Chapter 4
Environmental Consequences

The impact analyses in Chapter 4 focus on those areas where the potential exists for effects on the environment. Each of the options, including the four options under the No Action Alternative, the six options under the Restart Fast Flux Test Facility Alternative, the nine options under the Use Only Existing Operational Facilities Alternative, the three options under the Construct New Accelerator(s) Alternative, the three options under the Construct New Research Reactor Alternative, and the one option under the Permanently Deactivate Fast Flux Test Facility (with No New Missions) Alternative, is discussed separately in Sections 4.2 through 4.7. The cumulative impacts associated with the alternatives are presented in Section 4.8. A detailed discussion of each alternative is given in Chapter 2; a comparison of the environmental effects among alternatives and among options within alternatives is presented in Section 2.7.1.

4.1 INTRODUCTION

In this *Final Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility* (*Nuclear Infrastructure Programmatic Environmental Impact Statement* [NI PEIS]), the impact analyses assess all disciplines where the potential exists for effects on the environment, as follows:

- Land resources
- Noise
- Air quality
- Water resources
- Geology and soils
- Ecological resources
- Cultural and paleontological resources
- Socioeconomics
- Public and occupational health and safety (associated with normal operations, facility accidents, and transportation)
- Environmental justice
- Waste management
- Spent nuclear fuel management

These disciplines are analyzed in a manner commensurate with their importance under a specific option—the sliding-scale assessment approach. For example, under all options of Alternative 2 (Use Only Existing Operational Facilities), the U.S. Department of Energy (DOE) has determined that minimal or no impacts would be associated with land resources, noise, water resources, geology and soils, ecological resources, and cultural and paleontological resources. This is because existing facilities in developed areas would be used, no new land disturbance would take place, proposed activities would be consistent with current operations, and wastewater discharges would continue through permitted outfalls. Therefore, impacts associated with these resources are assessed in less detail. Where construction and decommissioning are integral parts of an option (all options under both Alternative 3 [Construct New Accelerator(s)] and Alternative 4 [Construct New Research Reactor]), the impacts associated with such construction and decommissioning are included in the assessments, and disciplines such as land resources and noise are assessed in more detail. The sliding-scale assessment approach has been applied in the evaluation of all the options addressed in this NI PEIS.

The environmental consequences associated with the alternatives assessed in this NI PEIS were generally calculated using appropriate computer models and by applying facility operational characteristics from

Appendixes A through F. The analyses were performed in accordance with the impact assessment methods described in Appendix G. More detailed descriptions of the development of the impacts for some resource areas are presented in Appendixes H through L, as follows:

- Appendix H, Evaluation of Human Health Effects from Normal Facility Operations
- Appendix I, Evaluation of Human Health Effects from Facility Accidents
- Appendix J, Evaluation of Human Health Effects of Transportation
- Appendix K, Environmental Justice Analysis
- Appendix L, Socioeconomic Analysis

The results of the assessments of environmental consequences associated with the various alternatives and their options are presented in this chapter. For brevity, numerical results are often rounded. Portions of some alternative options are equivalent. For example, for Alternative 2 (Use Only Existing Operational Facilities), the Radiochemical Engineering Development Center (REDC) at the Oak Ridge Reservation (ORR) would be used to fabricate and process the neptunium-237 targets under Options 1, 4, and 7. Therefore, the activities at REDC would be virtually the same for these three alternative options. The organization of Chapter 4 takes advantage of these equivalencies. When the impacts have already been described for a previous alternative or alternative option, the later impacts discussion provides a reference to the earlier section, rather than repeating the information.

4.2 NO ACTION ALTERNATIVE

Under the No Action Alternative (maintain status quo), Fast Flux Test Facility (FFTF) would be maintained in standby status for all or a portion of the 35-year evaluation period for operations covered in this NI PEIS. For the purpose of analysis in this NI PEIS, the maximum period of 35 years was assumed. Ongoing operations at existing facilities as described in Chapter 3, Affected Environment, would continue under this alternative. DOE would not establish a domestic plutonium-238 production capability, but could, instead, continue to purchase Russian plutonium-238 to meet the needs of future U.S. space missions. For the purpose of analysis in this NI PEIS, DOE assumed that it would continue to purchase plutonium-238 to meet the space mission needs for the 35-year evaluation period. DOE would continue its medical and industrial isotope production and civilian nuclear energy research and development activities at the current operating levels of existing facilities. A consequence of a No Action decision would be the need to determine the future of the neptunium-237 stored at the Savannah River Site (SRS). Therefore, the impacts of possible future transportation and storage of neptunium-237 are evaluated as part of the No Action Alternative. Four options are identified. If DOE decides not to establish a domestic plutonium-238 production capability in the future, the neptunium-237 would have no programmatic value and Option 1 would be selected. Conversely, if DOE decides to maintain the capability to establish a domestic plutonium-238 capability in the future, the inventory of neptunium-237 must be retained. In this case, Option 2, 3, or 4 could be selected.

- **Option 1.** Under this option, DOE would reconsider its stabilization strategy for the neptunium-237, currently stored in solution form at SRS, possibly leading to final disposition. The current plan is to stabilize the material to oxide, as described in the Supplemental Record of Decision for the *Final Environmental Impact Statement, Interim Management of Nuclear Materials at SRS* (62 FR 61099). This Record of Decision would be amended or new NEPA analysis performed, if necessary.

- **Options 2 through 4.** Under these options, the neptunium-237 oxide would be transported from SRS to one of three candidate DOE sites for up to 35 years of storage. For the purpose of analysis in this NI PEIS, the maximum period of 35 years was assumed. Option 2 would provide storage at the Oak Ridge National Laboratory's (ORNL) REDC facility, Option 3 at Idaho National Engineering and Environmental Laboratory's (INEEL) Building CPP–651, and Option 4 at the Hanford Site's (Hanford) Fuels and Materials Examination Facility (FMEF).

Each of the four options under the No Action Alternative includes importing plutonium–238 from Russia and maintaining FFTF in standby. Option 1 includes no other activities, whereas the other three options include the transportation of neptunium-237 from SRS to, and storage at, another DOE site. Under Option 2, this neptunium would be stored at ORR in REDC, under Option 3 at INEEL in Building CPP–651, and under Option 4 at Hanford in FMEF.

4.2.1 No Action Alternative—Option 1

Under Option 1, the United States would continue to purchase the plutonium-238 from Russia that is needed to fabricate radioisotope power systems for future U.S. space missions. As part of this option, FFTF at Hanford would be maintained in standby. This option does not include the transportation of neptunium-237 from SRS and its storage at another DOE site, as do the other three options under the No Action Alternative.

4.2.1.1 Importation of Plutonium-238 from Russia

Activities and impacts associated with transporting plutonium-238 to the United States from Russia are evaluated in two other NEPA documents: *Environmental Assessment of the Import of Russian Plutonium-238* (*Russian Plutonium-238 EA*) (DOE 1993a), and *Finding of No Significant Impact for Import of Russian*

Plutonium-238 Fuel (DOE 1993b). The proposed action in the *Russian Plutonium-238 EA* is to import up to 40 kilograms (88 pounds) of plutonium-238 fuel (isotopic mass) in dioxide form from Russia to supplement the current U.S. inventory. The action includes the transportation by ship of Russian plutonium-238 in 5-kilogram (11-pound) increments from St. Petersburg, Russia, to a U.S. port of entry. From the U.S. port of entry, the plutonium-238 would be ground transported by DOE safe, secure trailer/SafeGuards Transport (SST/SGT) to Los Alamos National Laboratory (LANL) in New Mexico and would be added to LANL's portion of the existing U.S. plutonium-238 inventory. As of November 2000, two shipments have been safely and securely transported to LANL.

The dose to transportation workers associated with importing 40 kilograms (88 pounds) of plutonium-238 to LANL was reported to be 2.6 person-rem; the dose to the public would be 4.5 person-rem. Accordingly, incident-free transportation of plutonium-238 would result in 0.0011 latent cancer fatality among transportation workers and 0.0023 latent cancer fatality in the total affected population over the duration of the transportation activities. The number of nonradiological fatalities from vehicular emissions was not reported (DOE 1993a).

The reported transportation accident risks under this option are as follows: a radiological dose to the population of 0.2 person-rem, resulting in 1.0×10^{-4} latent cancer fatality; and traffic accidents resulting in 0.0032 traffic fatality. These estimates include the risk to the crew, handlers, and the public during both ocean and highway transportation. DOE considered the environmental consequences on global commons (i.e., portions of the ocean not within the territorial boundary of any nation) in accordance with Executive Order 12114 (44 FR 1957) (DOE 1993a).

The risk estimated for importing 40 kilograms (88 pounds of plutonium-238) can be scaled to estimate the risk of importing 175 kilograms (5 kilograms per year times 35 years) (385 pounds) of plutonium-238 over the 35-year period covered by this NI PEIS. Approximately 35 shipments of plutonium-238 would be made by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be 114,000 kilometers (71,000 miles); and at sea by ships carrying plutonium-238, 298,000 kilometers (161,000 nautical miles).

The transportation impacts analysis is described in detail in Appendix J.

IMPACTS OF INCIDENT-FREE TRANSPORTATION. The dose to transportation workers from all transportation activities entailed by this option has been estimated at 12 person-rem; the dose to the public would be 20 person-rem. Accordingly, incident-free transportation of radioactive material would result in 0.0046 latent cancer fatality among transportation workers and 0.0099 latent cancer fatality in the total affected population over the duration of the transportation activities. Latent cancer fatalities associated with radiological releases were estimated by multiplying the occupational (worker) dose by 4.0×10^{-4} latent cancer fatality per person-rem of exposure, and the public accident and accident-free doses by 5.0×10^{-4} latent cancer fatality per person-rem of exposure (ICRP 1991). The estimated number of nonradiological fatalities from vehicular emissions associated with this option is 4.7×10^{-4}.

IMPACTS OF ACCIDENTS DURING TRANSPORTATION. Estimates of the total ground transportation accident risks under this option are as follows: a radiological dose to the population of 0.88 person-rem, resulting in 4.4×10^{-4} latent cancer fatality; and traffic accidents resulting in 0.014 traffic fatality.

4.2.1.2 Maintenance of FFTF in Standby

The environmental impacts associated with maintaining FFTF in standby for 35 years are discussed in the following sections.

4.2.1.2.1 Land Resources

LAND USE. Maintaining FFTF in standby would not change land use in the 400 Area for 35 years because maintenance activities would not require the development of additional land areas. Further, maintenance activities are consistent with the site's industrial nature.

VISUAL RESOURCES. Impacts on visual resources would not change for 35 years because no new construction or modification of existing structures would be required. Since there would be no change in the appearance of FFTF, the current Visual Resource Management Class IV rating for the 400 Area would continue for 35 years.

4.2.1.2.2 Noise

Maintaining FFTF in standby would not involve any new construction, major change in activities, or change in employment. Thus, there would be no change in noise impacts on wildlife around the 400 Area or on people near Hanford and this would be expected to continue for the next 35 years to the extent it is dependent on activities at FFTF.

4.2.1.2.3 Air Quality

Maintaining FFTF in standby for 35 years would not involve any new construction, change in activities, or change in employment. Thus, there would be no change in nonradiological air quality at Hanford. Emissions from maintaining FFTF in standby would be expected to continue for the next 35 years.

4.2.1.2.4 Water Resources

Impact on water resources associated with maintaining FFTF in standby for 35 years would include the continuation of groundwater withdrawals and process and sanitary wastewater discharges associated with Hanford 400 Area facilities (**Table 4–1**). Specifically, groundwater withdrawals by 400 Area facilities (mainly FFTF) would continue to average about 197 million liters (52 million gallons) per year. The discharge of approximately 76 million liters (20 million gallons) per year of FFTF cooling water to the 400 Area process sewer system and the 400 Area Pond (i.e., 4608 B/C percolation ponds) would continue. Also, it is expected that 400 Area sanitary wastewater flows of about 3.8 million liters (1 million gallons) annually could continue to be discharged to Energy Northwest for treatment. However, as groundwater use during standby would not be expected to affect regional groundwater levels and effluents would continue to be discharged to appropriate treatment facilities, the overall impact on water resources at Hanford should be negligible (DOE 2000a:11; Nielsen 1999:38, 39, 41). Further information on current water usage, effluent discharge, and water quality at Hanford is presented in Section 3.4.4.

Table 4–1 Water Use and Wastewater Generation Associated with Maintaining FFTF in Standby Under All Options of the No Action Alternative

Indicator (million liters per year)	Hanford 400 Area
	FFTF
Water use	197
Process wastewater generation	76
Sanitary wastewater generation	3.8

Note: To convert from liters per year to gallons per year, multiply by 0.264.
Source: DOE 2000a:11; Nielsen 1999:38, 39, 41.

4.2.1.2.5 Geology and Soils

Maintaining FFTF in standby for 35 years would not involve new construction. Therefore, geologic and soil resources in the 400 Area would not be disturbed. In the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (*Storage and Disposition PEIS*) (DOE 1996a:4-45), hazards from large-scale geologic conditions at Hanford, such as earthquakes and volcanoes, were evaluated. That analysis was reviewed in the *Surplus Plutonium Disposition Final Environmental Impact Statement* (*Surplus Plutonium Disposition EIS*) (DOE 1999a:4-260). Further review of the data and analyses presented in these referenced documents and the site-specific data presented in this NI PEIS indicates that the large-scale geologic conditions continue to present a low risk to FFTF. Ground shaking of Modified Mercalli Intensity V to VII (refer to Table 3–4) associated with postulated earthquakes would be expected to primarily affect the integrity of inadequately designed or nonreinforced structures. Damage to properly or specially designed or upgraded facilities would not be expected. Also, only minimal effects (e.g., ashfall) would be expected from postulated volcanic events in the Cascade Region. The potential for other nontectonic events to affect the facility is also low.

As stated in DOE Order 420.1, DOE requires that nuclear or nonnuclear facilities be designed, constructed, and operated so that the public, the workers, and the environment are protected from the adverse impacts of natural phenomena hazards, including earthquakes. DOE Order 420.1, Section 4.4, as supplemented by DOE Guide 420.1-2, stipulates the natural phenomena hazards mitigation requirements for DOE facilities and specifically provides for the reevaluation and upgrade of existing DOE facilities when there is a significant degradation in the safety basis for the facility. DOE uses the requirements of the latest model building codes and national standards to mitigate the consequences of natural phenomena hazards. Further, the natural phenomena hazards mitigation requirements of DOE Order 420.1 are consistent with the guidance for seismic design and construction contained in the National Earthquake Hazards Reduction Program 1997 provisions (BSSC 1997). In addition, DOE Guide 420.1-2 was recently issued to recognize the consolidation of the three previous U.S. model building codes, including the Uniform Building Code, into the *International Building Code* (ICC 2000). The DOE requirements for seismic engineering have followed the Uniform Building Code, unless the importance of achieving a high level of protection warrants the use of more demanding methods and criteria (DOE Guide 420.1-2). As necessary, the need to evaluate and upgrade existing DOE facilities with regard to natural geologic hazards would be assessed in accordance with DOE Order 420.1.

4.2.1.2.6 Ecological Resources

Maintaining FFTF in standby for 35 years would not involve new construction or other disturbance to the natural environment. As noted in Section 4.2.1.2.2, there would be no change in noise impacts on wildlife. Impacts on wetlands and aquatic resources (associated with manmade ponds on the site) would not change because water usage and wastewater discharge would not change. Due to the developed nature of the area and because no construction would take place, impacts on threatened and endangered species would not occur.

Consultation letters concerning threatened and endangered species were sent to the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the Washington State Department of Natural Resources, and the State of Washington Department of Fish and Wildlife (see Table 5–3). Each agency was asked to provide information on potential impacts of the proposed action on threatened and endangered species. Both the Washington State Department of Natural Resources and the State of Washington Department of Fish and Wildlife provided lists of state species of concern that occur in the vicinity of the project area. As noted above, no impacts to any threatened or endangered species are expected, including those of concern to these agencies. While DOE has made additional contacts with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, responses are pending from these agencies. Although no federally listed species are expected to be impacted by the proposed action, no action would be taken relative to the use of facilities at Hanford prior to the receipt of input from these Federal agencies.

4.2.1.2.7 Cultural and Paleontological Resources

Maintaining FFTF in standby for 35 years would not involve new construction and, thus, would not disturb cultural and paleontological resources in the 400 Area. No prehistoric, historic, or paleontological sites have been identified either in the 400 Area or within 2 kilometers (1.2 miles) of the 400 Area. Six buildings in the 400 Area, including two FFTF structures (the Reactor Containment Building and the FFTF Control Building), are eligible for the National Register of Historic Places as contributing properties in the Historic District recommended for mitigation. Maintaining FFTF in standby for 35 years would not affect the status of these structures. No Native American resources are known to occur in the 400 Area.

Consultation to comply with Section 106 of the National Historic Preservation Act was conducted with the State Historic Preservation Office (see Table 5–3) and resulted in concurrence by the State Historic Preservation Office that the proposed action would have no effect on historic properties at Hanford. Consultation was also conducted with interested Native American tribes that resulted in comments at public hearings by members representing the Nez Perce and Confederated Tribes of the Umatilla Indian Reservation. Responses to their specific comments are addressed in Volume 3.

4.2.1.2.8 Socioeconomics

Under the No Action Alternative, FFTF would continue to be maintained in standby for 35 years. Current employment of approximately 242 workers would be continued for the next 35 years (Nielsen 1999). No new employment or in-migration of workers would be required. Thus, there would be no additional impact on the socioeconomic conditions around Hanford.

4.2.1.2.9 Public and Occupational Health and Safety—Normal Standby Activities

Assessments of radiological and chemical impacts associated with this option are presented in this section. Supplemental information is provided in Appendix H.

RADIOLOGICAL IMPACTS. Potential radiological doses to three receptor groups are given in **Table 4–2**: the population within 80 kilometers (50 miles) of FFTF in the year 2020 (approximate midlife of the nuclear infrastructure activities assessed in this NI PEIS), the maximally exposed member of the public, and the average exposed member of the public. The projected number of latent cancer fatalities in the surrounding population and the latent cancer fatality risk to the maximally and average exposed individuals are also presented in the table.

Table 4–2 Radiological Impacts on the Public Around Hanford from Maintaining FFTF in Standby Under All Options of the No Action Alternative

Receptor	Standby
Population within 80 kilometers (50 miles) in the year 2020	
Dose (person-rem)	0.028
35-year latent cancer fatalities	4.9×10^{-4}
Maximally exposed individual	
Annual dose (millirem)	1.4×10^{-4}
35-year latent cancer fatality risk	2.4×10^{-9}
Average exposed individual within 80 kilometers (50 miles)	
Annual dose[a] (millirem)	5.7×10^{-5}
35-year latent cancer fatality risk	9.9×10^{-10}

a. Obtained by dividing the population dose by the number of people projected to live within 80 kilometers (50 miles) of FFTF in the year 2020 (503,300).

Source: Model results, using the GENII computer code (Napier et al. 1988).

Probability coefficients for determining the likelihood of a latent cancer fatality, given a dose, are taken from the *1990 Recommendations of the International Commission on Radiological Protection* (ICRP 1991). A probability coefficient of 5×10^{-4} latent cancer fatality per rem is applied for the public, and a coefficient of 4×10^{-4} latent cancer fatality per rem is applied for workers. The value for workers is lower due to the absence of children and the elderly, who are more radiosensitive.

A collective dose of 0.028 person-rem would be incurred by the surrounding population in the year 2020. The corresponding number of latent cancer fatalities in this population from 35 years of maintaining FFTF in standby would be 4.9×10^{-4}. Here, and throughout this document, a latent cancer fatality value of less than one can be related to the statistical probability of a latent cancer fatality. The most probable outcome of a population dose of 0.028 person-rem would be no latent cancer fatalities. However, in a small number of cases, this dose would result in a latent cancer fatality. The lower the number of cases, the less likely is this outcome. This issue is addressed in more detail in Appendix H.

An annual dose of 1.4×10^{-4} millirem is shown for the maximally exposed individual. From 35 years of standby activities, the corresponding risk of a latent cancer fatality to this individual would be 2.4×10^{-9}.

The expected average dose to a worker involved with storage activities while FFTF is maintained in standby and the associated expected dose to the total storage workforce would be 3.5 millirem and 0.69 person-rem, respectively (refer to **Table 4–3**). The associated risk of a latent cancer fatality to the average worker from 35 years of standby activities would be 4.9×10^{-5}, and the estimated number of latent cancer fatalities in the total workforce from 35 years of operations would be 0.0097.

Table 4–3 Radiological Impacts on FFTF Workers from Maintaining FFTF in Standby Under All Options of the No Action Alternative

Receptor—No Action Workers[a]	Standby
Total dose (person-rem per year)	0.69[b]
35-year latent cancer fatalities	0.0097
Average worker dose (millirem per year)	3.5
35-year latent cancer fatality risk	4.9×10^{-5}

a. The radiological limit for an individual worker is 5,000 millirem per year (10 CFR Part 835). However, the maximum dose to a worker involved with storage operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (DOE 1999j). Further, DOE recommends that facilities adopt a more limiting, 500 millirem per year, Administrative Control Level (DOE 1999j). To reduce doses to levels that are as low as is reasonably achievable (ALARA), an effective ALARA program would be enforced.

b. Based on an estimated 200 workers.

Source: Nielsen 1999.

HAZARDOUS CHEMICAL IMPACTS. No new chemicals would be introduced by maintaining FFTF in standby. Thus, there would be no change in impacts from emissions of hazardous chemicals. Emissions of hazardous air pollutants from maintaining FFTF in standby, would be expected to continue for the next 35 years.

4.2.1.2.10 Public and Occupational Health and Safety—Standby Accidents

In its current standby condition, FFTF is defueled with slightly radioactive sodium circulating through the primary heat transport system. A primary heat transport system sodium spill would be the accident with the highest consequences. A detailed description of the accident analysis is provided in Appendix I.

Estimates of radiological consequences have been developed for the maximally exposed individual, the offsite population within 80 kilometers (50 miles) of FFTF, and a noninvolved worker at a distance of 640 meters (0.4 miles) from the release point. Consequences are presented in terms of radiological dose (in rem) and the probability that the dose would result in a latent cancer fatality. Accident risk is defined as the product of the accident probability (i.e., accident frequency) and the accident consequence. In this NI PEIS, risk is expressed as the increased likelihood of a latent cancer fatality per unit of time (i.e., 1 year or 35 years) for an individual (the maximally exposed offsite individual or a noninvolved worker), and as the increased number of latent cancer fatalities per unit of time (i.e., 1 year or 35 years) in the offsite population.

Consequences to involved workers are addressed Appendix I, Section I.1.7.

Probability coefficients for determining the likelihood of a latent cancer fatality, given a dose, are taken from the *1990 Recommendations of the International Commission on Radiological Protection* (ICRP 1991). For low doses or dose rates, a probability coefficient of 4×10^{-4} latent cancer fatality per rem is applied for workers, and 5×10^{-4} latent cancer fatality per rem for the public. For high doses received at a high rate, probability coefficients of 8×10^{-4} and 0.001 latent cancer fatality per rem are applied for workers and the public, respectively. These higher probability coefficients apply for doses above 20 rads and dose rates above 10 rads per hour.

Potential consequences and associated risks are presented in **Tables 4–4** and **4–5**, respectively.

Table 4–4 FFTF Standby Accident Consequences Under All Options of the No Action Alternative

Accident	Maximally Exposed Individual		Population to 80 Kilometers (50 Miles)		Noninvolved Worker	
	Dose (rem)	Latent Cancer Fatality[a]	Dose (person-rem)	Latent Cancer Fatalities[b]	Dose (rem)	Latent Cancer Fatality[a]
Primary heat transport system sodium spill	1.34×10^{-7}	6.70×10^{-11}	9.99×10^{-3}	4.99×10^{-6}	1.62×10^{-8}	6.48×10^{-12}

a. Likelihood of a latent cancer fatality.
b. Number of latent cancer fatalities.
Source: Model results, using the MACCS2 computer code (Chanin and Young 1997).

Table 4–5 FFTF Standby Accident Risks Under All Options of the No Action Alternative

Accident (Frequency)	Maximally Exposed Individual[a]	Population to 80 Kilometers (50 Miles)[b]	Noninvolved Worker[a]
Annual primary heat transport system sodium spill risk (1×10^{-4})	6.70×10^{-15}	4.99×10^{-10}	6.48×10^{-16}
35-year risk	2.35×10^{-13}	1.75×10^{-8}	2.27×10^{-14}

a. Increased likelihood of a latent cancer fatality.
b. Increased number of latent cancer fatalities.
Source: Model results, using the MACCS2 computer code (Chanin and Young 1997).

With FFTF in standby for 35 years, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be 2.35×10^{-13} and 2.27×10^{-14}, respectively. The increased number of latent cancer fatalities in the surrounding population would be 1.75×10^{-8}.

The 35-year risks are conservative because they are based on current primary sodium radioactivity levels. The radioisotopes contained in the primary sodium are sodium-22, cesium-137, plutonium-239, and tritium. Examining the current inventories, half-lives, and dose conversion factors of these isotopes, it was determined that currently 99 percent of the dose is attributable to plutonium-239 and sodium-22, with sodium-22 accounting for 78 percent of the total dose. Plutonium-239 has a 24,400-year half-life and would have only decayed 0.1 percent after 35 years. Sodium-22, however, has a 2.6-year half-life and would have decayed over 99.99 percent after 35 years. In year 35, only 21 percent of the original total dose level would remain. The annual risks would decrease each year due mainly to the radioactive decay of sodium-22. Therefore, if the annual risks were recalculated for each subsequent year based on lower activity levels and then summed for the 35-year period, the resulting risks would be lower than those presented.

Maintaining FFTF in standby would not introduce any additional operations that require the use of hazardous chemicals. Thus, there would be no postulated hazardous chemical accidents attributable to maintaining FFTF in standby.

4.2.1.2.11 Public and Occupational Health and Safety—Transportation

There would be no transportation impacts associated with maintaining FFTF in standby.

4.2.1.2.12 Environmental Justice

As discussed in other parts of Section 4.2.1.2, normal and incident-free operations required to maintain FFTF in standby pose no significant risks to the public. For 35 years of normal standby operations, FFTF would be a small contributor to baseline emissions from the Hanford Site. Chemical emissions would not be altered and no transportation impacts are associated with maintenance of FFTF in standby. As discussed in Appendix K, under the conservative assumption that all food consumed in the potentially affected area during the 35-year operational period would be radioactively contaminated, no credible pattern of food consumption would pose a significant radiological health risk due to ingestion of contaminated food supplies. Radiological risks to the public due to accidents occurring at FFTF while in standby would be essentially zero. Thus, maintaining FFTF in standby would pose no disproportionately high and adverse risks to minority or low-income populations.

4.2.1.2.13 Waste Management

The expected generation rates of waste at Hanford that would be associated with maintaining FFTF in standby for 35 years are compared with Hanford's treatment, storage, and disposal capacities in **Table 4–6**. The impacts on the Hanford waste management systems, in terms of managing the waste, are discussed in this section. Radiological and chemical impacts on workers and the public from waste management activities are included in the public and occupational health and safety impacts that are given in Sections 4.2.1.2.9 through 4.2.1.2.11.

Table 4–6 Waste Management Impacts of Maintaining FFTF in Standby Under All Options of the No Action Alternative

Waste Type[a]	Estimated Waste Generation for FFTF in Standby (cubic meters per year)	Estimated Waste Generation as a Percent of[b]		
		Onsite Treatment Capacity	Onsite Storage Capacity	Onsite Disposal Capacity
Low-level radioactive waste				
Liquid	<6	(c)	(c)	(c)
Solid	17	NA	NA	0.03
Mixed low-level radioactive waste	<0.5	NA	0.11	0.13
Hazardous	4[d]	NA	NA	NA
Nonhazardous				
Process wastewater	76,000	(c)	(c)	(c)
Sanitary wastewater	3,800	1.6[e]	NA	NA
Solid	120	NA	NA	NA

a. See definitions in Section G.9.
b. The estimated amounts of waste generated annually are compared with the annual site treatment capacities. The estimated total amounts of waste generated over the assumed 35-year operational period are compared with the site storage and disposal capacities.
c. Refer to the text.
d. Represents both liquid and solid hazardous waste.
e. Percent of capacity of the Energy Northwest Sewage Treatment Facility.

Note: To convert from cubic meters per year to cubic yards per year, multiply by 1.308; < means "less than."
Key: NA, not applicable (i.e., the majority of this waste is not routinely treated, stored, or disposed of on site; refer to the text).
Source: DOE 2000a; Nielsen 1999.

In accordance with the Records of Decision for the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (Waste Management PEIS)* (DOE 1997a), waste could be treated and disposed of on site at Hanford or at other DOE sites or commercial facilities. Based on the Record of Decision for hazardous waste issued on August 5, 1998 (63 FR 41810), nonwastewater hazardous waste would continue to be treated and disposed of at offsite commercial facilities. Based on the Record of Decision for low-level radioactive waste and mixed low-level radioactive waste issued on February 18, 2000 (65 FR 10061), minimal treatment of low-level radioactive waste will be performed at all sites and, to the extent practicable, onsite disposal of low-level radioactive waste will continue. Hanford and the Nevada Test Site will be made available to all DOE sites for disposal of low-level radioactive waste. Mixed low-level radioactive waste analyzed in the *Waste Management*

PEIS will be treated at Hanford, INEEL, ORR, and SRS and will be disposed of at Hanford and the Nevada Test Site.

It is also assumed in this NI PEIS that low-level radioactive waste, mixed low-level radioactive waste, hazardous waste, and nonhazardous waste would be treated, stored, and disposed of in accordance with current and developing site practices. No high-level radioactive waste or transuranic waste would be associated with maintaining FFTF in standby.

Solid low-level radioactive waste associated with maintaining FFTF in standby would continue to be compacted, if possible, and packaged in appropriate containers or burial casks, certified, and transferred for disposal in the existing onsite low-level radioactive Burial Grounds.

Six hundred cubic meters (780 cubic yards) of solid low-level radioactive waste would be generated over the 35-year period as a result of maintaining FFTF in standby. This solid low-level radioactive waste represents approximately 0.03 percent of the 1.74-million-cubic-meter (2.28-million-cubic-yard) capacity of the low-level radioactive Burial Grounds. Using the 3,480-cubic-meter-per-hectare (1,842-cubic-yard-per-acre) disposal land usage factor for Hanford published in the *Storage and Disposition PEIS* (DOE 1996a:E-9), 600 cubic meters (780 cubic yards) of waste would require 0.17 hectare (0.42 acre) of disposal space at Hanford. The impacts of managing this low-level radioactive waste at Hanford would be minimal.

Maintaining FFTF in standby would result in 210 cubic meters (275 cubic yards) of liquid low-level radioactive waste over the 35-year period. Liquid low-level radioactive waste associated with maintaining FFTF in standby would continue to be stored in FFTF or the Maintenance and Storage Facility and transported, as necessary, to the 200 Area Effluent Treatment Facility for processing and disposal. This liquid low-level radioactive waste resulting from maintaining FFTF in standby represents a very small amount of waste that can be managed by the 200 Area Liquid Effluent Treatment Facility, which has a capacity of 0.57 cubic meter per minute (0.75 cubic yard per minute).

Mixed low-level radioactive waste would be stabilized, packaged, and stored on site for treatment and disposal in a manner consistent with the Tri-Party Agreement (EPA et al. 1989) for Hanford. Over the 35-year period, it is estimated that less than 18 cubic meters (24 cubic yards) of mixed low-level radioactive waste would be generated as a result of maintaining FFTF in standby. This mixed low-level radioactive waste is expected to be treated at a nearby commercial facility. This waste is also estimated to be less than 0.11 percent of the 16,800-cubic-meter (22,000-cubic-yard) storage capacity of the Central Waste Complex and less than 0.13 percent of the 14,200-cubic-meter (18,600-cubic-yard) planned disposal capacity of the Radioactive Mixed Waste Disposal Facility. Therefore, this waste would only have a minimal impact on the management of mixed low-level radioactive waste at Hanford.

Hazardous waste generated during maintaining FFTF in standby would be packaged in U.S. Department of Transportation (DOT)-approved containers and shipped off site to permitted commercial recycling, treatment, and disposal facilities. The waste load generated during the 35-year period would have only a minimal impact on the Hanford hazardous waste management system.

Nonhazardous solid waste would be packaged and transported in conformance with standard industrial practice. Solid waste such as office paper, metal cans, and plastic and glass bottles that can be recycled would be sent off site for that purpose. The remaining solid sanitary waste would be sent for offsite disposal in a municipal landfill. This waste load would have only a minimal impact on the nonhazardous solid waste management system at Hanford.

Nonhazardous process wastewater, which is composed mainly of blowdown water from the eight FFTF cooling towers and would continue to be discharged into the 400 Area Ponds. This discharge is regulated by State Waste Discharge Permit ST-4501.

Nonhazardous sanitary wastewater would continue to be discharged from the 400 Area, which is connected to the Energy Northwest Treatment System. Nonhazardous sanitary wastewater generated from maintaining FFTF in standby would represent 1.6 percent of the 235,000-cubic-meter-per-year (307,000-cubic-yard-per-year) capacity of the Energy Northwest Sewage Treatment Facility.

The generation rates of waste at Hanford that are associated with maintaining FFTF in standby (refer to Table 4–6) can be compared with the current total waste generation rates at the site, given in Table 3–34 (Section 3.4.11). The waste generation rates associated with maintaining FFTF in standby is a small fraction of the current total waste generation rates at the site.

4.2.1.2.14 Spent Nuclear Fuel Management

Ongoing surveillance and minimum maintenance would continue while FFTF is in standby, and no irradiated nuclear fuel would be transferred to dry storage (WHC 1994).

The current inventory of spent nuclear fuel at FFTF is approximately 11 metric tons (24,200 pounds) of heavy metal, composed predominantly of mixed plutonium-uranium oxide encapsulated in stainless steel cladding (DOE 1995a). The spent nuclear fuel is stored in the sodium-filled vessels and in the dry cask storage system. Spent nuclear fuel stored at FFTF during standby, would continue to be stored there under existing conditions. There is no radiological liquid released to the environment from spent nuclear fuel storage. During operation, the airborne releases from FFTF, including spent nuclear fuel storage, resulted in an annual total effective dose equivalent to the public of less than 1.0×10^{-4} millirem (Nielsen 1999). This dose is negligible compared with the U.S. Environmental Protection Agency’s (EPA) Clean Air Act standard of 10 millirem per year.

4.2.2 No Action Alternative—Option 2

Under Option 2 of the No Action Alternative, the United States would continue to purchase the plutonium-238 from Russia that is needed to fabricate radioisotope power systems for future U.S. space missions. However, to allow for potential future production of plutonium-238, neptunium-237 that could be used in targets would be transported from SRS to a new storage facility. This option evaluates REDC at ORR as that storage facility.

FFTF at Hanford would be maintained in standby as part of this option.

4.2.2.1 Importation of Plutonium-238 from Russia

The environmental impacts associated with importing the plutonium-238 from Russia are given in Section 4.2.1.1.

4.2.2.2 Transportation and Storage

The environmental impacts associated with transporting neptunium-237 oxide from SRS to ORR and storing it in REDC are addressed in the following sections.

4.2.2.2.1 Land Resources

LAND USE. REDC is an existing facility in the 7900 Area of ORNL. The use of this facility for storing neptunium-237 for 35 years would require internal modifications, but no new facilities would be built. Since no additional land would be disturbed and the use of REDC for neptunium-237 storage would be compatible with its present mission, there would be no change in land use at ORR.

VISUAL RESOURCES. All activities associated with storing neptunium-237 would take place over a 35-year period in REDC. Because REDC is an existing facility that would require no external modifications, there would be no change in its appearance. Thus, the current Visual Resource Management Class IV rating for the 7900 Area would continue for 35 years. Since there would be no change in the appearance of REDC or of the 7900 Area, there would be no impact on visual resources.

4.2.2.2.2 Noise

Neptunium-237 storage would generate noise levels similar to those presently associated with REDC operations, as well as other operations in the 7900 Area. Onsite noise impacts would be expected to be minimal, and changes in offsite noise levels would not be noticeable since the nearest site boundary is 2.5 kilometers (1.6 miles) to the southeast. Changes in traffic volume going to and from REDC would be small, and would result in only minor changes to existing onsite and offsite noise levels. There would be no loud noises associated with neptunium-237 storage that would adversely impact wildlife. Noise impacts from this option would be expected to be the same over the next 35 years.

4.2.2.2.3 Air Quality

There would be no additional nonradiological air pollutant emissions associated with the storage of neptunium-237 at REDC over the next 35 years; thus, there would be no change in nonradiological air quality impacts at ORR (Wham 1999a).

The air quality impacts of transportation are presented in Section 4.2.2.2.11.

4.2.2.2.4 Water Resources

There would be no additional impact on water resources associated with the storage of neptunium-237 at REDC over 35 years because there would be no incremental use of surface water or groundwater, and there would be no change in the quantity or quality of effluents discharged to surface water or groundwater (Wham 1999a). Information on current water usage, effluent discharge, and water quality at ORR is presented in Section 3.2.4.

4.2.2.2.5 Geology and Soils

Using REDC for storing neptunium-237 would not involve new construction. Therefore, geologic and soil resources in the 7900 Area of ORNL would not be disturbed. Hazards from large-scale geologic conditions at ORR, such as earthquakes and volcanoes, were previously evaluated in the *Storage and Disposition PEIS* (DOE 1996a:4-260). The analysis determined that these hazards present a low risk to long-term storage facilities. Further review of the data and analyses presented in the referenced document and the site-specific data presented in this NI PEIS indicates that the large-scale geologic conditions likewise present a low risk to REDC. This is based on the fact that there is no evidence of capable faults on or near ORR and no volcanic hazard exists. Ground shaking of Modified Mercalli Intensity VI (refer to Table 3–4) associated with postulated earthquakes would be expected to primarily affect the integrity of inadequately designed or nonreinforced structures. Damage to properly or specially designed or upgraded facilities would not be expected. While sinkholes are present in the Knox Group, the 7900 Area is underlain by the Conasauga Group, in which karst features are less well-developed. Thus, sinkholes do not present a geologic hazard to REDC. As necessary, the need to evaluate and upgrade existing DOE facilities with regard to natural geologic hazards would be assessed in accordance with DOE Order 420.1, which is described in Section 4.2.1.2.5.

4.2.2.2.6 Ecological Resources

Because no new construction is planned, direct disturbance to ecological resources, including wetlands, would not occur. As noted in Section 4.2.2.2.2, wildlife would not be adversely affected by noise associated with neptunium-237 storage. There would be no change in impacts on aquatic resources for 35 years because water usage and wastewater discharge would not change from current values (Section 4.2.2.2.4). Due to the developed nature of the area and because no new construction would take place, impacts on threatened and endangered species would not occur.

Consultation to comply with Section 7 of the Endangered Species Act was conducted with the U.S. Fish and Wildlife Service (see Table 5–3) and resulted in the Service concluding that it does not anticipate adverse effects to federally listed endangered species that occur near the project area. DOE has also consulted with the Tennessee Department of Environment and Conservation; a response concerning state-listed species is pending from this agency. Although no state-listed species are expected to be impacted by the proposed action, no action would be taken relative to the use of facilities at ORR prior to the receipt of input from the state.

4.2.2.2.7 Cultural and Paleontological Resources

Because no new construction is planned, impacts on cultural and paleontological resources would not occur. One structure on ORNL, the Graphite Reactor, is listed on the National Register of Historic Places as a National Historic Landmark. Additionally, several other structures proposed for listing on the National Register of Historic Places are found on or near ORNL. However, neither the Graphite Reactor nor any of the other structures is in the 7900 Area; thus, the status of cultural resources would not change for 35 years as a result of using REDC for neptunium-237 storage.

Consultation to comply with Section 106 of the National Historic Preservation Act was initiated with the State Historic Preservation Office (see Table 5–3). While DOE has made additional contact with the State Historic Preservation Office, a response is pending from this office. Although impacts to cultural resources are not expected as a result of the proposed action, no action would be taken relative to the use of facilities at ORR prior to the receipt of input from the State Historic Preservation Office.

4.2.2.2.8 Socioeconomics

The existing storage facilities at ORR would remain operational. The effort associated with this option can be filled from within the currently projected site employment of 16,276. No new employment or in-migration of workers would be required. Thus, there would be no additional impacts on the socioeconomic conditions in the region around ORR.

4.2.2.2.9 Public and Occupational Health and Safety—Normal Operations

Assessments of incremental radiological and chemical impacts associated with this option are presented in this section. Supplemental information is provided in Appendix H.

RADIOLOGICAL IMPACTS. Upper-bounding radiological doses to three receptor groups over a 35-year period are given in **Table 4–7**: the population within 80 kilometers (50 miles) of REDC in the year 2020, the maximally exposed member of the public, and the average exposed member of the public. For purposes of this evaluation, it is conservatively assumed that the doses from neptunium-237 storage would be 10 percent of the doses from neptunium-237 target fabrication and processing (refer to Appendix H). The projected number of latent cancer fatalities in the surrounding population and the latent cancer fatality risk to the maximally and average exposed individuals are also presented in the table.

Table 4–7 Radiological Impacts on the Public Around ORR from Storage in REDC Under Option 2 of the No Action Alternative

Receptor	Storage in REDC[a]
Population within 80 kilometers (50 miles) in the year 2020	
Dose (person-rem)	8.0×10^{-6}
35-year latent cancer fatalities	1.4×10^{-7}
Maximally exposed individual	
Annual dose (millirem)	1.7×10^{-7}
35-year latent cancer fatality risk	3.0×10^{-12}
Average exposed individual within 80 kilometers (50 miles)	
Annual dose[b] (millirem)	7.1×10^{-9}
35-year latent cancer fatality risk	1.2×10^{-13}

a. Because exposure data are not available for neptunium-237 storage exclusively, values are conservatively estimated to be 10 percent of the fabrication and processing component of the total neptunium-237 target fabrication, processing, and storage doses (see Table H–12). These values serve as an upper-bounding representation of the potential impacts that could be incurred from neptunium-237 storage (refer to Appendix H). Realistically, these values would be expected to be virtually zero.

b. Obtained by dividing the population dose by the number of people projected to live within 80 kilometers (50 miles) of REDC in the year 2020 (1,134,200).

Source: Model results, using the GENII computer code (Napier et al. 1988).

A probability coefficient of 5×10^{-4} latent cancer fatality per rem is applied for the public, and a coefficient of 4×10^{-4} latent cancer fatality per rem is applied for workers (ICRP 1991). The value for workers is lower due to the absence of children and the elderly, who are more radiosensitive.

A collective dose of 8.0×10^{-6} person-rem would be incurred by the surrounding population in the year 2020. The corresponding number of latent cancer fatalities in this population from 35 years of storage would be 1.4×10^{-7}. A bounding annual dose of 1.7×10^{-7} millirem is shown for the maximally exposed individual. From 35 years of storage, the corresponding risk of a latent cancer fatality to this individual would be 3.0×10^{-12}.

The upper-bound estimate of the average dose to a worker involved with neptunium-237 storage operations and the corresponding upper-bound dose to the total storage workforce would be 17 millirem and 1.2 person-rem, respectively (refer to **Table 4–8**). The associated risk of a latent cancer fatality to the average worker from 35 years of storage operations would be 2.3×10^{-4}, and the estimated number of latent cancer fatalities in the total storage workforce from 35 years of operations would be 0.017. The total workforce dose presented in Table 4–8 was assumed to be 10 percent of the annual average worker doses reported at REDC for the years 1998 and 1999 (Wham 2000). This reduction factor was applied because the values given in that document include dose components associated with all REDC activities required for neptunium-237 processing, and not just the storage of neptunium-237 (refer to Appendix H). The resulting dose still serves as a conservative representation of potential worker impacts associated with neptunium-237 storage.

Table 4–8 Radiological Impacts on ORR Workers from Operational Facilities Under Option 2 of the No Action Alternative

Receptor—No Action Workers[a]	Storage in REDC[b]
Total dose (person-rem per year)	1.2[c]
35-year latent cancer fatalities	0.017
Average worker dose (millirem per year)	17
35-year latent cancer fatality risk	2.3×10^{-4}

a. The radiological limit for an individual worker is 5,000 millirem per year (10 CFR Part 835). However, the maximum dose to a worker involved with storage operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (DOE 1999j). Further, DOE recommends that facilities adopt a more limiting, 500 millirem per year, Administrative Control Level (DOE 1999j). To reduce doses to levels that are as low as is reasonably achievable (ALARA), an effective ALARA program would be enforced.
b. Because exposure data are not available for neptunium-237 storage exclusively, values are conservatively estimated to be 10 percent of the total dose from neptunium-237 target fabrication/processing and neptunium-237 storage, given in Section 4.4.1.1.9 (Table 4–57), and serve as an upper-bounding representation of the potential impacts that could be incurred from neptunium-237 storage (refer to Appendix H).
c. Based on an estimated 75 badged workers.
Source: Wham 1999b, 2000.

HAZARDOUS CHEMICAL IMPACTS. Hazardous chemical impacts would be unchanged from baseline site operations because no new chemicals would be used at REDC (Wham 1999a). Ongoing emissions of hazardous chemicals would be expected to continue for the next 35 years.

4.2.2.2.10 Public and Occupational Health and Safety—Facility Accidents

There would be no consequences from postulated accidents for neptunium-237 storage in REDC. The most severe accident evaluated in this NI PEIS is the beyond-design-basis catastrophic earthquake. Although the building would be expected to collapse, the hot cells would be expected to remain intact, but with cracked walls. In addition, one or more of the shielded viewing windows could be cracked or broken. The neptunium-237 is stored in double steel cans, with both the inner and outer cans sealed. The double cans are stacked in an array of seismically supported steel storage tubes inside the hot cell. The storage tube array would maintain geometry and not be damaged by equipment dislodged in the hot cell during the earthquake. The storage cans would not be stressed to a level that would breach the double containment of the can design. Therefore, no neptunium would be released from the storage cans.

Storage of neptunium-237 at REDC would not require the introduction of hazardous chemicals. Thus, there would be no hazardous chemical accidents associated with the storage of neptunium-237 at REDC.

4.2.2.2.11 Public and Occupational Health and Safety—Transportation

Transportation impacts may be divided into two parts: the impacts of incident-free or routine transportation, and the impacts of transportation accidents. Incident-free transportation and transportation accident impacts are divided into two components: nonradiological and radiological. Incident-free transportation impacts include radiological impacts on the public and the crew from the radiation field that surrounds the package; nonradiological impacts are from vehicular emissions. Nonradiological impacts of potential transportation accidents include traffic accident fatalities. Only as a result of a severe fire and/or a powerful collision, which are of extremely low probability, could a transportation package of the type used to transport radioactive material be so damaged that there could be a release of radioactivity to the environment.

The impact of a specific accident is expressed in terms of probabilistic risk, which is defined as the accident probability (i.e., accident frequency) multiplied by the accident consequences. The overall risk is obtained by summing the individual risks from all reasonably conceivable accidents. The risks for radiological accidents are expressed as additional latent cancer fatalities, and for nonradiological accidents as additional immediate fatalities. The risks of incident-free effects are expressed in additional latent cancer fatalities.

The first step in the analysis was to determine the incident-free and accident risk factors, on a per-shipment basis, for ground transportation of the various materials. Calculation of risk factors was accomplished by using the HIGHWAY (Johnson et al. 1993) computer code to choose representative routes in accordance with DOT regulations. This code provides population estimates so that the RADTRAN 5 (Neuhauser and Kanipe 2000) code could be used to determine the radiological risk factors. This analysis is described in Appendix J.

Neptunium-237 would be transported from storage at SRS to REDC at ORR. The neptunium-237 would be shipped in Type B packages. Plutonium-238 would be imported from Russia and shipped to LANL. No other shipments of neptunium-237 or waste are anticipated.

Approximately 59 shipments of radioactive materials would be made by DOE under this option. The total distance traveled on public roads by trucks carrying radioactive materials would be 128,000 kilometers (80,000 miles), and at sea by ships carrying plutonium-238 would be 298,000 kilometers (161,000 nautical miles).

IMPACTS OF INCIDENT-FREE TRANSPORTATION. The dose to transportation workers from all transportation activities entailed by this option has been estimated at 12 person-rem; the dose to the public would be 21 person-rem. Accordingly, incident-free transportation of radioactive material would result in 0.005 latent cancer fatality among transportation workers and 0.011 latent cancer fatality in the total affected population over the duration of the transportation activities. Latent cancer fatalities associated with radiological releases were estimated by multiplying the occupational (worker) dose by 4.0×10^{-4} latent cancer fatality per person-rem of exposure, and the public accident and accident-free doses by 5.0×10^{-4} latent cancer fatality per person-rem of exposure (ICRP 1991). The estimated number of nonradiological fatalities from vehicular emissions associated with this option is 5.9×10^{-4}.

IMPACTS OF ACCIDENTS DURING TRANSPORTATION. The maximum foreseeable offsite transportation accident under this option (probability of occurrence: more than 1 in 10 million per year) would not breach the transportation package. The consequences of more severe accidents that could breach the transportation package and release radioactive material were evaluated and estimated to have probabilities of less than 1 in 10 million per year.

Estimates of the total ground transportation accident risks under this option are as follows: a radiological dose to the population of 0.88 person-rem, resulting in 4.4×10^{-4} latent cancer fatality; and traffic accidents resulting in 0.014 traffic fatality.

4.2.2.2.12 Environmental Justice

As discussed in other parts of Section 4.2.2.2, neptunium-237 storage operations at REDC would pose no significant health or other environmental risks to the public.

NORMAL OPERATIONS. For 35 years of normal operations, the likelihood of a radiological latent cancer fatality among the population residing within 80 kilometers (50 miles) of REDC would be essentially zero (derived from information in Table 4–7). There would be no significant incremental impact associated with emissions of hazardous chemicals at REDC (Section 4.2.2.2.9). As discussed in Section 4.2.2.2.11, no radiological or nonradiological fatalities would be expected to result from incident-free transportation.

ACCIDENTS. Postulated accidents that would affect neptunium-237 storage were found to have no radiological consequences because the storage containers would not be breached (Section 4.2.2.2.10). Accidents during ground transportation were found to have essentially no radiological consequences because credible transportation accidents would not breach the transportation packages for neptunium-237. As discussed in Section 4.2.2.2.11, a fatal vehicle collision would be unlikely.

The implementation of this option would no pose significant radiological or other environmental risks to the public. Under the conservative assumption that all food consumed in the potentially affected area during the 35-year operational period would be radioactively contaminated, no credible pattern of food consumption would pose a significant radiological health risk due to ingestion of contaminated food supplies (see Appendix K). The transportation of neptunium-237 to ORR and storage at REDC would pose no disproportionately high and adverse risks for minority or low-income populations.

4.2.2.2.13 Waste Management

The only anticipated waste generated would be from the decontamination of the shipping containers used to transport neptunium-237 from SRS to ORR for storage at REDC. The minor amounts of low-level radioactive waste that would be generated—less than 10 cubic meters (13.1 cubic yards) over a 35-year period (Brunson 1999a)—could be managed under the existing waste management practices discussed in Section 3.2.11. Incremental impacts on the environment would be negligible.

4.2.2.3 Maintenance of FFTF in Standby

The environmental impacts associated with maintaining FFTF in standby for 35 years are addressed in Section 4.2.1.2.

4.2.3 No Action Alternative—Option 3

Under Option 3 of the No Action Alternative, the United States would continue to purchase the plutonium-238 from Russia that is needed to fabricate radioisotope power systems for future U.S. space missions. However, to allow for potential future production of plutonium-238, neptunium-237 that could be used in targets would be transported from SRS to a new storage facility. This option evaluates the Building CPP-651 vault at INEEL as that storage facility. The CPP–651 vault is within 91 meters (100 yards) of the Fluorinel Dissolution Process Facility (FDPF). This vault has 100 in-ground concrete storage silo positions sealed with 5.1-centimeter (2-inch) stainless steel shielding plugs. The neptunium-237 storage cans would be placed in a rack inside the silo.

FFTF at Hanford would be maintained in standby as part of this option.

4.2.3.1 Importation of Plutonium-238 from Russia

The environmental impacts associated with importing the plutonium-238 from Russia are given in Section 4.2.1.1.

4.2.3.2 Transportation and Storage

The environmental impacts associated with transporting neptunium-237 oxide from SRS to INEEL and storing it in the Building CPP–651 vault are addressed in this section.

4.2.3.2.1 Land Resources

LAND USE. Building CPP–651 is in the Idaho Nuclear Technology and Engineering Center (INTEC) area of INEEL. The use of this facility for storing neptunium-237 for 35 years would require internal modifications of the facility, but no new facilities would be built. Since no additional land would be disturbed and the use of Building CPP–651 for neptunium-237 storage would be compatible with the missions for which it was designed, there would be no change in land use at INEEL.

VISUAL RESOURCES. All activities associated with storing neptunium-237 would take place in Building CPP–651. Because this facility would not require external modifications, there would be no change in its appearance. Thus, the current Visual Resource Management Class IV rating for INTEC would continue for 35 years. Since there would be no change in the appearance of Building CPP–651 or INTEC, there would be no impact on visual resources.

4.2.3.2.2 Noise

Neptunium-237 storage in Building CPP–651 would generate noise levels similar to those presently associated with operations conducted in INTEC. Onsite noise impacts would be expected to be minimal, and changes in offsite noise levels should not be noticeable since the nearest site boundary is 12 kilometers (7.5 miles) to the south. Changes in traffic volume going to and from INTEC would be small and would result in only minor changes to onsite and offsite noise levels. There would be no loud noises associated with neptunium-237 storage that would adversely impact wildlife. Noise impacts from this option would be expected to be the same over the next 35 years.

4.2.3.2.3 Air Quality

There would be no additional nonradiological air pollutant emissions associated with the storage of neptunium-237 at INEEL over the next 35 years; thus, there would be no change in nonradiological air quality impacts.

The air quality impacts of transportation are presented in Section 4.2.3.2.11.

4.2.3.2.4 Water Resources

There would be no additional impact on water resources associated with the storage of neptunium-237 in Building CPP–651 for 35 years because there would be no incremental use of surface water or groundwater, and there would be no change in the quantity or quality of effluents discharged to surface water or groundwater. Information on current water usage, effluent discharge, and water quality at INEEL is presented in Section 3.3.4

4.2.3.2.5 Geology and Soils

Building CPP–651 would be used to store neptunium-237. Because this is an existing facility, there would be no disturbance to either geologic or soil resources at INTEC. Hazards from large-scale geologic conditions at INEEL, such as earthquakes and volcanoes, were previously evaluated in the *Storage and Disposition PEIS* (DOE 1996a:4-148). The analysis determined that these hazards present a low risk to long-term storage facilities. That analysis was reviewed in the *Surplus Plutonium Disposition EIS* (DOE 1999a:4-267-268). Further review of the data and analyses presented in these referenced documents and the site-specific data presented in this NI PEIS indicates that the large-scale geologic conditions likewise present a low risk to the proposed INTEC facilities. Ground shaking of Modified Mercalli Intensity VI to VII (refer to Table 3–4) associated with postulated earthquakes would be expected to primarily affect the integrity of inadequately designed or nonreinforced structures. Damage to properly or specially designed or upgraded facilities would not be expected. Also, the likelihood of future volcanic activity during the 35-year storage period is considered low. The potential for other nontectonic events to affect INEEL facilities is also low. As necessary, the need to evaluate and upgrade existing DOE facilities with regard to natural geologic hazards would be assessed in accordance with DOE Order 420.1, which is described in Section 4.2.1.2.5.

4.2.3.2.6 Ecological Resources

Because no new construction is planned, direct disturbance to ecological resources would not occur. As noted in Section 4.2.3.2.2, wildlife would not be affected by noise associated with neptunium-237 storage. There would be no impact on aquatic resources for 35 years because water usage and wastewater discharge would not change from current values (Section 4.2.3.2.4). Due to the developed nature of the area and the fact that no new construction would take place, impacts on threatened and endangered species would not occur.

Consultation letters to comply with Section 7 of the Endangered Species Act were sent to the U.S. Fish and Wildlife Service and the Idaho Department of Fish and Game (see Table 5–3). Each agency was asked to provide information on potential impacts of the proposed action on threatened and endangered species. The Idaho Department of Fish and Game indicated that their database contained no known occurrences of special status plants or animals near the project area. While DOE has made additional contact with the U.S. Fish and Wildlife Service, a response is pending from this agency. Although no federally listed species are expected to be impacted by the proposed action, no action would be taken relative to the use of facilities at INEEL prior to the receipt of input from the Service.

4.2.3.2.7 Cultural and Paleontological Resources

Because no new construction is planned, impacts on cultural and paleontological resources at INTEC would not occur. The use of Building CPP–651 to store neptunium-237 for 35 years would not change the status of six historic structures located at INTEC. Also, Native American resources occurring in the vicinity of INTEC would not be impacted by the storage of neptunium-237.

Consultation to comply with Section 106 of the National Historic Preservation Act was initiated with the State Historic Preservation Office (see Table 5–3). The State Historic Preservation Office indicated that Building CPP-651 is likely to be eligible for the National Register of Historic Places as a contributory property in a potential historic district of exceptional significance. However, at this time, the State Historic Preservation Office has determined that more information is needed prior to assisting DOE in evaluating this property. The State Historic Preservation Office also indicated that since there would be no new construction, there is little potential for effects on archaeological properties. DOE would provide additional information as required to the Idaho State Historic Preservation Office prior to the use of any facility at INEEL for the proposed project. Consultation was conducted with interested Native American tribes; however, responses are pending.

4.2.3.2.8 Socioeconomics

The existing storage facilities at INEEL would remain operational. The effort associated with this option can be filled from within the currently projected site employment of 7,993. No new employment or in-migration of workers would be required. Thus, there would be no additional impacts on the socioeconomic conditions in the region around INEEL.

4.2.3.2.9 Public and Occupational Health and Safety—Normal Operations

Assessments of incremental and chemical impacts associated with this option are presented in this section. Supplemental information is provided in Appendix H.

RADIOLOGICAL IMPACTS. Under this option, INEEL would store neptunium-237 in CPP–651 in the INTEC area. Upper-bounding radiological doses to three receptor groups are given in **Table 4–9**: the population within 80 kilometers (50 miles) of INTEC in the year 2020, the maximally exposed member of the public, and the average exposed member of the public. For purposes of this evaluation, it is conservatively assumed that the doses from neptunium-237 storage would be 10 percent of the doses from neptunium-237 target fabrication and processing (refer to Appendix H). The projected number of latent cancer fatalities in the surrounding population and the latent cancer fatality risk to the maximally and average exposed individuals are also presented in the table.

Table 4–9 Radiological Impacts on the Public Around INEEL from Operational Facilities Under Option 3 of the No Action Alternative

Receptor	Storage in CPP–651[a]
Population within 80 kilometers (50 miles) in the year 2020	
Dose (person-rem)	3.5×10^{-7}
35-year latent cancer fatalities	6.1×10^{-9}
Maximally exposed individual	
Annual dose (millirem)	2.4×10^{-8}
35-year latent cancer fatality risk	4.2×10^{-13}
Average exposed individual within 80 kilometers (50 miles)	
Annual dose[b] (millirem)	1.9×10^{-9}
35-year latent cancer fatality risk	3.3×10^{-14}

a. Because exposure data are not available for neptunium-237 storage exclusively, values are conservatively estimated to be 10 percent of the fabrication and processing component of the total neptunium-237 target fabrication, processing, and storage doses (see Table H–12). These values serve as an upper-bounding representation of the potential impacts that could be incurred from neptunium-237 storage (refer to Appendix H). Realistically, these values would be expected to be virtually zero.

b. Obtained by dividing the population dose by the number of people projected to live within 80 kilometers (50 miles) of INTEC in the year 2020 (188,400).

Source: Model results, using the GENII computer code (Napier et al. 1988).

A probability coefficient of 5×10^{-4} latent cancer fatality per rem is applied for the public, and a coefficient of 4×10^{-4} latent cancer fatality per rem is applied for workers (ICRP 1991). The value for workers is lower due to the absence of children and the elderly, who are more radiosensitive.

A collective dose of 3.5×10^{-7} person-rem would be incurred in the surrounding population in the year 2020. The corresponding number of latent cancer fatalities in this population from 35 years of storage would be 6.1×10^{-9}. A bounding annual dose of 2.4×10^{-8} millirem is shown for the maximally exposed individual. From 35 years of storage, the corresponding risk of a latent cancer fatality to this individual would be 4.2×10^{-13}.

The upper-bound estimate of the average dose to a worker involved with neptunium-237 storage operations and the corresponding upper-bound dose to the total storage workforce would be 17 millirem and 1.2 person-rem, respectively (refer to **Table 4–10**). The associated risk of a latent cancer fatality to the average worker from 35 years of storage operations would be 2.3×10^{-4}, and the estimated number of latent cancer fatalities in the total storage workforce from 35 years of operations would be 0.017. The total workforce dose presented in Table 4–10 was assumed to be 10 percent of the annual average worker doses reported at REDC for the years 1998 and 1999 (Wham 2000). This reduction factor was applied because the values given in that document include dose components associated with all REDC activities, and not just the storage of neptunium-237 (refer to Appendix H). The resulting dose still serves as a conservative representation of potential worker impacts associated with neptunium-237 storage.

Table 4–10 Radiological Impacts on INEEL Workers from Operational Facilities Under Option 3 of the No Action Alternative

Receptor—No Action workers[a]	Storage in CPP–651[b]
Total dose (person-rem per year)	1.2[c]
35-year latent cancer fatalities	0.017
Average worker dose (millirem per year)	17
35-year latent cancer fatality risk	2.3×10^{-4}

a. The radiological limit for an individual worker is 5,000 millirem per year (10 CFR Part 835). However, the maximum dose to a worker involved with storage operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (DOE 1999j). Further, DOE recommends that facilities adopt a more limiting, 500 millirem per year, Administrative Control Level (DOE 1999j). To reduce doses to levels that are as low as is reasonably achievable (ALARA), an effective ALARA program would be enforced.

b. Because exposure data are not available for neptunium-237 storage exclusively, values are conservatively estimated to be 10 percent of the total dose from neptunium-237 target fabrication/processing and neptunium-237 storage, given in Section 4.4.2.1.9 (Table 4–69), and serve as an upper-bounding representation of the potential impacts that could be incurred from neptunium-237 storage (refer to Appendix H).

c. Based on an estimated 75 badged workers.

Source: Wham 1999b, 2000.

HAZARDOUS CHEMICAL IMPACTS. Hazardous chemical impacts at INEEL would be unchanged from baseline site operations because no new chemicals would be emitted to the air at INEEL. Ongoing emissions would be expected to continue for the next 35 years.

4.2.3.2.10 Public and Occupational Health and Safety—Facility Accidents

At INEEL, neptunium-237 would be stored in the Building CPP–651 vault, which is within 91 meters (100 yards) of FDPF. The Building CPP–651 vault has 100 in-ground concrete storage silo positions sealed with 5.1-centimeter (2-inch) stainless steel shielding plugs. The neptunium-237 storage cans would be placed in a rack inside the silo. While the postulated beyond-design-basis earthquake may cause portions of the facility to collapse, none of the storage cans in the in-ground storage silos would be breached. The storage cans would not be stressed to a level that would breach the double containment of the can design.

Storage of neptunium-237 in Building CPP–651 would not require the introduction of hazardous chemicals. Thus, there would be no hazardous chemical accidents associated with the storage of neptunium-237 in Building CPP–651.

4.2.3.2.11 Public and Occupational Health and Safety—Transportation

Neptunium-237 would be transported from storage at SRS to the Building CPP–651 vault at INEEL. The neptunium-237 would be shipped in Type B packages. Plutonium-238 would be imported from Russia and shipped to LANL. No other shipments of neptunium-237 and no shipments of waste are anticipated. The analysis is described in Appendix J.

Approximately 59 shipments of radioactive materials would be made by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be 203,000 kilometers (127,000 miles), and at sea by ships carrying plutonium-238 would be 298,000 kilometers (161,000 nautical miles).

IMPACTS OF INCIDENT-FREE TRANSPORTATION. The dose to transportation workers from all transportation activities entailed by this option has been estimated at 12 person-rem; the dose to the public would be 28 person-rem. Accordingly, incident-free transportation of radioactive material would result in 0.005 latent cancer fatality among transportation workers and 0.014 latent cancer fatality in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this option is 0.0009.

IMPACTS OF ACCIDENTS DURING TRANSPORTATION. The maximum foreseeable offsite transportation accident under this option (probability of occurrence: more than 1 in 10 million per year) would not breach the transportation package. The consequences of more severe accidents that could breach the transportation package and release radioactive material were evaluated and estimated to have probabilities of less than 1 in 10 million per year.

Estimates of the total ground transportation accident risks under this option are as follows: a radiological dose to the population of 0.88 person-rem, resulting in 4.4×10^{-4} latent cancer fatality; and traffic accidents resulting in 0.014 traffic fatality.

4.2.3.2.12 Environmental Justice

As discussed in other parts of Section 4.2.3.2, neptunium-237 storage operations would pose no significant health or other environmental risks to the public.

NORMAL OPERATIONS. For 35 years of normal storage operations, the likelihood of a radiological latent cancer fatality among the population residing within 80 kilometers (50 miles) of neptunium storage facilities at INEEL would be essentially zero (derived from information in Table 4–9). There would be no significant incremental impact associated with emissions of hazardous chemicals (Section 4.2.3.2.9). As discussed in Section 4.2.3.2.11, incident-free transportation activities conducted under this option would not be expected to result in fatalities.

ACCIDENTS. Postulated accidents that would affect neptunium-237 storage were found to have no radiological consequences because the storage containers would not be breached (Section 4.2.3.2.10). Accidents during ground transportation were found to have essentially no radiological consequences because credible transportation accidents would not breach the transportation packages for neptunium-237. No fatalities due to vehicle collisions would be expected.

The implementation of this option would pose no significant radiological or other environmental risks to the public. Under the conservative assumption that all food consumed in the potentially affected area during the 35-year operational period would be radioactively contaminated, no credible pattern of food consumption would pose a significant radiological health risk due to ingestion of contaminated food supplies (see Appendix K). The transportation of neptunium-237 to INEEL and storage in Building CPP–651 would pose no disproportionately high and adverse risks for minority or low-income populations.

4.2.3.2.13 Waste Management

The only anticipated waste associated with this option would be from decontamination of the shipping containers used to transport neptunium-237 from SRS to INEEL for storage. The minor amounts of low-level radioactive waste that would be generated—less than 10 cubic meters (13.1 cubic yards) over a 35-year period (Brunson 1999a)—could be managed under the existing waste management practices discussed in Section 3.3.11. Incremental impacts on the environment would be negligible.

4.2.3.3 Maintenance of FFTF in Standby

The environmental impacts associated with maintaining FFTF in standby for 35 years are addressed in Section 4.2.1.2.

4.2.4 No Action Alternative—Option 4

Under Option 4 of the No Action Alternative, the United States would continue to purchase the plutonium-238 from Russia that is needed to fabricate radioisotope power systems for future U.S. space missions. However, to allow for potential future production of plutonium-238, neptunium-237 that could be used in targets would be transported from SRS to a new storage facility. This option evaluates FMEF at Hanford as that storage facility.

FFTF at Hanford would be maintained in standby as part of this option.

4.2.4.1 Importation of Plutonium-238 from Russia

The environmental impacts associated with importing the plutonium-238 from Russia are given in Section 4.2.1.1.

4.2.4.2 Transportation and Storage

The environmental impacts associated with transporting neptunium-237 oxide from SRS to Hanford and storing it at FMEF are addressed in this section.

4.2.4.2.1 Land Resources

LAND USE. FMEF is in the 400 Area of Hanford. The use of this facility for storing neptunium-237 for 35 years would require internal modifications, but no new facilities would be built. Since no additional land would be disturbed and the use of FMEF for neptunium-237 storage would be compatible with the mission for which it was designed, there would be no change in land use at Hanford.

VISUAL RESOURCES. All activities associated with storing neptunium-237 would take place over 35 years in FMEF. Because FMEF would require no external modifications, there would be no change in its appearance. Therefore, the current Visual Resource Management Class IV rating for the 400 Area would continue for 35 years. Since there would be no change in the appearance of FMEF or that of the 400 Area, there would be no impact on visual resources.

4.2.4.2.2 Noise

Neptunium-237 storage would generate noise levels similar to those presently associated with operations in the 400 Area. Onsite noise impacts would be expected to be minimal, and changes in offsite noise levels should not be noticeable since the nearest site boundary is 7 kilometers (4.3 miles) to the east. Changes in traffic volume going to and from FMEF would be small and would result in only minor changes to onsite and offsite noise levels. There would be no loud noises associated with neptunium-237 storage that would adversely impact wildlife. Noise impacts from this option would be expected to be the same over the next 35 years.

4.2.4.2.3 Air Quality

There would be no additional nonradiological air pollutant emissions associated with the storage of neptunium-237 at Hanford over the next 35 years; thus, there would be no change in nonradiological air quality impacts.

The air quality impacts of transportation from SRS to Hanford are presented in Section 4.2.4.2.11.

4.2.4.2.4 Water Resources

There would be no additional impact on water resources associated with the storage of neptunium-237 in FMEF for 35 years because there would be no incremental use of surface water or groundwater, and there would be no change in the quantity or quality of effluents discharged to surface water or groundwater. Information on current water usage, effluent discharge, and water quality at Hanford is presented in Section 3.4.4.

4.2.4.2.5 Geology and Soils

Because the neptunium-237 would be stored in FMEF, an existing facility, there would be no disturbance to either geologic or soil resources in the 400 Area. Hazards from large-scale geologic conditions at Hanford, such as earthquakes and volcanoes, were previously evaluated in the *Storage and Disposition PEIS* (DOE 1996a:4-45). The analysis determined that these hazards present a low risk to long-term storage facilities. That analysis was reviewed in the *Surplus Plutonium Disposition EIS* (DOE 1999a:4-260). Further review of the data and analyses presented in these referenced documents and the site-specific data presented in this NI PEIS indicates that the large-scale geologic conditions likewise present a low risk to FMEF. Ground shaking of Modified Mercalli Intensity V to VII (refer to Table 3–4) associated with postulated earthquakes would be expected to primarily affect the integrity of inadequately designed or nonreinforced structures. Damage to properly or specially designed or upgraded facilities would not be expected. Also, only minimal effects (e.g., ashfall) would be expected from postulated volcanic events in the Cascade Region. The potential for other nontectonic events to affect the facility is also low. As necessary, the need to evaluate and upgrade existing DOE facilities with regard to natural geologic hazards would be assessed in accordance with DOE Order 420.1, which is described in Section 4.2.1.2.5.

4.2.4.2.6 Ecological Resources

Because no new construction is planned in the 400 Area, direct disturbance to ecological resources would not occur. As noted in Section 4.2.4.2.2, wildlife would not be affected by noise associated with neptunium-237 storage. Because water usage and wastewater discharge would not change from current values, there would be no change in impacts on aquatic habitat or wetlands associated with the Columbia River for 35 years (Section 4.2.4.2.4). Due to the developed nature of the area and the fact that no new construction would take place, impacts on threatened and endangered species would not occur.

Consultation letters concerning threatened and endangered species were sent to the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the Washington State Department of Natural Resources, and the State of Washington Department of Fish and Wildlife (see Table 5–3). Each agency was asked to provide information on potential impacts of the proposed action on threatened and endangered species. Both the Washington State Department of Natural Resources and the State of Washington Department of Fish and Wildlife provided lists of state species of concern that occur in the vicinity of the project area. As noted above, no impacts to any threatened or endangered species are expected, including those of concern to these agencies. While DOE has made additional contacts with the U.S. Fish and Wildlife Service and the National Marine

Fisheries Service, responses are pending from these agencies. Although no federally listed species are expected to be impacted by the proposed action, no action would be taken relative to the use of facilities at Hanford prior to the receipt of input from these Federal agencies.

4.2.4.2.7 Cultural and Paleontological Resources

Because FMEF is an existing facility in the highly disturbed 400 Area and new construction would not be required, there would be no change in the status of cultural and paleontological resources. No prehistoric, historic, or paleontological sites have been identified either in the 400 Area or within 2 kilometers (1.2 miles) of the 400 Area. Six buildings in the 400 Area have been determined to be eligible for listing on the National Register of Historic Places as contributing properties in the Historic District recommended for mitigation. The use of FMEF to store neptunium-237 for 35 years would not affect the eligibility of these structures for the National Register of Historic Places. No Native American resources are known to occur in the 400 Area.

Consultation to comply with Section 106 of the National Historic Preservation Act was conducted with the State Historic Preservation Office (see Table 5–3) and resulted in concurrence by the State Historic Preservation Office that the proposed action would have no effect on historic properties at Hanford. Consultation was also conducted with interested Native American tribes that resulted in comments at public hearings by members representing the Nez Perce and Confederated Tribes of the Umatilla Indian Reservation. Responses to their specific comments are addressed in Volume 3.

4.2.4.2.8 Socioeconomics

The existing storage facilities at Hanford would remain operational. The effort associated with this option can be filled from within the currently projected site employment of 16,005. No new employment or in-migration of workers would be required. Thus, there would be no additional impacts on the socioeconomic conditions in the region around Hanford.

4.2.4.2.9 Public and Occupational Health and Safety—Normal Operations

Assessments of incremental and chemical impacts associated with this option are presented in this section. Supplemental information is provided in Appendix H.

RADIOLOGICAL IMPACTS. This option involves the storage of neptunium-237 at FMEF. Upper-bounding radiological doses to three receptor groups are given in **Table 4–11**: the population within 80 kilometers (50 miles) of FMEF in the year 2020, the maximally exposed member of the public, and the average exposed member of the public. For purposes of this evaluation, it is conservatively assumed that the doses from neptunium-237 storage would be 10 percent of the doses from neptunium-237 target fabrication and processing (refer to Appendix H). The projected number of latent cancer fatalities in the surrounding population and the latent cancer fatality risk to the maximally and average exposed individuals are also presented in the table.

A probability coefficient of 5×10^{-4} latent cancer fatality per rem is applied for the public, and a coefficient of 4×10^{-4} latent cancer fatality per rem is applied for workers (ICRP 1991). The value for workers is lower due to the absence of children and the elderly, who are more radiosensitive.

A collective dose of 4.0×10^{-6} person-rem would be incurred in the surrounding population in the year 2020. The corresponding number of latent cancer fatalities in this population from 35 years of storage would be 7.0×10^{-8}. A bounding annual dose of 4.3×10^{-8} millirem is shown for the maximally exposed individual. From 35 years of storage, the corresponding risk of a latent cancer fatality to this individual would be 7.5×10^{-13}.

Table 4–11 Radiological Impacts on the Public Around Hanford from Operational Facilities Under Option 4 of the No Action Alternative

Receptor	Storage in FMEF[a]
Population within 80 kilometers (50 miles) in the year 2020	
Dose (person-rem)	4.0×10^{-6}
35-year latent cancer fatalities	7.0×10^{-8}
Maximally exposed individual	
Annual dose (millirem)	4.3×10^{-8}
35-year latent cancer fatality risk	7.5×10^{-13}
Average exposed individual within 80 kilometers (50 miles)	
Annual dose[b] (millirem)	8.1×10^{-9}
35-year latent cancer fatality risk	1.4×10^{-13}

a. Because exposure data are not available for neptunium-237 storage exclusively, values are conservatively estimated to be 10 percent of the fabrication and processing component of the total neptunium-237 target fabrication, processing, and storage doses (see Table H–12). These values serve as an upper-bounding representation of the potential impacts that could be incurred from neptunium-237 storage (refer to Appendix H). Realistically, these values would be expected to be virtually zero.

b. Obtained by dividing the population dose by the number of people projected to live within 80 kilometers (50 miles) of FMEF in the year 2020 (494,400).

Source: Model results, using the GENII computer code (Napier et al. 1988).

The upper-bound estimate of the average dose to a worker involved with neptunium-237 storage operations and the corresponding upper-bound dose to the total storage workforce would be 17 millirem and 1.2 person-rem, respectively (refer to **Table 4–12**). The associated risk of a latent cancer fatality to the average worker from 35 years of storage operations would be 2.3×10^{-4}, and the estimated number of latent cancer fatalities in the total storage workforce from 35 years of operations would be 0.017. The total workforce dose presented in Table 4–12 was assumed to be 10 percent of the average annual workforce doses reported at REDC for the years 1998 and 1999 (Wham 2000). This reduction factor was applied because the values given in that document include dose components associated with all REDC activities, and not just the storage of neptunium-237 (refer to Appendix H). The resulting dose still serves as a conservative representation of potential worker impacts associated with neptunium-237 storage.

Table 4–12 Radiological Impacts on Hanford Workers from Operational Facilities Under Option 4 of the No Action Alternative

Receptor—No Action Workers[a]	Storage in FMEF[b]
Total dose (person-rem per year)	1.2[c]
35-year latent cancer fatalities	0.017
Average worker dose (millirem per year)	17
35-year latent cancer fatality risk	2.3×10^{-4}

a. The radiological limit for an individual worker is 5,000 millirem per year (10 CFR Part 835). However, the maximum dose to a worker involved with storage operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (DOE 1999j). Further, DOE recommends that facilities adopt a more limiting, 500 millirem per year, Administrative Control Level (DOE 1999j). To reduce doses to levels that are as low as is reasonably achievable (ALARA), an effective ALARA program would be enforced.

b. Because exposure data are not available for neptunium-237 storage exclusively, values are conservatively estimated to be 10 percent of the total dose from neptunium-237 target fabrication/processing and neptunium-237 storage, given in Section 4.4.3.1.9 (Table 4–78), and serve as an upper-bounding representation of the potential impacts that could be incurred from neptunium-237 storage (refer to Appendix H).

c. Based on an estimated 75 badged workers.

Source: Wham 1999b, 2000.

HAZARDOUS CHEMICAL IMPACTS. Hazardous chemical impacts would be unchanged from baseline site operations because no new chemicals would be emitted to the air at Hanford. Ongoing emissions associated with storage at FMEF would be expected to continue for the next 35 years.

4.2.4.2.10 Public and Occupational Health and Safety—Facility Accidents

There would be no consequences from postulated accidents for neptunium-237 storage in FMEF. The most severe accident evaluated in this NI PEIS is the beyond-design-basis catastrophic earthquake. Although the building would be expected to collapse, the hot cells would be expected to remain intact, but with cracked walls. In addition, one or more of the shielded viewing windows could be cracked or broken. The neptunium-237 is stored in double steel cans, with both the inner and outer cans sealed. The double cans are stacked in an array of seismically supported steel storage tubes inside the hot cell. The storage tube array would maintain geometry and not be damaged by equipment dislodged in the hot cell during the earthquake. The storage cans would not be stressed to a level that would breach the double containment of the can design. Therefore, no neptunium would be released from the storage cans.

Storage of neptunium-237 at FMEF would not require the introduction of hazardous chemicals. Thus, there are no hazardous chemical accidents associated with the storage of neptunium-237 at FMEF.

4.2.4.2.11 Public and Occupational Health and Safety—Transportation

Neptunium-237 would be transported from storage at SRS to FMEF at Hanford. The neptunium-237 would be shipped in Type B packages. Plutonium-238 would be imported from Russia and shipped to LANL. No other shipments of neptunium-237 and no shipments of waste are anticipated.

Approximately 59 shipments of radioactive materials would be made by DOE under this option. The total distance traveled on public roads by trucks carrying radioactive materials would be 220,000 kilometers (137,000 miles), and at sea by ships carrying plutonium-238 would be 298,000 kilometers (161,000 nautical miles).

IMPACTS OF INCIDENT-FREE TRANSPORTATION. The dose to transportation workers from all transportation activities entailed by this option has been estimated at 12 person-rem; the dose to the public, 29 person-rem. Accordingly, incident-free transportation of radioactive material would result in 0.005 latent cancer fatality among transportation workers and 0.014 latent cancer fatality in the total affected population over the duration of the transportation activities. The estimated number of nonradiological fatalities from vehicular emissions associated with this alternative is 0.0009.

IMPACTS OF ACCIDENTS DURING TRANSPORTATION. The maximum foreseeable offsite transportation accident under this option (probability of occurrence: 1 in 10 million) would not breach the transportation package. The consequences of more severe accidents that could breach the transportation package and release radioactive material were evaluated and estimated to have probabilities of less than 1 in 10 million per year.

Estimates of the total ground transportation accident risks under this option are as follows: a radiological dose to the population of 0.88 person-rem, resulting in 4.4×10^{-4} latent cancer fatality; and traffic accidents resulting in 0.014 traffic fatality.

4.2.4.2.12 Environmental Justice

As discussed in other parts of Section 4.2.4.2, neptunium-237 storage operations at FMEF would pose no significant health or other environmental risks to the public.

NORMAL OPERATIONS. For 35 years of normal storage operations, the likelihood of a radiological latent cancer fatality among the population residing within 80 kilometers (50 miles) of neptunium storage facilities at Hanford would be essentially zero (derived from information in Table 4–11). There would be no significant incremental impact associated with emissions of hazardous chemicals at Hanford (Section 4.2.4.2.9). No fatalities would be expected from incident-free transportation (Section 4.2.4.2.11).

ACCIDENTS. Postulated accidents that would affect neptunium-237 storage were found to have no radiological consequences because the storage containers would not be breached (Section 4.2.4.2.10). Accidents during ground transportation were found to have essentially no radiological consequences because credible transportation accidents would not breach the transportation packages for neptunium-237. No fatal vehicle collisions would be expected.

The implementation of this option would pose no significant radiological or other environmental risks to the public. Under the conservative assumption that all food consumed in the potentially affected area during the 35-year operational period would be radioactively contaminated, no credible pattern of food consumption would pose a significant radiological health risk due to ingestion of contaminated food supplies (see Appendix K). The transportation of neptunium-237 to Hanford and storage in FMEF would pose no disproportionately high and adverse risks to minority or low-income populations.

4.2.4.2.13 Waste Management

The only anticipated waste associated with this option would be from decontamination of the shipping containers used to transport neptunium-237 from SRS to Hanford for storage at FMEF. The minor amounts of low-level radioactive waste that would be generated—less than 10 cubic meters (13.1 cubic yards) over a 35-year period (Brunson 1999a)—could be managed under the existing waste management practices discussed in Section 3.4.11. Incremental impacts on the environment would be negligible.

4.2.4.3 Maintenance of FFTF in Standby

The environmental impacts associated with maintaining FFTF in standby for 35 years are addressed in Section 4.2.1.2.