DOE/EIS-0015
VOLUME 1 OF 5

FINAL ENVIRONMENTAL IMPACT STATEMENT U. S. SPENT FUEL POLICY

Executive Summary

VOLUME 1

MAY 1980

U.S. Department of Energy

Assistant Secretary for Nuclear Energy

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A. Spent Fuel Storage Policy

1. Description of Policy

In October 1977, the Department of Energy (DOE) announced a Spent Fuel Storage Policy for nuclear power reactors. The announcement of this policy is reproduced as Appendix A of this volume. Under this policy, as approved by the President, U.S. utilities would be given the opportunity to deliver spent nuclear power reactor fuel to the U.S. Government in exchange for payment of a fee. The U.S. Government would also be prepared to accept a limited amount of spent fuel from foreign sources when such action would contribute to meeting U.S. nonproliferation goals. Under the new policy, spent fuel transferred to the U.S. Government would be delivered — at user expense — to a U.S. Government-approved site.

2. Spent Nuclear Fuel Act of 1979

A bill was submitted to Congress in March 1979 to authorize actions required to implement the Spent Fuel Storage Policy. This bill, known as the "Spent Nuclear Fuel Act of 1979" (see Appendix B of this volume) would authorize the Secretary of Energy to acquire or construct one or more away-from-reactor storage facilities. These storage facilities would be licensed by the Nuclear Regulatory Commission. The Secretary would be authorized to take title to and provide interim storage and ultimate disposal for domestic spent fuel and limited amounts of foreign spent fuel. Nondiscriminatory charges for storage, subject to prepayment, would cover all government costs of storage and ultimate disposal. Provisions may be made to refund a portion of the charges in the eventuality that spent fuel were to be reprocessed. A revolving fund would be established to finance activities and functions associated with away-from-reactor interim storage and ultimate disposal facilities. The Secretary of Energy would have the authority to sell up to $300,000,000 worth of bonds to the Treasury to assist in financing these activities.

3. Scope of Environmental Impact Analyses

Three draft environmental impact statements (EISs) analyzed the impacts of implementing or not implementing the policy for interim storage of spent power reactor fuel (one each for domestic fuel, foreign fuel, and for the charge for storage and disposal of spent fuel). The draft EIS on storage of domestic fuel was an evaluation of the potential environmental impacts associated with various options for governmental involvement in interim storage of domestic spent fuel, including the alternative of no Federal involvement outside the regulatory sphere. Ultimate disposition of spent fuel was not considered in that draft EIS.

The draft EIS on storage of foreign spent power reactor fuel was an analysis of the environmental impact of receipt of foreign spent fuel for interim storage and possible ultimate disposal by the U.S. Government. In the draft Foreign EIS, disposition alternatives were either fuel reprocessing (with disposal of reprocessing waste in geologic respositories) or disposition of spent fuel in geologic repositories. The environmental effects resulting from the disposition alternatives were presented to provide decisionmakers with an understanding of the possible long-term implications of the policy of accepting foreign spent fuel in the United States. The disposition alternatives were not part of the policy.

The draft EIS on spent fuel storage charge methodology was an analysis of the environmental impact of alternative approaches for the establishment of a charge for storage and disposal of spent fuel. The draft Charge EIS included a large number of options; it was not intended to establish the actual fee. Therefore, examples of the possible material and cash flows were analyzed only for illustrative purposes.

For domestic fuel, it was assumed that up to 72,200 MTU of spent fuel would be available from U.S. power reactors for acceptance under this policy through the year 2000. For foreign fuel, impacts were analyzed for a range of quantities of foreign fuel up to 19% of the amount of domestic fuel. The impact statement on the charge for spent fuel storage addressed itself to whether the fee charged, by its level or structure, would have had any effect on the environmental impacts of implementing the spent fuel policy.

4. Summary of Environmental Impact

The analysis of the environmental impacts for storage of domestic fuel shows that the impacts for the full range of alternatives considered are relatively small compared with available resources or background exposure of the population from natural radiation sources. The differences in impacts of storage of domestic fuel are attributed to the amount of fuel stored in

Independent Spent Fuel Storage (ISFS) facilities, the storage time, and, to a lesser degree, the differences in spent fuel transportation. The differences between comparable alternatives of implementing the policy or not implementing the policy are small.

The difference in impacts of storage of foreign fuel are attributed to the amount of fuel received under the policy and to the disposition mode analyzed. The impact of storage of foreign fuel (a small fraction of the amount of domestic fuel considered) is also small. As a result of the small differences in environmental impacts of all cases considered for foreign fuel, environmental impacts probably will not strongly influence the selection of the case that best meets U.S. nonproliferation goals. Proliferation benefits of the various cases analyzed vary significantly.

The structure and level of fee charged for storage of spent fuel will affect the degree of participation in the spent fuel storage program by utilities. However, the range of participation is within the range of alternatives analyzed in the draft EISs on storage of U.S. and foreign fuels, for which the environmental effects were found to be relatively small. The fee computed on the basis of full recovery of government costs should not significantly affect the cost of generating nuclear power.

B. Draft Environmental Impact Statements

1. Issuance

The three draft environmental impact statements and the supporting document on analytical methodology were published as follows:

- Storage of U.S. Spent Power Reactor Fuel, DOE/EIS-0015-D, August 1978 (called "Domestic EIS").
- Storage of U.S. Spent Power Reactor Fuel - Supplement DOE/EIS-0015-DS, December 1978 (called "Domestic Supplement").
- Storage of Foreign Spent Power Reactor Fuel, DOE/EIS-0040-D, December 1978 (called "Foreign EIS").
- Charge for Spent Fuel Storage, DOE/EIS-0041-D, December 1978 (called "Charge EIS").
- Analytical Methodology and Facility Description - Spent Fuel Policy, DOE-ET-0054, August 1978.

2. Request for Comments

Notice of availability of the draft environmental impact statement for storage of U.S. spent power reactor fuel was published by DOE in the Federal Register on September 6, 1978. A subsequent notice was published in the Federal Register on December 14, 1978 on the availability of the draft EISs on storage of foreign fuel, on charge for spent fuel storage, and a supplement to the draft EIS on storage of U.S. fuel. Copies of the draft EISs were distributed for review and comment by appropriate federal agencies, the 50 state governments, and other organizations and individuals who were known to have an interest in spent fuel storage activities and those who requested them. Comments and views concerning the draft EISs were requested from other interested agencies, organizations and individuals by means of the Federal Register notices. Approximately 1600 copies each of the draft Domestic, Foreign, and Charge EISs were distributed for comment. The closing date for comments to be received on the draft EISs was February 15, 1979. Copies of the EISs (upon publication) and comment letters received were placed for public inspection in DOE public document rooms at 10 locations throughout the country. To the extent practicable, comments received after the closing date were also considered in the preparation of the final EIS.

3. Comments Received

A total of 78 comment letters (some with supplements) were received. Approximately 46% of the comment letters were received from local, state, and Federal government agencies, 30% from industry (primarily utilities), 14% from individuals, and 10% from nonindustrial organizations. Twenty-one state governments submitted 32 comment letters. These states are shown as lined areas in Figure 1. Some of the comment letters did not express any opinion of the Spent Fuel Storage Policy or the conclusions expressed by DOE in the draft EISs. A review of the letters that did express an opinion revealed the following statistics:

	Number of Opinions
Support Spent Fuel Storage Policy	21
Oppose Policy or Suggest Moratorium on Nuclear Power	12
No Substantial Comment	16
Concur with "No Significant Environmental Effect" Finding	17

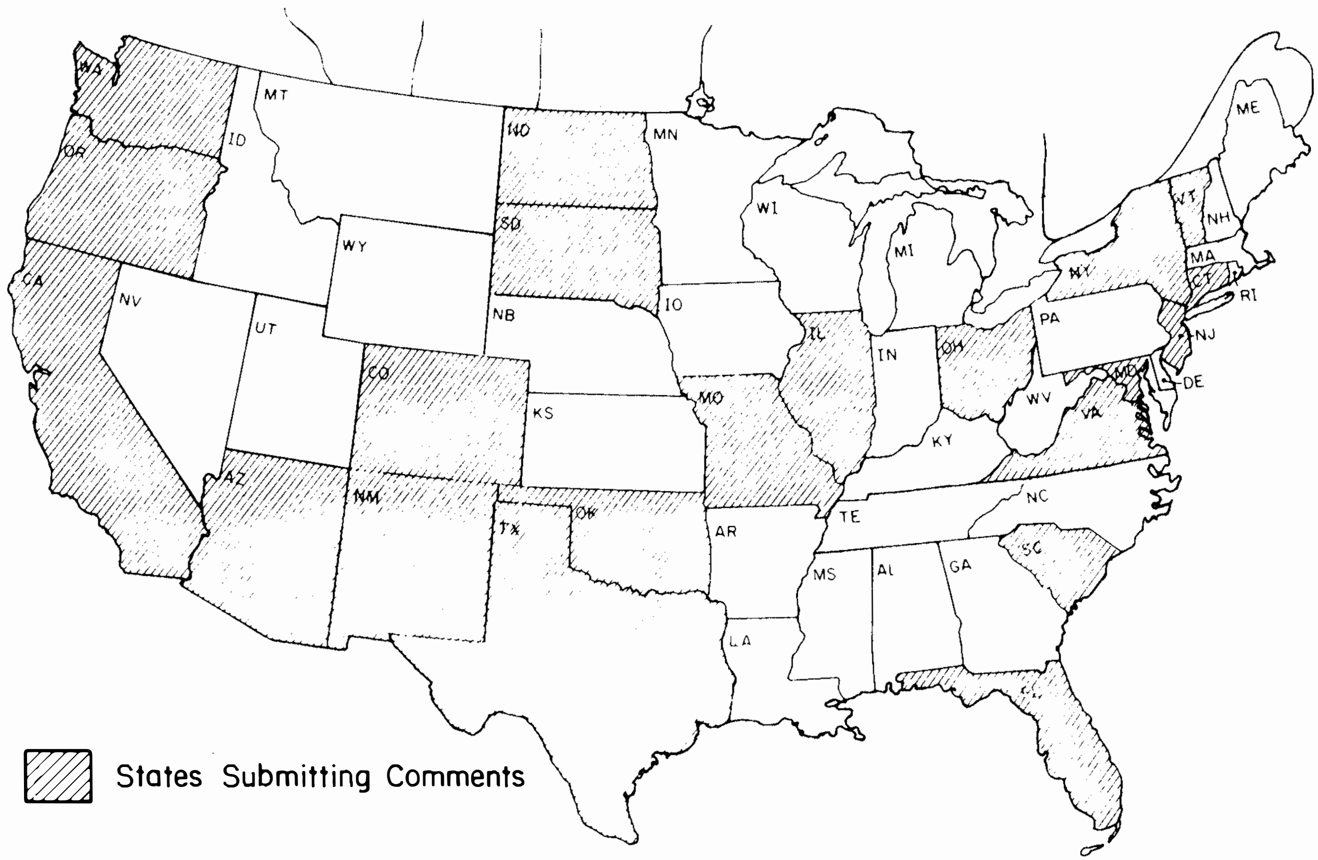

FIGURE 1. States Commenting on Draft EISs

A listing of commentors appears in Appendix C of this volume and the comment letters are reproduced in Volume 5 of this EIS. Approximately 600 specific comments were identified in these letters. About half of these were identified as substantive, and required a Department of Energy response in the final EIS. Many of these substantive comments were of a similar nature. Rather than respond to each comment individually, comments of a similar nature were grouped into 102 major categories and a response was provided for each category. These comments and the DOE responses are published in Volume 5 of this EIS. The "DOE Response" section of Volume 5 identifies the location in the EISs where changes were made as a result of a comment (volume number and page number are identified).

4. Response to Comments

The three draft EISs (storage of domestic fuel, storage of foreign fuel, and charge for spent fuel storage) were issued as three separate documents (including a supplement). In preparing the Final Environmental Impact Statement, U.S. Spent Fuel Policy, these were combined into a single document (DOE/EIS-0015) consisting of five volumes. The contents of these volumes are

Volume 1	Executive Summary
Volume 2	Storage of U.S. Spent Power Reactor Fuel
Volume 3	Storage of Foreign Spent Power Reactor Fuel
Volume 4	Charge for Spent Fuel Storage
Volume 5	Comment Letters on Draft Statements and Major Comments with DOE Responses

In the final EIS (Volumes 2, 3, and 4), changes from the draft EISs are indicated by a vertical line in the left margin of the pages. Where the change is the result of a comment, the change is identified with a line covering the changed material and a number and a letter corresponding to its designation in Volume 5. If the change is the result of an error in the Draft EISs, it is identified with the letter "E." If the change is made to clarify or expand on the draft statement, it is identified with the letter
C "C." As an example, if this sentence were added to one of the EISs to clarify a section, it would be identified with a vertical line and the letter "C" as shown to the left.

5. Preparation of the EISs

The draft EISs and the final EIS were prepared under the guidance of the Department of Energy by the Savannah River Laboratory (operated by E. I. du Pont de Nemours and Company for the Department of Energy) and the S. M. Stoller Corporation with direct input, review, and approval by the Department of Energy. Other DOE contractors provided technical review of specific sections of the drafts and final EIS.

The Council on Environmental Quality regulations for implementing the procedural provisions of the National Environmental Policy Act (40 CFR 1500) requires that environmental impact statements list the names, together with qualifications (expertise, experience, professional disciplines), of the persons who were primarily responsible for preparing the environmental statement or significant background papers, including basic components of the statement. Although these regulations do not apply to this EIS, such a list has been provided as Appendix D of this volume.

C. Facilities and Environment

1. Generic Treatment of Facilities and Environment

In order to assess the environmental impact of facilities and operations that have not been specifically identified, the environmental impact statements were prepared on a generic basis. Generic facilities, incorporating state-of-the-art technology, are described in Volumes 2 and 3 of this final EIS and in the analytical methodology and facility description document (DOE-ET-0054). These also include a description of the generic environment (including such pertinent information as meteorology, hydrology, demography, ecology, etc.), generic transportation equipment and methods, and analytical methods used to assess the impact of the proposed Spent Fuel Storage Policy.

If a decision is made to implement the Spent Fuel Storage Policy, an away-from-reactor spent fuel storage facility EIS (AFR EIS) will be prepared to provide environmental input into the selection of facilities to meet the demand for spent fuel storage. The demand for spent fuel storage will be developed by using the latest available data as supplied by utilities concerning their plans for expansion, compaction, transshipment, and the expected quantities of spent fuel discharges.

2. Independent Spent Fuel Storage (ISFS) Facilities and Stand-Alone At-Reactor Basin (ARB) Facilities

The generic ISFS or ARB facilities in this generic EIS are assumed to consist of a set of modular water-filled basins. These facilities are considered to be stand-alone facilities, that is, they are designed to be complete facilities that do not depend on other existing nuclear facilities for service, etc. The maximum capacity of a single interim storage facility is assumed to be 18,000 metric tons of uranium (MTU) of spent fuel with minimum size of 500 MTU. The storage basins at these facilities are stainless-steel-lined concrete structures.

The facility is designed to receive, handle, decontaminate, and reship spent fuel casks; to remove irradiated fuel from casks; to place the fuel in the basins; and to cool and control the quality of the water. The facility is also designed for removal of spent fuel from the storage basins, loading the spent fuel into shipping casks, decontaminating loaded casks, and shipping spent fuel. Modular construction allows facility expansion with a minimum of additional support facilities and services. All the storage basins will be designed to protect the fuel cladding against mechanical, chemical, or thermal damage. The fuel cladding is the primary barrier for confining fuel core material. The storage facility will also provide safe, subcritical arrangement of fuel and adequate shielding under normal operating conditions or during extreme natural phenomena such as tornadoes and earthquakes.

3. Transportation of Spent Fuel

Transportation of spent fuel and waste involves use of massive, heavily shielded shipping casks transported by ship, rail, and truck. It is assumed that manufacturers will provide casks as needed for transportation of domestic and foreign fuel. It is assumed that foreign nations will provide their own casks designed to meet U.S. shipping regulations. About ten times more fuel can be shipped in a rail cask than in a truck cask. However, truck shipments normally require less turnaround time than rail shipments.

4. Geologic Repository

The ultimate disposal of spent fuel is beyond the scope of this EIS. However, to enable estimates of the impacts of receipt of foreign fuel, the generic impacts of disposing of any spent fuel or reprocessing waste are analysed. For purposes of analysis, the generic geologic repository is assumed to be constructed in a salt formation. The selection of a salt formation as a reference for this analysis is not intended to indicate a preference for salt as a host material for geologic repositories. The type of repository is not expected to affect significantly the environmental effects considered.

5. Fuel Reprocessing and Fabrication

If a U.S. decision is made in the future to proceed with fuel reprocessing, the generic fuel reprocessing plant (FRP) in the U.S. is assumed to be collocated with a mixed-oxide (MOX) fuel fabrication plant sized to handle the output from the FRP.

For purposes of assessing the environmental impact of storage of foreign spent fuel (Volume 3), fuel reprocessing plants coming online in the late 1900's are assumed to include equipment currently under development. This equipment will reduce and control releases of tritium, krypton-85, carbon-14, radioiodine, and particulates. All U.S. and certain foreign FRP-MOX plants are also assumed to meet current and future requirements for proliferation resistance and safeguards, and the environmental effects will not be increased over previously analyzed FRP-MOX plants.

6. Facility Decommissioning

In all cases considered in this final EIS, facilities are assumed to be decommissioned after completion of the operating phase. The reference decommissioning mode is decontamination and dismantlement of the surface facilities, combined with some restriction of future subsurface activities at the geologic repository.

D. Storage of U.S. Spent Fuel (Detailed in Volume 2)

1. Scope

The environmental impact statement on storage of U.S. spent fuel (Volume 2) is an analysis of the impacts of implementing or not implementing the policy for storage of U.S. spent fuel. Two basic alternatives are considered: 1) Implement the Spent Fuel Storage Policy, in which the U.S. Government accepts title to the spent fuel. This alternative also assumes either centralized storage in large Government-owned ISFS facilities or decentralized storage in small privately or Government-owned ISFS facilities.

2) The other alternative is the Spent Fuel Policy is not implemented, and private industry provides decentralized storage capacity by compaction (store more fuel in existing reactor discharge basins), transshipment of limited amounts of fuel between basins, construction of new ISFS facilities, and/or construction of standalone at-reactor storage facilities.

2. Parameters Considered

Within the two basic alternatives analyzed 1) Policy Implemented and 2) Policy Not Implemented, the effect of varying certain key parameters was considered. These parameters are briefly described in this section.

- Reactor Discharge Basin Reserve Capacity. Most discharge basins at nuclear power plants are designed to accommodate the equivalent of one and one third reactor loadings of spent fuel. This capacity was originally intended to provide storage space for one annual discharge (1/3 of the fuel elements in a reactor), plus capacity to store a full-core discharge from the reactor. This full-core reserve is desirable in the event the entire core has to be discharged for inspection, maintenance, etc. Full-core-reserve storage capacity is not a safety requirement; therefore the Nuclear Regulatory Commission does not include this as a part of the licensing requirement. Full-core reserve is desirable to reduce the risk of a larger economic penalty that would occur if a lengthy reactor shutdown was necessitated because a full-core discharge becomes necessary. It also provides increased flexibility during operation of a power reactor. At a minimum, reactors have to maintain reserve storage capacity for one annual discharge of fuel (about 1/3 of a reactor core). Reactor storage capacity ranging from full-core reserve to discharge capability is analyzed.

- Basin Compaction. Some utilities have increased or plan to increase spent fuel storage capacity in the reactor discharge basins. This increased capacity may be achieved by more efficient use of basin space. The methods that might be used include 1) reducing the space between stored assemblies with neutron absorbers in the storage array, 2) using stacked storage for deep reactor discharge basins (i.e., double tiering the storage racks), and 3) disassembling the fuel bundle and placing individual fuel elements in a more compact arrangement (i.e., pin storage). These methods of increasing spent fuel storage capacity are considered.

- Transshipment. Power reactors can extend reserve storage capacity at a given reactor by transshipment of spent fuel from reactors needing the capacity to reactors with excess storage capacity within the same utility system. The EIS considers both no transshipments and limited transshipments.

- Centralized and Decentralized Storage in ISFS Facilities. Centralized storage is the concept of use of a single or a few large U.S. Government-owned ISFS facilities serving the nuclear power industry. These facilities would be located to serve power reactors from the entire nation. Decentralized storage consists of use of more privately or government-owned ISFS facilities regionally located. These facilities are usually smaller than those considered in the centralized storage concept. The storage capacity of these two types of facilities were assumed to be 6000 and 18,000 MTU for decentralized and centralized storage options, respectively. These capacities were established in the EIS for illustrative purposes.

- ISFS and ARB Facilities. An ISFS facility is assumed to be either a centralized or decentralized storage basin facility to serve reactors either nearby or from a large region in the U.S. These facilities are independent because they are not located at or associated with a specific power reactor. Stand-alone ARB facilities are also storage basin facilities that are similar to ISFS facilities except that they will probably be smaller and located at existing power reactor sites and will serve only the reactors where they are located. Both types of storage facilities are considered.

- Interim Storage Capacity Requirements. The timing of the disposition action for spent fuel is important in determining the amount of interim storage that must be provided. Figure 2 shows the influence of disposition facility startup on needed interim storage capacity. Forecasts are based on 1) maintaining only discharge capability in reactor basins, 2) maintaining full-core reserve, and 3) transferring of all fuel to the U.S. Government when it has cooled 5 years. A recent DOE sensitivity analysis* indicates that the interim storage requirements shown on Figure 2 are higher than the probable storage requirements for domestic fuel. The probable storage requirement shown as the "Base Planning Case" on Figure 2 results from the recent DOE sensitivity analysis. The required ISFS capacity was developed to show the effects of maintaining full-core reserve and discharge capability in reactor discharge basins for various disposition facility startup dates. Environmental effects were determined for disposition facility startup in the years 1985 and 1995 based upon full core reserve and discharge capability requirements shown on Figure 2. The environmental effects of the "Base Planning Case" were not determined for

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* Spent Fuel Storage Requirements - The Need for Away-From-Reactor Storage - An Update of DOE/ET-0075. USDOE Report DOE/NE-0002, U.S. Department of Energy, Washington DC January 1980).

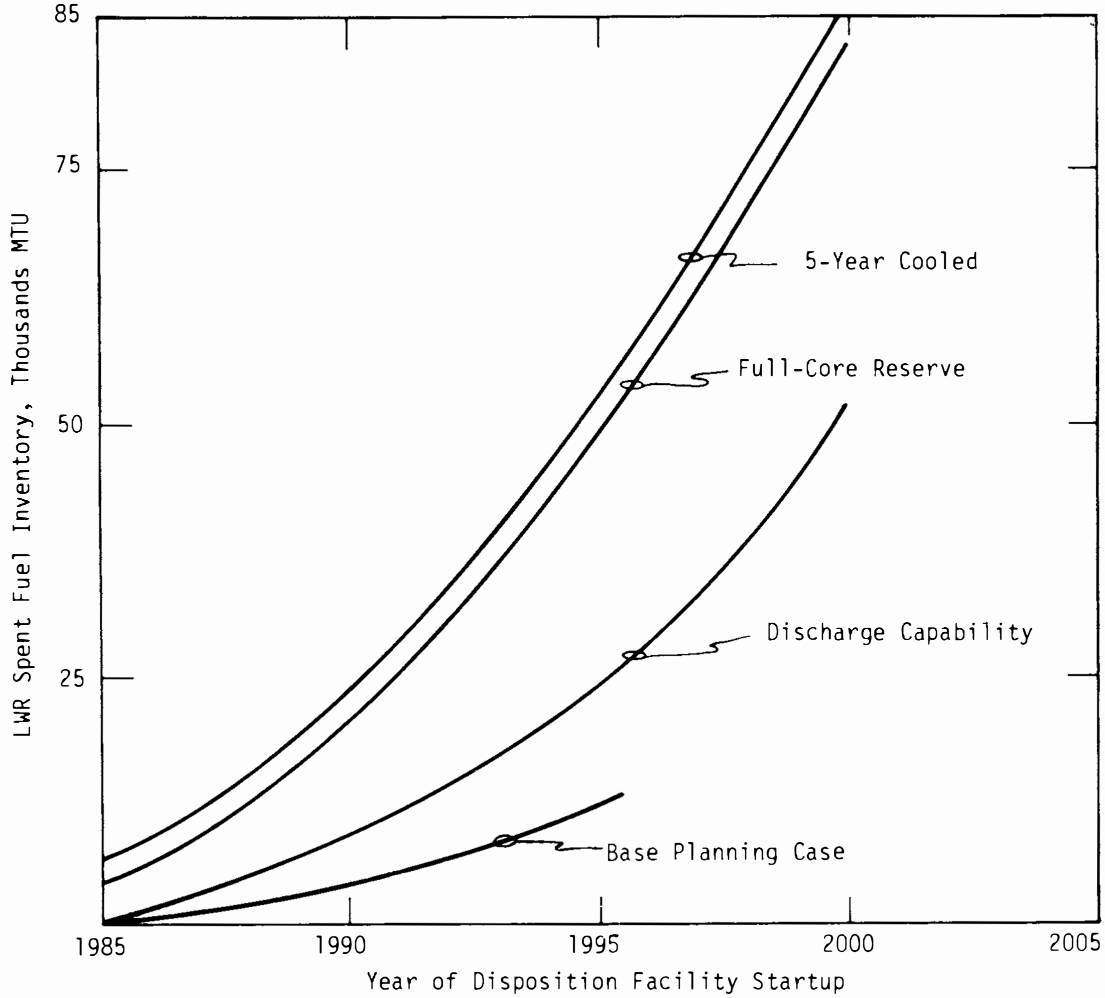

FIGURE 2. Interim Storage Capacity Dependence on Disposal Facility Startup

these cases because the effects would be less than those that had previously been identified. An analysis of the effects of delayed startup of the disposition facility until 2010 was added to Volume 2 of the EIS (Appendix E) while it was being prepared in final form. This section was added because the current DOE estimate on the initial geologic repository startup (1997-2006) could be later than the latest year analyzed in the draft EIS. It was decided that this new analysis should also incorporate DOE's current judgements on probable storage requirements. As such, this analysis used the "Base Planning Case" shown on Figure 2 and startup of the initial disposition facility in the year 2010.

3. Alternatives

When the draft version of the Domestic EIS was prepared in the latter part of the year 1977 and early 1978, the national objective was to open the first geologic repository in the year 1985. Environmental effects of interim storage of spent reactor fuels were determined for the disposition facility operation beginning in the year 1985 or 1995, and ISFS facility effects were determined through the year 2000 to ensure that the range of actions was covered by the EIS. The alternatives analyzed were Alternative 1 — Policy Implemented and Alternative 2 — Policy Not Implemented. Between the time the draft document was published and this final EIS was complete, DOE recognized that the first repository might not be in operation until the years from 1997 to 2006. To demonstrate the effects of a delayed repository opening beyond the year 1995, an appendix was prepared for Volume 2 (Appendix E) to show the environmental effects with the first repository startup in the year 2010.

The analyses used to show the environmental effect comparison of disposition facility startup in the year 2010 were selected to parallel Alternatives 1 and 2 in the draft Domestic EIS. Although not true decision alternatives, these analyses have been labeled Alternative 3 — Policy Implemented and Alternative 4 — Policy Not Implemented. These alternative numbers were selected to differentiate between the alternatives which consider earlier startup dates for the disposition facility (Alternatives 1 and 2). Alternatives 3 and 4 (disposition facility startup in the year 2010) use an updated forecast of fuel flow and interim storage requirements than Alternatives 1 and 2, so Alternatives 1 and 2 cannot be directly compared to Alternatives 3 and 4. The comparison of environments effects to be used in the decision to implement or not to implement the policy should be based on comparison of alternatives for the same disposition facility startup date.

Two basic alternatives are considered in this statement. In the first alternative (Alternative 1 for 1985 or 1995 disposition facility startup, and Alternative 3 for a year 2010 startup), the Spent Fuel Storage Policy, in which the U.S. Government accepts title to the spent fuel, is assumed to be implemented. In the second alternative (Alternative 2 for 1985 or 1995 disposition facility startup, and Alternative 4 for a year 2010 startup), the Spent Fuel Storage Policy is assumed not be be implemented.

Two options associated with Alternatives 1 and 3 were examined. In Option A (called Alternative 1A or Alternative 3A), centralized storage was assumed. Large ISFS facilities owned or operated by the U.S. Government would be used in Option A. In Option B (called Alternative 1B or Alternative 3B), decentralized storage was assumed. Small privately or government-owned ISFS facilities would be used. In all alternatives, it is assumed that utilities utilize compaction and in Alternative 1 transshipments are used to limit the amount of fuel transferred to the U.S. Government for interim storage in ISFS facilities. Alternative 3 assumes no transshipment. In DOE current planning, transshipment is thought to serve as a backup to meet short term emergency needs and should not be a planning base for all reactors. These options span the possible range of fuel management under the new policy.

In Option B (decentralized storage), two suboptions were examined. These were:

- Alternative 1B-1 and Alternative 3B. As soon as ISFS facilities could be provided, inventories at individual reactor discharge basins would be reduced sufficiently to permit full-core reserve in each reactor basin.

- Alternative 1B-2. Less ISFS capacity would be provided in this alternative. It assumes the reserve capacities at individual reactor discharge basins would be limited to one annual reactor discharge (about 1/3 of a full core). When the disposition facility becomes available at full operating capacity, reactor basins will be able to regain full-core reserve.

In Alternative 2 and Alternative 4, the "Policy-Not-Implemented" case, the U.S. Government does not accept spent fuel for interim storage. Two options were also analyzed in this basic alternative. In both of these options, private industry is assumed to use compaction to limit the number of privately owned interim storage facilities that will be required. Under Option A, two variations were considered (Alternative 2A and Alternative 4A). It is assumed that in Alternative 2A the amount of spent fuel accumulated in reactor basins is limited to maintain capacity for one annual reactor discharge until full-scale operation of a dispostion facility becomes available at a capacity sufficient to allow full-core reserve to be regained. This alternative also assumes some transshipment of spent fuel to minimize the amount of new ISFS capacity needed. In Alternative 4A, it was assumed that full-core reserve in all reactor discharge basins was regained as soon as ISFS basins could be provided. This alternative also assumes that no transshipment is used. This alternative is based on the assumed fuel flows used by DOE in their current planning which assumes that transshipment serves as a backup to meet short-term emergency needs and should not be a planning basis for all reactors. In the second option (Option B - called Alternative 2B and Alternative 4B), small, stand-alone ARB facilities are constructed by industry at existing reactor sites for interim storage of spent fuel from on-site ractors. It is further assumed in Alternative 2B and Alternative 4B that after ARB facilities are completed, no further transshipment is used and full-core reserve is regained in reactor discharge basins.

DOE's preferred alternative is to implement the Spent Fuel Policy and take title to U.S. spent fuel offered to the U.S. Government. In general, utilities can and should provide their own spent fuel storage capability but in some isolated cases this may not be practicable due to technical or regulatory reasons. Furthermore, it is desirable for U.S. utilities to maintain reserve capacity for storing the full reactor core, if its discharge becomes necessary. DOE recognizes, however, that if the policy is not implemented, some isolated reactor shutdowns could occur. These shutdowns represent only a small increment of the total generated power capacity and could result in the purchase of more costly power. Because of the short advanced notice for these reactor shutdowns, the construction of new power generating facilities is not possible to replace the lost electric generating capability and the lost power must be made up using existing power generation facilities. The generic impacts of reactor shutdowns are discussed in Volume 2, Section III. DOE has no preferences at this time between storing spent fuel accepted under the preferred alternative in large centralized (Alternative 1A or Alternative 3A) or smaller decentralized (Alternative 1B-1 or Alternative 3B) ISFS facilities.

The parameters used in the analysis of alternatives and options considered in Volume 2 of this final EIS are summarized in Table 1.

4. Environmental Effects of Alternatives

For each alternative considered in this EIS, some resources will be consumed; and small amounts of radioactivity will be released to the environment. The work force will be exposed to limited amounts of radiation and will experience occupational accidents at rates comparable to those in similar industries. The adverse environmental effects of the alternatives will be limited by engineered systems, administrative controls, and monitoring programs. The environmental effects believed to be of greatest significance are given in Table 2 for Alternatives 1 and 2 and in Table 3 for Alternatives 3 and 4. Uses of other natural resources, releases of thermal and nonradioactive effluents, and secondary effects on biota are judged to have very minor impact and are not included in Table 2. Table 3 also does not include the above listed items nor the energy resources that are shown in Table 2. Scenarios in which the disposition facility is assumed to be delayed would require increased energy and materials because of increased construction and the length of operation of ISFS or ARB facilities.

The population doses from environmental release of nuclides from facility operation and transportation are determined for local [within 80 km (50 mi) of the facility], U.S., and the world populations. The doses determined for the world population are shown in Tables 2 and 3. Effects of long-lived nuclides in the 100-year period following the end of the study are included to provide an assessment of effects of persistent nuclides. The doses range from about 1000 man-rem to the world population for Alternative 1A, with disposition beginning in the year 1985, to 85,000 man-rem if fuel disposition is delayed until the year 2010 and ARB facilities are used. About half of these doses are received by the population within 80 km (50 mi) of facilities. To place a perspective on these doses, they are a very small fraction of the exposure from natural radiation sources in the same period [about 200,000,000,000 man-rem to the world population and 30,000,000 man-rem to the 80 km (50 mi) radius population for the time periods assumed in preparation of Table 2, and 400,000,000,000 man rem to the world population and 40,000,000 man-rem to the 80 km (50 mi) radius population for the time periods assumed in preparation of Table 3].

For the alternatives which consider 1985 and 1995 disposition facility startup (Alternatives 1 and 2), total health effects (malignancies and genetic effects) in the world population and work force calculated from the radiation exposures range from 2 to 32 as shown in Table 2. Worldwide natural radiation dose

TABLE 1

Summary of Parameters Involved in Alternatives/Options Analyzed

Alternative/Option	1A	1B-1	1B-2	2A	2B	3A	3B	4A	4B
U. S. Spent Fuel Policy is Implemented and U. S. Government Takes Title to Spent Fuel	●	●	●[a]			●	●		
U. S. Spent Fuel Policy is Not Implemented				●	●			●	●
Year of Disposition Facility Startup	1985 1995	1985 1995	1985 1995	1985 1995	1985 1995	2010	2010	2010	2010
Full-Core Reserve Status									
• FCR Regained, year (1985 Disposition Facility Startup)	1986	1986	1991	1991	1986				
• FCR Regained, year (1995 Disposition Facility Startup)	1986	1986	After 2000	After 2000	1986				
• FCR Regained, year (2010 Disposition Facility Startup)						1983	1983	1983	1983
Basin Compaction Utilized	●	●	●	●	●	●	●	●	●
Transshipments Between Reactors, MTU									
• 1985 Disposition Facility Startup	7100	7100	7100	7100	650				
• 1995 Disposition Facility Startup[b]	7100	7100	7200	7200	650				
• 2010 Disposition Facility Startup						none	none	none	none
Centralized Storage Utilized	●					●			
Decentralized Storage Utilized		●	●	●	●		●	●	●
ISFS Facilities Utilized	●	●	●	●		●	●	●	
ARB Facilities Utilized					●				●
U. S. Government Builds ISFS Facilities	●	●	●			●	●		
Private Industry Builds ISFS Facilities		●	●	●				●	
Private Industry Builds Stand-Alone ARBs					●				●
Interim Storage Capacity Required in ISFSs and ARBs, MTU									
• 1985 Disposition Facility Startup	5400	5400	500	500	5400				
• 1995 Disposition Facility Startup[b]	51500	51500	24000	24000	52500				
• 2010 Disposition Facility Startup						91200	91200	91200	91200
Number of Interim Storage Facilities Needed									
• 1985 Disposition Facility Startup	1	1	1	1	45				
• 1995 Disposition Facility Startup[b]	1	9	4	4	93				
• 2010 Disposition Facility Startup						6	16	16	269

a. Same parameters whether U. S. Government owned or private utility owned.
b. Delay of disposition facility startup beyond the year 2000 is possible and is discussed in Section III of Volume 2.

TABLE 2

Summary of Environmental Effects — Alternatives 1 and 2

Effects	*Centralized Storage (Alternative 1A) or Decentralized Storage with Full-Core Reserve (Alternative 1B-1)[a] - Policy Implemented* — *Disposition Facility Startup 1985*	*1995[b]*	*Decentralized Storage with Discharge Capabilities - Policy Implemented (Alternative 1B-2) or Policy Not Implemented (Alternative 2A)* — *Disposition Facility Startup 1985*	*1995[b]*	*Decentralized Storage in At-Reactor Basins — Policy Not Implemented (Alternative 2B)* — *Disposition Facility Startup 1985*	*1995[b]*
Energy Resources						
Propane, m^3	5.9×10^2	2.7×10^3	1.7×10^2	1.8×10^3	7.7×10^3	1.6×10^4
Diesel fuel, m^3	1.7×10^5	2.2×10^5	1.7×10^5	2.0×10^5	3.1×10^5	4.8×10^5
Gasoline, m^3	1.0×10^4	4.7×10^4	3.0×10^3	3.0×10^4	1.4×10^5	2.8×10^5
Electricity, MW-yr	6.5×10^1	1.0×10^3	8.2×10^0	5.0×10^2	1.8×10^2	1.4×10^3
Coal, tonne	4.0×10^5	6.2×10^6	5.4×10^4	3.0×10^6	1.2×10^6	7.6×10^6
Manpower, man-hour	4.5×10^7	8.5×10^7	3.9×10^7	7.6×10^7	1.1×10^8	1.9×10^8
Radiation Dose Commitment, man-rem						
Worldwide population[c]	1×10^3	2×10^4	3×10^2	9×10^3	4×10^3	3×10^4
Workforce	1×10^3	5×10^3[d]	8×10^2	4×10^3	6×10^3	3×10^4
Health Effects[e]						
Worldwide population	1	10	1	6	2	13
Workforce	1	4[f]	1	3	4	19
Occupation Accidents (nonradiological fatalities)[g]	11	14[h]	11	14	23	42

a. The resource commitments for Alternative 1B-1 are similar to those shown for Alternative 1A but not exactly the same. The differences are small. Impacts are same whether provided by U.S. or utilities if policy is not implemented.

b. Delay of disposition facility startup beyond the year 2000 is possible and is discussed in Section III and Appendix E of Volume 2.

c. Whole body dose during the operating period plus the next 100 years. (For comparison, the equivalent dose to the world population from natural radiation sources over the same period is about 2×10^{11} man-rem. This natural radiation dose will result in 120 million health effects.)

d. For Alternative 1B-1 the work force dose commitment is 8×10^3 man-rem.

e. Serious genetic and somatic health effects were calculated from radiation doses, assuming a linear dose-health effect relation. EPA dose-effect factors were used.

f. For Alternative 1B-1, the work force health effects are 6.

g. Includes construction deaths.

h. For Alternative 1B-1, the fatalities from occupational accidents are 17.

TABLE 3

Summary of Environmental Effects — Alternatives 3 and 4 for 2010 Startup of Disposition Facility

	Policy Implemented		*Policy Not Implemented*	
	Centralized Storage (Alternative 3A)	*Decentralized Storage (Alternative 3B)*	*Decentralized Storage (Alternative 4A)*	*Storage in ARBs (Alternative 4B)*
World Population, Whole Body Dose Commitment, man-rem	46,200	46,200	46,200	85,100
Occupational Exposure, man-rem	9,600	15,300	15,300	92,400
World Health Effects[a]	34	38	38	113
World Accidental Deaths	20	26	26	112

a. Serious genetic and somatic health effects were calculated from radiation doses, assuming a linear dose-health effect relation. EPA dose-effect factors were used. Health effects from organ doses are not shown independently, but these organ health effects are included in these lines along with those caused by the whole body dose. (See Appendix B of Volume 2 for more detail on methodology used in determining health effects.)

commitment during this same period would result in 120,000,000 health effects. For the alternatives that assume delayed disposition facility startup and current DOE planning forecast of fuel that will probably require ISFS facility storage (Alternatives 3 and 4), the total health effects in the world population and work force range from 34 to 113. Worldwide natural radiation dose commitment during this same period would result in 200,000,000 health effects. These heath effects were calculated with EPA dose-effect factors. No threshold dose is assumed for health effects. These dose-effect estimates are quite uncertain and may either underestimate or overestimate the actual effect. Occupational radiation exposure is also summarized in Tables 2 and 3. Doses are increased if the disposition facility is delayed because of a longer period of operation of the interim storage facilities. The dose increases for the alternatives in which ARB facilities are used because of the larger occupational force used in these ARB facilities.

The number of nonradiation-related fatalities expected in the work force, including transportation and construction workers and operating personnel, ranged from 11 to 112 for the entire period of this study for the alternatives analyzed. For perspective, the number of accidental deaths estimated for the entire period of these alternatives (about 20 years for time periods in Table 2 and 50 years for time periods used in Table 3) can be compared with 12,500 deaths in the year 1976 from occupational accidents in the United States.

As indicated earlier, for Alternative 2B, ARB facilities are used and transshipment of spent fuel between reactor discharge basins is minimized. The principal advantage of not allowing transshipment of spent fuel is to minimize transportation activities. The minimized transportation activities result in decreased exposures of about 4 man-rem to the public and about 50 man-rem to transportation workers. The principal disadvantage is that additional storage basins are needed. The additional basin requirements are expected to result in an increased exposure to the public of up to 5000 man-rem from release of particulate radioactivity which is assumed to be proportional to basin surface area. More significantly, accidental deaths are expected to increase by up to about 28 deaths, primarily due to the additional construction activities.

In the analyses, the environmental risks from major abnormal events and accidents are very small and are essentially the same for Alternatives 1 and 2. The maximum individual doses received from abnormal natural events (e.g., tornadoes) and severe accidents (e.g., criticality) at ISFS or ARB facilities that might occur during operation of the facilities are all below one rem; the probability of these events occurring is very low. Greater consequences are estimated for transportation activities in which the shipping cask is accidentally breached in an extreme accident. However, the risk is small because of the low probability of cask failure. No near-term biological effects of any significance are expected from the accidents analyzed. The environmental risks were not determined for Alternatives 3 and 4, but the risks for these alternatives would be proportional to those of Alternatives 1 and 2 corrected for the changes in program size and duration.

Transportation and storage of spent fuel (which contains radioactive and fissionable materials) can, under specific circumstances, be interfered with to create an unacceptable public risk. The spent fuel will therefore be safeguarded, and the adequacy of the safeguards is considered in the environmental analysis. However, compared with other fissionable material in the Light Water Reactor (LWR) fuel cycle, spent fuel is relatively easy to safeguard, because of its intense radiation. In addition, the consequences that could occur from the credible sabotage scenarios involving spent fuel are less than would be encountered for other comparable sabotage scenarios not involving nuclear material. It is concluded that the alternatives described do not impose an unacceptable safeguards risk or hazard to the public.

5. Summary of Environmental Impact of Storage of Domestic Fuel

The activities associated with implementing or not implementing the proposed policy are similar. The environmental impacts of alternatives vary with the amount of spent fuel received by the U.S. Government for interim storage, the number of facilities at which it is received, the storage time, and, to lesser degree, the differences in spent fuel transportation. The differences between comparable alternatives of implementing or not implementing the policy are small.

The environmental impacts from all alternatives considered, either from implementing or not implementing the spent fuel storage policy, are small. The decreased resource consumptions and environmental impacts for alternatives that assume reactor discharge basin operation at less than full-core reserve must be balanced against the reduced flexibility in reactor operation and the possibility of forced shutdowns. Forced shutdown could lead to the use of higher cost supplemental power or reduction of electrical power generation.

Providing full-core reserve capacity is a prudent and economical method by which to avoid reactor outages due to inspection or an emergency situation. Full-core reserve capacity should be provided by either the government or utilities. The impacts for decentralized ISFS facilities providing full-core reserve are considered the same for either government or private facilities.

Nevertheless, utilities have operated without full-core reserve rather than shut down. Utilities may choose to operate without full-core reserve to defer commitments to new storage facilities. Utilities may also operate at less than full-core reserve if prevented from providing the storage capacity due to institutional or regulatory constraints.

The environmental effects of ARB facilities are greater than those caused by ISFS facility storage because additional storage basins are constructed, operated, and decommissioned. However, the impacts are relatively small compared with available resources and risks from natural radiation sources.

In summary, although environmental impacts of all alternatives are small, differences do exist. Centralized government ISFSs may have more transportation impact than private ARBs. However, ARBs result in greater radiological impact due to the increased number of facilities and larger total workforce. Decentralized ISFSs would have the same impacts regardless of whether or not the government provides them; however, institutional and regulatory problems are believed to be greater for private facilities.

E. Storage of Foreign Spent Fuel (Detailed in Volume 3)

1. Scope

Under the Spent Fuel Storage Policy, the U.S. Government would be prepared to accept a limited amount of spent fuel from foreign sources when such action would contribute to meeting U.S. nonproliferation goals. Under this policy, the foreign fuel would be delivered to the interim storage facility at user expense. The user would be assessed a fee to cover the full cost of interim storage and disposition in return for the U.S. Government accepting title to the spent fuel and responsibility for its disposition.

Storage of foreign fuel (Volume 3 of the EIS) is an analysis of the environmental effects associated with implementing or not implementing the policy for foreign fuels. The incremental environmental effects associated with the foreign fuel that may be accepted by the U.S. Government are analyzed. If the policy is implemented for both the domestic and foreign fuel, the total effects can be determined by the addition of the effects given in Volume 3 of this EIS for foreign fuel and the effects given in Volume 2 of this EIS for domestic fuels. If the policy is implemented for the foreign fuel only, then the effects will be those reflected in Volume 3. The combined environmental effects of both domestic and foreign fuels are shown in Sections G and H of this volume.

2. Purpose of Foreign Policy

The U.S. policy is to encourage other nations to delay conventional reprocessing of spent fuel until more proliferation-resistant technologies and/or institutional arrangements can be developed. The U.S. offer to accept limited quantities of foreign spent power reactor fuel for storage in this country is intended to contribute to this and other nonproliferation objectives. Storage in the U.S. provides an option other than reprocessing to nations that have no alternative, acceptable from a nonproliferation point of view, for disposing of their spent fuel. If the foreign nations accept this offer, time would then be available for interested and eligible countries to develop their own storage capability or to investigate national or multinational storage facilities.

National storage facilities, in this context, are facilities owned by a single country that have a bilateral agreement with the U.S. on adequate safeguards applied to this storage. Multinational storage facilities are those serving several countries under the auspices of suitable international agency or organization such as the IAEA. The nations would then have time to evaluate and develop more proliferation-resistant technologies and/or institutional arrangements for their nuclear fuel cycles. If eligible countries take advantage of the U.S. offer, these actions may assist in promoting an international consensus favoring a delay in moving to a plutonium economy and limiting the spread of reprocessing plants.

The environmental impacts of a full range of U.S. options associated with implementing the policy are evaluated and compared with the alternative of not implementing the policy. Basically, the U.S. offer to store foreign spent fuel involves a tradeoff between the potential gains for the nonproliferation policy and the additional risks to the environment posed by the transportation and storage of foreign fuel within the United States.

3. Parameters Considered

In analyzing the effects of the Spent Fuel Storage Policy in regard to storage of foreign spent fuel, variation in several key parameters was considered. These parameters are briefly described in this section.

- Country Groups Considered. Three levels of foreign nation participation are considered. The first level, Option 1, consists of countries in sensitive regions where the protracted storage of spent fuel might be judged inappropriate or troublesome in terms of nonproliferation concerns. The term "sensitive region" means areas of the world in which international tensions are high, and a risk of violent conflict may exist. The term also applies to areas in which a country's nuclear power program may represent an additional source of international tensions.

Option 2, the second level of participation, consists of countries in Option 1 and a limited number of other countries where there is a nonproliferation benefit, and the countries have no ready alternative solutions for spent fuel disposition that are acceptable from a nonproliferation standpoint. The U.S. might give preference to countries that do not undertake reprocessing or avoid entering into reprocessing contracts with other countries.

Option 3, the third level of participation, consists of countries in Option 2 and some of the larger, industrialized, non-nuclear-weapons states. Each of these latter countries would be selected on a case-by-case basis when U.S. nonproliferation interests are served and there is an apparent need for action. These needs could be to 1) provide an alternative to reprocessing, 2) encourage development of national or multinational storage facilities, and 3) encourage adherence to nonproliferation treaties.

- Quantity of Domestic Plus Foreign Fuel. The three assumed foreign spent fuel options are presented in Figure 3 combined with the estimated amount of domestic fuel assumed for maintaining full-core reserve capacity (Alternative 1A of the EIS on storage of domestic fuel, Volume 2). The domestic fuel estimate is given to provide perspective to the foreign fuel options. The foreign fuel increment is 3% of domestic fuel for Option 1, 6% for Option 2, and 19% for Option 3.

- Degree of U.S. Participation. The degree of U.S. participation considered in storage of foreign spent fuel ranges from no U.S. Government participation to storage of spent fuel in the United States. In terms of meeting U.S. nonproliferation goals, these represent the least acceptable and most desirable cases. Between these two extremes U.S. support for storage of spent fuel in foreign nations not in sensitive regions is also considered.

- Type of Interim Storage Facilities. As described earlier, a wide range of interim storage facilities (ISFS facilities) is considered. This includes national facilities (with no U.S. input on storage security), national facilities (with U.S. input on storage security), multinational facilities (under the auspices of an international agency acceptable to the U.S.) and facilities located within the United States. Each of these types of facilities offers non-proliferation benefits to the U.S., when compared to reprocessing of the foreign spent fuel.

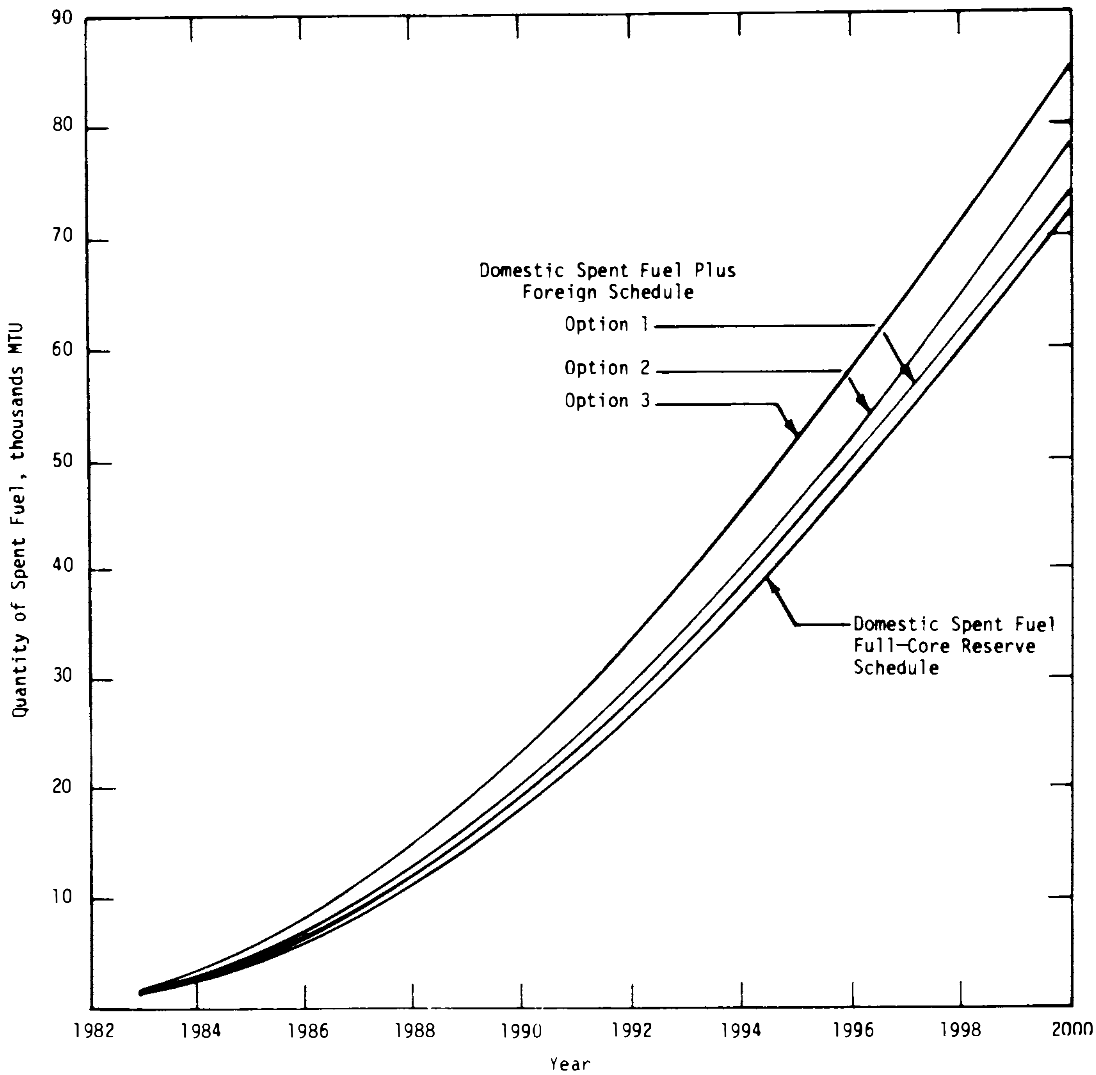

FIGURE 3. Cumulative Foreign Plus Domestic Spent Fuel

- Disposition of Spent Fuel. As used in the volume on storage of foreign fuel (Volume 3), "disposition" means either 1) disposal of spent fuel as waste in a geologic repository or 2) reprocessing of spent fuel, with storage of reprocessing wastes in a geologic repository, and recycling of recovered uranium and plutonium in power reactors. In terms of meeting U.S. nonproliferation goals, disposal of spent fuel in a geologic repository reduces the risk of diversion and furthers U.S. nonproliferation goals while reprocessing in foreign nations is least desirable. These cases are analyzed in Volume 3 of this EIS. To provide some detail on nonproliferation effects of intermediate cases, the following are also analyzed: 1) interim storage of foreign spent fuel in the U.S., followed by return of fuel to foreign nations for reprocessing; 2) interim storage of spent fuel in the U.S. followed by reprocessing in the U.S. and recycling of uranium and plutonium in U.S. power reactors; and 3) interim storage of spent fuel in the U.S. followed by reprocessing in the U.S. and returning uranium and plutonium as refabricated proliferation-resistant fuel assemblies for recycle in foreign power reactors.

- Initial Operation of U.S. Geologic Repository. The environmental effects for the cases that involve shipment of foreign spent fuel to the U.S. are considered for a range of initial startup dates for the U.S. geologic repository. The draft EIS, Storage of Foreign Spent Power Reactor Fuel (DOE/EIS-0040-D) considers a range of dates varying between the years 1985 and 1995. The Report to the President by the Interagency Review Group on Nuclear Waste Management (TID 29442) indicated that initial operation of the first geologic repository for high-level waste (spent fuel or reprocessing waste) was expected between the years 1988 and 1992.

  President Carter's Program on Radioactive Waste Management recently announced (February 12, 1980) the administration's position on nuclear waste management and estimated that a decision on the location of the first repository will be made around the year 1985, and initial operation of the first repository would begin in the mid-1990s. DOE's recent input to the NRC rulemaking on nuclear waste storage and disposal estimates that the first repository may be available between the years 1997-2006. To show the environmental effects of delayed repository opening beyond the year 1995, DOE expanded the analyses that were in the draft EIS (DOE/EIS-0040-D) to show the environmental effects associated with interim storage of foreign spent power reactor fuel in ISFS facilities with the first geologic repository startup in the year 2010. Startup of the geologic repository in the year 2010 was arbitrarily selected to establish an upper limit on startup of the geologic repository.

4. Cases Analyzed

Eleven cases spanning the range of options associated with implementing and not implementing the U.S. offer to accept the foreign spent fuel are analyzed. In two of these cases, the alternative of not implementing the Spent Fuel Storage Policy, the U.S. Government would take no action with respect to the storage of foreign spent fuel. The alternative of implementing the policy considers two major subalternatives:

- U.S. Government accepts no spent fuel from foreign governments but provides assistance to foreign countries for storage of their spent fuel abroad.

- U.S. Government accepts foreign spent fuel for interim storage. The remaining seven cases consider a range of possibilities under this subalternative. The amount of fuel accepted by the U.S. is projected and analyzed for three acceptance options.

The descriptive titles of the eleven cases analyzed are given below.

Case A. Fuel Remains in Foreign Countries — No U.S. Support (Option 3 Fuel Schedule)

Case B. Fuel Remains in Foreign Countries — U.S. Supports Multinational Interim Storage (Option 3 Fuel Schedule)

Case C. Fuel Remains in Foreign Countries — U.S. Supports National Interim Storage (Option 3 Fuel Schedule)

Case D. Fuel Shipped to U.S. — Later Disposed of in U.S. Geologic Repository* (Option 3 Fuel Schedule)

Case E. Fuel Shipped to U.S. — Later Returned for Reprocessing (Option 3 Fuel Schedule)

Case F-1. Fuel Shipped to U.S. — Later Reprocessed and Recycled in U.S. (Option 3 Fuel Schedule)

Case F-2. Fuel Shipped to U.S. — Later Reprocessed in U.S. and Plutonium and Uranium Returned as Refabricated Proliferation-Resistant Fuel (Option 3 Fuel Schedule)

Case G. Fuel Shipped to U.S. — Later Disposed of in U.S. Geologic Repository* (Option 2 Fuel Schedule)

Case H. Fuel Shipped to U.S. — Later Disposed of in U.S. Geologic Repository* (Option 1 Fuel Schedule)

* Analyzed assuming initial operation of U.S. geologic repository begins in the years 1985 and 1995.

Case I. Fuel Shipped to U.S. — Later Disposed of in U.S. Geologic Repository* (Option 2 Fuel Schedule)

Case J. Fuel Remains in Foreign Countries — No U.S. Support* (Option 2 Fuel Schedule).

The purpose of providing spent fuel storage in the U.S. for foreign fuels is to reduce the potential for proliferation of sensitive nuclear materials and facilities. Although not readily quantifiable, any reduction in proliferation potential is a major environmental and societal benefit. For purposes of comparing the nonproliferation effects of the various cases analyzed, it is assumed that disposal of spent fuel as waste in a geologic repository reduces the risk of diversion and reduces the nuclear proliferation potential. This does not indicate that DOE has made a decision on the ultimate disposal method for spent fuel.

DOE's preferred alternative is Case G; i.e., spent fuel from Option 2 (mid-range) countries, is shipped to the U.S. for storage in ISFS facilities. The fuel covered by the U.S. under this policy would be selected to provide a nonproliferation benefit to the U.S., as described above. This foreign fuel may eventually be disposed of as waste in a U.S. geologic repository. It should be noted however that DOE is not making a choice between reprocessing and geologic storage at this time. DOE intends also to continue to support multinational storage, not by subsidies, but by discussion with foreign nations.

4.1 Cases A and J

In the context of the U.S. nonproliferation goals, Cases A and J are least acceptable. In Case A, the U.S. takes no action in regard to storage of spent fuel from foreign power reactors. The environmental and nonproliferation effects of this case were determined, assuming the Option 3 fuel schedule, the highest level of potential foreign country participation. Some nations lacking sufficient storage capability may turn to national reprocessing as an alternative. Some nations may contract with other countries for reprocessing services. Thus, additional countries would acquire facilities capable of producing material usable in nuclear explosive devices; sensitive materials would be stored in many countries, some in sensitive regions. If this case were adopted,

* Analyzed assuming initial operation of U.S. geologic repository beginning in the year 2010.

the U.S. would restrict its opportunity to promote its nonproliferation goals to forestall the introduction of reprocessing plants and to decrease the widespread national storage of spent fuel containing plutonium.

In Case J, the U.S. takes no action in regard to storage of spent fuel from foreign power reactors. The environmental effects of this case were determined for interim operations (i.e., of transfers from reactor discharge basins to the reprocessing facilities) on Option 2 fuel through the year 2000. This is equivalent to about 30% of the interim effects for Case A. The nonproliferation effects of this case would be the same as Case A.

4.2 Cases B and C

Spent fuel remains in foreign countries in Cases B and C. In these cases, the U.S. would support either multinational storage (Case B) or national storage (Case C). The environmental and nonproliferation effects were analyzed, assuming the Option 3 fuel schedule. The nonproliferation benefits of multinational storage are greater than those for national storage because the countries eligible for bilateral support of multinational storage would have to be outside sensitive regions and show financial capability to support an expanded spent fuel storage program after U.S. assistance stops. In Case B, multinational storage is assumed for all fuel from sensitive countries.

Multinational ownership and/or operation of spent fuel storage facilities could also provide an additional barrier to diversion of material for reprocessing to obtain materials that could be used in nuclear weapons. National storage (Case C) would provide no fuel storage for countries in sensitive regions, and, in itself, would not achieve fully the nonproliferation goals of the United States. This option could be used along with other options (e.g., Case H for fuel from sensitive countries) to implement the U.S. nonproliferation goals.

4.3 Cases D, E, F-1, and F-2

In Cases D, E, F-1, and F-2 spent fuel is stored in the U.S., and the Option 3 fuel schedule is assumed but with differing modes of ultimate disposal. Options for disposal include:

1) Disposition of foreign fuel in a U.S. geologic repository (Case D)

2) Return of foreign fuel for foreign reprocessing under conditions that meet nonproliferation objectives (Case E)

3) Reprocessing of foreign fuel in the U.S. and recycling of uranium and plutonium in the U.S. by using a proliferation-resistant technology (Case F-1)

4) Reprocessing of foreign fuel in the U.S. and return of fabricated mixed oxide fuel to foreign countries not in sensitive regions (Case F-2).

Cases E, F-1, and F-2 assume that the foreign spent fuel is reprocessed either in the U.S. or abroad to show several alternatives that utilize spent fuel reprocessing. This assumption is inconsistent with present U.S. policy of indefinite deferral of spent fuel reprocessing to provide time to study more proliferation-resistant reprocessing options. If the U.S. agrees to the reprocessing of the fuel, it would be carried out under international safeguards by using proliferation-resistant technologies that meet the nonproliferation objectives of the United States.

4.4 Cases G, H, and I

Cases G, H, and I are similar to Case D in that foreign fuel is stored in the U.S. and later disposed of in a U.S. geologic repository. The differences between Cases G and I and Case H are the countries included in the policy and the amount of foreign fuel received by the United States. Case H (Option 1 — the least amount of foreign fuel) includes only countries in sensitive regions. Cases G and I (Option 2) include countries in sensitive regions, plus a limited number of smaller countries in less sensitive regions with clearly identified spent fuel storage problems. Case D (Option 3 — largest amount of foreign fuel) includes countries in Case G plus a few larger, industrialized, non-nuclear-weapons states. Cases G and I both assume the same fuel schedule (Option 2), therefore, the same countries are involved.

In Case H, the spent fuel is removed from countries in sensitive regions, a major objective of the U.S. nonproliferation policy. However, other foreign nations would have to choose a course of action for storage of their spent fuel. Sensitive material would be stored in a number of locations, and some countries might select reprocessing as an alternative even though adequate safeguards to meet nonproliferation objectives are not available. Larger, industrialized nations are better able to finance spent fuel storage facilities on a national or multinational basis and to set an example in support of spent fuel storage for the international community. They are more likely, however, to construct a reprocessing plant, either jointly or on an individual basis. Therefore, Case D, which includes larger, industrialized non-nuclear-weapon nations offers the highest benefits to the U.S. nonproliferation policy.

Table 4 summarizes the parameters and operations considered in each of the eleven cases analyzed.

5. Environmental Effects of Cases

The relative nonproliferation differences of the range of cases have been discussed in Sections E.1 through E.4. This section describes other environmental effects. Those believed to be of the greatest significance are given in Tables 5, 6, and 7. Tables 5 and 7 include only the environmental effects associated with interim storage of foreign spent fuel, and are presented to allow a comparison with the EIS on storage of domestic fuel (Volume 2) in which the interim storage of domestic fuel is assessed. Table 6 includes the effects of both interim storage and disposition of foreign spent fuel.

Volume 3 of the EIS on storage of foreign fuel is an analysis of the environmental impact on the U.S. and global commons from implementation of the proposed U.S. Spent Fuel Storage Policy for foreign fuel and alternatives. Tables 5, 6, and 7 present the impacts on the world and on the U.S. and global commons. These cumulative impacts on the U.S. and global commons were calculated by determining the total world environmental effects less those associated with regional effects* resulting from operations in foreign nations. The environmental effects within the territories of foreign states are not analyzed in this EIS.

Some of the cases in this analysis include reprocessing of the foreign spent fuel, while others do not (Cases A, B, and C discuss both options). An analysis of operations associated with the back-end of the fuel cycle is included. If the fuel is reprocessed and the recovered plutonium and uranium recycled, a decrease in virgin uranium feed requirements would result. This in turn would lead to a reduction in mining and milling activities to provide uranium, which are operations at the front-end of the fuel cycle. The reduction in mining and milling activities would result in a significant decrease in radiation health effects to the population (from a decrease in lung dose from radon gas) and in accidental mining and milling deaths to occupational employees. These reduced mining and milling effects more than offset the health effects and accidental deaths arising from the transportation, storage, reprocessing, or ultimate disposition of the

* The regional effects are those impacting on a hypothetical land area of nine million km^2 (an area equal to that of the U.S.) with the foreign nation carrying out the activities located at the center of that area.

TABLE 4

Summary of Parameters and Operations Involved in Cases Analyzed for Storage of Foreign Fuel

Case	A	B	C	D	E	F-1	F-2	G	H	I	J
Country Groups Considered											
Option 1 - Sensitive Regions									●		
Option 2 - Option 1 Plus Countries with Storage Problems								●		●	●
Option 3 - Option 2 Plus Industrialized Nonnuclear Weapons States	●	●	●	●	●	●	●				
Quantity of Spent Foreign Fuel, MTU	13600	13600	13600	13600	13600	13600	13600	4350	2160	4350	4350
Degree of U. S. Involvement											●
No. U. S. Involvement	●										
U. S. Support of Foreign Storage		●	●								
Interim Storage in U. S. ISFS				●	●	●	●	●	●	●	
Spent Fuel Disposition Options											
U. S. Repository				●				●	●	●	
Foreign Repository		●[a]	●[a]								
Reprocessing in U. S., Waste to U. S. Repository						●	●				
Reprocessing in Foreign Nations, Waste to Foreign Repository	●	●[a]	●[a]		●						●
Separated Plutonium and Uranium Recycled in U. S.						●[b]					
Separated Plutonium and Uranium Recycled in Foreign Nation	●[c]	●[b]	●[b]		●[b]		●[b]				●[c]

a. Foreign countries may choose to reprocess rather than dispose of spent fuel in a repository.

b. Separated plutonium and uranium recycled in proliferation-resistant reactor fuel.

c. Separated plutonium and uranium not controlled by the U. S.

TABLE 5

Summary of Environmental Effects From Interim[a] Storage of Foreign Spent Fuel

	A,B,C[b]	*D*	*D*	*E*	*F-1*	*F-2*	*G*[c]	*G*[c]	*H*[c]	*H*[c]
Year U.S. Geologic Repository Begins Initial Operation	1985	1985	1995	1985	1985	1985	1985	1995	1985	1995
Population Whole Body Dose Commitment, man-rem										
U.S. and Global Commons	0[d]	730	2840	980	1000	1000	170	1040	47	550
World	2.5	730	2840	980	1000	1000	174	1040	47	550
Occupational Exposure, man-rem										
U.S. and Global Commons	0[d]	440	1220	345	510	510	138	450	73	190
World	16	510	1270	370	570	580	157	470	82	200
Health Effects[e]										
U.S. and Global Commons	0[d]	0.74	2.5	0.83	0.96	0.96	0.19	0.93	0.08	0.46
World	0.01	0.78	2.6	0.85	1.0	1.0	0.21	0.94	0.08	0.47
Accidental Deaths										
U.S. and Global Commons	0[d]	1.6	2.4	0.87	1.8	1.8	0.47	0.82	0.22	0.38
World	0.4	1.6	2.4	1.2	1.8	1.8	0.47	0.82	0.22	0.38

a. Does not include incremental environmental effects of mining and milling.

b. Case A effects are shown. The effects for Cases B and C are essentially the same.

c. Case G includes environmental impacts for receipt of Option 2 spent fuel in the U.S., and Case H includes environmental impacts for receipt of Option 1 spent fuel in the U.S.

d. In Case A no operations occur in the U.S. or the global commons. For Cases B and C, there are no operations with foreign spent fuel in the U.S. but some fuel may be shipped by sea between countries other than the U.S.

e. Serious genetic and somatic health effects were calculated from radiation doses, assuming a linear dose-health effect relation. EPA dose-effect factors were used. Health effects from organ doses are not shown independently, but these organ health effects are included in these lines along with those caused by the whole body dose. (See Appendix B of Volume 2 for more detail on methodology used in determining health effects.)

TABLE 6

Summary of Major Environmental Effects from Interim Storage and Disposition of Foreign Spent Fuel

	A,B,C[a]	D	D	E[a]	F-1[a]	F-2[a]	G[b]	G[b]	H[b]	H[b]
Year U.S. Geologic Repository Begins Initial Operation	1985	1985	1995	1985	1985	1985	1985	1995	1985	1995
Population Whole Body Dose Commitment, man-rem										
U.S. & Global Commons	5500	850	2950	6930	11,500	11,500	198	1080	67	570
World	7200	850	2950	8260	11,500	11,500	202	1080	67	570
Occupational Exposure, Man-rem										
U.S. & Global Commons	0	700	1480	440	5810	6060	228	540	118	235
World	8700	770	1530	7910	5870	6210	247	560	127	245
Health Effects[c]										
U.S. & Global Commons	3.2	1.02	2.8	4.3	11.1	11.3	0.28	1.02	0.12	0.51
World	10.5	1.06	2.8	10.6	11.1	11.4	0.30	1.03	0.13	0.52
Accidental Deaths										
U.S. & Global Commons	0	3.4	4.2	1.6	9.4	10.6	1.1	1.5	0.56	0.72
World	7.9	3.4	4.2	8.3	9.4	10.9	1.1	1.5	0.56	0.72

a. Does not include incremental environmental effects of mining and milling. In Cases A,D,C,E, F-1 and F-2, it is assumed the foreign spent fuel is reprocessed and the recovered plutonium and uranium is recycled; reduced mining and milling requirements would result in a decrease of ~120 health effects (because of reduced lung exposure to the population and work force) and a decrease of ~31 in occupational deaths.

b. Case G includes environmental impacts for receipt of Option 2 spent fuel in the U.S. and Case H includes environmental impacts for receipt of Option 1 spent fuel in the U.S.

c. Serious genetic and somatic health effects were calculated from radiation doses, assuming a linear dose-health effect relation. EPA dose-effect factors were used. Health effects from organ doses are not shown independently, but these organ health effects are included in these lines along with those caused by the whole body dose. (See Appendix B of Volume 2 for more detail on methodology used in determining health effects.)

TABLE 7

Summary of Environmental Effects from Interim Storage of Foreign Spent Fuel, 2010 Startup of U.S. Geologic Repository

Case	*I*[a]	*J*[b]
Year U.S. Geologic Repository Begins Initial operation	2010	2010
Population Whole Body Dose Commitment, man-rem		
U.S. and Global Commons	1400	0
World	1400	8.5
Occupational Exposure, man-rem		
U.S. and Global Commons	330	0
World	360	43
Health Effects[c]		
U.S. and Global Commons	1.0	0
World	1.1	0.04
Accidental Deaths		
U.S. and Global Commons	0.5	0
World	0.5	0.1

a. Case I includes environmental impacts for Option 2 spent fuel received in the U.S.

b. In Case J, no operations occur in the U.S. or the global commons.

c. Serious genetic and somatic health effects were calculated from radiation doses, assuming a linear dose-health effect relation. EPA dose-effect factors were used. Health effects from organ doses are not shown independently, but these organ health effects are included under this column along with those caused by the whole body dose. (See Appendix B of Volume 2 for more detail on methodology used in determining health effects.)

foreign spent fuel. However, the effects from mining and milling activities are not included in the following discussion of the effects for the different cases and are not shown in Tables 5 and 6 because these operations are not directly associated with the operations at the back-end of the fuel cycle nor involved in the Spent Fuel Policy offer.

Table 5 shows the population whole body dose commitments resulting from interim storage of the foreign spent fuel. These commitments range up to about 3000 man-rem. The population dose commitments range from about 70 to about 11,500 man-rem when both interim storage and disposition of the foreign spent fuel are considered, as shown in Table 6. These population dose commitments compare with about 1000 to 30,000 man-rem shown in Table 2 for the EIS on storage of domestic fuel. Effects of long-lived nuclides in the 100-year period after the end of the period of operation are included in the data in these tables to provide an assessment of effects of persistent nuclides. These population doses are very small fractions of the whole body exposure to the world population of about 200,000,000,000 man-rem from natural radiation sources in the same period. Table 7 shows the population whole body dose commitment for interim operation from Option 2 fuel schedule that might exist if the U.S. geologic repository startup is delayed until the year 2010. Table 7 shows that the dose commitments range up to 1400 man-rem. Since the effects of interim operation associated with not implementing the policy are small (transportation from reactor discharge basins to fuel reprocessing plants only), the population dose commitment is quite small (8.5 man-rem) and results in world dose commitment only. The differences between the different cases are not judged to be of sufficient importance to strongly influence the selection of the case or combination of cases that best implements the U.S. nonproliferation policy.

Occupational radiation exposures are also summarized in Tables 5, 6, and 7. These exposures increase in the cases when initial operation of the geologic repository is assumed to be delayed (Cases D, G, H, and I). The increases occur because of the larger work force and longer period of operation at the ISFS facilities. The occupational dose is greatest for the cases with reprocessing, and the doses are so low that they would not strongly influence the decision of whether to implement the U.S. offer to store foreign fuel.

The health effects calculated from the population and occupational doses range from 0.01 to 2.6 when only interim storage of the foreign spent fuel is considered (see Tables 5 and 7) and from 0.13 to 11.5 when disposition of the foreign fuel is also considered (see Table 6). For perspective, there will be 120,000,000 health effects to the world population from natural radiation during this same period.

The number of accidental deaths range up to 2.4 for activities associated only with interim storage of the foreign spent fuel. When activities associated with disposition of the foreign spent fuel are included, the range is up to 11. Again, these effects are small enough to not have a significant effect on a decision to implement the U.S. offer to store foreign fuel.

Analyses are also made of the environmental risks from major abnormal events and accidents in the facilities considered in this statement. These risks are shown to be very small and essentially the same for Cases A through H. The environmental risks from abnormal events and accidents were not determined for Cases I and J, but the risks for these cases would be proportional to those of Cases G and A, respectively, corrected for program size and duration. The maximum individual dose commitments following abnormal natural events (e.g., tornadoes) and severe accidents (e.g., criticality) that may occur during operation of the facilities are all below one rem, and the probability of these events occurring is very low. Somewhat greater consequences are estimated for extreme transportation accidents in which a shipping cask is breached. Body doses up to 1.6 rem may be expected in an extreme transportation accident involving the breaching of four shipping casks containing spent fuel expected to be transported under this policy; but the probability of an accident in which cask failure occurs is very low, i.e., less than 7×10^{-5} for the entire study period for the maximum amount of foreign fuel considered (Option 3 fuel schedule). The accident that might result in a 1.6 rem body dose was developed for a maritime accident (See Section III of Volume 3). A comparable severe accident involving land transport would probably breach no more than a single spent fuel cask and as such would result in a body dose of 0.4 rem. In cases involving transportation of wastes from reprocessing of spent fuel, body doses up to 4 rem/accident may be expected. No biological effects of any significance are expected from the accidents analyzed.

Special arrangements and precautions can be made for shipments of short-cooled spent fuel if considered necessary since the consequences of a release from an accident involving short-cooled fuel are significantly greater than the consequences of the accidents analyzed in this EIS. However, existing licensed casks are designed to carry fuel cooled for 120-150, days and the probability of undetected rupture of a cask is so remote that such precautions appear unnecessary.

Transportation and storage activities associated with spent fuel involve radioactive and fissionable material that can, under specific circumstances, be misused to create an unacceptable public risk. However, spent fuel is relatively easy to protect because of its intense radiation and the technical problems associated with separating the plutonium it contains.

The level of consequences that could occur from credible sabotage scenarios involving spent fuel is low and of the same order or smaller than sabotage incidents not involving nuclear materials. Property damage resulting from sabotage incidents would consist mostly of localized contamination that would necessitate limited access until cleanup operations could be completed. Therefore, the spent fuel storage and transportation operations described in this statement do not impose an unacceptable safeguards risk or hazard to the public.

Cases that include the assumption that the geologic repository is delayed require more energy and materials because of increased construction and the longer operations of ISFS facilities. Resource consumption is greater if the decision is made to reprocess the foreign spent fuel either in the U.S. or abroad, but it is still small.

Releases of thermal and nonradioactive effluents and secondary effects on biota are judged to be minor and are not discussed.

6. Summary of Environmental Impact of Foreign Fuel Storage

In summary, implementation of the U.S. offer to store foreign spent fuel would involve a tradeoff between the potential gains for nonproliferation policy and the additional risks to the environment posed by the transportation and storage of foreign fuel within the United States. With respect to the global commons, the tradeoff of environmental impacts is unclear and depends upon 1) the risks of additional spent fuel shipments as weighed against the risks of shipments which would take place anyway, and 2) the potential risks associated with any reprocessing and subsequent disposition of plutonium and wastes that may take place in the absence of a U.S. offer. World environmental effects are also given for completeness.

However, the environmental impacts from all alternatives considered, either from implementing or not implementing the Spent Fuel Storage Policy in regard to foreign fuel, are small. The differences in environmental impact between the cases are not significant enough to strongly influence the decision on acceptance of foreign fuel.

F. Charge for Spent Fuel Storage (Detailed in Volume 4)

1. Scope

If the U.S. Spent Fuel Storage Policy is implemented, domestic and, on a selective basis, foreign utilities would deliver spent fuel to the U.S. Government for interim storage. The policy specifies that 1) the U.S. Government will establish a fee for this interim storage and also for final disposal of the spent fuel and 2) this fee will be paid by the spent fuel sender. The purpose of the EIS on charge for spent fuel storage (Volume 4) is to show whether the fee, by its level or structure, would have any effect or influence on the environmental impacts of the Spent Fuel Policy. Alternative fee procedures could, in theory, influence utility decisions and, therefore, result in different environmental impacts. Alternative fee structures, levels of fee, payment times, and accrual procedures have been evaluated to determine if, within the policy constraints, the environmental impacts are significantly changed.

The fee and its structure can have two primary effects on utilities' decisions: 1) because of its structure and level, it could influence utilities to utilize different interim fuel storage procedures with a different resultant environmental effect, and 2) depending upon the level of the fee and its relationship to the total cost of nuclear power, it could influence the decision on a nuclear commitment, and the overall growth of nuclear power with its associated environmental impact.

2. Parameters Considered

A series of options for determining the charge for spent fuel storage and disposal are available to the U.S. Government. The choice of the option will determine the amount of the fee. The following options are considered.

- Establishment of a fee based upon full-cost recovery or, alternatively, a fee subsidizing either the customer or the U.S. Government.

- Collection of the fee either at the time of transfer of fuel to the U.S. Government or at an earlier or later time.

- Establishment of a fee related to services utilized ("use-based") or, alternatively, the same fee to all customers for spent fuel acceptance by the U.S. Government independent of whether or not interim storage is needed ("levelized").

- Establishment of a fee based upon equal charges for either foreign or domestic fuel and alternatives to this option.

- Establishment of a one-time fee, i.e., that of payment for all services used based upon values of these services at the time the service was contracted, or non-one-time fee, i.e., payment for interim storage at the time the service was contracted and later payment of disposal fee based upon later definition of the value of those costs.

- Accrual and disbursement of funds through the DOE budget process, through a separate trust fund, or directly through the U.S. Treasury.

Alternative fee structures and philosophies were analyzed to determine if certain structures would have a bearing on environmental effects. The analyses also consider whether these alternatives are feasible, desirable and acceptable to utilities, Public Utility Commissions (PUC) and the U.S. Government. The key elements of the alternative fee structure considerations are

- Type of Fee. A fee could be based upon 1) full-cost recovery to the U.S. Government (reference case), 2) less than full-cost recovery based on promoting the national nonproliferation objectives and 3) a higher than full-cost recovery, e.g., commercial pricing. Generally, the effect of a fee higher than the reference case would be to encourage at-reactor storage or utility owned storage. A fee lower than the reference case would encourage more transfers of spent fuel to the U.S. Government at an earlier date. Historically, except for unusual circumstances, the U.S. pricing policy is to have full-cost recovery for services rendered.

- Use-Based and Levelized Fee. With a use-based fee, utilities would pay only for services received. Those utilities requiring both storage and disposal would pay a single fee for both services, and those not requiring interim storage would pay only for disposal. An alternative pricing policy would be to set a single fee (levelized) for all customers independent of whether they required storage and disposal or disposal alone. A levelized fee system would not motivate utilities to make any additional at-reactor storage capacity available as such modifications would represent an additional investment over and above the payments they would be required to make for storage by the government at an ISFS facility.

- Charges for Domestic and Foreign Utilities. Alternative fee methodologies included in Volume 4 of the EIS are equal charges for both domestic and foreign fuels and possible subsidies (both positive and negative) for foreign fuel.

- Level of the Fee. Although the EIS on charge for storage of spent fuel (Volume 4) in itself does not establish a fee, a reference fee calculation was developed from the DOE Preliminary Estimate of the Charge for Spent-Fuel Storage and Disposal Services (DOE/ET-0055) for capital and unit cost parameters. A storage and disposal charge of $202/kg (in constant 1978 dollars) was calculated. The components of this charge are summarized in Table 8. A number of variations from the reference case assumptions have been considered in order to establish a

TABLE 8

Reference Fee, Domestic and Foreign Fuel[a]
(Dollars/Kg in 1978 Dollars)

Facility or Operation	*Disposal Only*	*Storage and Disposal*
ISFS	-	89
Transportation	--	24
Encapsulation	33	23
Geologic Repository	50	35
R&D and Government Overhead	31	31
Total	114	202

a. This case differs from that developed in Preliminary Estimates of the Charge for Spent Fuel Storage (DOE/ET-0055) because of the addition of 2160 MTU of fuel from foreign sources.

range of costs. The resultant fee ranges from \$83 to 160/kg for disposal only, and from \$127 to 271/kg for storage and disposal. It is intended that the fee, as set by the U.S. Government, would be adjusted from time to time to reflect the best current estimate for the service.

- Fee Payment Schedule. Cost to the U.S. Government can be distributed between several categories, including capital investment, operations and maintenance, decommissioning, surveillance charges, research and development, overhead and carrying charges. All of these costs, except for carrying charges, are specific dollar investments and would be amortized and recovered on a "unit of production" basis.

  Carrying charges are determined by a cash flow analysis, that is, the timing of investment dollars as related to the receipt of fees from the utilities. This component of cost is, therefore, dependent upon the payment schedule as defined by the U.S. Government. Early payments would provide the U.S. with the monies needed for investment in facilities, etc. and, therefore, significant new (debt) money would not be required. Late payments, on the other hand, would require the U.S. Government to provide for all of the investment monies; therefore, the carrying charges would be increased. The carrying charge rate is assumed to be equal to the cost of money to the U.S. Government. Therefore, the fee would be indifferent to the payment schedule since full-cost recovery would be achieved, including the cost of money.

The utilities' view of the payment schedule, however, is quite different from that of the U.S. Government. Early and fully defined charges are more easily dealt with by both utilities and their PUCs; furthermore, early defined cost allows the user of the generated electrical energy to be responsible for and to be billed for the services associated with fuel storage and disposal. The standard utility accrual procedure is to collect the monies from customers for any direct charge, such as the storage and disposal fee during the period when fuel is generating power. At the time the fuel is discharged from the reactor, they would then have on hand the monies as required for the U.S. Government storage and disposal service. Substantive changes in that fee, after the fuel has been discharged, represent an issue which would have to be resolved with individual state regulatory agencies.

In the U.S. Government's viewpoint there are advantages and disadvantages of both early and late payments. An early payment gives the U.S. Government cash so that additional, and possibly significant, investment may not be required. On the other hand, late payment is at a point in time when the cost of services is better known; therefore, the fee is more precisely reflective of the costs for that particular fuel batch. Early payment is also manageable by the U.S. Government, which still maintains full-cost recovery by applying to later fuel an additional charge which recovers not only the current costs but also those costs not recovered on previous batches. The utilities would see such an additional charge in the fee not as a recovery of previous costs, but as a new value applicable to the then current fuel.

3. Alternatives and Environmental Impact

• Storage Requirement

The fee structure can have an influence on the utilities' handling of the interim storage of fuel. A high interim storage fee would influence the utilities to provide their own storage, starting with additional storage of the lowest cost, e.g., that of "fuel compaction" in existing reactor discharge basins. A lower interim storage fee would influence utilities to use storage which would be more costly to the U.S. Government, e.g., new facilities, either U.S. Government facilities or privately owned facilities which would be leased to the U.S. Government. These facilities could be located either at the reactor or away from the reactor.

A "levelized fee," which imposes the same fee to all utilities for interim storage and disposition, regardless of whether interim storage is or is not used, would not motivate utilities to provide their own facilities. Instead, utilities would transfer spent fuel to the U.S. Government for interim storage because this interim storage would cost the utilities no additional fee.

The environmental impacts (Table 9) range between a maximum impact associated with not implementing the policy (Case A), and a minimum impact associated with implementing the policy and use of a use-based fee, but only to meet discharge capability (Case B). The use of centralized Government ISFS facilities with a levelized fee and meeting full core reserve (FCR) requirements (Case C) results in an impact which lies between these cases. Decentralized ISFS facilities would result in environmental impacts slightly higher than Case C.

- <u>Nuclear Growth</u>

The fee level has a potential relationship to the growth of nuclear power. An analysis of costs based upon "full-cost recovery" developed a range for the cost of fuel storage and disposal which varied from 0.23 to 0.42 mils/kWh, or about 1 to 2% of total generation cost. It thus appears, that even at the upper end of the range of fees examined, that the Spent Fuel Policy would not have a significant cost impact on the economics of nuclear power and would not change the economic comparison between nuclear power and coal power generation in most regions of the United States.

An implemented fuel policy has the advantage of giving a definiteness to the disposal end of the nuclear fuel cycle as well as documenting the cost. Both of these conditions have a positive influence on the selection of nuclear power, offsetting, to a degree, the negative influence of the charge itself. As a result of these offsetting effects, it would be anticipated that the fee charged for this storage and disposal service would not significantly alter nuclear power commitments and the resultant growth projections.

- <u>Possibility of Future Reprocessing</u>

The fee structure does not explicitly consider any provisions for a change in U.S. Government Policy reinstituting reprocessing of spent fuel and recycle of the uranium and plutonium. Such a change in U.S. Government Policy would be accomplished in conformance with the NEPA requirements, and at that time a number of cost questions would have to be addressed and answered. Following a principle of full-cost recovery to the U.S. Government, the charge, return of fuel, and the possible

TABLE 9

Major Fee-Related Environmental Effects[a]

	Case A		*Case B*		*Case C*	
	Non-Implementation of Spent Fuel Policy (At-Reactor Basin Storage)		*Implementation of Spent Fuel Policy "Use-Based" Fee*		*Implementation of Spent Fuel Policy "Levelized" Fee*	
	Domestic Fuel[b]	*Foreign Fuel*[c]	*Domestic Fuel*[d]	*Foreign Fuel*[e]	*Domestic Fuel*[f]	*Foreign Fuel*[e]
Effects						
Energy						
Propane, m^3	7.7×10^3	0	1.7×10^2	3.3×10^2	5.9×10^2	3.3×10^2
Diesel Fuel, m^3	3.1×10^5	0	1.7×10^5	2.7×10^5	1.7×10^5	2.7×10^5
Gasoline, m^3	1.4×10^5	0	3.0×10^3	4.6×10^3	1.0×10^4	4.6×10^3
Electricity, MW-yr	1.8×10^2	0	8.2×10^0	8.9×10^1	6.5×10^1	8.9×10
Coal, Tonne	1.2×10^6	0	5.4×10^4	3.4×10^5	4.0×10^5	3.4×10^5
Man-power, man-hour	1.1×10^8	0	3.9×10^7	1.1×10^7	4.5×10^7	1.1×10^7
Radiation Dose Commitment, man-rem						
Population[g]	4×10^3	5.5×10^3	3×10^2	8.5×10^2	1×10^3	8.5×10^2
Work Force	6×10^3	0	8×10^2	7.1×10^2	1×10^3	7.1×10^2
Health Effects[h]						
Population	2	NA*	1	NA*	1	NA*
Work Force	4	NA*	1	NA*	1	NA*
Total	6	3.2	2	1.0	2	1.0
Occupational Accidents (Nonradiological Fatalities)	23	0	11	3.4	11	3.4

a. Summary of major environmental effects of storage and disposal of spent fuel amounts affected by the fee structure. Reference (use-based) fee and levelized fee. Non-implementation of spent fuel policy is included for comparison. Disposal of spent fuel is assumed to begin in the year 1985. See Table IV-3 in Volume 4 for details.

b. Case A (Domestic Fuel) is equivalent to Alternative 2B in the EIS on storage of domestic fuel (Volume 2).

c. Case A (Foreign Fuel) is equivalent to Case A in the EIS on storage of foreign fuel (Volume 3). The population effects listed are for U.S. and Global Commons.

d. Case B (Domestic Fuel) is equivalent to Alternative 1B-2 in the EIS on storage of domestic fuel (Volume 2).

e. Cases B and C (Foreign Fuel) is equivalent to Case D in the EIS on storage of foreign fuel (Volume 3). The population and work force effects listed are for U.S. and Global Commons.

f. Case C (Domestic Fuel) is equivalent to Alternative 1A in the EIS on storage of domestic fuel (Volume 2).

g. Whole body dose during the operating period plus the next 100 years. For comparison, the equivalent dose to the world population from natural radiation sources over the same period is 2×10^{11} man-rem. This natural dose will result in 120 million health effects.

h. Serious genetic and somatic health effects were calculated from radiation doses, assuming a linear dose-health effect relation. EPA dose-effect factors were used.

* NA - not available.

refund of the fee would be influenced by the status of existing facilities, expenditures for facilities planned and under construction, revenues already received, quantities of fuel in storage or committed for storage, etc. Because of this wide range of future uncertainties, it is not possible to include in the current fee structure specific return provisions except to state that return would be considered under conditions and costs to be determined later.

DOE's preferred action is that the Spent Fuel Policy announced October 1977 be implemented. The proposed action is to charge a fee for acceptance of spent fuel for storage and/or disposal that will recover the full cost to the government of providing the services. These costs will be assessed appropriately for the combined storage and disposal services or for disposal services only, as required by individual customers (that is, the fee will be "use-based"). The fee will be identical for all fuel, regardless of country of origin.

G. Environmental Effects of Proposed Action and Policy-Not-Implemented

DOE proposes that the Spent Fuel Storage Policy announced in October 1977, be implemented by the U.S. Government taking title to some domestic and foreign spent fuel and storing the fuel away from reactors. The U.S. Government should provide sufficient storage capacity to

- Allow U.S. utility reactors to maintain full-core reserve storage capacity. This storage capacity should be provided by construction of either centralized ISFS facilities (Alternative 1A of Volume 2) or smaller decentralized ISFS facilities (Alternative 1B-1 of Volume 2) by the U.S. Government and/or private industry.

- Allow receipt of foreign spent fuel from Option 2 (mid-range) countries into the U.S. for storage in ISFS facilities. The spent fuel covered by the U.S. under this policy would be selected to provide a nonproliferation benefit to the United States. This foreign spent fuel may eventually be disposed of as waste in a U.S. geologic repository. (DOE is not making a choice between reprocessing and disposal at this time.) This proposed action is equivalent to Case G in Volume 3. Further, DOE intends to continue to support multinational storage by discussion of storage technology with foreign nations.

The proposed action is to charge a fee for acceptance and storage and/or disposal of the spent fuel. This fee will be sufficient to recover the full cost to the U.S. Government for providing these services. The fee will be identical for all spent fuel, regardless of country of origin.

The combined environmental effects of this proposed action are given in Table 10. This table includes only the environmental effects associated with interim storage of spent fuels. The effects of disposition of the domestic fuel is unchanged by this policy and the effect of disposition of the foreign fuel can be developed by differences between the results given in Tables 6 and 5. These disposition effects were not included in Table 10.

Also given in Table 10 are the combined environmental effects that could be expected if the policy were not implemented. To place these major effects into perspective, the last column of Table 10 gives the dose commitment to the same world population from natural background radiation and the expected health effects that would result. The accidental deaths are compared with the occupational deaths expected in the U.S. during the same period. The U.S. occupational deaths are given for comparison since comparable world effects are not available. World effects would be significantly higher. A comparison of these background effects will readily show that the environmental effects of either implementing or not implementing the Spent Fuel Policy are a very small fraction of the exposure or health effects to the same population from natural radiation sources and the number of nonradiation-related fatalities expected. As can be seen from Table 10, the environmental effects of implementing the proposed action are less than those of not implementing the policy.

H. Environmental Effects of Proposed Action and Policy-Not-Implemented for Delay of Disposition Facility to Year 2010

The preceding section discusses the environmental effects of the proposed action (interim storage of domestic and foreign spent fuel) and not implementing the policy assuming initial operation of the first disposition facility by the year 1995. Between the time the draft Domestic and Foreign EISs were published and the final EIS completed, DOE recognized that the first repository might not be in operation until after the year 1995 and therefore extended the analysis given in the Draft EISs. The delay in repository startup would increase the amount of domestic spent fuel stored, the number of facilities required, and increase the average storage period. The alternatives analyzed for the U.S. and foreign fuels are comparable to those described in Section G of this volume with the following three exceptions

TABLE 10

Major Environmental Effects of Proposed Action and Policy not Implemented[a] — Alternatives 1 and 2

	Proposed Action[b]			*Policy Not Implemented*			
	Domestic Fuel	*Foreign Fuel*	*Total*	*Domestic Fuel*	*Foreign Fuel*	*Total*	*Background Effect*
World Population Whole Body Dose Commitment,[c] man-rem	9×10^3-2×10^4	1.0×10^2	1-2×10^4	9×10^3-3×10^4	2.5	9×10^3-3×10^4	2×10^{11} (both rows)
Occupational Exposure, man-rem	1-5×10^3	4.7×10^2	1.5-5.5×10^3	1-3×10^4	16	1-3×10^4	
World Health Effects[d]	9-16	<1	10-17	9-32	<1	9-32	1.2×10^8
World Accidental Deaths	14-17	<1	15-18	14-42	<1	14-42	2.4×10^5 [e]

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a. With Disposition Facility startup in the year 1995.

b. Includes environmental impacts of interim storage of foreign spent fuel received in the U.S.

c. Whole body dose during the operating period plus the next 100 years.

d. Serious genetic and somatic health effects were calculated from radiation doses, assuming a linear dose-health effect relation. EPA dose-effect factors were used.

e. Accidental occupational deaths in U.S. during the period.

- The disposition facility startup is delayed until the year 2010

- The environmental effects of U.S. spent fuel are determined using current DOE predictions of amount of electric power generation, the amount of spent fuel expected to be stored in reactor discharge basins, and the amount of spent fuel storage capacity expected to be required if utilities maintain the capacity in reactor discharge basins for full core discharge

- The environmental effects of foreign spent fuel are determined for Option 2 fuel flows continuing through the year 2000 and then no more foreign involvement under this policy.

The combined environmental effects of the proposed action with delay of startup of the first U.S. disposition facility until the year 2010 are given in Table 11. (Values from Table 10 in the previous section cannot be directly compared to values from Table 11 because different fuel flows and time frames are assumed.)

Table 11 includes only the environmental effects associated with interim storage of spent fuels. Also given in Table 11 are the combined environmental effects that could be expected if the policy were not implemented. To place these major effects into perspective, the last column of Table 11 gives the dose commitment to the same world population from natural background radiation and the expected health effects that would result. The accidental deaths are compared with the occupational deaths expected in the U.S. during the same period. The U.S. occupational deaths are used for comparison since comparable world effects are not available. World effects would be significantly higher. A comparison of these background effects will readily show that the environmental effects of either implementing or not implementing the Spent Fuel Storage Policy are a small fraction of the exposure of health effects to the same population from natural radiation sources and the number of nonradiation-related fatalities expected. As can be seen from Table 11, the environmental effects of implementing the proposed action are less than those of not implementing the policy.

TABLE 11

Major Environmental Effects of Proposed Action and Policy Not Implemented for 2010 Startup of Disposition Facility

	Proposed Action[a]			*Policy Not Implemented*[a]			
	Domestic Fuel	*Foreign Fuel*	*Total*	*Domestic Fuel*	*Foreign Fuel*	*Total*	*Background Effect*
World Population Whole Body Dose Commitment,[b] man-rem	$5x10^4$	$1x10^3$	$5x10^4$	$5-9x10^4$	9	$5-9x10^4$	$4x10^{11}$ (combined)
Occupational Exposure, man-rem	$1-2x10^4$	$4x10^2$	$1-2x10^4$	$2-9x10^4$	43	$2-9x10^4$	
World Health Effects[c]	34-38	1.0	35-39	38-113	<1	38-113	$2x10^8$
World Accidental Deaths	20-26	<1	21-27	26-112	<1	26-112	$6x10^5$[d]

a. Includes environmental impacts of interim storage of foreign spent fuel received in the U.S.

b. Whole body dose during the operating period plus the next 100 years.

c. Serious genetic and somatic health effects were calculated from radiation doses, assuming a linear dose-health effect relation. EPA dose-effect factors were used.

d. Accidental occupational deaths in U.S. during the 48-year operating period.

APPENDIX A

U.S. SPENT FUEL STORAGE POLICY (DOE Press Release)

OCTOBER 18, 1977

DOE ANNOUNCES NEW SPENT NUCLEAR FUEL POLICY

WASHINGTON, D.C. -- The Department of Energy today announced that the Federal Government is proposing to accept and take title to used, or spent nuclear reactor fuel from utilities on payment of a one-time storage fee.

On April 7, 1977, President Carter announced that the United States would defer indefinitely all civilian reprocessing of spent nuclear fuel. He also asked other countries to join the U.S. in defering use of this technology in order to evaluate alternative fuel cycles and processes which may reduce the risk of nuclear weapons proliferation. These initiatives are critical if the U. S. and other countries are to act responsibly to address proliferation risks associated with future developments in nuclear power technologies.

Storage of spent nuclear fuel, however, is an issue which cannot await the outcome of longer term studies for interim resolution. Currently utilities are faced with the prospect of storing the fuel discharged from reactors for an indefinite period with no approved plan for ultimately disposing of it. This produces an increasing uncertainty in the utilities' economic calculations, making advance planning difficult.

(more)

The new policy approved by the President is a logical extension given the indefinite deferral of reprocessing of the long-established federal responsibility for permanent disposal of high-level wastes. The policy will also remove the uncertainty faced by utilities by having the Federal Government accept and take title to spent reactor fuel upon payment of a one-time storage fee. It is important, however, that the utilities pay the full costs of nuclear waste storage and ultimate disposal.

Under this new policy, spent fuel transferred to the U. S. Government must be delivered to a government-approved storage site at user expense. The one-time storage fee will cover the full cost of the government of providing for interim storage and permanent disposal of the spent fuel should that be required. No credit will be included for either the plutonium or uranium contained in the fuel. If, at some time in the future, the U. S. should decide that commercial reprocessing or other energy recovery methods for spent fuel can be accomplished economically and without serious proliferation risks, the spent fuel could either be returned with an appropriate storage charge refund, or compensation could be provided for the net fuel value.

In order to implement this policy, the Government will need both interim and permanent spent fuel storage capability. The Department of Energy will begin immediately discussions with private industry to determine whether suitable interim fuel storage services can be provided to the government on a contract basis. Utilities will be surveyed to provide an estimate of the amount and timing of spent fuel transfer to

(more)

the Government. If adequate private storage services cannot be provided, Government interim fuel storage facilities would be required.

Questions surrounding the permanent disposition of nuclear wastes have not yet been resolved. Different options for a retrievable permanent repository are being evaluated. Such facilities would be owned by the Government. The Department of Energy places high priority upon development of permanent disposal systems for nuclear wastes.

Preliminary estimates of storage and disposal costs indicate that the total fee should add less than 1 mill per kilowatt hour to nuclear power electricity costs, which are now about 40 mills per kilowatt hour to the consumer. The Department of Energy will develop detailed storage and disposal costs estimates which will be published for comment prior to official adoption. It is anticipated that this cost schedule will be published for comment early next year.

Although this spent fuel policy will have its primary impacts domestically, the U. S. Government also intends, in support of its non-proliferation goals, to extend the offer to foreign users on a limited basis. At the same time, the U. S. is encouraging other nations to expand their own storage capacity and is strongly supporting the study of regional or international storage sites.

Under this policy, the U. S. would be prepared to store limited foreign spent fuel when this action would contribute to meeting non-proliferation goals. The U.S.'s ability to negotiate more effective non-proliferation measures with foreign countries and to prevent premature entry into the

(more)

plutonium economy will be enhanced by this policy. It is expected that foreign spent fuel will be a small part of the total spent fuel stored in the U. S.

Although specific details remain to be worked out, arrangements for storage of spent fuel from foreign users would probably be on the same terms as domestic spent fuel, subject to appropriate limitations established later.

The Department of Energy will work closely with the Congress, state governments, other agencies, utilities, industry, the public, and, in conjunction with the State Department, with foreign partners, in working out the details and implementation of the policy. As part of this process the Department of Energy intends to assess the environmental impacts of implementing the policy. In preparing the appropriate statements the Department will draw upon existing and ongoing studies done by the several cognizant Federal agencies.

A briefing will be held for interested individuals and organizations on Wednesday, October 26, at 10 A.M. in the National Guard Memorial Auditorium, One Massachusetts Avenue, N.W., Washington, D. C.

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October 18, 1977

APPENDIX B

PROPOSED SPENT NUCLEAR FUEL ACT OF 1979

96TH CONGRESS
1ST SESSION

H.R. 2586

To provide for the timely management of the spent fuel from nuclear reactors.

IN THE HOUSE OF REPRESENTATIVES

MARCH 1, 1979

Mr. STAGGERS (for himself and Mr. DEVINE) (by request) introduced the following bill; which was referred jointly to the Committees on Interior and Insular Affairs and Interstate and Foreign Commerce.

A BILL

To provide for the timely management of the spent fuel from nuclear reactors.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Spent Nuclear Fuel Act of 1979".

SEC. 2. Section 161 of the Atomic Energy Act of 1954 is amended by adding the following subsection:

"x. enter into contracts, for such periods of time as the Secretary of Energy deems necessary or desirable, to take title to, and to provide interim storage and ultimate disposal of spent fuel from foreign and domestic nuclear reactors: *Provided*, That (i) charges for services under this subsection shall be established on a nondiscriminatory basis; (ii) charges shall be subject to prepayment; and (iii) charges established under this subsection shall defray all costs of storage and ultimate disposal: *And provided further*, That contracts entered into pursuant to this subsection may provide for refund of an appropriate portion of the charges in the event that it is determined that spent fuel may be reprocessed and the spent fuel is returned to the former owner or reprocessed in the United States".

SEC. 3. Chapter 19 of the Atomic Energy Act of 1954 is amended by adding thereto the following sections:

"SEC. 264. SPENT FUEL STORAGE AND DISPOSAL FUND. —

"a. The Secretary of Energy (hereinafter referred to as the 'Secretary') is authorized to establish a fund to be used as a revolving fund to finance activities relating to the storage and disposal of spent nuclear fuel (hereafter referred to as the 'Fund'). The Fund shall consist of (1) all receipts, collections, and recoveries of the Secretary in cash from the exercise of the authority granted to him under subsection 161 x. of this Act; (2) proceeds from the investment by the Secretary of any moneys of the Fund; and

(3) all proceeds derived from the sale of bonds by the Secretary pursuant to section 265.

"b. The Secretary may make expenditures from the Fund without fiscal year limitation, but within such specific directives or limitations as may be included in appropriation Acts, for any purpose necessary or appropriate to the conduct of the Secretary's functions and activities for the provision of services for the interim storage and ultimate disposal of spent fuel from foreign and domestic nuclear reactors, including but not limited to, the acquisition, construction, operation, maintenance, and surveillance of facilities and real property for the interim storage or ultimate disposal of spent fuel from foreign and domestic nuclear reactors, the procurement of spent nuclear fuel interim storage services for such periods of time as the Secretary deems necessary or desirable; the making of refunds under contracts executed pursuant to subsection 161 x. of this Act, and for paying the interest on, and principal of all bonds issued under section 265 of this Act: *Provided, however*, That until expressly authorized by Congress, no expenditures can be made from the Fund for the construction of a repository for the ultimate disposal of spent fuel from foreign and domestic reactors.

"c. The provisions of the Government Corporation Control Act (31 U.S.C. 841 et seq.) shall be applicable to the Secretary in his utilization of the Fund in the same manner as they are applied to the wholly owned Government corporations named in section 101 of such Act (31 U.S.C. 846).

"d. If the Secretary determines that the moneys of the Fund are in excess of current needs he may request the investment of such amounts as he deems advisable by the Secretary of the Treasury in obligations of the United States with maturities suitable for the needs of the Fund and bearing interest at rates determined by the Secretary of the Treasury taking into consideration the current average market yield on outstanding marketable obligations of the United States with remaining period to maturities comparable to the maturities of such investments: *Provided, however,* That the interest rate on such investments shall not exceed the average interest rate applicable to existing borrowings.

"SEC. 265. REVENUE BONDS. —

"a. The Secretary is authorized to issue and sell to the Secretary of the Treasury from time-to-time, bonds, notes, and other evidences of indebtedness (collectively referred to herein as 'bonds') to assist in financing the acquisition, construction, operation, maintenance, and surveillance of facilities and real property for the interim storage or ultimate disposal of spent fuel from foreign or domestic nuclear reactors; the procurement of spent nuclear fuel interim storage services and to issue and sell bonds to refund such bonds. Such bonds shall be in such forms and denomination, bear such maturities, and be subject to such terms and conditions as may be prescribed by the Secretary of the Treasury taking into account terms and conditions prevailing in the market for triple-A rated nongovernment utility bonds and the useful life of the facilities for which the bonds are issued. Any refunding provisions may be prescribed by the Secretary. Such bonds shall bear interest at a rate determined by the Secretary of the Treasury, taking into consideration the current average market yield on outstanding marketable obligations of the United States of comparable maturities, plus an amount in the judgment of the Secretary of the Treasury to provide for a rate comparable to the rate in the prevailing market for triple-A rated nongovernment utility bonds. The aggregate principal amounts of any such bonds shall not exceed $300,000,000. All borrowing authorized in the subsection shall be available only to such extent or in such amounts as contained in appropriations Acts.

"b. The Secretary of the Treasury shall purchase any bonds issued by the Secretary under this section and for that purpose is authorized to use as a public debt transaction the proceeds from the sale of any securities issued under the Second Liberty Bond Act, as now or hereafter in force, and the purposes for which securities may be issued under the Second Liberty Bond Act, as now or hereafter in force, are extended to include any purchases of the bonds issued by the Secretary under this section. The Secretary of the Treasury may, at any time, sell any of the bonds acquired by him under this section. All redemptions, purchases, and sales by the Secretary of the Treasury of such bonds shall be treated as public debt transactions of the United States."

APPENDIX C

LIST OF COMMENTORS ON EISs ON STORAGE OF SPENT FUEL

APPENDIX C

LIST OF COMMENTORS ON EISs ON STORAGE OF SPENT FUEL

No.	Date	Received	Organization	Name of Individual	No. of Pages	Reports Affected: Domestic	Domestic Supplement	Foreign	Charge	Policy General
1	10/20/78	11/21/78	North Dakota State Planning Division State Intergovernmental clearinghouse	Mrs. Leonard E. Banks Associate Planner	3	x				
2	10/10/78	11/21/78	Department of Health, Education & Welfare Public Health Service	Mr. Charles L. Weaver Consultant	2	x				
2 (Supplement)	3/22/79	3/29/79	Department of Health, Education & Welfare	L. David Taylor, Deputy Asst. Secretary for Management Analysis & Systems	2		x	x		
3	10/30/78	11/21/78	New Mexico State Clearinghouse Dept. of Financing & Administration Planning Division	Mr. Jack M. Mobley Planning Bureau	4	x				
3 (Supplement)	2/9/79	3/1/79	State Clearinghouse, New Mexico	Jack M. Mobley, Planning Bureau	8		x	x	x	
4	11/10/78	11/21/78	Vermont State Clearinghouse State Planning Office	Mr. John E. Holmberg State AGS Coordinator	2	x				
5	11/16/78	11/21/78	Natural Resources Defense Council, Inc.	Mr. Arthur R. Tamplin	11 + 14 Attachment	x				
6	11/15/78	11/29/78	Maryland Dept. of State Planning	Vladimir Wahbe Sec. of State Planning	3	x				
7	11/8/78	11/29/78	State of Illinois Clearinghouse Bureau of the Budget	Mr. T. E. Kornbacker Director	3	x				
8	11/21/78	12/19/78	South Dakota Planning Bureau	Mr. Steve Merrick Commissioner	1	x				
9	12/4/78	12/19/78	Arizona State Land Dept.	Ms. Peggy Spaw Administrative Asst.	1	x				
10	12/8/78	12/19/78	U.S. Dept. of Interior	Mr. Larry L. Meierotta Deputy Asst. Secretary	2	x				

APPENDIX C, Contd

No.	Date	Received	Organization	Name of Individual	No. of Pages	Reports Affected: Domestic	Domestic Supplement	Foreign	Charge	Policy General
11	11/22/78	12/26/78	American Small Farm Institute	Mr. Ellery W. Newton Founder-Director	2	x				
12	12/20/78	1/24/79	Arizona State Clearinghouse	Ms. Jo Ann Youngblood	6	x				
12 (Supplement-1)	2/22/79	2/28/79	Arizona State Clearinghouse	Ms. Jo Ann Youngblood	20		x			
12 (Supplement-2)	3/6/79	3/7/79	Arizona State Clearinghouse	Ms. Jo Ann Youngblood	17			x		
13	1/18/79	1/26/79	Florida State Planning Div.	Mr. R. G. Whittle, Jr. Director	5	x				
14	11/22/78	12/6/78	Seattle, WA	Mr. Wayne Iverson	2					x
15	1/3/79		Philadelphia, PA	Mr. Marvin I. Lewis	2	x	x	x		
16	1/18/79	1/23/79	North Dakota State Planning Division	Mr. Leonard E. Banks Associate Planner	5		x	x	x	
17	1/18/79	1/29/79	New Mexico Department of Finance & Administration	Mr. Jack M. Mobley Planning Bureau	14		x	x	x	
18	1/19/79	2/5/79	Research & Special Programs Administration, Department of Transportation	Mr. Alan I. Roberts Associate Director for Hazardous Materials Regulation	1			x		
19	1/25/79	1/31/79	Office of Administration State of Missouri	Ms. Lois Pohl, Chief Grants Coordination	7	x		x	x	
20	1/29/79		Friends of the Earth	Ms. Lorna Salzman	2	x				
21	1/31/79	2/15/79	Maryland Department of State Planning	Mr. James W. McConnaughhay Chief, State Clearinghouse	3		x	x		
22	2/2/79	2/15/79	State of Connecticut, Office Policy & Management	Mr. Aden H. Maben	2	x	x	x	x	
23	2/7/79	2/16/79	State of Washington, Office of Financial Management	Mr. Thomas A. Mahar Assistant Director	3	x		x	x	

APPENDIX C, Contd

No.	Date	Received	Organization	Name of Individual	No. of Pages	Reports Affected: Domestic	Domestic Supplement	Foreign	Charge	Policy General
24	2/7/79	2/21/79	State of New Mexico, Dept. of Finance & Administration	Mr. Jack M. Mobley Planning Bureau	5			x		
25	2/8/79	2/14/79	Arizona State Clearinghouse	Ms. Jo Ann Youngblood	34			x		
26	2/8/79	2/16/79	Oregon Intergovernmental Relations Division	Ms. Kay Wilcox A-95 Coordinator	5	x				
27	2/9/79	2/16/79	Consumers Power Company	Mr. Stephen H. Howell Senior Vice President	4	x	x		x	
28	2/9/79	2/16/79	State of Florida Department of Administration Division of State Planning	Mr. R. G. Whittle, Jr. Director	6	x				
29	2/9/79	2/22/79	Portland General Electric Co.	Mr. W. J. Lindbland Vice President Engineering-Construction	7	x	x		x	
30	2/12/79	2/16/79	Lower Alloways Creek Township	Mr. Samuel E. Donelson Mayor	3	x				
31	2/12/79	2/21/79	Northeast Utilities	Mr. W. G. Counsil Vice President Nuclear Engineering & Operations	9	x	x	x	x	
32	2/13/79	2/22/79	State of New York, Department of Environmental Conservation	Mr. M. Peter Lanahan, Jr. First Deputy Commissioner	12	x	x	x		
33	2/14/79	2/21/79	Arms Control & Disarmament Agency	Mr. Thomas Graham, Jr.	2	x		x	x	
34	2/15/79	2/15/79	Commonwealth of Virginia	Mr. J. B. Jackson, Jr. Administrator	10	x		x	x	
35	2/15/79	2/22/79	University Park, PA	Mr. William A. Lochstet	8	x	x			
36	1/31/79	2/8/79	--	R. W. Kleimola	1					x
37	undated	2/26/79	Houston, TX	William A. Brant, Attorney-at-Law	2	x	x	x	x	

APPENDIX C, Contd

No.	Date	Received	Organization	Name of Individual	No. of Pages	Reports Affected: Domestic	Domestic Supplement	Foreign	Charge	Policy General
38	2/11/79	2/22/79	Sierra Club	Richard Worthen, Chairman Piasa Palisades Group	2	x				
39	2/12/79	2/23/79	Arizona Nuclear Power Project	E. E. Van Brunt, Jr. Vice President Nuclear Projects	2	x				
40	2/12/79	2/26/79	Spring, TX	Dean A. Zajicek	2	x				
41	2/14/79	2/23/79	Atomic Industrial Forum, Inc.	Edwin A. Wiggin Executive Vice President	26	x	x	x	x	
42	2/14/79	2/28/79	American Small Farm Institute	Ellery W. Newton Founder and Director	1		x		x	
43	2/15/79	2/28/79	Public Service Electric & Gas Company	R. A. Uderitz General Manager, Fuel Supply	2				x	
44	2/15/79	2/28/79	Westinghouse Electric Corp.	J. S. Moore General Manager	3	x	x	x		
45	2/15/79	2/28/79	Lowenstein, Newman, Reis, Axelrad & Toll, Attorney for Utility Waste Management Group	Marice Axelrad Principal	7	x	x	x	x	
46	2/15/79	2/28/79	Exxon Nuclear Company, Inc.	R. Nilson, Manager Licensing	1	x	x			
47	2/15/79	2/26/79	Edison Electric Institute	John J. Kearney Senior Vice President	44	x	x	x	x	
48	2/23/79	2/28/79	Natural Resources Defense Council, Inc.	S. Jacob Scherr Thomas B. Cochran Gregory A. Thomas	18			x		
49	2/22/79		United States Environmental Protection Agency	William N. Hedeman, Jr. Director Office of Federal Activities	8	x	x			

No.	Date	Received	Organization	Name of Individual	No. of Pages	Reports Affected: Domestic	Domestic Supplement	Foreign	Charge	Policy General
50	2/22/79		United States Environmental Protection Agency	William H. Hedeman, Director Office of Federal Activities	15			x		
50 (Supplement)	3/13/79	3/23/79	United States Environmental Protection Agency (SAI Review)	Robert H. Fuhrman Policy Planning Division	42			x		
51	2/7/79	3/2/79	Office of the Governor, State of Texas	Tom B. Rhodes, Director Budget & Planning Office	16	x	x	x	x	
52	2/12/79	3/7/79	Beaumont, TX	John E. Barry	4			x	x	
53	2/12/79	3/2/79	Ohio Environmental Protection Agency	James F. McAvoy, Director	5	x	x	x		
54	2/12/79	2/28/79	The Committee for a Better Environment	John Vig, Director	7		x	x	x	
55	2/13/79	3/7/79	Consolidated Edison Company of New York, Inc.	William J. Cahill, Jr. Vice President	2					x
56	2/13/79	3/7/79	State Grant-In-Aid Clearing-house, State of Oklahoma	Don N. Strain, Director	1					x
57	2/14/79	2/28/79	Colorado Division of Planning	Stephen O. Ellis Principal Planner	18	x	x	x	x	
58	2/14/79	3/2/79	Southern California Edison Co.	J. H. Drake Vice President	1					x
59	2/15/79	3/2/79	Commonwealth Edison	Cordel Reed Assistant Vice President	3	x	x			
60	2/79	3/2/79	Citizens for a Better Environment	Peter Cleary, Staff Physicist	6	x				
61	2/15/79	3/7/79	Carolina Power & Light Co.	E. E. Utley Senior Vice President Power Supply	3	x	x	x	x	
62	2/15/79	3/2/79	Columbia, South Carolina	Ruth S. Thomas	3					x

APPENDIX C, Contd

No.	Date	Received	Organization	Name of Individual	No. of Pages	Reports Affected: Domestic	Domestic Supplement	Foreign	Charge	Policy General
63	2/15/79	3/2/79	Duke Power Company	Austin C. Thies Senior Vice President Production and Transmission	4	x		x	x	
64	2/16/79	3/2/79	Virginia Electric & Power Co.	W. N. Thomas, Vice President Fuel Resources	4	x	x	x	x	
65	2/20/79	3/2/79	Department of Environmental Protection, State of New Jersey	Lawrence Schmidt, Chief Office of Environmental Review	6	x		x	x	
66	2/20/79	3/7/79	Washington Public Power Supply System	D. L. Renberger Assistant Director, Technology	6	x	x	x	x	
67	2/20/79	3/2/79	Houston Lighting & Power Co.	G. W. Oprea, Jr. Executive Vice President	2	x	x			
68	2/22/79	3/2/79	Department of Commerce	Sidney R. Galler Deputy Assistant Secretary for Environmental Affairs	4	x				
69	2/23/79	3/7/79	Department of the Interior	Larry E. Meierotto Deputy Assistant Secretary	1	x				
70	2/27/79	3/2/79	Nuclear Regulatory Commission	Voss A. Moore, AD for Environmental Projects	23	x	x	x	x	
71	3/2/79	3/12/79	Department of Environmental Conservation, State of New York	M. Peter Lanahan, Jr. First Deputy Commissioner	5	x	x		x	
72	3/6/79	3/16/79	Environmental Protection Agency	William N. Hedeman, Jr.	3			x		
73	3/8/79	3/16/79	Tennessee Valley Authority	Harry G. Moore, Jr.	3	x				
73 (Supplement)	3/30/79	4/6/79	Tennessee Valley Authority	Harry G. Moore, Jr. Acting Director of Environmental Compliance	5		x	x	x	
74	2/2/79	3/16/79	Oklahoma City, Oklahoma	Ilene Younghein	6+ Attachment	x		x	x	

APPENDIX C, Contd

No.	Date	Received	Organization	Name of Individual	No. of Pages	Reports Affected: Domestic	Domestic Supplement	Foreign	Charge	Policy General
75	2/6/79	3/26/79	The Resources Agency of California	L. Frank Goodson Assistant Secretary for Resource	2	x				
75 (Supplement)	3/13/79	3/22/79	The Resources Agency of California	L. Frank Goodson Assistant Secretary for Resource	2		x	x	x	
76	3/9/79	3/26/79	State of South Carolina	Elmer C. Whitten, Jr. Grants Coordinator	3		x	x	x	
77	1/10/79	-	Natural Resource Defense Council	Anthony Z. Roisman	15		x			
78	3/19/79	-	Natural Resource Defense Council	Thomas B. Cochran	9					x

APPENDIX D

LIST OF PREPARERS AND REVIEWERS OF DRAFT EISs AND THE FINAL EIS

The Council on Environmental Quality (CEQ) regulations (40 CFR 1500) for implementing the procedural provisions of the National Environmental Policy Act (NEPA) require that environmental impact statements (EIS) include a list of the names, together with qualifications (expertise, experience, professional disciplines), of the persons responsible for preparing the environmental impact statement or significant background papers related to that statement. Table D-1 provides a listing of preparers of the draft and final EIS on the Spent Fuel Storage Policy. Although these regulations do not apply to the EIS, Table D-2 lists areas of responsibility for the EIS and professional qualifications for each preparer. Table D-3 provides a list of reviewers who had significant input into the scope and content of the EIS and assisted in DOE's evaluation of the EIS prior to its approval.

TABLE D-1

List of Preparers

EIS Preparers	Domestic EIS DOE/EIS-0015-D	Domestic Supplement DOE/EIS-0015-DS	Foreign EIS DOE/EIS-0040-D	Charge EIS DOE/EIS-0041-D	Final EIS DOE/EIS-0015
W. L. Poe	x	x	x		x
R. W. Kupp				x	x
C. E. Bailey			x		
W. H. Baker	x	x			
R. W. Benjamin		x			
D. M. Chavis	x	x	x		x
F. E. Driggers	x				
F. R. Field (deceased)	x				
W. A. Franks				x	
P. L. Gray					x
L. A. Heinrich	x		x		
W. G. Holmes	x	x	x		
R. T. Huntoon					x
F. D. King	x				
W. L. Marter	x	x	x		x
E. Milenky			x		x
P. E. Miller	x				
R. A. Moyer	x	x	x		x
G. F. O'Neill			x		
W. L. Pillinger	x	x	x		x
L. Pullman				x	
W. C. Reinig	x	x	x		
L. Rutland				x	
A. T. Stephenson					x
C. C. Stanton				x	x
S. M. Stoller				x	x
T. T. Thompson		x			

TABLE D-2

Professional Qualifications and Responsibilities

NAME

William Lee Poe, Jr.

EDUCATION

BS Chemistry, Tulane University, New Orleans, LA; MS Chemical Engineering, University of Alabama, Tuscaloosa, AL

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Staff Engineer, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

6 years — Short- and long-range environmental planning related to SRP operations and nuclear power reactor spent fuel waste storage (primarily interim storage)

4 years — Long-range technical, financial, and strategic planning related to SRP's production and AEC (ERDA) complex production planning

17 years — Technology development and technical assistance related to heavy water production and chemical separation production (fuel reprocessing)

EIS RESPONSIBILITIES

Coordinated and managed both technical and administrative portions of preparation of the drafts of the Domestic, Domestic Supplement, and Foreign EISs and preparation of Volumes 1, 2, 3, and 5 of the final EIS. Coordinated Volumes 1, 2, 3, and 5 of the final EIS with Volume 4 (prepared by S. M. Stoller Corporation). Also prepared analyses and sections on disposition facilities and disposal in the geologic repository in the draft EISs and final EIS.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

Analytical Methodology and Facility Description — Spent Fuel Policy. USDOE Report DOE-ET-0054.

NAME

Robert William Kupp

EDUCATION

BS Chemical Engineering, Wayne State University, Detroit, MI

CERTIFICATION

Licensed Professional Engineer, New York State and Colorado

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Adjunct Professor of Nuclear Engineering, Polytechnic Institute of New York, Brooklyn, NY

Vice President, The S. M. Stoller Corporation, New York, NY

20 years — Directs engineering execution of all SMSC assignments, including power reactor, reprocessing and waste management systems. Directed the development of several utility financial models, addressing such areas as nuclear fuel lease evaluation, and risk analysis for procuring enrichment services.

13 years — Studies in hazards analysis, heat transfer, health physics, and waste disposal incident to design of research and power reactors, radiological laboratories, and fuel cycle facilities.

2 years — Operations Supervisor, Gaseous Diffusion Plant, Oak Ridge, TN

EIS RESPONSIBILITIES

Directed preparation of the draft Charge EIS and was principal author of the Costing Development and Implementation Sections. Responsible for incorporation of public comments into and preparation of Volume 4 of the final EIS.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

Charles Edward Bailey

EDUCATION

BS Chemistry, University of Tennessee, Knoxville, TN; MS Chemistry, University of Tennessee, Knoxville, TN; PhD Physical Chemistry, University of Tennessee, Knoxville, TN

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Staff Chemist, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

3 years – Development of models and computer programs to determine the dose-to-man from releases of radioactive materials to the environment

2 years – Short- and long-range environmental planning related to SRP operations and nuclear power reactor spent fuel waste storage

3 years – Long-range technical, financial, and strategic planning related to SRP's production program

12 years – Nuclear Reactor Safety, Reactor Kinetics and Dynamics. Responsible for preparation of Safety Analysis reports.

EIS RESPONSIBILITIES

Assisted in preparation of all portions of the draft Foreign EIS with particular emphasis on Section III.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

William Hubert Baker

EDUCATION

BS Mechanical Engineering, Virginia Polytechnic Institute, Blacksburg, VA; MS Nuclear Engineering, Virginia Polytechnic Institute, Blacksburg, VA

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Staff Engineer, Savannah River Plant, E. I. du Pont de Nemours and Company, Aiken, SC

1 year – Technical support for spent fuel storage

18 years – Technology development and technical assistance for isotope production and related problems.

2 years – Instructor, Mechanical Engineering Department, Virginia Polytechnic Institute teaching thermodynamics, mechanisms, turbomachinery

EIS RESPONSIBILITIES

Prepared analyses and sections on underwater storage facilities for spent LWR fuel.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

Spent Fuel Storage Fact Book (to be published).

Analytical Methodology and Facility Description – Spent Fuel Policy. USDOE Report DOE-ET-0054.

Alternatives for Managing Wastes from Reactor and Post-Fission Operation in the LWR Fuel Cycle, Section 17, Volume 3, Interim Storage of Spent Fuel Elements. USERDA Report ERDA-76-43.

"Capabilities for Processing Shipping Casks at Spent Fuel Storage Facilities." 1978 Annual Meeting of ANS, San Diego, CA, June 1978. CONF-780622-33.

"Interim Storage of Spent Fuel Assemblies." International Symposium on the Management of Waste from the LWR Fuel Cycle, Denver, CO, July 1976. CONF-760701-8.

Spent Fuel Handling and Storage Facility for an LWR Fuel Reprocessing Plant. DPSTD-AFCT-77-7.

NAME

Richard Walter Benjamin

EDUCATION

BS Mechanical Engineering, Lamar State College of Technology, Beaumont, TX; MS Nuclear Engineering, Southern Methodist University, Dallas, TX; PhD Physics, The University of Texas, Austin, TX

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Staff Physicist, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

2 months — Defense waste disposal studies

3 months — Decommissioning costs for nuclear facilities

1 year — Development of techniques and instrumentation for activation analysis and x-ray fluorescence

1 year — Studies of the proliferation resistance of alternative nuclear fuel cycles

3 years — Radiation dosimetry for biophysics experiments

8 years — Nuclear reactor production studies

18 years — Experimental and theoretical nuclear data work

EIS RESPONSIBILITIES

Assisted with the preparation and review of the Supplement to the draft Domestic EIS.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

Doris McCormick Chavis

EDUCATION

BA English, University of South Carolina, Columbia, SC

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Editor, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

3 years — Editor of technical reports for the Savannah River Laboratory

5 years — Teacher of English and Spanish at Aiken High School, SC

7 years — Technical report typing and preparation

EIS RESPONSIBILITIES

Supervised the editing, styling, typing, and illustrating of the draft of the Supplement to the Domestic EIS and the draft Foreign EIS and of Volumes 1, 2, 3, and 5 of the final EIS. Performed a technical review of comment letters and assisted in the identification and listing of pertinent comments. Reviewed the draft Charge EIS and suggested changes which resulted in improved continuity with Volumes 1, 2, 3, and 5 of the final EIS.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

Analytical Methodology and Facility Description — Spent Fuel Policy. USDOE Report DOE-ET-0054.

NAME

Frank Edgar Driggers

EDUCATION

BS Physics, University of California, Berkeley, CA; MS and PhD, Physics, University of Michigan, Ann Arbor, MI

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Research Associate, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

2 years — Facility Characterization and Proliferation Resistance of nuclear fuel cycles

3 years — Commercial nuclear fuel cycle economic studies

2 years — SRP representative on AEC Combined Operations Planning Group at Oak Ridge

11 years — Savannah River Plant production and cost studies

1 year — Liaison with AECL at Ghalk River, Canada

12 years - Theoretical reactor physics

EIS RESPONSIBILITIES

Developed initial schedule for fuel deliveries to the ISFS for alternatives considered in the draft Domestic EIS.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

"Economics of Water Basin Storage of Spent Light Water Reactor Fuel, 1978." ANS Annual Meeting, San Diego, CA, June 18-23, 1978. CONF-80622-35.

NAME

Frank Remsen Field, Jr. (now deceased)

EDUCATION

BS Chemical Engineering, Cornell University, Ithaca, NY

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Research Staff Physicist, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

1 year — Need and capacity for away-from-reactor spent fuel storage

2 years — Proliferation resistance characteristics of nuclear fuel cycles

3 years — Nuclear fuel cycle economic evaluations

9 years — Nuclear material production and cost studies

17 years — Nuclear reactor design and safety

EIS RESPONSIBILITIES

Developed initial schedule for fuel deliveries to the ISFS for alternatives considered in the draft Domestic EIS.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

Classified report relative to technical features of proliferation.

NAME

William Allen Franks

EDUCATION

BS Physics, Principia College, Elsah, IL; MS Nuclear Engineering, Columbia University, New York, NY

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Project Manager, The S. M. Stoller Corporation, New York, NY

2 years — Served as SMSC principal in DOE contracted studies to support the development of a "one-time-charge" and development of a computer program to evaluate the need for away-from-reactor spent fuel storage.

6 years — Coordinated client nuclear fuel procurement activities, authored, or contributed to SMSC uranium studies. Participated in SMSC efforts as an expert witness on behalf of the utilities in the Westinghouse Uranium Contracts Litigation, including presenting expert testimony during the trial in Federal District Court, Richmond, VA.

4 years — Participated in development of SMSC's proprietary nuclear reactor simulation code and related fuel management studies, including training utility clients in use of the system.

2 years — Detailed physics design and analysis of pressurized water reactor nuclear fuel cores.

EIS RESPONSIBILITIES

Prepared cost data sections of draft Charge EIS.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

Spent Fuel Storage Requirements — The Need for Away-From-Reactor Storage. USDOE Report DOE/ET-0075.

NAME

Peter Lansingh Gray

EDUCATION

BE Mechanical Engineering, Yale University, New Haven, CT

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Research Staff Chemist, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

1½ years — Licensing and quality assurance activities in support of DOE Spent Fuel Storage Program

2½ years — Supervision of mechanical, instrument, electrical, machine shop, operations, and custodial personnel in SRL Laboratory Services Division

6½ years — Supervision of and technical assistance in operation of SRL research reactors and subcritical facility. This included design and construction of physics experiments tested in these facilities.

4 years — Technical assistance in high flux research activities and operation of production reactors (SRP)

2 years — Technical assistance in heavy water power reactor program and operation of test reactor (HWCTR)

1½ years — U.S. Technical Liaison Representative for the startup of first Canadian power reactor (NPD)

8½ years — Technical assistance and technology development for production reactors (SRP) operation

1 year — Technical assistance for heavy water production

EIS RESPONSIBILITIES

Provided assistance in early organization of responses to public comments.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

Lawrence Allen Heinrich

EDUCATION

BS Engineering Physics, University of Kansas, Lawrence, KS

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Research Staff Physicist, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

10 years – Operations analysis and long-range strategic planning related to SRP and related industrial operations

14 years – Technology development and technical assistance for production reactor operation

4 years – Experimental Reactor Physics relating to the design and operation of production reactor lattices

EIS RESPONSIBILITIES

Analyses and draft preparation relating to safeguards topics in Domestic and Foreign EISs.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

Wilbur Garner Holmes, Jr.

EDUCATION

BS Chemical Engineering, Auburn University, Auburn, AL; MS, PhD Metallurgical Engineering, University of Michigan, Ann Arbor, MI

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Staff Engineer, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

3 years – Environmental planning and assessments related to SRP production and waste management operations, closing of the back-end of the LWR fuel cycle, and providing interim storage for spent fuel from nuclear power reactors.

22 years – Nuclear reactor fuel and target development, materials compatibility testing, and technical assistance to SRP operations.

EIS RESPONSIBILITIES

Contributed to sections describing alternatives and environmental tradeoffs for the drafts of the Domestic, Domestic Supplement, and Foreign EISs.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

Richard Thomas Huntoon

EDUCATION

BS and MS Metallurgical Engineering, Carnegie Institute of Technology, Pittsburgh, PA

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Research Manager, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

1 year — Managed effort on environmental analysis to support SRP programs

27 years — Performed, supervised, and managed R&D programs in support of all phases of production activities at the Savannah River Plant, including fuel fabrication, radiation damage, corrosion, hydrogen embrittlement, radioisotopic heat source development, and others.

EIS RESPONSIBILITIES

Provided senior management review of the final EIS and provided assistance in formulating the approach used in responding to the comments received on the draft EISs.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

Franklin Delano King

EDUCATION

BS Chemical Engineering, West Virginia University; MS Nuclear Engineering, West Virginia University

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Chief Supervisor, Savannah River Plant, E. I. du Pont de Nemours and Company, Aiken, SC

3 years — Program manager of and technical support for spent fuel storage

8 years — Research and long-range planning for isotope use and production

9 years — Technical assistance to reactor operation

EIS RESPONSIBILITIES

Managed the Away-From-Reactor Spent Fuel Storage Program in which the storage-related technical data were developed for the draft Domestic EIS.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

Spent Fuel Storage Fact Book (to be published)

Alternatives for Managing Wastes from Reactors and Post-Fission Operations in the LWR Fuel Cycle. USERDA Report ERDA-76-43.

"Status of Away From Reactor Spent Fuel Storage." 72nd Annual Meeting of the AIChE, San Francisco, CA, November 25-29, 1979.

Spent Fuel Handling and Storage Facility for the International Spent Fuel Storage Program. DPSTD-ISFS-78-7.

Spent Fuel Receipt and Lag Storage Facility for the Spent Fuel Handling and Packaging Program. DPSTD-SFHP-78-10.

"AFR Storage Basin Design for a Federal Site." ANS Transactions, Vol. 32, P 414, June 1979

Design Comparisons for Away-From-Reactor Spent Fuel Storage Basins. ANS Transactions, Vol. 28, P 331, June 1978.

"Design Bases for U.S. Department of Energy Storage Basin." NEA Seminar, Madrid, Spain, June 1978.

NAME

Walter Landreth Marter

EDUCATION

BS Chemical Engineering, Rensselaer Polytechnic Institute, Troy, NY

CERTIFICATION

Certified member of American Board of Health Physics

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Staff Engineer, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

8 years — Short- and long-range environmental analysis and planning related to SRP operations, LWR fuel recycling, and nuclear power reactor spent fuel storage

10 years — Supervisory responsibilities for SRP's environmental monitoring program and associated research

2 years — Health physics design liaison for new chemical processing facilities

8 years — Health physics supervisory responsibilities in reactor fuel and target manufacturing, reactor operation, chemical reprocessing of reactor fuel and targets, and research laboratories

4 years — Process engineering and quality control in manufacturing of photographic film

EIS RESPONSIBILITIES

Developed and utilized environmental dosimetry used in the Domestic, Domestic Supplement, and Foreign EISs. Developed environmental radionuclide release data for EISs. Also prepared sections on health effects and fuel reprocessing/MOX fuel fabrication facilities (Foreign EIS). Participated in preparation of draft and final EISs.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

Analytical Methodology and Facility Description — Spent Fuel Policy. USDOE Report DOE-ET-0054.

NAME

Edward Stuart Milenky

EDUCATION

BA Political Science and Economics, Tufts University, Medford, MA; MA, Fletcher School of Law and Diplomacy (International Relations); MALD, Fletcher School of Law and Diplomacy (International Relations); PhD Fletcher School of Law and Diplomacy (International Relations)

PROFESSIONAL DISCIPLINE AND EXPERIENCE

3 years — Foreign Affairs Officer, Office of International Affairs/Nuclear Affairs, US Department of Energy

7 years — Assistant Professor of Political Science at Boston College, Chestnut Hill, Massachusetts; Albion College, Albion, Michigan; Colby College, Waterville, Maine; Universided del Salvador, Buenos Aires, Argentine

EIS RESPONSIBILITIES

Prepared, coordinated, and reviewed policy sections of drafts of foreign EIS and executive summary, and replies to comments on these sections

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

Phillip Edward Miller, II

EDUCATION

BA Science Education, University of Northern Iowa, Cedar Falls, IA; MA Science Education, University of Iowa, IA; NSF Science Writing Intern, History of Science, University of Wisconsin, Madison, WI

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Senior Editor, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

2 years — Senior editor of technical reports for the Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

3 years — Editor, Agricultural Experimental Station, University of Minnesota, St. Paul, MN

6 years — Science editor and journalism teacher and writer for Michigan State University, East Lansing, MI

2 years — Biology instructor, Western Kentucky University, Bowling Green, KY

2 years — Teacher of chemistry and physics, Millersburg High School, IA

EIS RESPONSIBILITIES

Supervised the editing, styling, typing, and illustrating of the draft of the Domestic EIS.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

Richard Angstadt Moyer

EDUCATION

BS Engineering Physics, Lehigh University, Bethlehem, PA

CERTIFICATION

Certified member of American Board of Health Physics

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Research Engineer, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

3 years — Short- and long-range environmental planning related to SRP operations and nuclear power reactor spent fuel disposition by reprocessing or waste storage (primarily interim storage).

6 years — Special radiological engineering studies, including containment facilities design, instrumentation development and participation in design, testing, safety analysis, and performance testing for transplutonium shipping packages for onsite, offsite, and international shipping.

17 years — Radiation protection and radiological engineering for laboratory and process development operations, primarily with transuranic radioisotopes, including packaging and shipping of gases, liquids, and solids.

EIS RESPONSIBILITIES

Prepared the analyses and sections on transportation and institutional factors in the drafts of the Domestic, Domestic Supplement, and Foreign EISs and preparation of Volumes 1, 2, 3, and 5 of the final EIS.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

Analytical Methodology and Facility Description — Spent Fuel Policy. USDOE Report DOE-ET-0054.

NAME

George Francis O'Neill

EDUCATION

BS, St. Mary's College, Emmitsburg, MD; MS and PhD, Fordham University, Bronx, NY; Post-Doctoral, Columbia University, New York, NY

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Research Staff Physicist, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

24 years — Savannah River Laboratory - critical and exponential reactors (15 years), long-range planning for Savannah River operation (9 years).

2 years — Oak Ridge Atomic Energy Planning Group - strategic planning related to AEC (ERDA) complex production

3 years — Argonne National Laboratory - experimental nuclear reactor development

1 year — Brookhaven National Laboratory - charged particle reasearch

EIS RESPONSIBILITIES

Wrote sections of the foreign EIS DOE/EIS-0040-D

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

William Lewis Pillinger

EDUCATION

BS Physics, The Ohio State University, Columbus, OH; PhD Physics, The Ohio State University, Columbus, OH

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Research Physicist, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

4 years — Environmental analysis and planning related to SRP waste management operations and the interim storage of nuclear power reactor spent fuel

4 years — Surface physics studies of nuclear materials. Low energy electron diffraction, Auger spectroscopy and electron microprobe analysis

7 years — Research leading to the discovery of recoilless emission of nuclear gamma rays after alpha decay. Mössbauer spectroscopy of the actinides

9 years — Development of instrumentation for chemical separation facilities (fuel reprocessing). Calorimetry of tritium

EIS RESPONSIBILITIES

Provided environmental analysis and prepared portions of the drafts of the Domestic, Domestic Supplement, and Foreign EISs and Volumes 1, 2, 3, and 5 of the final EIS. Primary areas of responsibility were the commitment of resources for construction, operation, and decommissioning of facilities and the environmental effects from construction and decommissioning. Assisted in the preparation of DOE responses to public comments.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

Analytical Methodology and Facility Description — Spent Fuel Policy. USDOE Report DOE-ET-0054.

NAME

Louise (NMN) Pullman

EDUCATION

BS Mathematics, New Jersey College for Women (now Douglas College of Rutgers University, New Brunswick, NJ)
Graduate studies in Mathematics, Statistics, and Economics
Reactor Technology Course at Oak Ridge National Laboratory, Oak Ridge, TN

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Programmer and Statistician, The S. M. Stoller Corporation, New York, NY

7 years — Development and execution of computer programming methods for reactor calculations, fuel cycle cost calculations, and fuel cycle accounting

10 years — Development and execution of reactor calculation techniques

3 years — Actuarial, cost analysis, and economic research in bond market field

EIS RESPONSIBILITIES

Participated in developing the methodology for computing the Charge for Spent Fuel Storage and Disposal. Prepared Appendix A of the draft Charge EIS (Volume 4 of the final EIS), describing the methodology.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

William Charles Reinig

EDUCATION

B. Mechanical Eng., Brooklyn, NY Polytechnic Institute.

CERTIFICATION

Certified member of American Board of Health Physics.
Certified member of American Board of Industrial Hygiene.

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Superintendent of Health Protection Department, Savannah River Plant, E. I. du Pont de Nemours and Company, Aiken, SC

3 years — Short- and long-term environmental planning relating to SRP operations, LWR fuel cycle, and interim storage of spent power reactor fuel

30 years — Health Physics and Industrial Hygiene operations related to protection of workers and public from potential hazards of radioactive materials and other toxic materials.

EIS RESPONSIBILITIES

Provided senior management review of the drafts of the Domestic, Domestic Supplement, and Foreign EISs.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

Lawrence (NMN) Rutland

EDUCATION

BS Chemical Engineering (Nuclear Option), Polytechnic Institute of Brooklyn, Brooklyn, NY; MS Chemical Engineering, City University of New York, New York, NY

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Manager, Radioactive Waste Management Projects, The S. M. Stoller Corporation, New York, NY*

8 years — Design and management of radioactive waste treatment systems for nuclear power reactors. Prepared Safety Analysis Report for the transportation of irradiated fuel assemblies from a nuclear power reactor as well as the dismantlement plan and safety analysis for transportation of fissile material from a research reactor.

11 years — Analytical efforts in radiation shielding, reactor core physics, nuclear engineering and related safety studies, managed program to transfer fuel fabrication and management expertise to a client utility.

1 year — Participated in technical analyses and safety studies for nuclear power utilities.

1 year — Design of gamma irradiators and facilities.

EIS RESPONSIBILITIES

Prepared sections of the draft Charge EIS on Shipping Costs.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

* Currently with ANEFCO Corp., White Plains, NY

NAME

Catherine Colgan Stanton

EDUCATION

BS Mathematics, St. Joseph's College, Brooklyn, NY; MS Nuclear Engineering, Ohio State University, Columbus, OH

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Associate Engineer, The S. M. Stoller Corporation, New York, NY

5 years — Comparative analyses of environmental and health effects of alternate energy sources, technical support efforts for utilities party to NRC generic rulemaking hearings on the Uranium Fuel Cycle and Mixed Oxide Fuel Cycle.

3 years — Analysis of planned and operating reactor facilities in the areas of waste treatment and releases of radioactive materials, guidance of field monitoring programs to measure environmental radiation levels. Participated in studies related to sabotage, safeguards, and diversion of special nuclear materials at fixed sites and in transit.

1½ years — Licensing uses of radioactive material under New York State Agreement Program with (then) AEC.

EIS RESPONSIBILITIES

Prepared environmental effects section of draft Charge EIS and portions of the rest of the draft, coordinated responses to public comments and development of Volume 4 of the final EIS.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

Albert Trantham Stephenson

EDUCATION

BS Zoology, Presbyterian College, Clinton, SC; MS Radiological Physics, North Dakota State University, Fargo, ND

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Physicist, Savannah River Plant, E. I. du Pont de Nemours and Company, Aiken, SC

1 year — Special programs

- AFR spent fuel storage

6 years — Personnel radiation contamination control

- plutonium production
- tritium production
- reactor operation
- fuel storage operation

4 years — Personnel radiation shielding design

EIS RESPONSIBILITIES

Prepared DOE response to public comments.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

NAME

Sidney M. (NMN) Stoller

EDUCATION

BS Chemical Engineering, The College of the City of New York, New York, NY

CERTIFICATION

Licensed Professional Engineer, New York State

PROFESSIONAL DISCIPLINE AND EXPERIENCE

President and Chief Executive Officer, The S. M. Stoller Corporation, New York, NY

About 35 years engineering experience, 30 in the nuclear field.

20 years — Direction of and participation in company assignments related to such matters as choices between base load generation alternatives, selection of nuclear power equipment supply, long-term fuel procurement policy and research and development program management.

12 years — Responsible for engineering efforts on government atomic energy installations, including irradiated fuel reprocessing plants, production reactors, uranium milling facilities, test facilities for advanced reactor development and such pioneering power reactor projects as Indian Point 1 and Fermi 1.

EIS RESPONSIBILITIES

Provided senior management review of the draft Charge EIS with particular input to the Summary and Conclusions Section.

PUBLISHED PAPERS AND REPORTS (related to spent fuel storage)

None

NAME

Theron Theodore Thompson

EDUCATION

BS Chemical Engineering, Case Institute of Technology, Cleveland, OH; MS Chemical Engineering, University of South Carolina, Columbia, SC

PROFESSIONAL DISCIPLINE AND EXPERIENCE

Research Engineer, Savannah River Laboratory, E. I. du Pont de Nemours and Company, Aiken, SC

2 years -- Long-range technical, financial, and strategic planning to SRP's production and DOE complex production planning

10 years — Technical planning and research in SRL isotope separation efforts

15 years — Technical, financial, and strategic planning and supervision of laboratory support groups

EIS RESPONSIBILITIES

Developed fuel schedules for Domestic Supplement.

PUBLISHED PAPERS OR REPORTS (related to spent fuel storage)

None

TABLE D-3

LIST OF REVIEWERS

EIS Reviewers		*Domestic EIS DOE/EIS-0015-D*	*Domestic Supplement DOE/EIS-0015-DS*	*Foreign EIS DOE/EIS-0040-D*	*Charge EIS DOE/EIS-0041-D*	*Final EIS DOE/EIS-0015*
C. M. Borgstrom	- NEPA Affairs Div., Office of Environmental Compliance and Overview, Office of the Assistant Secretary for Environment, U.S. Dept. of Energy, Washington, DC.		x	x	x	x
M. S. Crosland	- Office of Assistant General Counsel for Environment, Office of General Counsel, U.S. Dept. of Energy, Washington, DC	x	x	x	x	x
D. M. Ericson	- Nuclear Facility Analysis Division, Nuclear Fuel Cycle Safety Research Dept., Sandia Laboratories, Albuquerque, NM					x
J. M. Freedman	- Transportation Analysis and Information Division, Nuclear Materials Transportation Technology Department, Sandia Laboratories, Albuquerque, NM					x
J. J. Fiore	- Division of Transportation and Fuel Storage, Office of Nuclear Waste Management, Office of Assistant Secretary for Nuclear Waste, U.S. Dept. of Energy, Germantown, MD				x	x
S. Goldberg	- Nuclear Policy Staff, Office of Energy Research, U.S. Dept. of Energy, Washington, DC	x	x	x	x	
S. H. Greenleigh	- Office of Assistant General Counsel for Environment, Office of General Counsel, U.S. Dept. of Energy, Washington, DC	x	x	x	x	x
C. A. Kouts	- NEPA Affairs Div., Office of Environmental Compliance and Overview, Office of the Assistant Secretary for Environment, U.S. Dept. of Energy, Germantown, MD					x
M. J. Lawrence	- Division of Transportation and Fuel Storage, Office of Nuclear Waste Management, Office of Assistant Secretary for Nuclear Energy, U.S. Dept. of Energy, Germantown, MD	x	x	x	x	x

TABLE D-3 (Continued)

EIS Reviewers		Domestic EIS DOE/EIS-0015-D	Domestic Supplement DOE/EIS-0015-DS	Foreign EIS DOE/EIS-0040-D	Charge EIS DOE/EIS-0041-D	Final EIS DOE/EIS-0015
B. Mann	- Division of Transportation and Fuel Storage, Office of Nuclear Waste Management, Office of Assistant Secretary for Nuclear Energy, U.S. Dept. of Energy, Germantown, MD	x	x	x	x	x
E. S. Milenky	- Foreign Affairs Officer, Office of International Affairs/Nuclear Affairs, U.S. Dept. of Energy, Washington, DC				x	
R. T. Reese	- Transportation Analysis and Information Division, Nuclear Material Transportation Technology Department, Sandia Laboratories, Albuquerque, NM					x
W. H. Pennington	- (Retired) - Office of Environmental Compliance and Overview, Office of Assistant Secretary for Environment, U.S. Dept. of Energy, Washington, DC	x	x	x	x	
R. J. Stern	- NEPA Affairs Div., Office of Environmental Compliance and Overview, Office of Assistant Secretary for Environment, U.S. Dept. of Energy, Washington, DC			x		
J. L. Todd	- International Safeguard Division, Facilities Protection Dept., Sandia Laboratories, Albuquerque, NM					x
J. C. Tseng	- Environmental Activities Branch Safety and Environmental Division, U.S. Dept. of Energy, Savannah River Operations, Aiken, SC	x	x	x	x	
G. Weisz	- Director, Office of Safeguards and Security in the Office of Assistant Secretary for Defense Programs, U.S. Dept. of Energy, Germantown, MD					x
R. P. Whitfield	- Spent Fuel Project Office, U.S. Dept. of Energy, Savannah River Operations, Aiken, SC	x				x
W. E. Wisenbaker	- Environmental Activities Branch Safety and Environmental Division, U.S. Dept. of Energy, Savannah River Operations, Aiken, SC					x

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