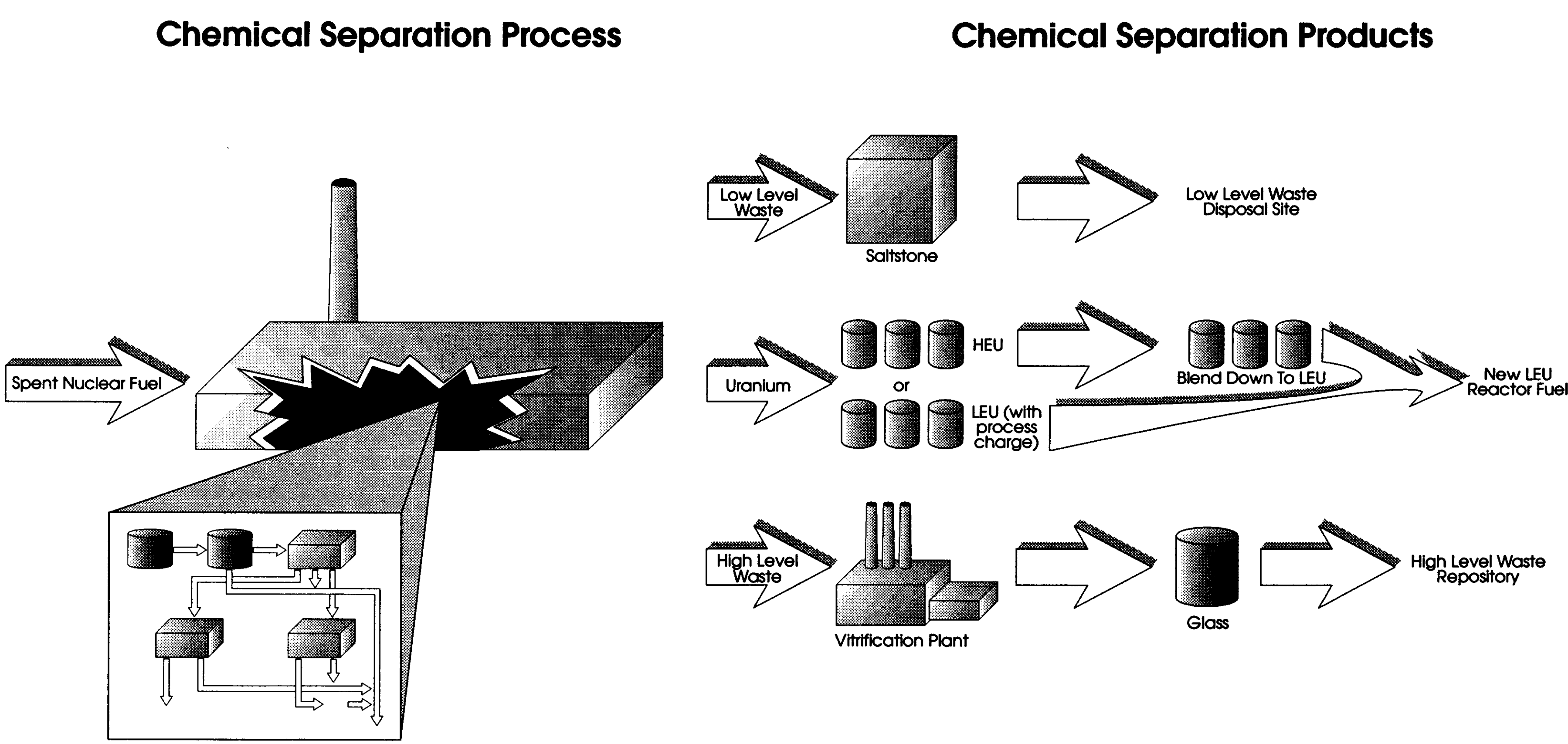

Figure S-10 Chemical Separation Overview measures to be implemented would be included in the Transportation Plan developed by DOE in consultation with State, local, and Tribal officials prior to any actual spent nuclear fuel shipments.

S.2.10 Additional Alternatives Considered but Dismissed from Detailed Analysis

The EIS considered additional alternatives that were dismissed as unreasonable and therefore were not further analyzed. These are the use of an air mode of transportation and acceptance of foreign research reactor spent nuclear fuel only from countries that present an actual nuclear weapons nonproliferation risk.

The air mode of transportation was not considered to be a feasible alternative to the sea

First, there is no commercial operational experience in the United States with air transport of spent nuclear fuel. Second, no spent nuclear fuel transportation cask has been certified to meet air transport packaging standards.

Accepting foreign research reactor spent nuclear fuel only from countries posing an actual nuclear weapons nonproliferation risk would not fully address the key U.S. nuclear weapons nonproliferation goal of the proposed policy--namely, to reduce and eventually amount of HEU that could be removed from international commerce under each alternative, and 2) the extent to which each alternative would provide incentives for foreign research reactor operators to convert their reactors to LEU fuel.

environment. The analyses are based on conservative assumptions (that is, those that tend to overstate the risks). In other words, the analytical approaches are designed to produce estimates of the maximum reasonably foreseeable risks. Cumulative impacts were determined by evaluating past, present, and reasonably foreseeable DOE and non-DOE related activities, in combination with the alternatives. Radiological impacts were calculated in terms of absorbed dose and associated health effects in the exposed populations. Nonradiological impacts to the environment, namely land use, waste management, cultural resources, aesthetic and scenic resources, geology, air quality, water quality, ecology, noise, utilities and energy, and socioeconomics were also analyzed in

S.4.1.1 General Radiological Health Effects

One way of presenting potential impacts to human populations in the EIS is by using radiation dose. Potential damage to human cells from radiation is measured in rem and millirem (mrem). The U.S. government has set a limit of 5,000 mrem (5 rem) per year for individual radiation workers and 100 mrem (0.1 rem) per year for individual members of the public from man-made, non-medical sources. The average American receives about 300 mrem of radiation per year from natural sources such as radon gas from the earth's soil. Living in a brick house rather than a wood-frame house can add 45-50 mrem annually to one's dose. Living at high altitudes rather than at sea level also increases one's dose. A single coast-to-coast flight exposes an individual to about 4 mrem.

Another way of presenting results in the EIS is by using the concept of risk. The most significant radiation-related illness is the inducement and development of cancers that may lead to death in later years. This effect is called a latent cancer fatality. The risks of incurring a latent cancer fatality are estimated by converting radiation doses into possible numbers of future cancer fatalities.

For an exposed population group, the latent cancer fatality number is the chance that there would be an additional latent cancer fatality within the exposed group. The chance that a member of that group would develop a latent cancer fatality depends on the size of the exposed group. For example, if the estimated number of latent cancer fatalities for a group of 100,000 people is one, the average member of this group would have a one in 100,000 chance of developing a latent cancer fatality.

Radiological risk can also be expressed for hypothetical individuals who could record the highest possible dose in a given situation. Examples are a seaman who inspects the casks at sea, a port worker who unloads the casks, a truck driver who transports the casks to a management site, or an individual living at the site boundary of a management site. When a latent cancer fatality number is given for an individual, it represents the chance that the exposed individual would develop a latent cancer fatality. As a practical matter, the maximally exposed individual during incident-free operations

Measuring Radiation Exposure

Potential radiological impacts are estimated for the highest radiation dose any single person might receive, as well as the collective dose a particular population might receive, such as all those living in the vicinity of a port. Two primary units of radiation dose measurement are used in the Final EIS to estimate these impacts: the rem and person-rem.

The rem is a unit of radiation dose. Because 1 rem is a relatively large dose, the unit actually used most frequently is the millirem (mrem), which is equal to 1/1000 of a rem. It is estimated that the average individual in the United States receives a background dose of about 300 mrem/yr from all natural sources including radon.

Radiation dose to a population or a group of persons is measured in person-rem. The total population dose (all the person-rem) is determined by adding all the individual doses in the exposed group. This measurement is particularly important when trying to take into account the potential impacts of very small doses on very large populations (for example, all those living along a transportation route).

Using a conversion factor, the estimated doses can be converted into possible numbers of health effects. Because the doses predicted in this study are far less than those known to cause immediate illness or fatality, only delayed health effects would occur. A delayed effect is measured in latent (future) cancer fatalities. For the general population, a collective dose of 2,000 person-rem is estimated to result in one additional latent cancer fatality within the affected population group.

Latent Cancer Fatalities Caused by Natural Background Radiation for an Individual Member of the General Public

Dose: Radioactivity from all natural sources combined produces about a 300 mrem (0.3 rem) dose to the average individual per year.

Probability: The probability of continuous exposure to this average dose is one.

Average Life Span: 72 years is considered to be the average lifetime.

Latent Cancer Fatalities Caused per Rem for an Individual Member of the General Public: 0.0005 latent cancer fatalities are estimated to be caused by exposure to 1 rem.

Calculation: Dose rate x life span x cancers caused per rem = 0.3 rem/yr x 72 yr x 0.0005 latent cancer fatalities per rem = 0.01 latent cancer fatalities per individual lifetime.

Risk: Probability x latent cancer fatalities = 1 x 0.01 = 0.01 latent cancer fatalities, which is about 1 chance in 100 of death from exposure to natural background radiation over a lifetime.

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would be a worker because he or she would be close to the spent nuclear fuel. If necessary, DOE would implement mitigation measures to maintain individual doses under the regulatory limit for the general public. The doses and risks estimated in the EIS reflect DOE mitigation efforts directed at ship crews, port workers, and truck drivers.

Radiological risks calculated in the EIS are also compared to those of common activities, such as smoking, flying, or receiving a medical x-ray.

S.4.2 Policy Considerations and Environmental Impacts of the Basic Implementation of Management Alternative 1

Under the basic implementation of Management Alternative 1, all the foreign research reactor spent nuclear fuel could be accepted into the United States. Up to 4.6 metric tons (5.1 tons) of HEU would be removed from international commerce. DOE and the Department of State believe implementation of this alternative would promote the nuclear weapons nonproliferation objective of reducing, and eventually eliminating, the use of highly-enriched (weapons-grade) uranium in civil programs worldwide. The spent nuclear fuel could be managed safely and securely at any of five management sites.

The following sections summarize the environmental impacts of the four segments of the affected environment under the basic implementation of Management Alternative 1.

S.4.2.1 Marine Transport Impacts

The shipment of foreign research reactor spent nuclear fuel would begin with the transport of the spent nuclear fuel from the onsite storage facility at the foreign research reactor to the foreign port. The spent nuclear fuel would then be shipped in transportation casks by sea (except for shipments from Canada) to a U.S. port. The potential impact of marine transport in the territorial waters of the United States was evaluated. Because implementation of the proposed action could involve ocean transport, the EIS also considers the environmental impacts on the global commons in accordance with Executive Order 12114. Shipments of any material via ocean transport entails risks to the ship's crew members and the environment. The risks result from transportation-related accidents and, in the case of radioactive materials, from exposure to the material itself.

S.4.2.1.1 Impacts of Incident-Free Marine Transport

The primary impact of incident-free marine shipping of foreign research reactor spent nuclear fuel would be upon the crews of the ships used to carry the spent nuclear fuel casks. Members of the general public and marine life would not receive any measurable dose from the spent nuclear fuel during marine transport. The crew would normally be separated from the cargo and shielded from radiation emitted from the cask by both the ship's structure and other cargo, resulting in small risk to the crew during most crew activities. Crew exposure would primarily be limited to crew members exposed during the loading and off-loading of the spent nuclear fuel casks and to crew members who would inspect the cargo daily to ensure secure stowage and operational safety of the vessel. This exposure from loading, inspection, and unloading of the casks would pose the highest radiation risk during incident-free marine transport.

An estimate of the maximum radiation dose that a member of a ship's crew might receive during an incident-free voyage of 21 days carrying foreign research reactor spent nuclear fuel is approximately 66 mrem. If this same crew member were to be involved in multiple voyages per year, then the yearly dose to this individual could exceed the DOE and NRC annual limit of 100 mrem per year for the public. Although this situation is not likely to occur, DOE would implement a system to track, through the contracted shippers, each ship and crew member involved in the shipment of foreign research reactor spent nuclear fuel. A clause in the contract for shipment of foreign research reactor spent nuclear fuel would require that any crew member approaching the 100 mrem per year limit be rotated to another job.

Nonradiological impacts were found to result in a small impact on the health of the public and workers. The number of shipments necessary to transport about 720 transportation casks would result in a minimal change in the number of ocean crossings by transport vessels. No increase in the exposure of the public to ship exhaust emissions or marine transport-related accidents is anticipated.

S.4.2.1.2 Impacts of Accidents During Marine Transport

The EIS analyzes two kinds of ocean accidents: 1) a ship collision, which in this EIS was assumed to result in damage to the cask and an on-board fire, and 2) loss of a cask at sea, where the cask sinks, and seawater penetrates the cask seals. However, the probability of a collision or fire resulting in a cask breach is low. The probability of a large radiation release is low because the spent nuclear fuel is a solid metal. In the type of collision or fire that could breach the cask and liberate significant quantities of radiation, the major impact on the crew would be the collision or fire, not the radiation. The radioactive particles dispersed over the ocean would not be in large enough amounts to have a measurable impact on the environment.

Immersing a cask in water does not cause the radioactive contents to be released immediately. Casks can be recovered in coastal waters and much deeper waters with modern technology. Thus, if a cask were to fall overboard in U.S. coastal waters or inland waters, DOE would employ modern underwater search techniques to locate and recover the cask, thus minimizing the potential impacts to marine life. Outside U.S. coastal waters, if a cask were to sink, modern technology would be used, if possible, in an effort to retrieve the cask. If the cask could not be recovered, seawater would penetrate the cask seals and corrode the spent nuclear fuel. There is no mechanism, however, by which the seawater entering the cask could be forced out of the cask. Thus, the radioactive material would escape from the cask at a very low rate and would have a very small effect on the marine environment.

S.4.2.2 Port Activities Impacts

Ports having high-, medium-, and low-population density and covering the Atlantic, Pacific, and Gulf coasts were analyzed. The risk of incurring latent cancer fatalities was found to be so low that the most likely outcome would be zero latent cancer fatalities due to accidents at ports. Calculations for incident-free and accident conditions clearly demonstrate that for the general population, including minority and low-income groups, the impacts would be very low. In consideration of environmental justice concerns, the EIS analyzed the characterization and distribution of minority and low-income households near candidate ports of entry. Minority and low-income populations living near the potential ports of entry would not be subjected to any greater impacts than the general population. Therefore, these populations would not receive disproportionately high and adverse impacts, but would be subject to the same very low impacts as would the general population.

Implementation of the proposed action would have few nonradiological effects on the environment at candidate ports, including the social and economic status of the general population, minority populations, and the low-income population surrounding candidate ports. The EIS analyses show that economic benefits resulting from increased cargo handling and transportation in the port area would be small for the general population, or any particular segment of the population, residing near candidate ports.

S.4.2.2.1 Impacts of Incident-Free Port Activities

The incident-free risks would predominantly be those to inspectors and port workers who would handle spent nuclear fuel casks. Based on the time to conduct port activities and the distances from the cask to the worker during these activities, a maximum dose (higher than the limit of 100 mrem per year) could result if the same individual inspected every shipment. This risk is not likely to occur, however, due to the fact that the same inspectors and port workers would not likely be responsible for all the shipments made in a given year. Nevertheless, DOE would mitigate this effect by implementing a system to track each inspector and port worker involved in the handling of foreign research reactor spent nuclear fuel to ensure that other inspectors or port workers would be used if any of these individuals approach a 100 mrem dose in any year.

S.4.2.2.2 Impacts of Accidents During Port Activities

Marine accidents could occur in the open ocean or in coastal passages. Taking into account the severity of the accident (i.e., severe collision with and without severe fires), the probability of the accident (i.e., the more severe the accident the less likely it is), the location of the accident (i.e., in the harbor channel or at the dock), meteorology, and nearby populations, the highest estimated risk of cancer for the entire population over the entire foreign research reactor spent nuclear fuel program is less than one in 10,000. This translates into less than one additional latent cancer fatality for the affected port population. The highest estimated risk to the maximally exposed individual of a future cancer death is less than one in a billion.

S.4.2.3 Ground and Barge Transport Impacts

Foreign research reactor spent nuclear fuel is transported in large, heavy transportation casks designed and constructed to contain radioactivity during severe transportation accidents. The NRC has estimated that transportation casks will withstand 99.4 percent of truck and rail accidents without breaching the cask. Only in severe accident conditions, which are of low probability, could the transportation cask be so damaged that there would be a reasonable possibility of release of radioactivity to the environment. Since 1949, there have been 21 incidents involving vehicles carrying irradiated fuel elements. None of these incidents resulted in damage to the structural integrity of the spent nuclear fuel transportation cask or release of the radioactive contents. The EIS calculations for incident-free and accident conditions demonstrate that for the general population the impacts would be low. Minority or low-income populations living near these routes would not be subjected to any greater impacts. Therefore, these populations would not receive disproportionately high and adverse impacts, but would be subject to low impacts as would the general population.

Impacts from barge transportation were also evaluated as a substitute for truck or rail transport. The only two locations where barge transport is feasible are from the Port of Portland, OR, up the Columbia River to the Hanford Site in Washington, and from the Port of Savannah, GA, up the Savannah River to the Savannah River Site in South Carolina. The net result is that the foreign research reactor spent nuclear fuel could be transported by barge with approximately the same level of risk to workers and the public as if it was transported by truck or rail. This level of risk is very low.

Implementation of the proposed action would have extremely low nonradiological effects on the environment along transportation routes, including the social and economic status of the general population, minority populations, and the low-income population residing along transportation routes. The EIS analyses show that economic benefits resulting from increased transportation of cargo along transportation routes would be small for the general population, or any particular segment of the population residing along transportation routes.

S.4.2.3.1 *Impacts of Incident-Free Ground Transport*

For incident-free ground transport, the radiological impacts result from the radiation field that surrounds the cask. Impacts are estimated for workers and the population along the transportation route. These impacts were quantified as the estimated number of radiation-related cancer fatalities and the estimated number of nonradiological fatalities from vehicular emissions and traffic accidents.

Allowing for transport by truck and/or rail, and assuming a wide range of inter-site shipments (depending on the management site(s) chosen for the program), the incident-free ground transport of foreign research reactor spent nuclear fuel in the United States is estimated to result in up to 0.30 (i.e., less than one) latent cancer fatalities over the entire duration of the program. This includes risk to both the public and the transportation workers. In other words, DOE and the Department of State would not expect any fatalities from cancer as a result of the ground transport of spent nuclear fuel if the proposed policy were implemented.

In the case of truck transport, truck driver(s) would be monitored for radiation dose. The regulatory limit of 100 mrem per year would never be reached during any single shipment, but the same driver could be used for multiple shipments throughout the year. DOE would implement mitigation measures through the foreign research reactor spent nuclear fuel acceptance contracts to ensure that each individual driver's dose remains below the regulatory limit. Should any individual truck driver's accumulated dose approach the 100 mrem limit in a year, DOE would require that a new driver(s) be used to keep each individual driver's dose below the regulatory limit.

S.4.2.3.2 *Impacts of Accidents During Ground Transport*

The most severe ground transport accidents would be truck or train crashes, followed by a large fire. Although this type of accident is highly unlikely, total ground transportation accident risks would be up to 0.00028 latent cancer fatalities from radiation and up to 0.14 for traffic fatalities depending on the transportation mode and foreign research reactor spent nuclear fuel management sites. The radiological risk of 0.00028 latent cancer fatalities means that the chance of any additional cancers among the population due to a ground transport accident is less than one in 1,000. The risk of 0.14 for a traffic fatality means that, under these conservative assumptions, there would be a 14 percent chance of a traffic fatality.

For the maximally exposed individual member of the public along the transportation route, the radiological risk from ground transport accidents would be 0.000000000014, or less than one chance in 10 billion of that individual incurring a fatal cancer.

The use of NRC- and Department of Transportation-approved routes and the development of specific foreign research reactor spent nuclear fuel transportation plans that would incorporate and integrate State and local emergency response plans would increase emergency responder effectiveness and reduce the potential consequences of a foreign research reactor spent nuclear fuel accident.

S.4.2.4 Foreign Research Reactor Spent Nuclear Fuel Management Site Impacts

The EIS examined the potential environmental impacts resulting from activities at the proposed management sites under the basic implementation of Management Alternative 1. The analysis examined environmental topics including land use, socioeconomics, cultural resources, aesthetic and scenic resources, geology, air quality, water quality, ecology, occupational and public health and safety, noise, traffic and transportation, utilities and energy, and waste management. The analysis showed that at any of the proposed spent nuclear fuel management sites (the Savannah River Site, the Idaho National Engineering Laboratory, the Nevada Test Site, the Oak Ridge Reservation, and the Hanford Site), the potential impacts on the environment would be low. Further, there were no major differences among the spent nuclear fuel management sites for any of these environmental topics.

Potential radiation exposures to workers and the public at the management sites would be low. The EIS characterized the number and location of minority and low-income populations residing near candidate management sites. Minority or low-income populations living near the proposed management sites would not be subjected to any greater impacts. Therefore, these populations would not receive disproportionately high and adverse impacts. Rather, they would be subjected to very low impacts as would the general population.

Implementation of the proposed action would have few nonradiological effects on the environment at management sites, including the social and economic status of the general population, minority populations, and the low-income population surrounding management sites. The EIS analyses show that the economic benefits resulting from increased cargo handling, transportation, and storage at management sites would be small for the general population or any particular segment of the population residing near management sites.

S.4.2.4.1 Impacts from Incident-Free Management Site Activities

The EIS analyses show that the risk to the maximally exposed individual member of the public from incident-free operations on DOE's spent nuclear fuel management sites would be 0.00000014 latent cancer fatalities for the duration of the foreign research reactor spent nuclear fuel receipt period. This hypothetical individual would be living at the site storage at a different site. The maximum exposure to an individual worker was not calculated due to the large uncertainties involved with such calculations. A very conservative upper bound, however, would be the regulatory limit of 5,000 mrem per year, which translates to 0.026 latent cancer fatalities for workers receiving such a dose for the 13-year period during which receipts could take place.

S.4.2.4.2 Impacts of Accidents During Management Site Activities

The analysis of hypothetical accidental radioactive releases included meteorological conditions at the sites, population distributions, and food production and consumption rates within 80 kilometers (50 mi) of the storage location. Accident scenarios consisted of fuel assembly breach, dropped fuel cask, aircraft crash with and without fire, and accidental criticality. Consequences were estimated for a member of the public at the nearest site boundary and the population within 80 kilometers (50 mi) of the management site.

The highest estimated risk of incurring a latent cancer fatality for the maximally exposed individual member of the public would be 0.000010 for the duration of the foreign research reactor spent nuclear fuel receipt and storage period at the Oak Ridge Reservation. This represents one chance in 100,000 that this hypothetical individual would develop a latent cancer fatality. The greatest population risk to the public would be 0.11 latent cancer fatalities resulting from hypothetical accident conditions during Phase 1 receipt and storage at the Savannah River Site followed by Phase 2 receipt and storage at the Oak Ridge Reservation.

S.4.2.4.3 Other Potential Environmental Impacts from Management Site Activities

The EIS characterized each environmental component that would be impacted by site would be conducted prior to construction. In the event that cultural resources were found, the State Historic Preservation Officer would be contacted. Tribal leaders would be contacted if any Native American resources were found.

Aesthetic and Scenic Resources. New storage facilities would be located far from public view in areas previously disturbed or designated for industrial use. Construction activities would generate dust that could temporarily affect visibility. Every effort would be made, however, to minimize such conditions. Facility operations would not produce emissions that would affect visibility.

Geology. Except for the potential existence of gold, tungsten, and molybdenum at Nevada Test Site, geologic resources consist of sand, gravel, or clay deposits, all of which have low economic value. Construction activities would disturb these surface deposits, but because of the large volume of these materials on the potential sites, the impact would be small.

Air Quality. Construction activities would cause temporary, minor increases in dust emissions, but the use of standard dust-suppression techniques would mitigate this problem. Overall, particulate emissions during construction could temporarily affect visibility in localized areas but would not exceed Federal or State requirements.

Water Quality. Water consumption during construction would require very small amounts of water when compared to daily water usage at the proposed management sites. During operations, the maximum annual water consumption would be about 2.1 million liters (550,000 gal). This amount represents no more than 0.2 percent of the annual water consumption at any of the proposed foreign research reactor spent nuclear fuel management sites. At the Nevada Test Site, where available water is limited, a cumulative water supply impact would be significant from activities other than foreign research reactor spent nuclear fuel management, but the foreign research reactor spent nuclear fuel management contribution would be very small. Under normal operations, there would be no direct discharge or effluent to ground or surface waters from a new dry storage facility.

Ecology. During construction of new facilities, individual or small populations of some wildlife species could be disturbed, displaced, or destroyed. However, the size of the affected areas would be small compared to the size of the remaining natural habitats.

Noise. Construction activities would generate noise levels consistent with light industrial activity. Based on existing studies, these noises would not be expected to propagate offsite at levels that would affect the general population. Noises generated during operations would be less than that during construction.

Materials, Utilities, and Energy. For existing facilities, incremental increases in materials, utilities, and energy would be very small. New dry storage facilities would result in increased demands on water, power, and sewage. Increased water usage during construction would add no more than 0.2 percent to existing site-wide levels. Increased annual electricity requirements would be about 800 to 1000 megawatt-hours per year. Increased sewage generation would be less than one percent above existing site-wide levels. At the Nevada Test Site, a central sewage system would have to be constructed for spent nuclear fuel management activities, including foreign research reactor spent nuclear fuel storage facilities. However, all other existing system capacities would manage the estimated increases for materials, utilities, and energy.

Waste Management. At all proposed foreign research reactor spent nuclear fuel management sites, the amount of waste generated from foreign research reactor spent nuclear fuel storage would be very small when compared to annual waste projection for each site, and could be handled by existing capacity at each site.

S.4.2.4.4 Cumulative Impacts at the Management Sites

The contribution to cumulative impacts from activities required for foreign research reactor spent nuclear fuel storage at any site would be very small in comparison with other spent nuclear fuel management activities and even smaller in comparison with other ongoing and reasonably expected non-spent nuclear fuel-related projects. A cumulative impact results from the incremental impact of a contemplated action added to the impacts of other past, present, and reasonably foreseeable future actions.

S.4.2.4.5 Impacts of Ultimate Disposition

Because title to the foreign research reactor spent nuclear fuel would pass to the United States if the proposed policy were adopted and foreign research reactor spent nuclear fuel were accepted into the United States, the Nuclear Waste Policy Act provides authority for its disposal in a geologic repository. A separate environmental evaluation of proposed geologic disposal activities would be conducted prior to such disposal.

It is possible that the foreign research reactor spent nuclear fuel could be accepted intact in a geologic repository. If DOE determines that geologic disposal of intact foreign research reactor spent nuclear fuel is possible, then there would be no onsite impacts beyond those associated with storage and packaging of the foreign research reactor spent nuclear fuel.

It is also possible that some form of processing (e.g., that associated with the new treatment technologies that would be examined under the preferred alternative) could be necessary to convert foreign research reactor spent nuclear fuel into a more stable form prior to its ultimate disposal. This processing could be a near-term new treatment technology, conventional chemical separation, or a new treatment technology that is implemented after an interim period of storage. The environmental impacts of such processing activities in the future cannot be precisely estimated at this time because the processes that might be used have not been fully developed. DOE expects that any new technology would produce no greater impacts than those that resulted from historical reprocessing activities in the United States. Therefore, the impacts of near-term treatment of the foreign research reactor spent nuclear fuel would be no greater than the impacts of chemically separating the same material as analyzed in the EIS. If a new treatment technology is implemented after an interim period of storage and technology development, then DOE expects that it would provide substantial improvements over conventional chemical separation.

When disposal space is available, DOE would transport the intact or processed foreign research reactor spent nuclear fuel to a repository. This transportation would be expected to produce impacts similar to the ground transportation impacts discussed in

Section S.4.2.3 of the Summary. After emplacement in a geologic repository, however, DOE expects there would be no more impacts to workers, the public, or the environment because the radioactive material would be effectively isolated.

In the event that the geologic repository were to be delayed, DOE assumed for the purposes of this analysis that it would continue to manage the foreign research reactor spent nuclear fuel, or the high-level radioactive waste form resulting from the chemical separation or other processing of such spent nuclear fuel, at the management sites until a geologic repository becomes available. The risk associated with this continued management is low and would not exceed the annual risk discussed in Section S.4.2.4.1.

S.4.3 Policy Considerations and Environmental Impacts from Implementation Alternatives of Management Alternative 1

In addition to the basic implementation of Management Alternative 1, the EIS analyzed implementation of Management Alternative 1 by various other means. The range of these implementation alternatives (which are variations on the basic implementation), deals with: 1) different amounts of material to be accepted; 2) different policy durations; 3) different financial arrangements; 4) alternative locations for taking title; 5) wet storage technology for new construction instead of new dry facilities; 6) near-term conventional chemical separation in the United States instead of interim storage in the United States; and 7) development and use of new treatment and/or packaging technologies instead of conventional chemical separation or storage. A discussion of the policy considerations and environmental impacts for each of the implementation alternatives follows. The impacts reported below cover the full range of activities (i.e., marine transport, port activities, ground transport, and site management activities) necessary to carry out the particular implementation alternative.

S.4.3.1 Implementation Alternative 1: Different Amounts of Material

The EIS evaluated impacts from accepting two different amounts of foreign research reactor spent nuclear fuel, plus target material, under this implementation alternative. These impacts are discussed below.

- *Implementation Subalternative 1a: Accept Foreign Research Reactor Spent Nuclear Fuel Only From Countries with Other-Than-High-Income-Economies*

  By excluding high-income economy countries, this subalternative would have adverse consequences for U.S. nuclear weapons nonproliferation policy. The amount of HEU that could be removed from international commerce under this implementation subalternative is less than ten percent of the amount that could be removed under the basic implementation. Furthermore, if this was the only spent nuclear fuel accepted, research reactor operators in high-income economy countries would be likely to implement several measures contrary to U.S. nuclear weapons nonproliferation policy, such as delaying or canceling plans to convert to LEU fuel, or, in some cases, reconverting from LEU to HEU fuel. The environmental impacts would be reduced in comparison with the basic implementation in direct proportion to the reduced amount of spent nuclear fuel accepted.

- *Implementation Subalternative 1b: Accept Only HEU Foreign Research Reactor Spent Nuclear Fuel*

  Foreign research reactor operators have stated that they would not participate in the Reduced Enrichment for Research and Test Reactors Program unless the United States accepts their spent nuclear fuel, including LEU spent nuclear fuel. Thus, this implementation subalternative could result in the end of that program. Furthermore, this implementation subalternative would be contrary to the broader U.S. nuclear weapons nonproliferation policy. Since the number of elements in this implementation subalternative is about half the number of elements in the basic implementation, the potential environmental impacts would be approximately half of those calculated for the basic implementation.

- *Implementation Subalternative 1c: Accept HEU and LEU Target Material in Addition to Foreign Research Reactor Spent Nuclear Fuel*

  This implementation subalternative would remove the most HEU from civil commerce and provides the most support to U.S. nuclear weapons nonproliferation policy. Acceptance of this material in addition to the spent nuclear fuel would give incentives to reactor operators producing radioisotopes to switch from HEU targets to LEU targets, thus removing additional HEU from future international civil commerce. As with the basic implementation, acceptance of this additional material would have a small impact on all environmental, health, and safety issues. The dose rate from casks loaded with target material would be lower than the dose rate from casks loaded with foreign research reactor spent nuclear fuel. Up to 140 additional cask shipments are estimated to be needed for this material. These cask shipments would include up to 125 overland Canadian shipments. The environmental impacts are expected to be slightly higher than those associated with the basic implementation due to these additional cask shipments. The total incident-free population risk to the exposed public and workers would be 0.58 latent cancer fatalities as compared with 0.55 latent cancer fatalities under the basic implementation of Management Alternative 1.

S.4.3.2 Implementation Alternative 2: Alternative Policy Durations

The EIS evaluates the impacts of reducing the policy duration to 5 years of spent nuclear fuel acceptance or of continuing the policy for acceptance of HEU spent nuclear fuel indefinitely and LEU for 10 years.

- *Implementation Subalternative 2a: 5-Year Policy*

  The amount of HEU that could be removed from international commerce under this implementation subalternative is about 88 percent of the amount that could be removed under the basic implementation. The 5-year policy would accelerate the point at which the foreign research reactor operators and governments would become responsible for disposal of their own spent nuclear fuel. This may not be enough time for some countries, especially other-than-high-income economy countries, to make arrangements for alternative means of managing their spent nuclear fuel.

Under this implementation subalternative, approximately 81 percent of the total number of shipments under the basic implementation would be needed. The environmental impacts under this implementation subalternative would be reduced as compared with the basic implementation in direct proportion to the lesser amounts of foreign research reactor spent nuclear fuel accepted. As in the basic implementation, the effects would be small and no fatalities from cancer or accidents would be expected.

- *Implementation Subalternative 2b: Indefinite HEU/10-Year LEU Policy*

  The amount of spent nuclear fuel would be the same as in the basic implementation — only the timing for shipment of the HEU spent nuclear fuel would be different. Indefinite acceptance of HEU would promote U.S. nuclear weapons nonproliferation goals by allowing more time to remove the HEU from international commerce. The potential environmental impacts would be the same as or slightly lower than those of the basic implementation. Delaying the acceptance of a small fraction of the total amount of foreign research reactor spent nuclear fuel accepted would have a very small effect.

S.4.3.3 Implementation Alternative 3: Alternative Financing Arrangements

The EIS evaluated three alternative financing arrangements. These are: 1) subsidize all countries; 2) charge all countries the full cost of accepting and managing their spent nuclear fuel; and 3) subsidize other-than-high-income economy countries and charge high-income economy countries the full cost of managing their spent nuclear fuel. The first financing arrangement would be the most expensive for the United States, while the second would cost the United States nothing, and the third would fall somewhere in between.

These financing arrangements could have an indirect effect on the environmental impacts of accepting foreign research reactor spent nuclear fuel because the number of foreign research reactor operators participating in the program would depend on the fee the United States proposed to charge. The indirect effects are impossible to quantify, but would only result in a reduction in the amount of HEU removed from international commerce and in the environmental impacts on United States territory.

S.4.3.4 Implementation Alternative 4: Alternative Locations for Taking Title

The EIS evaluated alternative locations for taking title. These include: prior to shipment; at the port(s) of entry; and at the proposed foreign research reactor spent nuclear fuel management site(s).

The environmental impacts of the proposed foreign research reactor spent nuclear fuel program are not affected by who the owner of the spent nuclear fuel is or the point at which title is transferred. The Price-Anderson Act would apply to the spent nuclear fuel shipments, once they arrive in territorial United States, regardless of who holds title to the fuel. Thus, there would be no change in the liability protection provided to the citizens of the United States, no matter where DOE would take title. Ownership would not affect shipping arrangements and precautions, or liability protection, other than to increase DOE's potential liability if DOE were to take title before shipment.

S.4.3.5 Implementation Alternative 5: Wet Storage Technology for New Construction

Wet storage technology was evaluated under the EIS as a site storage option for Phase 2 storage. At the conclusion of Phase 1, the spent nuclear fuel could be stored in new wet storage facilities or in one non-DOE facility (Barnwell Nuclear Fuels Plant) located adjacent to the Savannah River Site which could be acquired and refurbished for use as a wet storage facility. This implementation alternative would support U.S. nuclear weapons nonproliferation policy to the same extent as the basic implementation.

Impacts to the health and safety of the public and workers would be similar to those discussed for new dry storage in the basic implementation. The risk of an accidental criticality, however, is higher for wet storage technology than for dry storage technology. Thus, the total population risk to the public due to accident conditions would be 0.16 latent cancer fatalities under this implementation alternative, compared to 0.11 latent cancer fatalities under the basic implementation.

The highest maximally exposed individual risk to the public due to accident conditions would be 0.00015 latent cancer fatalities under this implementation alternative, which is the highest of all the alternatives. This individual's chance of incurring a latent cancer fatality would be less than two in 10,000.

S.4.3.6 Implementation Alternative 6: Near-Term Conventional Chemical Separation in the United States

The EIS evaluates near-term conventional chemical separation at the Savannah River Site and the Idaho National Engineering Laboratory for five key environmental impacts; 1) waste management; 2) air quality; 3) water quality; 4) occupational and public health and safety; and 5) socioeconomics. The facilities at the Savannah River Site are technically capable of chemically separating the aluminum-based foreign research reactor spent nuclear fuel. After some upgrading, the facilities at the Idaho National Engineering Laboratory would be technically capable of chemically separating all the foreign research reactor spent nuclear fuel.

The same amount of HEU could be removed from international commerce under this implementation alternative as under the basic implementation. Foreign research reactor operators would have the same incentives not to use HEU in their reactors under this implementation alternative as they would under the basic implementation.

The principal environmental impacts under this implementation alternative would be occupational and public health and safety impacts. The total incident-free population risk to the worker population of incurring a latent cancer fatality resulting from this implementation alternative would be 0.32 latent cancer fatalities among all marine, port, ground transport, and site workers combined. The largest contribution to this total risk would be from onsite radiation workers. The risk to onsite radiation workers would be 0.21 latent cancer fatalities, which translates to 21 chances in 100 that one worker within the group of exposed workers would develop a latent cancer fatality.

The total incident-free population risk to the general public would be 0.39 latent cancer fatalities among the entire affected population under this implementation alternative. The total population risk due to accident conditions to the general public would be 0.43 latent cancer fatalities among people living near the affected site.

S.4.3.7 Implementation Alternative 7: Developmental Treatment and/or Packaging Technologies

This implementation alternative could be selected in connection with other implementation alternatives. The environmental impacts of the developmental treatment and/or packaging technologies cannot be precisely estimated at this time because the technologies and procedures are still under development. Implementation of certain treatment and/or packaging technologies would require new facilities and thus would generate impacts associated with construction as well as operation. Appropriate NEPA documentation would be prepared for any proposed implementation of new treatment and/or packaging technologies. A new facility using a new treatment technology would not be operational in the near-term, so in this case, this implementation alternative would be selected in conjunction with one of the near-term storage alternatives.

Any new facilities would be designed to meet modern environmental compliance and health and safety standards. The new design would minimize air and water emissions and would limit the public and worker radiation doses to levels no greater than those in existing facilities. Therefore, it is expected that these impacts would be somewhat lower than those presented for conventional chemical separations.

S.4.4 Implementation of the Preferred Alternative

Under the preferred alternative, as described in Section S.2.3, DOE would accept and manage the foreign research reactor spent nuclear fuel and target material in the United States. The aluminum-based foreign research reactor spent nuclear fuel and target material would be transported to and managed at the Savannah River Site. The TRIGA foreign research reactor spent nuclear fuel would be transported to and managed at the Idaho National Engineering Laboratory. Under the preferred alternative, up to 17,800 aluminum-based foreign research reactor spent nuclear fuel elements representing approximately 675 casks, and the target material from overseas, would arrive at candidate ports on the east coast of the United States, preferably the Naval Weapons Station at Charleston, South Carolina. Most of the target material would be received at the U.S.-Canadian border and all target material, representing 140 casks, would be managed at the Savannah River Site. Up to approximately 38 casks of TRIGA foreign research reactor spent nuclear fuel could arrive at candidate ports on the United States west coast, preferably the Naval Weapons Station Concord, California. DOE would strive to minimize the number of shipments necessary by coordinating shipments from several reactors at a time (i.e., by placing multiple casks [up to eight] on a ship). DOE currently estimates that approximately five shipments through the Naval Weapons Station Concord would be necessary. All the TRIGA foreign research reactor spent nuclear fuel, representing approximately 162 casks and 4,900 elements would be transported to and managed at the Idaho National Engineering Laboratory.

The policy considerations and the impacts of marine transport, port, ground transport, and management site activities of the preferred alternative presented in this section are based on analysis performed for the basic implementation of Management Alternative 1 (Section S.4.2), Implementation Alternative 1c (Section S.4.3.1), Implementation Alternative 6 (Section S.4.3.6), and Implementation Alternative 7 (Section S.4.3.7).

S.4.4.1 Policy Considerations

A critical result of implementing the preferred alternative would be support for the Reduced Enrichment for Research and Test Reactors Program, which has the goal of minimizing and eventually eliminating the use of HEU in civil nuclear programs. The successful expansion of the program to Russia, other Newly-Independent States, China, South Africa, and other countries, and the establishment of a world-wide norm discouraging the use of HEU is dependent on the United States commitment to action such as that embodied in this preferred alternative. By including the target material, the preferred alternative maximizes the amount of HEU to be removed from international commerce. By assisting foreign research reactor operators with peaceful applications of nuclear energy, the preferred alternative complies with U.S. obligations under the *Treaty on the Non-Proliferation of Nuclear Weapons*. By not encouraging reprocessing for either nuclear power or nuclear explosive purposes, the preferred alternative supports the Administration's nuclear weapons nonproliferation policy objectives.

DOE's preferred alternative allows for the use of chemical separation under certain circumstances, such as when alternative technologies present higher safety risks, are more costly, or are unavailable. If chemical separation is used to process the foreign research reactor spent nuclear fuel, the HEU would be blended down during the separation process to a low enriched form that is unsuitable for nuclear weapons purposes (the blenddown is also required because the F-canyon cannot safely process HEU beyond initial dissolution). No plutonium would be separated. Instead, the plutonium would be left in the waste stream with the high-level radioactive chemical separation wastes. In addition, the waste generated during reprocessing would be handled using technologies that are intended to be used for substantially larger quantities of pre-existing wastes (e.g., vitrification of high-level liquid radioactive wastes, grouting for low-level wastes, and incineration for some supernatant).

This potential method of handling the foreign research reactor spent nuclear fuel would be consistent with United States nonproliferation policy, despite the use of chemical separation because (1) it would reduce the worldwide stockpiles of this nuclear weapons material; (2) no plutonium would be separated; and (3) the chemical separation would not be taking place for either nuclear weapons or nuclear power purposes.

DOE is aware that the inclusion of chemical separation within the preferred alternative could be interpreted by some nations, organizations, and persons as a signal of endorsement of the use of chemical separation as a routine method of waste management for spent nuclear fuel or a reversal of United States policy on chemical separation. This would not be an accurate interpretation. The United States policy regarding chemical separation was established in Presidential Decision Directive 13, and DOE and the

Under accident conditions, the maximum population risk to the general public (which would be to the people living near both management sites at the time of an accident) would be 0.45, or an approximate 45 percent chance of incurring one additional latent cancer fatality among all the people living near both sites. The maximum estimated accident radiological risk to the maximally exposed individual is 0.000047 latent cancer fatalities, which applies to a hypothetical member of the public who lives at the site boundary. This individual's chance of incurring a latent cancer fatality due to an accident under this alternative would be less than one in 10,000. There is approximately a five drawbacks from a nuclear weapons nonproliferation policy standpoint. The accumulation overseas of ever larger amounts of spent nuclear fuel containing HEU poses a risk that such weapons-usable material might be illicitly diverted to a weapons program. Although U.S. assistance in maintaining adequate physical security for foreign research reactor spent nuclear fuel repositories may lessen the potential for diversion, the proliferation risk would still be greater than under the basic implementation of Management Alternative 1. As the foreign research reactor spent nuclear fuel ages, it would become less radioactive and thus a more attractive target for illicit diversion.

S.4.5.2 Impacts From Overseas Reprocessing With U.S. Nontechnical Assistance

The EIS considers a subalternative in which all of the reprocessing activities occur overseas using foreign reprocessing and vitrification technology. In one subalternative, [illegible]

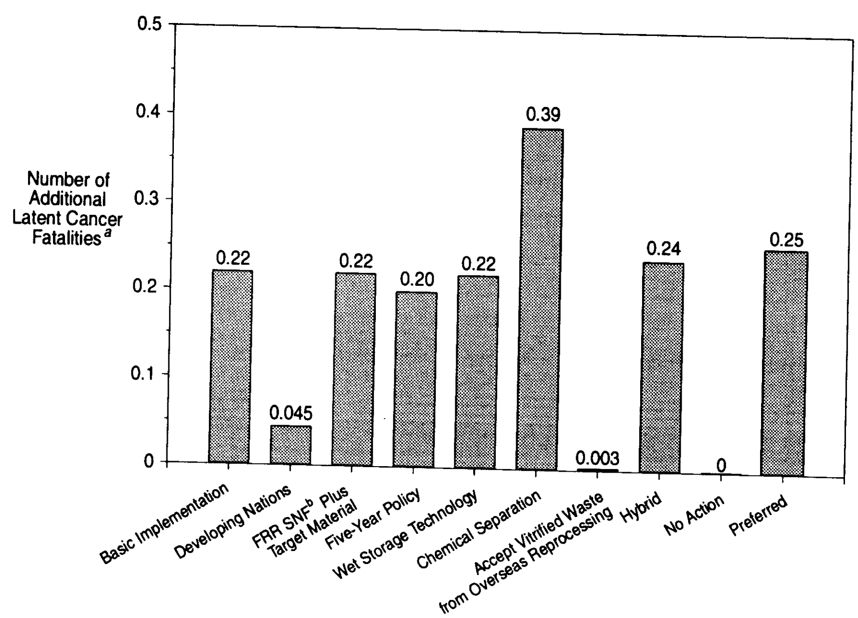
S.4.8 Comparison of the Radiological Risks

This section provides a comparison of the potential maximum estimated risks associated with the alternatives evaluated in the EIS for the general public, the workers, and the maximally exposed individual. Essentially this risk would occur during the first 13 years of the program.

Figure S-11 shows the greatest incident-free population risk to the general public under each alternative. Figure S-12 shows the greatest accident population risk to the general public under each alternative. These estimated risks (including the maximum estimated risk of 0.39 latent cancer fatalities under incident-free conditions, and 0.45 latent cancer fatalities under accident conditions) would be less than one-half additional latent cancer fatality among the public living near [within 80 kilometers (50 mi)] any of the management sites.

The accident risks to the population are estimated by combining the probabilities of accidents and the consequences of those accidents, then summing over the full range of accidents that might reasonably be expected to occur during marine transport, port activities, ground or barge transport, and management site activities. The single accident with the highest risk is estimated to have a probability of approximately 0.02 occurrences per year and a consequence of approximately 1.3 latent cancer fatalities.

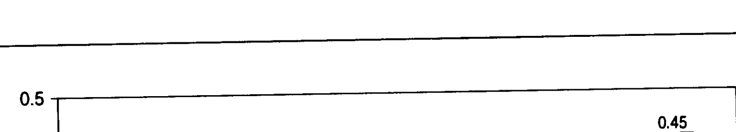
Incident-free population risks for workers are depicted in Figure S-13. The greatest incident-free radiological population risk to workers from any of the alternatives would occur in the alternative in which target material is added to the basic implementation of

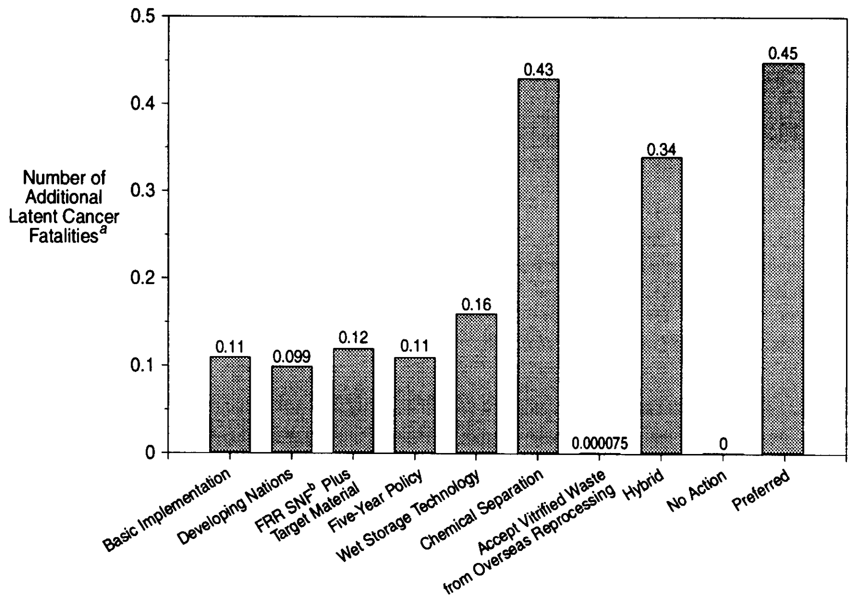


[a] *Impacts evaluated were those in the United States and on the Global Commons.*

[b] *Foreign Research Reactor Spent Nuclear Fuel*

Figure S-11 Maximum Estimated Incident-Free Radiological Population Risk to the General Public Under [illegible]

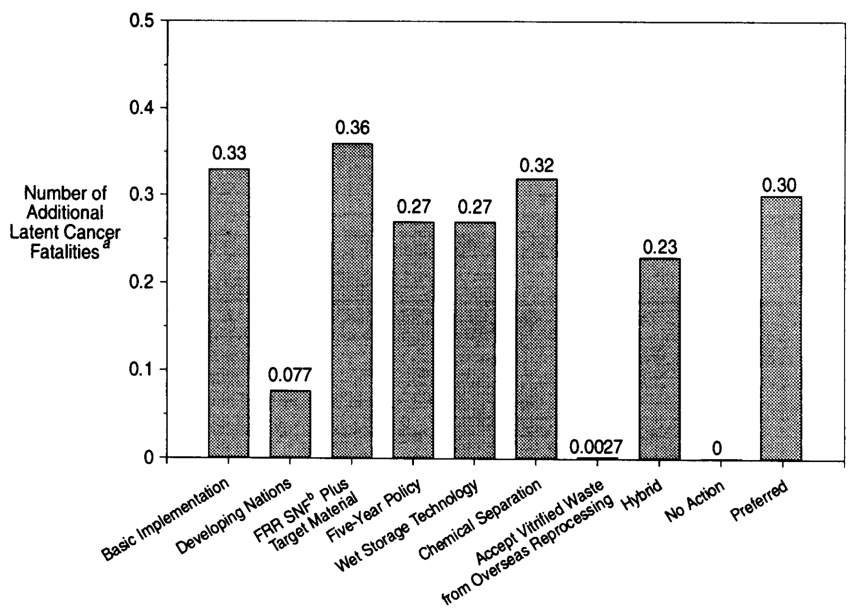




[a] *Impacts evaluated were those in the United States and on the Global Commons.*

[b] *Foreign Research Reactor Spent Nuclear Fuel*

Figure S-12 Maximum Estimated Accident Radiological Population Risk to the General Public Under Each Alternative



[a] *Impacts evaluated were those in the United States and on the Global Commons.*

[b] *Foreign Research Reactor Spent Nuclear Fuel*

Figure S-13 Maximum Estimated Incident-Free Radiological Population Risk for Workers Under Each Alternative

Management Alternative 1. This low risk would mainly occur during the first 13 years of the program and could be up to 0.36 additional latent cancer fatalities to the worker group under incident-free conditions.

The analysis in this EIS indicates that the highest estimated individual risk would be to an onsite radiation worker (i.e. the maximally exposed worker) receiving a dose equal to the regulatory limit of 5,000 mrem each year for 13 years under incident-free conditions. This risk would be 0.026 latent cancer fatalities, and this hypothetical individual's estimated chance of developing a fatal cancer would be 2.6 chances in 100. However, DOE would prevent workers from receiving this high radiation dose through existing administrative procedures.

The EIS analysis indicates that the highest estimated maximally exposed individual risk to members of the public under the proposed action is 0.00015 latent cancer fatalities. This would be a hypothetical individual member of the public who was at the worst possible location during an accidental criticality on the Oak Ridge Reservation under Implementation Alternative 5, Wet Storage Technology for New Construction. This accident is estimated to have a frequency of approximately 0.0031 occurrences per year and a consequence of approximately 0.0017 latent cancer fatalities. This hypothetical individual's chance of incurring a fatal cancer would be increased by less than two in 10,000.

The highest estimated incident-free population risk to the general public (See Figure S-11) living near any of the management sites, or ports, from any of the implementation alternatives is less than one-half latent cancer fatality. This risk occurs under Implementation Alternative 6, near-term Chemical Separation in the United States at the Savannah River Site. This risk would be spread among the roughly 600,000 people who live near the Savannah River Site, so the average risk among these people would be less than one in a million over the entire 40-year period. Common activities that produce a comparable risk of death per year are presented in Table S-1.

Table S-1 Risks Estimated to Increase Chance of Death in Any Year by

Table S-2 Potential Total Costs
(Net Present Value, Millions of 1996 Dollars in 1996)

	Minimum	Other Cost	Other Cost	Potential Total	1% Real
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

S.5 Overview of the Public Comments and DOE Response

On April 21, 1995, DOE published in the *Federal Register* a Notice of Availability of the *Draft Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (60 FR 19899). In accordance with DOE NEPA regulations 10 CFR Part 1021, the Notice invited interested agencies, organizations, and the general public to provide oral and written comments on the Draft EIS.

S.5.1 The Public Comment Process

The public comment period on the Draft EIS was initially scheduled from April 21, 1995 to June 20, 1995. In response to public requests, the comment period was extended an additional 30 days through July 20, 1995. During the comment period, DOE held 17 public hearings in the locations most likely to be directly affected by the EIS alternatives, including the 10 candidate ports of entry and five candidate management sites. In addition, a public hearing was held in Washington, D.C. The hearing dates and locations are shown in Figure S-14. The Draft EIS was made available to the public through mailings, requests to DOE's Environmental Management Information Center, and at DOE Public Reading Rooms and other designated information locations.

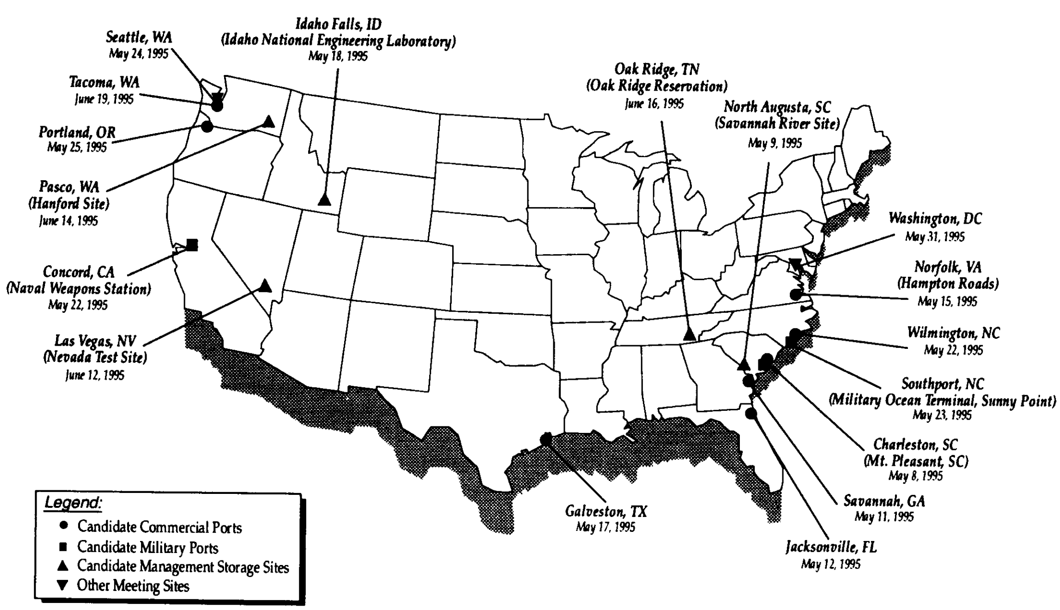


Figure S-14 Public Comment Hearing Locations and Dates

S.5.2 Written Comments

DOE received approximately 5,040 written comments contained within approximately 1,250 submissions. Written comments were submitted to DOE by mail and facsimile and at many of the public hearings. These written comments were received from individuals, Federal and State agencies, Tribal governments, local governments, foreign entities, and non-government organizations such as environmental, public interest, and industry groups. All written comments were reviewed and considered in the preparation of the Final EIS and are presented in Section 2 of Volume 3 of the Final EIS.

S.5.3 Public Hearings

In an effort to encourage a dialogue between members of the public and government officials at the public hearings, DOE used an informal, interactive format and an independent professional facilitator. The hearings were preceded by an hour-long "open house" at which exhibits, videos, and other information materials were available for review, along with opportunity for one-on-one exchanges with DOE representatives. Comment forms were provided for those wishing to submit written comments at the hearings.

Public hearings began with an explanation of the hearing format by the independent facilitator, followed by a 30-minute overview by a DOE official on the proposed policy and the factors leading to the proposal's development. Following this presentation, attendees were encouraged to ask questions, offer comments, and engage in dialogue. Notetakers summarized the questions and comments and DOE responses at all hearings. A summary of all oral comments and statements from each hearing, along with the DOE responses, is presented in Volume 3, Section 3 of the EIS.

Approximately 900 people attended the 17 public hearings. An interactive format was used at all hearings except in Tacoma, Washington. At the Tacoma public hearing, attendees expressed a desire for a more traditional approach in which people presented statements of up to five minutes, with little or no dialogue between commentors and DOE. In addition, the Tacoma hearing attendees requested that a verbatim transcript be made of the meeting. A copy of this transcript is included as Attachment 1 to Volume 3, Section 3 of the EIS.

S.5.4 Environmental Protection Agency Rating of EIS

The U.S. Environmental Protection Agency reviewed and rated the Draft EIS proposed action and each alternative as "lack of objections (LO)," which means that the EPA has not identified any potential environmental impacts requiring modifications to the proposal. A copy of the U.S. Environmental Protection Agency rating is included among the written comments in Volume 3, Section 2 of the Final EIS.

S.5.5 Major Issues Raised by Commentors

The public comments addressed a wide range of policy, economic, and technical issues. Of the approximately 6,000 written and oral comments received, few were critical of, or directed against, the analytical methods presented in the Draft EIS. The following is a summary characterizing the most frequently raised issues and the corresponding summary of DOE's responses. (In each case, a summary of DOE's response is provided in bold text following the summary of the public comment.) DOE's full response to each specific comment and issue are provided in Sections 2 and 3, Volume 3 of the Final EIS.

S.5.5.1 Policy Considerations and Management Alternatives

Numerous comments and questions were received concerning the need for a policy to manage foreign research reactor spent nuclear fuel. Commentors questioned the need to adopt a policy to manage spent nuclear fuel from allied countries or from countries that are considered sufficiently developed to manage their own spent nuclear fuel. Other commentors questioned the objectives of the stated U.S. nuclear weapons nonproliferation policy and the rationale for considering the proposed policy, pointing out that some of the allied nations under the proposed action do not pose a nuclear weapons proliferation risk. ***The purpose of the proposed action is to support a U.S. nuclear weapons nonproliferation policy that seeks to reduce, and eventually eliminate, the use of highly-enriched (nuclear weapons-grade) uranium in civil programs worldwide. It is necessary to deal with spent nuclear fuel from the developed countries for several reasons.***

First, if the United States does not assist the developed countries with management of their spent nuclear fuel, the only mechanism available to them for spent nuclear fuel disposition would be to stay on or reconvert to use of highly-enriched uranium for fuel. Those who can accept the reprocessing wastes would disposition their spent nuclear fuel by having it reprocessed, and would recycle the remaining highly-enriched uranium. They would have to seek out sources of new highly-enriched uranium to make up for that burned, and to keep the enrichment level of the recycled uranium high enough to be of use. Since the United States could not ship additional highly-enriched uranium to them, they would likely resort to Russia or China as suppliers. Such actions could destroy all the progress made by the Reduced Enrichment for Research and Test Reactors program in attempting to eliminate the use of highly-enriched uranium in civil programs.

Second, many developed countries manufacture research reactors and sell them to developing countries. If, due to inaction by the United States, research reactors in the developed countries refuse to convert to low enriched uranium fuel, or switch back to the use of highly-enriched uranium fuel, their customers in developing countries would likely insist on obtaining reactors that also use highly-enriched uranium fuel.

Third, inaction by the United States that leads research reactors in developed countries to shut down due to the absence of a timely means of dispositioning of their spent fuel is likely to lead, rightly or wrongly, to accusations that the United States is failing to comply with its obligations

capabilities and increased operating costs that generally accompany conversion to low enriched uranium fuel. Furthermore, by not accepting low enriched uranium, the United States would be penalizing the reactors that converted earlier under the Reduced Enrichment for Research and Test Reactors Program, because those reactors are now generating only low enriched uranium

Many commentors expressed concern about the cost to the United States of managing foreign research reactor spent nuclear fuel. Several opposed full subsidization of developed countries which they consider capable of managing their own spent nuclear fuel. Other commentors favored competitive pricing or charging the foreign research reactor operators a full-cost recovery fee for management of their spent nuclear fuel. Representatives of certain foreign research reactor operators expressed their willingness to pay a cost-based price, and stated that they are not asking U.S. taxpayers to subsidize their fuel cycles. A number of commentors asked for additional information in the Final EIS on life cycle costs, risks, and benefits. ***DOE and the Department of State have evaluated several financing options in the EIS, ranging from fees from the research reactor operators that would pay all of the costs of the program to full subsidization of the program by DOE. One of these options would be for developed countries (which represent about 87 percent of the spent nuclear fuel total mass and about 78 percent of the spent nuclear fuel elements) to pay a competitive fee for U.S. management of their spent nuclear fuel. As part of this option, DOE would subsidize the costs of managing the spent nuclear fuel from developing countries. The United States does not believe the developing countries can afford to pay the expense for spent nuclear fuel management either in the United States or in the host country.***

S.5.5.2 Ultimate Disposition

The ultimate disposition of DOE-owned spent nuclear fuel was a widely expressed policy concern. Many commentors, concerned with a lack of long-term storage options, raised the issue of the availability, or lack thereof, of a permanent geologic repository. Many urged that, before the United States accepts any spent nuclear fuel from foreign research reactors, a permanent repository must be established in this country. Some comments promoted reprocessing as a means to stabilize and prepare the spent nuclear fuel for geologic disposal. ***The Nuclear Waste Policy Act of 1982, as amended, establishes a framework for the ultimate disposition of spent nuclear fuel in the United States in a geologic repository. Any foreign research reactor spent nuclear fuel accepted into the United States under the alternatives considered in the EIS would be eligible for disposal in a geologic repository. Under authority of the Act, DOE is currently evaluating the feasibility of locating a geologic repository at Yucca Mountain in Nevada. In the meantime, however, DOE and the Department of State are seeking to stem the use of highly-enriched uranium in civil programs. Under the preferred alternative, if any foreign research reactor spent nuclear fuel were accepted into the United States, it would be treated and/or packaged, and the resulting materials placed in "road ready" storage pending the availability of a geologic repository, if it were not otherwise disposed of in the meantime.***

S.5.5.3 Transportation and Emergency Response

Transportation and emergency preparedness were key concerns expressed during the public comment period. The majority of comments dealt with identification of parties responsible for responding to an accident involving transport of the foreign research reactor spent nuclear fuel, local emergency response capability, marine and ground transportation routing, shipment methods, procedures, and safety criteria. ***Local and State responders would be the first to respond to a transportation accident involving the foreign research reactor spent nuclear fuel shipments, as they would to any overland shipment involving hazardous materials. State, local, and some Tribal governments have the basic capabilities and training that would be required in order to*** *materials, (i.e., assess the scene, administer emergency care, control the area, and call for a hazardous materials special team). DOE would develop emergency plans with the carrier, port officials, State, local, and Tribal officials and provide training courses for first responders to enhance their capabilities to respond appropriately in the unlikely event of an accident involving these spent nuclear fuel shipments. Technical assistance would also be provided to supplement existing State, local, or Tribal resources if any deficiencies are identified. In the event of an accident, if requested by a State, Tribal, or local government, DOE would send a radiological monitoring assistance team from the closest of eight DOE regional offices located across the country.*

Appendix H, which was added to the Final EIS in response to public comments, contains the general provisions for emergency preparedness and security measures associated with the transportation of foreign research reactor spent nuclear fuel in the United States. The provisions include communications and meetings between DOE and State, Tribal, and local authorities, prior to the implementation of the policy, for the identification and resolution of emergency management and security issues specific to the communities that would be affected. These issues include capabilities and training of first emergency responders.

Many commentors were concerned about the safety of transportation casks. *Spent nuclear fuel is transported in "Type B" transportation casks that are designed and built to preclude release of radioactive material. They are subject to stringent design, fabrication, and operating requirements imposed by the Nuclear Regulatory Commission and Department of Transportation in the United States and by the International Atomic Energy Agency for international shipments, to withstand very severe accidents without releasing their contents. These casks are required to be able to pass stringent tests, including a 30-foot drop onto an unyielding surface (such surfaces are engineered and built for these tests and do not exist in nature), a drop onto a steel post (a puncture test), and a high temperature fire test. As a result of their very robust design and construction, to date, no "Type B" spent nuclear fuel transportation cask has ever been punctured, nor has one ever released its radioactive contents, even as the result of an accident.*

Comments on land transportation dealt mostly with routing concerns and emergency response. Several commentors requested that DOE provide notification to local officials and private citizens of the specific routes that would be used for truck or rail shipments. Many commentors expressed concern regarding the risks associated with the use of specific routes (major interstates through population centers) and during adverse weather and traffic conditions. Some questioned the safety records of radioactive waste trucking firms and inquired about the safety requirements imposed on these firms and the contract arrangements that DOE would make with the shippers. *As part of the development of a Transportation Plan (in which State, local and Tribal officials in addition to DOE, the carrier, shippers agent, the port and other Federal agencies would be involved), highway routes would be identified using criteria developed by the Department of Transportation. These criteria include using the Interstate highway system, selecting the shortest route or time in travel from the U.S. port of entry to the closest Interstate, and using by-passes or beltways to avoid major population centers. States and Tribes may designate alternate routes that are equivalent to the Interstate system in consultation with local officials, and approved by the U.S. Department of Transportation. Rail routing criteria used by the Department include avoiding interchanges and using the best available track. NRC approval of either rail or truck routes selected for use would be required. Official notification of the shipments would be provided to the Governor of each*

State and Governors or Chairpersons of Indian tribes along the route at least seven days in advance of shipment. In addition, DOE would use a satellite-based tracking system to notify Tribes and States of the pending shipment and to continuously track shipment progress. In order to maintain security, Governors and Tribal leaders are required by the NRC to only notify State and local officials who would need to know about the shipment, usually emergency management or law enforcement officials. With respect to the safety record of potential trucking firms, DOE has developed and implemented a mandatory Motor Carrier Evaluation Program with twelve evaluation criteria. Under the Motor Carrier Evaluation Program criteria, trucking firms with poor safety records would be excluded from transporting the spent nuclear fuel. The Motor Carrier Evaluation Program would be invoked as one of the requirements in DOE's foreign research reactor spent nuclear fuel acceptance contract. Other requirements would be discussed during the development of the Transportation Plan with the appropriate State, local, and Tribal officials.

Many commentors requested coordination with emergency responders en route so that localities can be prepared in the unlikely case of an accident. Many State, Tribal, and local representatives, as well as private citizens, commented that communities along shipping routes and at port and management site locations may have inadequate capabilities to respond to emergencies involving radioactive release. Many expressed the need for DOE funding for training, equipment, monitoring for local emergency responders, transportation plans, and real-time shipment tracking that would be accessible to emergency response personnel. A number of commentors suggested that the Final EIS should evaluate the potential impact on local services due to the financial burden associated with emergency response preparedness. *DOE is committed to working with State, Tribal, and local governments to ensure that they are prepared to carry out their responsibilities in the unlikely event of an accident involving shipment of foreign research reactor spent nuclear fuel. Details of emergency preparedness, security, and coordination of DOE with local emergency response authorities would be contained in the Transportation Plan, which would be prepared prior to any individual spent nuclear fuel shipment and coordinated with State, Tribal, and local officials. Any additional training or equipment needed would be provided as part of the planning process. In addition to direct Federal assistance to State, Tribal, and local governments for maintaining emergency response programs, there are three national emergency response plans under which DOE provides radiological monitoring and assessment assistance. Under these plans, DOE provides technical advice and assistance to the State, Tribal, and local agencies who might be involved in responding to a radiological incident.*

Another group of commentors expressed concern regarding risks of terrorist activities. Several noted that terrorist activity is a concern of all countries, including the United States, citing the Oklahoma City bombing incident as an example. Commentors also stated that transporting nuclear material overseas to the United States would unnecessarily expose shipments to an increased possibility of terrorist threat. *In response to these concerns, Section D.5.9 was added to Appendix D of the EIS to specifically address terrorism and sabotage. This section concludes that while the risk of certain terrorist and sabotage attempts cannot be precluded, proper security measures would greatly reduce the risk. All shipments of foreign research reactor spent nuclear fuel would be conducted meeting, or exceeding, all the relevant security requirements in the Code of Federal Regulations. DOE would ensure through the spent nuclear fuel acceptance contracts with the reactor operators that proper security is provided at a port or in transit, based on the Nuclear Regulatory Commission requirements. Often local or State law enforcement personnel would be employed*

by the carrier to satisfy these security requirements, which include having armed escorts on board or near the shipment when it is in highly populated areas or at the port in the United States. In the case of military ports, a high level of security is inherently in place.

With regard to marine transport, many commentors stated a preference for using special purpose, chartered, or military ships rather than regularly-scheduled commercial liners to ship spent nuclear fuel. ***The use of commercial liners, chartered ships, and purpose-built ships was considered for the marine transport of the spent nuclear fuel. The analyses in the EIS indicate that the impacts associated with the use of any of the ships evaluated would be small. The impacts of using military ships were not analyzed in the EIS because DOE believes that the added security provided by such ships would not be required to ensure safe transport. DOE's preferred alternative includes the use of military ports as points of entry to the United States.*** Independent inspections by State, local, and/or public interest groups prior to and during shipments were suggested by some commentors. ***DOE would encourage inspections by authorized State agencies for both radiological and vehicle inspections prior to shipment and after arrival at the management site. These inspections would be coordinated with the States through the transportation planning process.***

S.5.5.4 Port Selection Criteria and Activities

Many commentors, predominately those from communities at or near potential ports of entry, questioned DOE's port selection process and the methods for application of the selection criteria, especially with respect to populations in and around candidate ports. Particular concerns were that longshoremen may not be adequately trained to handle radioactive materials or that they could be exposed to high levels of radioactivity. As an alternative, military ports were supported as having the necessary experience in handling nuclear material and being more secure. ***Section 3151 of Public Law 103-160 (the National Defense Authorization Act for the fiscal year 1994), requires that "the Secretary of Energy shall, if economically feasible and to the maximum extent practicable, provide for the receipt of spent nuclear fuel... at a port of entry in the United States which...had the lowest human population in the area surrounding the port of entry...". While this Act was written specifically to apply only to the receipt and storage of spent nuclear fuel at the Savannah River Site, DOE elected to apply this criterion, among others, to the maximum extent practicable, in identifying all suitable ports of entry for potential receipt of foreign research reactor spent nuclear fuel. In application of the population criterion, DOE considered both the population nearest the potential ports of entry analyzed, and the total population along the transportation routes. Analysis of the list of candidate ports against this criterion did not identify any port as a clear choice. Therefore, DOE selected ports that best met all of the criteria discussed in Appendix D to the EIS (e.g.,*** [illegible] *virtue of their training and experience in performing their military function. Consideration of all these factors led to designation of the Naval Weapons Stations at Charleston and Naval Weapons Station Concord as the preferred ports of entry.*

DOE notes that, although the maximum allowable radiation dose rate is 200 mrem per hour, this limit is applicable at the surface of the transportation cask, which would be inside of the container. The maximum radiation dose rate limit to those that would be near the container, such as longshoremen, is 10 mrem per hour at a distance of 2 meters (6.6 ft) from the surface of the container. The actual total dose that a longshoreman would get handling a cask would be quite small due to the fact that a handler would not be present at the surface of the container for long, and the total time near the cask would be quite short. The additional barrier imposed by the standard shipping container would also prevent the longshoreman from being in the near vicinity of the cask. The analysis in the EIS indicates that both the dose and dose rate for the port workers would be low.

Concerns over possible storage of spent nuclear fuel at the port of entry were raised by a number of commentors. *DOE's goal would be to minimize holding times at the ports and to provide safe transport of the spent nuclear fuel to its destination as quickly as possible. Under normal circumstances, the foreign research reactor spent nuclear fuel would remain at the port for only a few hours (e.g., 2 to 4 hours) and no more than 24 hours. In the very unlikely event that the spent nuclear fuel could not be moved within 24 hours, special provisions to move the fuel to a secure area at the port would be made. Part of the overall plan and agreements with the Department of Defense would include these special provisions.*

Several commentors pointed to recent increases in marine traffic and industrial congestion in the port areas and questioned whether the selection criteria would be affected by these factors. Some cited the need to consider site-specific factors such as hurricanes, severe winds, seismic activity, extreme weather conditions, and sinkholes. *In general, the number of ship mishaps is not proportional to the amount of ship traffic because port ship traffic is slow, and even when heavy, is normally a small number of ships per hour. Historically, increasing the volume does not significantly increase the probability of an accident. Rather, the number of ship mishaps is associated with navigational hazards and distances from the port to the open ocean or a large bay. In order to further assure safety, the U.S. Coast Guard would establish a moving zone of exclusion, which would keep all vessels away from the ship bringing the spent nuclear fuel into port. Coast Guard escort boats would accompany the ship to port. As for accidents, the potential consequences of a port or land transport accident due to an earthquake are represented and bounded by the potential port and land transportation accidents that are assessed in the EIS. Local hazards, such as earthquakes, volcanoes, and mud slides could be accident initiators; however, they would not increase the consequences of the accident, which were found to be low. Earthquakes were not analyzed separately in the EIS because seismic activity would not result in greater damage to a transportation cask than that analyzed for accidents such as challenges to the transportation cask integrity that could be caused by casks falling from a bridge or down an embankment. These kinds of accidents are within the design standards developed by the NRC and by which cask designs are evaluated. The NRC certifies the designs that contain the appropriate level of safety to protect workers, the public, and the environment from the radioactive material being transported. Analysis of the potential impacts associated with the possible existence of sinkholes along potential rail routes was added to the Final EIS in response to public comment.*

S.5.5.5 Economic Impacts to Candidate Port and Site Communities

Potential economic impacts on affected port and site communities were the subject of many comments. Of particular concern were the socioeconomic impacts to a community in the event of an accidental release of radiation. Examples of potential impacts cited by commentors include disruptions in normal commerce, loss of business, loss of tourism, devaluation of property, and closure of ports and highway routes. Several port authorities were concerned about the potential for declining business due to the perceived stigma associated with handling nuclear waste materials in their ports, while others viewed handling these shipments positively. The costs of emergency response, cleanup, health care, and potential economic losses associated with accidents or releases were key concerns of several State, Tribal, and local officials. ***The risk associated with shipments of foreign research reactor spent nuclear fuel through any of the ports identified would be less than the risk associated with the handling of other hazardous cargoes due to the rigid criteria established for spent nuclear fuel shipping casks. In fact, no adverse impacts have been observed during the 30 years that foreign research reactor spent nuclear fuel was accepted into the United States. Historically, shipping foreign research reactor spent nuclear fuel through ports has not created a stigma or had an adverse economic impact on business, major industries, tourism, or future business development at ports. DOE does not believe that actions such as permanent road closures would be required for the safe and uneventful transportation of foreign research reactor spent nuclear fuel. Costs of emergency response are covered under insurance that is required of hazardous material carriers. If that level of coverage is exceeded, Price-Anderson and other Federal provisions would cover costs.***

S.5.5.6 Health Effects and Environmental Risks

Many commentors raised concerns about health effects and environmental risks that could result from accidents during marine transport, handling operations at ports, ground transportation, and interim management. Of particular concern were the effects of possible radioactive releases into the ocean and rivers, and on highways and railroads; the impacts to fish, wildlife, ecosystems, and drinking water; and the possibility of an increased risk to workers and the public of cancer and genetic defects. ***Human health and safety were primary considerations during the evaluation of environmental effects for the proposed alternatives. Conservative estimates of radiological and nonradiological impacts indicate that risks to the population and workers would be low. The analysis in the EIS indicates that the risks associated with an accident at sea or a port accident would be low. The impacts of the incident-free receipt, handling, and transportation of foreign research reactor spent nuclear fuel would also be extremely low. In over 40 years of spent nuclear fuel transportation, no "Type B" spent nuclear fuel transportation cask has ever been punctured or released any of its radioactive material contents. DOE believes that spent nuclear fuel transportation casks passing through any of the potential ports of entry or any other part of the country would be highly unlikely (i.e., less than a 1 in 10 million chance) to release their contents or adversely affect air or water quality.***

Several commentors questioned the results of the risk analyses in the EIS, suggesting that DOE may have underestimated the risk potential for accidents, radioactive release(s), and exposures to both workers and the public. ***DOE believes that the analyses of risk to people during marine transport and for those who live near potential ports of entry, along transportation routes, and near management sites are conservative (i.e., are likely to overstate the actual risk). These estimates were generated using standard computer codes (e.g.,*** *RADTRAN) that have been adopted and used by the Nuclear Regulatory Commission and Department of Transportation for transportation calculations for over 19 years. These computer codes are available for public review.*

Some commentors expressed concern about potential health impacts resulting from a cask sinking in deep waters. Many challenged the applicability of the severe accident tests applied to the casks (e.g., crash, fire, drop, immersion), stating that the conditions of real-life accidents were of greater magnitude than the conditions in the tests. For example, commentors cited fires that were alleged to have burned longer and hotter than those used to test the transportation cask and pointed out that the water in Puget Sound is deeper than the cask recovery depth cited in the Draft EIS. *The EIS presents an evaluation of the consequences of accident scenarios that would result in the sinking of a spent nuclear fuel transportation cask on the continental shelf (water depth of about 200 meters), and in the deep ocean (water depth of more than 200 meters). In the unlikely event that a transportation cask loaded with foreign research reactor spent nuclear fuel were to sink in any U.S. coastal or inland waters, it would be recovered, even from the deepest portions of the Puget Sound, which reach depths of 305 meters (1,000 feet). The sequence of testing scenarios (i.e., cask drop onto unyielding surface, cask drop on a steel post [puncture], and cask fire) is required by the Nuclear Regulatory Commission as part of the certification of "Type B" spent nuclear fuel transportation casks. These tests conservatively represent a wide range of accident conditions that could occur during transport. The test results indicate that if such accidents were to occur, the cask most likely would not fail, and would not lead to a loss of containment. The cask drop and puncture tests evaluate the resulting impact on the most vulnerable orientation of the cask*

EIS. Commentors at the heavily-attended west coast port hearings tended to favor the more traditional, formal public hearing format, and strongly opposed the use of notetakers to summarize hearing issues. In the Tacoma area, commentors urged DOE to hold another hearing to tape record their comments for the record, without allowing for dialogue with DOE representatives. Many State and local officials requested that DOE provide better advance notification to communities that are being considered as candidate ports or management sites so that they have more time to review the Draft EIS. Many individuals stated they had not received the Draft EIS in a timely manner and consequently, had little time to review and comment. Several commentors expressed a desire for increased DOE interaction with local officials and more community participation in DOE's planning and decisionmaking processes.

Notice of the availability of the Draft EIS for public review and comment was published in the Federal Register (60 FR 19899, April 21, 1995). This notice advised concerned parties, including State, Tribal, and local authorities, of the availability of the Draft EIS and the dates and locations of the public hearings on the Draft EIS. In addition, advertisements of the public hearings were placed in local papers prior to their occurrence. The public hearing format adopted by DOE provided an opportunity for interaction between DOE and the public, thus serving to facilitate communication.

In response to public concerns of insufficient time to review the Draft EIS, DOE extended the deadline for submission of written public comments from June 20 to July 20, 1995. DOE considers that this 90-day period was sufficient for public comment. All oral comments presented at each hearing were summarized and have been addressed along with the written comments in Volume 3 of the Final EIS. DOE considers that these actions have provided ample opportunity for the public to comment. Issues raised by the public during the comment period were considered in selection of the preferred alternative for this proposed action. All comments, written and oral, are part of the public record.

S.5.6 Availability of the EIS

Copies of the EIS and the EIS Summary may be obtained by calling DOE's Center for Environmental Management at 1-800-736-3282 (1-800-7-EM DATA). The EIS and EIS Summary may be reviewed at any of the Reading Rooms identified in this Summary.

General questions concerning the NEPA process, under which EISs are prepared, may be addressed to:

Ms. Carol Borgstrom
Office of NEPA Policy and Assistance (EH-42)
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585
Telephone (202) 586-4600, or leave message at 1-800-472-2756

Written request for clarifications concerning the Foreign Research Reactor Spent Nuclear Fuel program may be sent to:

Mr. Charles Head, Program Manager
Office of Spent Nuclear Fuel Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585

S.5.7 Record of Decision

The Record of Decision, to be issued no less than 30 days after the Environmental Protection Agency publishes a *Federal Register* Notice of Availability for the Final EIS, will document the decisions made by DOE and the Department of State after the evaluation of the potential environmental impacts of the range of alternatives and appropriate non-environmental factors.

S.5.8 DOE Reading Rooms

A complete copy of the Final EIS and a list of reference documents may be reviewed at any of the public Reading Rooms and information locations listed below.

- Department of Energy Reading Rooms -

Public Reading Room for U.S. Department of Energy Headquarters

Room 1E-190, Forrestal Building
Freedom of Information Reading Room
1000 Independence Avenue, SW
Washington, DC 20585

(202) 586-6020

Public Reading Room for U.S. Department of Energy Oakland Operations Office

Environmental Information Center
1301 Clay Street, Room 700 N
Oakland, CA 94612

(510) 637-1762

Public Reading Room for U.S. Department of Energy Rocky Flats Operations Office

Front Range Community College Library
3645 W. 112th Avenue, Level B
Westminister, CO 80030

(303) 469-4435

Public Reading Room for U.S. Department of Energy Idaho Operations Office

Public Reading Room
1776 Science Center Drive
Idaho Falls, ID 83402

(208) 526-9162

Public Reading Room for U.S. Department of Energy University of Illinois at Chicago Library

Government Documents Section
801 South Morgan Street
Chicago, IL 60607

(312) 996-2738

Public Reading Room for U.S. Department of Energy National Atomic Museum

87117 Wyoming Boulevard, SE (Kirtland AFB)
Albuquerque, NM 87185

(505) 845-4378

Public Reading Room for U.S. Department of Energy Nevada Operations Office

Coordination and Information Center
3084 South Highland Drive
P.O. Box 98521
Las Vegas, NV 89106

(702) 295-0731

Public Reading Room for U.S. Department of Energy Fernald Operations Office

Public Environmental Center
JANTER Building 10845
Hamilton-Cleves Highway
Harrison, OH 44503

(513) 738-0164

Public Reading Room for U.S. Department of Energy Savannah River Operations Office

DOE Public Reading Room
University of South Carolina - Aiken Campus
Grigg-Graniteville Library
2nd Floor
171 University Parkway
Aiken, SC 29801

(803) 641-3320

Public Reading Room for U.S. Department of Energy Oak Ridge Operations Office

Public Reading Room
55 Jefferson Avenue
Oak Ridge, TN 37831

(615) 576-1216

Public Reading Room for U.S. Department of Energy Richland Operations Office

Washington State University Tri-Cities
100 Sprout Road, Room 130 West
Richland, WA 99352

(509) 376-8583

- Other Locations -

Concord Branch Library
2900 Salvio Street
Concord, CA 94519
(510) 646-5455

George A. Smathers Libraries, Library West
University of Florida Library, Room 241
P.O. Box 11701
Gainesville, FL 32611-7001
(904) 392-0367

Jacksonville Public Library
Documents Department
122 North Ocean Street
Jacksonville, FL 32202
(904) 630-2665

Atlanta Public Library
Government Documents Section
1 Margaret Mitchell Square
Atlanta, GA 30303
(404) 730-1700

Reese Library
Augusta College
2500 Walton Way
Augusta, GA 30904-2200
(706) 737-1744

Chatham-Effingham-Liberty Regional Library
2002 Bull Street
Savannah, GA 31401
(912) 234-5127

Boise Public Library
Government Documents Section
715 South Capitol Boulevard
Boise, ID 83702
(208) 384-4023

INEL Oversight Program Library
Idaho Department of Health & Welfare
1410 North Hilton, Third Floor
Boise, ID 83706
(208) 334-0498

Idaho Falls Public Library
457 Broadway
Idaho Falls, ID 83402
(208) 529-1462

Pocatello Public Library
812 East Clark Street
Pocatello, ID 83201
(208) 232-1263

Twin Falls Public Library
Reference Desk
434 Second Street East
Twin Falls, ID 83301
(208) 733-2964

Amargosa Valley Community Library
HCRoute 69, Box 401-T
829 Farm Road
Amargosa Valley, NV 89020
(702) 372-5340

Carson City Public Library
900 North Roop Street
Carson City, NV 89701
(702) 887-2244 or (702) 887-2245

Nye County Nuclear Waste Repository Project Office
P.O. Box 1767
475 St. Patrick Street
Tonopah, NV 89049
(702) 482-8183

Brunswick County Government Center
Mr. Wyman Yelton, City Manager
P.O. Box 249
45 Court House Drive, NE
Bolivia, NC 28422
(910) 253-4331

Pembroke State University Library
1 University Drive
Pembroke, NC 28372
(910) 521-6265

- Other Locations (Continued) -

D. H. Hill Library
North Carolina State University
P.O. Box 7111
Raleigh, NC 27695-7111
(919) 515-3364

New Hanover County Public Library
Attn: Daniel Horn
201 Chestnut Street
Wilmington, NC 28401
(910) 341-4390

Brantford Price Millar Library
Portland State University
934 S.W. Harrison
Portland, OR 97201
(503) 725-4617

Charleston County Main Library
404 King Street
Charleston, SC 29403
(803) 723-1645

South Carolina State Library
1500 Senate Street
Columbia, SC 29201
(803) 734-8666

Berkeley County Library
100 Library Street
Monks Corner, SC 29461
(803) 722-3550

Otranto Regional Library
2261 Otranto Road
North Charleston, SC 29418
(803) 572-4094

Clinton Public Library
118 South Hicks Street
Clinton, TN 37716
(615) 457-0519

Lawson McGhee Public Library
500 West Church Avenue
Knoxville, TN 37902
(615) 544-5750

Memphis/Shelby County Public Library and Information Center
1850 Peabody Avenue
Memphis, TN 38104
(901) 725-8800

Oak Ridge Public Library
Civic Center
Oak Ridge, TN 37830
(615) 482-8455

Rosenberg Library
Attn: Judy Young
2310 Sealy Avenue
Galveston, TX 77550-2296
(409) 763-2526

Houston Public Library
Attn: Social Sciences
500 McKinney
Houston, TX 77002
(713) 247-2222

Hampton Public Library
4207 Victoria Boulevard
Hampton, VA 23669
(804) 727-1154

Newport News Public Library
Grissom Branch
366 Deshazor Drive
Newport News, VA 23602
(804) 886-7896

Kirn Library
301 East City Hall Avenue
Norfolk, VA 23510
(804) 441-2429

- Other Locations (Continued) -

Portsmouth Public Library

Main Branch
601 Court Street
Portsmouth, VA 23704

(804) 393-8501

Owen Science & Engineering Library

Washington State University
Pullman, WA 99164-3200

(509) 335-4181

Seattle Public Library

1000 Fourth Avenue
Seattle, WA 96104

(206) 386-4636

Suzallo Library, SM25

University of Washington Libraries
University of Washington
Seattle, WA 98185

(206) 543-9158

Foley Center

Gonzaga University
East 502 Boone Avenue
Spokane, WA 99258

(509) 328-4220, Extension 3125

Pierce County Library

300 512th Street, East
Tacoma, WA 98446

(206) 536-6500

Tacoma Public Library

1102 Tacoma Avenue South
Tacoma, WA 98402

(206) 591-5666