# EXECUTIVE SUMMARY

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# EXECUTIVE SUMMARY

## S.1 Introduction

This U.S. Department of the Navy's (Navy) Final Environmental Impact Statement (EIS) for a Container System for the Management of Naval Spent Nuclear Fuel evaluates a range of alternatives that would provide a system of containers for management of naval spent nuclear fuel following examination at the Idaho National Engineering Laboratory (INEL). The proposed action is to select a container system for the management of naval spent nuclear fuel which would also provide for management of special case low-level radioactive waste. Unless otherwise noted in this EIS, the term “naval spent nuclear fuel” will be used to mean naval spent nuclear fuel after it has been examined at the INEL. This EIS provides the details and results of specific evaluations of environmental effects associated with each alternative.

A container system which allows naval spent nuclear fuel to be loaded and stored dry at the INEL in the same container that would be used to ship the naval spent nuclear fuel outside the State of Idaho could be advantageous in meeting the Navy’s current and future needs; such a system would improve the efficiency of fuel management by minimizing the handling of unshielded naval spent nuclear fuel. Four of the six alternatives evaluated, the Multi-Purpose Canister, Dual-Purpose Canister, Transportable Storage Cask, and Small Multi-Purpose Canister Alternatives, would fulfill this objective.

The identification of a preferred alternative in this Final EIS, and the future selection of an alternative in the Record of Decision, takes into consideration the following factors: 1) public comments; 2) protection of human health and the environment; 3) cost; 4) technical feasibility; 5) operational efficiency; 6) regulatory impacts; and 7) storage or disposal criteria which may be established for a repository or centralized interim storage site outside the State of Idaho. Based on these factors, the Navy’s preferred alternative for a container system for the management of naval spent nuclear fuel is a dual-purpose canister system. The primary benefits of a dual-purpose canister system are efficiencies in container manufacturing and fuel reloading operations, and potential reduction in radiation exposure. The adverse impacts associated with all the considered alternatives are small. As with all the alternative container systems evaluated in this EIS, the Navy’s preferred alternative will allow the safe storage and shipment of naval spent nuclear fuel for ultimate disposition.

This EIS evaluates options for a dry storage facility for naval spent nuclear fuel, including existing facilities at INEL and currently undeveloped locations potentially not above the Snake River Aquifer. The Navy’s preferred alternative for a dry storage location for naval spent nuclear fuel is to utilize either a site adjacent to the Expended Core Facility at the Naval Reactors Facility or a site at the Idaho Chemical Processing Plant at INEL. These locations offer several important advantages, including already existing fuel handling facilities and trained personnel. In addition, use of these INEL facilities would protect previously undisturbed areas; development of these undisturbed sites would incur increased adverse environmental impacts while offering no environmental advantage.

Unlike civilian spent nuclear fuel which, after removal from the reactor, is currently stored in plants throughout the country, all pre-examination naval spent nuclear fuel is shipped to one place, INEL, for examination and temporary storage pending ultimate disposition outside the State of Idaho. For this reason, evaluations for the storage and transportation of naval spent nuclear fuel at INEL make use of information specific to that location. The Nuclear Waste Policy Act, as amended, designates Yucca Mountain at the Department of Energy's (DOE's) Nevada Test Site as the only site currently authorized by legislation to be characterized as a geologic repository; its suitability has not yet been determined. Therefore, the analysis in this EIS covers transportation to that location as a representative or notional destination. The Nuclear Waste Policy Act authorizes disposal of spent nuclear fuel, including naval spent nuclear fuel, in a geologic repository. There is a possibility that future legislation will allow centralized interim storage of spent nuclear fuel, possibly including naval spent nuclear fuel. As a convenience for analysis, this EIS examines transportation to the same location as a representative or notional centralized interim storage site. This EIS does not make presumptions concerning the Yucca Mountain site's suitability as a geologic repository or designation for use as a centralized interim storage site. Before the Navy container system would be used for shipments off the INEL site, appropriate environmental documentation will be submitted in support of an interim storage facility or a repository in accordance with the Nuclear Waste Policy Act. This documentation will include the potential impacts of shipments of spent nuclear fuel and high-level waste from reactor sites and DOE facilities to the recommended location and the site specific impacts of operations at that location.

In addition to a discussion of container systems, the scope of this EIS also includes several actions that are related to the container system choice:

- Manufacturing of the container system.

- Handling, storage and transportation impacts associated with the container system including unloading of containers at a representative or notional repository.

- Modifications at the Expended Core Facility and the Idaho Chemical Processing Plant at INEL to support loading naval spent nuclear fuel into containers suitable for dry storage. Specifically, expansions evaluated at both locations would allow loading operations to take place in either a shielded, filtered-air, dry cell facility or in an underwater loading facility.

- The location of the dry storage area at INEL. Areas investigated include the current naval spent nuclear fuel handling facilities at the Naval Reactors Facility and storage facilities of Idaho Chemical Processing Plant that are above the Snake River Plain Aquifer, as is most of INEL, and two areas that might not be above the aquifer but that are not currently in the industrial-use areas of INEL.

- The storage, handling and transportation of certain kinds of low-level radioactive waste (characterized as a type of special case waste, associated with naval spent nuclear fuel, that has concentrations of certain short- and long-lived isotopes which are greater than those specified for Class C in 10 CFR Part 61.55) that might reasonably utilize the same container system as is used for naval spent nuclear fuel. This EIS does not presume that naval special case waste will be shipped to the same repository or centralized interim storage facility as spent nuclear fuel and the EIS does not lead to such a decision.

Two time frames are used for analyses in this EIS. For complete system operations, 1996-2035, a time period of 40 years is used. For analyses concerning transportation to a repository and handling of naval spent nuclear fuel at INEL, the period 2010 to 2035 (25 years) is used because a repository is not expected to be accepting spent nuclear fuel before 2010. The actual date that a repository begins accepting spent nuclear fuel would have minimal impacts on the results of the EIS and in particular would have similar effects on the results reported for each of the alternatives since it would not change the number of shipments to be made. Therefore, the use of the actual date would not affect the inter-alternative comparisons of this EIS.

There is also the possibility that a centralized storage site may be designated for interim storage of civilian spent nuclear fuel until a repository is available. If such a centralized interim storage site were opened and if naval spent nuclear fuel were allowed by law to be stored there, transportation of naval spent nuclear fuel might begin before 2010. The transportation analyses completed for this EIS result in conclusions which would also be suitable for inter-alternative comparison of the impacts associated with transportation to a centralized interim storage site.

DOE is a cooperating agency in this EIS because DOE, under the Nuclear Waste Policy Act, is responsible for the ultimate disposition of all spent nuclear fuel including civilian and military. DOE is also responsible for the facilities at INEL where naval spent nuclear fuel is currently stored.

During management of naval spent nuclear fuel, which includes removal of excess non-fuel bearing structural portions of fuel assemblies to facilitate examination, a type of special case waste associated only with naval spent nuclear fuel is generated. The containers designed for management of naval spent nuclear fuel could also be used for management of this special case waste because radiation levels on the exterior of the containers holding special case waste from naval spent nuclear fuel would be lower than the levels outside these same containers if they were holding naval spent nuclear fuel. Therefore, the use of these containers for the management of this special case waste is also analyzed in this EIS.

Shipments of special case waste from naval spent nuclear fuel management could also be made to a repository or centralized storage location. However, the Navy has no proposals under evaluation at the current time concerning ultimate disposition and/or designation of a site for such disposition. Although the DOE is currently developing a repository for the disposal of transuranic waste (the Waste Isolation Pilot Plant in southern New Mexico) and is developing an EIS to evaluate a proposal to construct, operate and eventually close a separate geologic repository (Yucca Mountain) for the disposal of spent nuclear fuel and high-level radioactive waste, special case waste is not authorized under current regulations for disposition in those repositories. Nevertheless, in order to assess the complete environmental impacts that result from management of naval spent nuclear fuel, an evaluation of handling, storage, and transportation of special case waste from naval spent nuclear fuel management is included in this EIS. Strictly for purposes of this evaluation, this EIS evaluates transportation to Yucca Mountain as a representative or notional site. This EIS does not presume that special case waste would be shipped to Yucca Mountain, but rather this location is used purely for analytical purposes.

## S.2 Container Alternatives

This EIS considers six general alternative systems for the storage, transport, and disposal of naval spent nuclear fuel and management of special case waste. The alternatives are described in detail in Chapter 3 and Appendix D of this EIS and make use either of existing containers or of containers that could be produced by manufacturers of such equipment. For all alternatives, the loaded containers would be shipped from INEL by rail directly to a repository or to interim storage using commercial rail lines. For purposes of analysis in this EIS, the location of a potential centralized interim storage site (if legislation were passed to include interim storage of naval spent nuclear fuel) has been assumed to be the same as the candidate repository.

A container shipment (hereafter referred to as "shipment") is defined as a single loaded container (cask or canister in overpack) that is transported to a repository or to a centralized interim storage site. Several casks or canisters may be shipped together in the same train, so the number of trains will likely be smaller than the number of container shipments. For reusable casks, such as the M-140 transportation cask currently used to transport pre-examination naval spent nuclear fuel, each reuse is counted as a container shipment. A total of 300 to 500 shipments of naval spent nuclear fuel would be required during the period extending to 2035, depending on the alternative selected. The addition of special case waste would increase the number of containers required under any alternative by about 15-20%.

Because of differences in configurations and sizes of naval spent nuclear fuel and assemblies, all of the alternatives would require containers to have internal baskets designed for specific spent nuclear fuel types. Some naval spent nuclear fuel can use the same internal basket as is expected to be designed for civilian spent nuclear fuel from commercial pressurized or boiling water reactors; however, other naval fuel would require internal baskets different from those proposed for civilian spent nuclear fuel because of differences in dimensions. Some special baskets would be required no matter which container alternative is chosen.

Each alternative is briefly described in the following sections. The order in which the alternatives are listed is the same as that employed in the EIS which the DOE had been preparing on multi-purpose canisters, but which subsequently was terminated due to programmatic decisions and funding changes. The Navy assumed lead responsibility for the EIS which was announced in the Federal Register notice of December 7, 1995 (60 FR 62828).

### S.2.1 Multi-Purpose Canister Alternative

Under this alternative, naval spent nuclear fuel would be placed in about 300 canisters designated as 125-ton multi-purpose canisters. Multi-purpose canisters are metal containers for spent nuclear fuel that are permanently sealed by welding. They require overpacks to provide necessary radiation shielding and impact resistance. Different canister overpacks would be required at every stage of the process: for handling on the INEL site, for dry storage, for transportation by rail from INEL to a repository or centralized interim storage site, and for disposal. The canisters are called multi-purpose because the fuel would remain sealed in the same canister for all phases of spent fuel management; once sealed, only the canister would be handled, not individual fuel assemblies. Other alternatives require movement of naval spent nuclear fuel from one container to another container, for example, from a transportation container to a disposal container. Up to 60 additional canisters would be needed for the management of special case waste along with approximately 30 additional storage overpacks, 3 additional transportation overpacks and 60 additional disposal overpacks.

### S.2.2 No-Action Alternative (Current Technology)

The No-Action Alternative is based on using current technology at INEL to handle, store, and subsequently transport naval spent nuclear fuel to a geologic repository or centralized interim storage site. This alternative would be based on the M-140 transportation cask. Prior to shipment to a repository or centralized interim storage site, individual assemblies of naval spent nuclear fuel managed at INEL, either at the Naval Reactors Facility or at the Idaho Chemical Processing Plant, would be loaded into M-140 transportation casks. The loaded M-140 transportation casks would be shipped by rail to a repository or centralized interim storage site. At a repository or centralized interim storage site, the individual naval spent nuclear fuel assemblies would be unloaded from the M-140 transportation casks and placed in the surface facilities for loading into disposal containers. Following unloading, the M-140 transportation casks would be returned to INEL for reuse. Because existing M-140 transportation casks are needed to maintain scheduled fleet refuelings and defuelings, approximately 24 additional M-140 transportation casks would have to be manufactured to handle the shipment of about 425 cask loads of naval spent nuclear fuel to a repository between 2010 and 2035, the period of time used for analyses of shipments. Up to 30 additional storage containers would be needed for the management of special case waste along with approximately 4 additional M-140 transportation casks and 60 additional disposal containers. Prior to shipment to a geologic repository or centralized interim storage site, naval spent nuclear fuel and special case waste would be stored at INEL primarily in commercially available single-purpose dry storage containers.

### S.2.3 Current Technology/Rail Alternative (Current Technology Supplemented by High-Capacity Rail)

This alternative would use the same storage methods at INEL and the same M-140 transportation casks as the No-Action Alternative. However, redesigned internal structures for the M-140 transportation casks would accommodate a larger amount of naval spent nuclear fuel per cask. Thus, there would be fewer container shipments required. For purpose of analysis, we have assumed that approximately 24 additional M-140 transportation casks would be needed in order to expedite shipments. For this alternative, approximately 325 containers of naval spent nuclear fuel would be shipped by rail to a repository or centralized interim storage site. Up to 26 additional storage containers would be needed for the management of special case waste along with approximately 4 additional M-140 transportation casks and 60 additional disposal containers. Prior to shipment to a geologic repository or centralized interim storage site, naval spent nuclear fuel and special case waste would be stored at INEL primarily in commercially available single-purpose dry storage containers.

### S.2.4 Transportable Storage Cask Alternative

An existing, commercially available transportable storage cask would be used for storage at INEL as well as for transportation to a repository or centralized interim storage site. At a repository, individual assemblies of naval spent nuclear fuel would be unloaded from the casks and placed in the surface facilities for loading into disposal containers. The unloaded transportable storage casks would be returned to INEL for further storage and transport. Approximately 325 shipments of the reusable transportable storage cask (150 casks required) are necessary for the shipment of all naval spent nuclear fuel. Up to 21 additional storage casks would be needed for the management of special case waste along with approximately 60 additional disposal containers.

### S.2.5 Dual-Purpose Canister Alternative

An existing, commercially available canister and overpack system suitable for both storage and transportation would be used under this alternative for storage at INEL and for shipment to a repository or centralized interim storage site. At a repository, individual assemblies of naval spent nuclear fuel would be unloaded from the canisters and placed in surface facilities for loading into disposal containers.

Under this alternative, approximately 300 canisters would be required for dry storage and shipment of naval spent nuclear fuel by rail to a repository or centralized interim storage site. Up to 45 additional canisters would be needed for the management of special case waste along with approximately 23 additional storage overpacks, 3 additional transportation overpacks and 60 additional disposal containers.

### S.2.6 Small Multi-Purpose Canister Alternative

Under this alternative a canister system designated as the 75-ton multi-purpose canister would be used. The small multi-purpose canister was identified as an alternative as a result of public concern expressed in a scoping meeting, for potential damage to railway trackage from the weight of the 125-ton canister system. This alternative would require about 500 small multi-purpose canisters for naval spent nuclear fuel that would be shipped by rail to a repository or centralized interim storage site during the period evaluated. Up to 85 additional canisters would be needed for the management of special case waste along with approximately 39 additional storage overpacks, 5 additional transportation overpacks and 85 additional disposal overpacks. Like the larger 125-ton multi-purpose canister, the 75-ton multi-purpose canister will be suitable for disposal, therefore, eliminating the need to re-handle the individual naval spent nuclear fuel assemblies at a geologic repository.

### S.2.7 Alternatives Eliminated from Detailed Analysis

This section briefly describes alternatives that were considered and subsequently eliminated from detailed analysis.

The universal cask, or multi-purpose unit, is a concept for a single cask that would function as the multi-purpose canister system does, but the various overpacks would be integral parts of the universal cask. As with the multi-purpose canister, the individual spent fuel assemblies would not be handled again after sealing. Because the two systems are functionally similar, and because no feasible universal cask design currently exists that would be capable of receiving Nuclear Regulatory Commission certification, the universal cask was not considered further.

License applications for other systems of the types already described might be submitted in the future by vendors. Any potential impacts of using such proposed canisters or casks are expected to be bounded by the alternatives evaluated in this EIS. Therefore, other potential designs were not analyzed further. All of the designs currently certified by the Nuclear Regulatory Commission or in the process of being certified are covered under one or more of the alternatives evaluated in this EIS.

All of the alternatives addressed in this EIS utilize dry storage of naval spent nuclear fuel at INEL. The Nuclear Regulatory Commission concluded that for dry storage, all areas of safety and environmental concern (e.g., maintenance of systems and components, prevention of material degradation, and protection against accidents and sabotage) have been addressed and shown to present no more potential for adverse impact on the environment and public health and safety than storage of spent nuclear fuel in water pools. The Nuclear Regulatory Commission also concluded that dry container storage involves a simpler technology than that represented by water storage systems (NRC 1984). Moreover, water pool storage does not facilitate transportation or storage of naval spent nuclear fuel outside the State of Idaho. Therefore, water pool storage as an alternative for naval spent nuclear fuel management was not further analyzed. However, the impacts of storing naval spent nuclear fuel in water pools until dry storage in containers can be implemented were analyzed and are reported in this EIS. It should be noted that the agreement among the State of Idaho, the United States Navy, and the United States Department of Energy (U.S. District Court, 1995) calls for dry storage of all spent nuclear fuel by 2023.

Analyses in this EIS are based on the use of rail transportation for naval spent nuclear fuel, as is current practice. The use of trucks as the principal means for transporting naval spent nuclear fuel was eliminated from detailed analysis because, unlike truck transport, rail transport permits the shipment of a greater number of large assemblies per container, resulting in fewer shipments. Truck shipments also pose a higher risk of accidents (DOE 1995). Further, some container systems, such as the M-140 transportation cask, cannot be accommodated by truck. Those container systems which can be physically accommodated by trucks would require many more shipments, with resultant increased environmental impacts. The ultimate decision, however, on transportation options (legal-weight truck, some combination of legal-weight truck and rail, or rail/heavy-haul truck) will be made by the DOE on the basis of analyses to be performed in the repository EIS.

### S.2.8 Representative Container Designs Used for Analytical Purposes

The alternatives chosen for analysis are representative of families or classes of container types. The evaluations of the Multi-Purpose Canister and the Small Multi-Purpose Canister Alternatives, for example, are based on a DOE multi-purpose canister conceptual design report (TRW 1993). However, other multi-purpose canister systems may be developed by other manufacturers and ultimately chosen for naval spent nuclear fuel. The evaluations of the other categories of containers are based on information from currently existing container designs certified by the Nuclear Regulatory Commission or undergoing Nuclear Regulatory Commission design review. For analytical purposes, the transportable storage cask designed by Nuclear Assurance Corporation International has been used in this EIS as a representative design for the transportable storage cask type. The existing M-140 transportation cask designed by the Naval Nuclear Propulsion Program was used for the No-Action and Current Technology/Rail Alternatives. The NUHOMS-MP187® design (VECTRA Fuel Services) has been used in this EIS as a representative design for dual-purpose canisters. Additional containers appropriate for use under all of the alternatives either are available (e.g., the Holtec HI-STAR dual-purpose canister) or may become available in the future and might be selected for use with naval spent nuclear fuel depending on which alternative is finally selected in the Record of Decision.

## S.3 Impacts of Manufacturing Alternative Canister and Cask Systems

### S.3.1 Environmental Impacts

The impacts on air quality, health and safety, material availability, waste generation, socio-economics and environmental justice from manufacturing the various containers for any alternative container system are very small. No land-use impacts would be expected because manufacturing would likely occur at existing facilities. Disproportionately high and adverse impacts on minorities or low-income groups are not expected, based on the evaluation in Chapter 4 of the EIS.

Manufacturing canisters, casks, and other components of these container systems would result in the consumption of nonrenewable materials. Although some of the components might eventually be recyclable, other materials would be processed as waste or disposed of in a repository as part of the waste container. Manufacturing would also consume nonrenewable fuels, primarily fossil-based products. The relatively small amounts of these materials needed for the program do not represent a significant commitment of resources.

Many of the impacts associated with manufacturing container systems would be unavoidable. Manufacturing alternative container systems would consume nonrenewable resources (energy and various materials such as steel, hafnium, aluminum, or other metals) and produce some emissions and wastes. These materials would be needed to help ensure adequate isolation of naval spent nuclear fuel from the environment and as shielding to reduce external radiation doses to regulatory levels.

Components would be reused whenever possible throughout the life of the project to minimize impacts. At the end of the entire program, equipment and hardware not disposed of in the repository would be reused, recycled or otherwise disposed. In general, scrap metals would be recycled; concrete would be disposed of as non-radiological solid waste. Some containers would need to be radiologically decontaminated prior to recycling or they would be managed as low-level radioactive waste. Table S.1 summarizes the equipment that would be manufactured for each alternative and highlights equipment for reuse, recycling or disposal at the end of the program.

TABLE S.1 Hardware Requirements for Each Alternative Container System for Naval Spent Nuclear Fuel and Special Case Waste

| Hardware Component | Total Life of Project Requirement per Alternative[a,b,c] | | | | | |
|---|---|---|---|---|---|---|
| | MPC | NAA | CTR | TSC | DPC | SmMPC |
| Canisters | [360] | - | - | - | 345 | [585] |
| TSCs | - | - | - | 171 | - | - |
| Storage overpacks | 180 | 255 | 176 | - | 173 | 264 |
| Storage containers | - | 255 | 176 | - | - | - |
| Transportation overpacks | 18 | - | - | - | 18 | 30 |
| M-140 transportation casks | - | 28 | 28[d] | - | - | - |
| Disposal containers | - | [360] | [360] | [360] | [360] | - |
| Disposal overpacks | [360] | - | - | - | - | [585] |

[a] Notation: Storage containers = single-purpose storage canisters or storage casks, MPC = Multi-Purpose Canister; NAA = No-Action; CTR = Current Technology/Rail; TSC = Transportable Storage Cask; DPC = Dual-Purpose Canister; SmMPC = Small Multi-Purpose Canister.

[b] Assumes a repository or centralized interim storage site will be available by 2010.

[c] Items in brackets are disposed of at a repository. All other items would be reused, recycled or disposed of as waste.

[d] High-Capacity M-140 transportation cask

### S.3.2 Socioeconomic Impacts

The socioeconomic impacts of implementing each of the alternatives would be very small. The primary socioeconomic impact of the alternatives considered would be increases in output, income, and employment associated with manufacturing, but all impacts would be quite small in relative terms and generally would be considered positive. The number of additional jobs would be so small that there would be no discernible impact on local services, infrastructure, or economics from manufacturing, operations at INEL, a geologic repository, or a centralized interim storage site, or transportation to a geologic repository or centralized interim storage site.

## S.4 Impacts of Handling and Storage of Naval Spent Nuclear Fuel at INEL

Evaluation of the full range of environmental impacts and other effects associated with the loading and storage of naval spent nuclear fuel shows that for all alternatives considered, the impacts would be so small and differ so little among alternatives that they would be of little assistance in differentiating among the alternatives. Among the areas considered in the evaluation were the effects on the public health, ecology, cultural resources, aesthetic and scenic values, air and water resources, and geology. Impacts on such areas as noise, traffic and transportation, and utilities normally associated with routine daily activities were also considered. All environmental impacts in these areas would be small. The radiological impacts of each alternative were evaluated over the same time period, 40 years for INEL operations.

### S.4.1 Public Health Impacts

A primary concern for most people is the risk to the public from exposure to radiation or radioactive material for each of the alternatives. Risk is defined as the product of the consequences of an event multiplied by the probability of that event. The exposure to radiation could be a result of normal operations or of an accident. The most common method used to characterize the public risk resulting from actions involving exposure to radioactive materials is to estimate the number of immediate fatalities and latent cancer fatalities that might result. Health effects other than fatalities have also been evaluated.

The analyses in this EIS show that no immediate fatalities due to radiation exposure would be expected from the radiation exposure associated with accidents or normal operations for any of the alternatives considered. Analyses further indicate that for normal operations there would be less than one latent cancer fatality under any of the alternatives for the entire 40-year period. Other health effects would be similar.

#### S.4.1.1 Public Health Impacts From Normal Handling and Storage Operations

No immediate fatalities from radiation exposure or latent cancer fatalities would be expected from normal operations including handling, loading, and dry storage. Table S.2 provides a comparison of the alternatives in terms of the calculated increase in the risk of latent cancer fatalities that might occur in the general population from normal operations (40 years) at INEL due to naval spent nuclear fuel. For normal operations, the number of latent cancer fatalities (consequences) and the risk (consequence times probability) of latent cancer fatalities are identical since the probability of occurrence of normal operations is one.

Similarly for all alternatives, the risk from normal operations at INEL is estimated to be one chance in 2,900 or smaller (derived from the largest risk value from Table S.2) that there would be a single latent cancer fatality in the population surrounding the site for the period considered. The risk to an average individual would be even smaller since that value (1 chance in 2,900) would be divided by the number of people in the community. The risks of all other health effects would be similar.

It is important to emphasize that these latent cancer fatalities are calculated estimates rather than actual expected fatalities. A calculation was required because the exposures would be so small that the expected number of such fatalities during normal operations could not be distinguished from the much larger number of such deaths from naturally occurring conditions and other man-made effects not related to naval spent nuclear fuel operations. In all the alternatives, thousands of years of facility operations would be required before a single fatal cancer might be expected to occur.

TABLE S.2 Summary of Total Radiological Risks (latent cancer fatalities to the general population) for Normal Operations at INEL[a,b]

| | Number of Latent Cancer Fatalities | | |
|---|---|---|---|
| Alternative | NRF[b] | ICPP[b] | Total of Both Sites |
| Multi-Purpose Canister | $2.2 \times 10^{-6}$ | $2.0 \times 10^{-5}$ | $2.2 \times 10^{-5}$ |
| No-Action | $1.9 \times 10^{-4}$ | $1.5 \times 10^{-4}$ | $3.4 \times 10^{-4}$ |
| Current Technology/Rail | $1.9 \times 10^{-4}$ | $1.5 \times 10^{-4}$ | $3.4 \times 10^{-4}$ |
| Transportable Storage Cask | $2.2 \times 10^{-6}$ | $2.0 \times 10^{-5}$ | $2.2 \times 10^{-5}$ |
| Dual-Purpose Canister | $2.2 \times 10^{-6}$ | $2.0 \times 10^{-5}$ | $2.2 \times 10^{-5}$ |
| Small Multi-Purpose Canister | $2.2 \times 10^{-6}$ | $2.0 \times 10^{-5}$ | $2.2 \times 10^{-5}$ |

[a] Notation: NRF = Naval Reactors Facility; ICPP = Idaho Chemical Processing Plant.
[b] Values represent the risk of increase in latent cancer fatalities for the entire 40-year period and include special case waste. These values are also found in Table 3.2

### S.4.1.2 Public Health Impacts From Accidents at INEL Facilities

Accident analyses were performed for reasonably foreseeable accidents, defined conservatively in this EIS as accidents that might have the probability of occurring more frequently than once in 10 million years. The range of accidents considered includes those resulting from human errors or mechanical failure (e.g., improper handling of spent nuclear fuel or an airplane crash into storage facilities). Natural disasters such as earthquakes and tornadoes have also been analyzed. The goal in selecting hypothetical accidents to be analyzed has been to evaluate events that would produce effects that would be as severe or more severe as those from any accident that might be reasonably postulated. Because of conservative assumptions, the risks presented are believed to be at least 10 to 100 times larger than would actually occur. Table S.3 presents the estimated annual risks of latent cancer fatalities from a maximum foreseeable facility accident. The annual risk is defined as the number of latent cancer fatalities if the accident were to occur times the probability (number of times per year) of occurrence of the accident.

TABLE S.3 Estimated Annual Risk of Latent Cancer Fatalities in the General Population from an INEL Facility Accident with the Most Severe Risk[a b c]

| | Latent Cancer Fatalities | |
|---|---|---|
| Alternative | NRF [d] | ICPP [d] |
| Multi-Purpose Canister | $1.7 \times 10^{-7}$ | $2.4 \times 10^{-6}$ |
| No-Action | $1.7 \times 10^{-7}$ | $2.4 \times 10^{-6}$ |
| Current Technology/Rail | $1.7 \times 10^{-7}$ | $2.4 \times 10^{-6}$ |
| Transportable Storage Cask | $1.7 \times 10^{-7}$ | $2.4 \times 10^{-6}$ |
| Dual-Purpose Canister | $1.7 \times 10^{-7}$ | $2.4 \times 10^{-6}$ |
| Small Multi-Purpose Canister | $1.7 \times 10^{-7}$ | $2.4 \times 10^{-6}$ |

[a] Notation: NRF = Naval Reactors Facility; ICPP = Idaho Chemical Processing Plant.
[b] Values represent a single accident event.
[c] No immediate fatalities due to radiation exposure would be expected under any alternative.
[d] The limiting risk accident is a drained water pool at NRF and ICPP (see Table A.3).

No immediate fatalities due to radiation exposure would be expected to result from facility accidents under any alternative. The highest risk for a maximum foreseeable facility accident was determined to be from a drained water pool at the Idaho Chemical Processing Plant. This accident, if it were to occur, was calculated to result in less than one latent cancer fatality and has a probability of occurring approximately once in 100,000 years. This accident has been calculated to produce a risk of less than one chance in 400,000 of a latent cancer fatality per year. The risks from all other accidents associated with the handling, loading, and dry storage of naval spent nuclear fuel would be even smaller. The risks of other health effects would be similar.

#### S.4.1.3 Other Accident Impacts on Public Health

In addition to the human health effects which are presented in Tables S.2 and S.3, in the unlikely event of a facility accident involving naval spent nuclear fuel, it is estimated that as much as 600 acres of land might be affected for the most severe case (airplane crash into dry storage at the Idaho Chemical Processing Plant). In the other facility accidents analyzed, smaller areas of land would be affected. The affected area might require decontamination, and during this cleanup, access controls might have to be established. However, because of the limited land area affected, any restrictions would likely only be temporary and the impact on issues such as socioeconomics, treaty rights, tribal resources, ecology, and land use would be small and limited in time. With prudent controls and remediation operations, the affected land and buildings could be recovered. As demonstrated in the accident analyses in Appendix A of this EIS, the human health effects would be small. The effects on wildlife and other biota would also be small, partly because of the relatively small area affected and partly because of the limited effects of the accident.

### S.4.2 Health Impacts on Radiation Workers

An assessment of the occupational radiation dose that workers are expected to receive during loading and storage of naval spent nuclear fuel was also performed. It is expected that most radiation workers would receive annual radiation doses near or less than the Naval Reactors Facility historical average of about 100 mrem and that no radiation workers involved in these activities will exceed 500 mrem annually, which is 10% of the allowable annual federal limit. If an individual were to receive a 100 mrem dose during the year, this would result in a likelihood of a latent cancer fatality of $4.0 \times 10^{-5}$ (0.00004 or about 1 in 25,000).

### S.4.3 Environmental Impacts at the INEL Site From Construction for Any Alternative

Dry Storage at Existing INEL Facilities Minimal construction of facilities at INEL would be needed to accommodate the dry storage of naval spent nuclear fuel until a geologic repository or centralized interim storage site outside the State of Idaho is available if existing areas already used for industrial purposes at the Expended Core Facility or the Idaho Chemical Processing Plant were used. Construction activities associated with dry storage of naval spent nuclear fuel would produce very little impact on the environment and would comply with all applicable laws and regulations, using established procedures for preserving air and water quality, for protecting previously unknown archeological or cultural artifacts, and for minimizing such impacts as noise and disturbances or destruction of habitat. No additional impact on land use would occur if paved areas or simple structures needed to protect workers were developed on the already existing industrial sites.

Dry Storage at Locations Not Above the Snake River Aquifer The technical feasibility of building a dry storage facility within INEL at a point not above the Snake River Plain Aquifer is being considered by DOE pursuant to the October 17, 1995 Court Order in Civil Case No. 91-00540-5-EJL (U.S. District Court, 1995) and the agreement with the State of Idaho, the U.S. Navy and the U.S. Department of Energy. Two possible locations have been identified, one located along the west boundary of INEL and the other in the northwest corner of the INEL reservation. A facility located at either of these sites would be closer to the site boundaries and the local population than existing INEL facilities approximately 1 mile from the INEL boundary at its closest point. If such a location were selected, impacts would result from construction of a road and possibly a rail spur to the location as well as construction of facilities at the location and possibly rail access. A review of these areas indicates that the development of a dry storage facility at either of these remote locations might have a greater impact on Native American cultural resources, ecological resources, and land use than providing for dry storage at the Expended Core Facility or the Idaho Chemical Processing Plant. The two possible locations are in areas of higher seismic activity and, while not appearing to be above the Snake River Aquifer may ultimately drain to that aquifer. These potential impacts of choosing either of the two locations are assessed in Appendix F of this EIS.

Modifications of the Facilities For the Container Systems The Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement (DOE 1995, Volume 2, Part B, Appendix C) [referred to as the Programmatic SNF and INEL EIS] covered the potential environmental impacts of construction of dry fuel handling facilities at the Expended Core Facility and at the Idaho Chemical Processing Plant, which were shown to be small. Therefore, the environmental impacts of projects within the existing major facility areas such as the Expended Core Facility and the Idaho Chemical Processing Plant would also be small based on the analysis in the Programmatic SNF and INEL EIS (DOE 1995). For an existing industrial area, at the Expended Core Facility for example, only previously disturbed soil would be affected, no significant animal displacement or mortality would be expected, and there would be small additional non-radiological emissions. No additional radiological exposure would occur as a consequence of facility construction.

It may be necessary to modify and enlarge existing or planned facilities so that they can load the containers described in the current EIS. Since the environmental impacts of the facility construction itself were evaluated in the Programmatic SNF and INEL EIS as small, the impacts for the modifications would be small with minimal differences among the alternatives.

## S.5 Impacts of Unloading Naval Spent Nuclear Fuel at Surface Facilities of a Repository or Centralized Interim Storage Site

The evaluation of environmental effects associated with the unloading of naval spent nuclear fuel at a repository or centralized interim storage site shows that, for all alternatives considered, the impacts would be small. The radiological risks associated with both of the multi-purpose canister alternatives are smaller than those for the other alternatives since the naval spent nuclear fuel does not need to be removed from the canisters.

The analyses in this EIS show that no immediate fatalities due to radiation exposure would be expected from the radiation exposure associated with accidents or normal operations for any of the alternatives considered. Analyses further indicate that for normal operations there would be less than one latent cancer fatality under any of the alternatives for the entire program. Other health effects would be similar.

### S.5.1 Public Health Impacts From Unloading at a Repository or Centralized Interim Storage Site

No immediate fatalities from radiation exposure (i.e. those where death occurs from other than cancer, and in a short period of time) or latent cancer fatalities would be expected from normal operations of unloading of naval spent nuclear fuel. Table S.4 provides a comparison of the alternatives in terms of the calculated increase in the risk of latent cancer fatalities that might occur in the general population and during unloading at a repository or centralized interim storage site. For normal operations, the number of latent cancer fatalities (consequences) and the risk (consequence times probability) of latent cancer fatalities are identical since the probability of occurrence of normal operations is one.

TABLE S.4 Summary of Total Radiological Risks (latent cancer fatalities in the general population) for Normal Operations at a Repository or Centralized Interim Storage Site[a]

| Alternative | Latent Cancer Fatalities |
|---|---|
| Multi-Purpose Canister | 0[b] |
| No-Action | 0.00030 |
| Current Technology/Rail | 0.00030 |
| Transportable Storage Cask | 0.00030 |
| Dual Purpose Canister | 0.00030 |
| Small Multi-Purpose Canister | 0[b] |

[a] Numerical values for normal operations include special case waste and represent the risk of increase in latent cancer fatalities for the entire 40-year period; numbers are also found in Table 3.2.
[b] Sealed multi-purpose canisters do not contribute any airborne releases; they do not need to be re-opened.

In all the alternatives, thousands of years of facility operations would be required before a single fatal cancer might be expected to occur.

### S.5.2 Public Health Impacts From Accidents at a Repository or Centralized Interim Storage Site

Accident analyses were performed for reasonably foreseeable accidents, defined conservatively in this EIS as accidents that might have the probability of occurring more frequently than once in 10 million years. The range of accidents considered includes those resulting from human errors or mechanical failure and natural disasters. At a repository or centralized interim storage site the limiting risk accident would be a wind driven projectile into a cask or canister. Risks associated with that accident are shown in Table S.5 for all alternatives.

TABLE S.5 Estimated Annual Risk of Latent Cancer Fatalities in the General Population from a Repository or Centralized Interim Storage Site Facility Accident with the Most Severe Risk[a b c]

| Alternative | Latent Cancer Fatalities |
|---|---|
| Multi-Purpose Canister | $1.5 \times 10^{-8}$ |
| No-Action | $1.0 \times 10^{-8}$ |
| Current Technology/Rail | $1.8 \times 10^{-8}$ |
| Transportable Storage Cask | $1.8 \times 10^{-8}$ |
| Dual-Purpose Canister | $1.8 \times 10^{-8}$ |
| Small Multi-Purpose Canister | $1.0 \times 10^{-8}$ |

[a] Values represent a single accident event.
[b] No immediate fatalities due to radiation exposure would be expected under any alternative.
[c] The limiting risk accident is a wind driven projectile into a cask/canister at a repository or centralized interim storage site (see Table A.3).

No immediate fatalities due to radiation exposure would be expected to result from facility accidents under any alternative. All risks of latent cancer fatalities from accidents associated with the unloading of naval spent nuclear fuel at a repository or centralized interim storage site would be expected to be less than one chance in 55 million. The risks of other health effects would be similar.

## S.6 Impacts of Transportation of Naval Spent Nuclear Fuel to a Repository or Centralized Interim Storage Site

The range of environmental impacts and other effects associated with the transportation of naval spent nuclear fuel shows that, for all alternatives considered, the impacts would be small. The radiological impacts of each alternative were evaluated over a time period of 25 years for transportation to a geologic repository or centralized interim storage site.

The analyses in this EIS show that no immediate fatalities would be expected from the radiation exposure associated with accidents or normal operations for any of the alternatives considered. Analyses further indicate that for normal operations there would be less than one latent cancer fatality under any of the alternatives for the entire transportation period. Other health effects would be similar.

### S.6.1 Public Health Impacts From Incident-Free Transportation

No immediate fatalities from radiation exposure or latent cancer fatalities would be expected from transportation of naval spent nuclear fuel. For all the alternatives, the risk of latent fatal cancer to the general population or other health effect along transportation routes to a repository or centralized interim storage site or within a 50-mi (approximately 80-km) radius of INEL from normal naval spent nuclear fuel transportation would be very small. Table S.6 provides a comparison of the alternatives in terms of the calculated increase in the risk of latent cancer fatalities and non-radiological fatalities from pollution that might occur in the general population for the total program from incident-free transportation (25 years) for naval spent nuclear fuel shipments to a repository or centralized interim storage site.

For all alternatives, the radiological risk from incident-free transportation is estimated to be about one chance in 100 that there would be a single latent cancer fatality in the entire population along the transportation routes for the entire period evaluated. The risks of all other radiological health effects would be similar.

For all alternatives, the risk of non-radiological fatalities which would be expected to result from pollutants, such as diesel air emissions, would be less than one chance in 1,100.

The risks of latent cancer fatalities for transportation of naval spent nuclear fuel shown in Table S.6 for the No-Action and the Current Technology/Rail Alternatives are about ten times smaller than those for the other alternatives because the M-140 transportation cask is already being used to ship pre-examination naval spent nuclear fuel so measured radiation levels were available to be used in the calculations. The containers for the other alternatives have never been used with naval spent nuclear fuel so the maximum radiation level allowed by the applicable regulations were used and that level is about ten times greater than the values measured for the M-140. The risks for all of the alternatives are so small that this difference has no effect on the comparison of impacts among the alternatives.

TABLE S.6 Summary of Total Risks (latent cancer fatalities and non-radiological fatalities to the general population) for Incident-Free Transportation

| Alternative | Latent Cancer Fatalities[a] | Estimated Nonradiological Fatalities |
|---|---|---|
| Multi-Purpose Canister | $7.5 \times 10^{-3}$ | $5.2 \times 10^{-4}$ |
| No-Action | $1.0 \times 10^{-3}$ [b] | $6.9 \times 10^{-4}$ |
| Current Technology/Rail | $8.0 \times 10^{-4}$ [b] | $5.5 \times 10^{-4}$ |
| Transportable Storage Cask | $7.2 \times 10^{-3}$ | $5.3 \times 10^{-4}$ |
| Dual-Purpose Canister | $7.4 \times 10^{-3}$ | $5.0 \times 10^{-4}$ |
| Small Multi-Purpose Canister | $1.2 \times 10^{-2}$ | $8.4 \times 10^{-4}$ |

[a] Numerical values for transportation include special case waste and represent the risk of increase in latent cancer fatalities for the entire 25-year period; numbers are also found in Tables 3.2 and 7.4.

[b] Actual historic measured dose rates have been used for the M-140 casks whereas container design dose rates were used for the other alternatives.

It is important to emphasize that these latent cancer fatalities are calculated estimates rather than actual expected fatalities. A calculation was required because the exposures would be so small that the expected number of such fatalities during normal operations could not be distinguished from the much larger number of such deaths from naturally occurring conditions and other man-made effects not related to naval spent nuclear fuel operations. In all the alternatives, thousands of years of transportation of naval spent nuclear fuel would be required before a single fatal cancer might be expected to occur.

### S.6.2 Public Health Impacts From Transportation Accidents

The risks of transportation accidents were calculated in terms of the estimated risk of latent cancer fatalities to the general population from the total number of container shipments (Table S.7). No immediate fatalities due to radiation exposure would be expected to result from a transportation accident under any alternative. The risk of increases in latent fatal cancers from transportation accidents associated with the naval spent nuclear fuel container shipments to a repository or centralized interim storage site would be very low. For 25 years of container shipments under any of the alternatives, there would be less than one chance in 250,000 that there would be an additional latent fatal cancer in the general population from a transportation accident. Risks for other health effects would be just as low.

The non-radiological risks of a transportation accident resulting in a fatality for the entire 25 years of shipments would be expected to be less than one fatality.

TABLE S.7 Accident Risk from the Total Number of Container Shipments [a,b]

| Alternative | Shipments of SNF Containers | Shipments of SCW Containers | Latent Cancer Fatalities | Non-Rad Fatalities |
|---|---|---|---|---|
| Multi-Purpose Canister | 300 | 60 | $3.2 \times 10^{-6}$ | 0.055 |
| No-Action | 425 | 55 | $2.5 \times 10^{-6}$ | 0.073 |
| Current Technology/Rail | 325 | 55 | $2.4 \times 10^{-6}$ | 0.058 |
| Transportable Storage Cask | 325 | 45 | $3.9 \times 10^{-6}$ | 0.056 |
| Dual-Purpose Canister | 300 | 45 | $3.3 \times 10^{-6}$ | 0.052 |
| Small Multi-Purpose Canister | 500 | 85 | $3.0 \times 10^{-6}$ | 0.089 |

[a] Notation: SNF = Naval Spent Nuclear Fuel; SCW = special case waste; Non-Rad = non-radiation.
[b] Values are from Table 7.5. The accident risks are for the total 25-year program.

## S.6.3 Health Impacts on Radiation Workers

In addition to looking at the health impacts on the general public, the risk to workers who receive occupational radiation exposure was also estimated (Table S.8).

TABLE S.8 Summary of Total Radiological Risks (latent cancer fatalities to the occupational population) for Incident-Free Transportation[a]

| Alternative | Latent Cancer Fatalities |
|---|---|
| Multi-Purpose Canister | $4.4 \times 10^{-3}$ |
| No-Action | $7.2 \times 10^{-4}$ |
| Current Technology/Rail | $5.7 \times 10^{-4}$ |
| Transportable Storage Cask | $4.3 \times 10^{-3}$ |
| Dual-Purpose Canister | $4.2 \times 10^{-3}$ |
| Small Multi-Purpose Canister | $7.1 \times 10^{-3}$ |

[a] Values are based on Table B.10.

For all alternatives thousands of years of transportation of naval spent nuclear fuel would be required before a single cancer might be expected to occur among workers.

## S.7 Summary of Environmental Justice Assessments

Environmental justice assessments have been performed for manufacturing operations, handling and storage at INEL facilities, and for transportation of naval spent nuclear fuel. The environmental consequences and impacts on health and safety for the actions described in this EIS would be small for all population groups and therefore, it would be expected that there would be no disproportionately high or adverse impacts to any minority or low-income population.

## S.8 Cumulative Impacts, Pollution Prevention and Other Considerations

### S.8.1 Cumulative Impacts

A cumulative impact results when the incremental impact associated with implementation of an alternative is added to the impacts of other past, present, or reasonably foreseeable future actions. The implementation of any of the alternatives considered in this EIS would not significantly contribute to cumulative impacts. Although impacts to human health and the environment have been analyzed, the individual and cumulative impacts would be very small for all alternatives, especially when considered on a national, state, or regional basis. In fact, the detailed analyses in this EIS show that the impacts would not make a substantial contribution to cumulative effects at a single site. Cumulative effects do not provide a basis for distinguishing among the alternatives considered in this EIS.

Manufacturing. The cumulative environmental impacts resulting from the manufacturing of container systems would be very small. The containers needed for naval spent nuclear fuel represent about 1 to 4 percent of the total number of containers needed for both naval and civilian spent nuclear fuel which would be shipped to a repository or centralized interim storage site. The total material use over the 40-year period for naval spent nuclear fuel and special case waste is less than 0.3 percent of the annual material use in the United States except for depleted uranium and lead. Use of depleted uranium and lead are also small percentages of the available materials in the United States.

Facilities. For facility operations at INEL involving handling and storage of naval spent nuclear fuel, the cumulative environmental impacts are small when compared to the impacts of operation of the entire INEL. The loading and storage operations for naval spent nuclear fuel would not result in discharges of radioactive liquids. None of the alternatives considered would cause the total air emissions to exceed any applicable air quality requirement or regulation in any radiological or non-radiological category. No additional land would have to be withdrawn from public use as a result of the handling and storage of naval spent nuclear fuel because the INEL is a federal reservation. There would be only minor cumulative impacts associated with the INEL facilities.

At a repository or a centralized interim storage site, the naval spent nuclear fuel and special case waste would be about 1 to 4 percent of the total number of containers of civilian spent nuclear fuel received at a facility over 25 years. Therefore, it is expected that the impacts of unloading naval spent nuclear fuel at a facility would have little effect on the environment and population surrounding the site.

Transportation. The total impact of the transportation of naval spent nuclear fuel and special case waste would be approximately 1 to 4 percent of the total impact of all spent nuclear fuel shipments to a geologic repository or a centralized interim storage site. The transportation risks, both radiological and non-radiological, are extremely small when compared to the cumulative impacts of the shipment of all nuclear materials in the United States (DOE 1995).

### S.8.2 Pollution Prevention

Implementation of any of the alternatives for the management of naval spent nuclear fuel would generate some waste with the potential for releases to air and water. To control both the volume and toxicity of waste generated and to reduce impacts on the environment, pollution prevention practices would be implemented. Program components include waste minimization, source reduction and recycling, and procurement practices that preferentially procure products made from recycled materials.

Implementation of the pollution prevention plans would continue to minimize the amount of waste generated during the manufacturing, handling, storage and transportation of naval spent nuclear fuel.

### S.8.3 Other Considerations

In all cases for all alternatives, appropriate mitigative measures would be employed to further reduce the already small unavoidable adverse environmental effects, so this does not assist in discriminating among alternatives. The only discernible irreversible and irretrievable commitments of resources are the relatively small amounts of energy and metals used to construct the containers and these commitments are small on a national scale and would represent only about 1 to 4% of the commitments required for management of spent nuclear fuel from commercial reactors.

In summary, the impacts associated with all of the alternatives considered are small and selection of an appropriate alternative would allow the safe storage and shipment of naval spent nuclear fuel for ultimate disposition, leading to the conclusion that the short-term use of the environment would not compromise the long-term productivity of the environment.