

#### **4.6 ALTERNATIVE 4—CONSTRUCT NEW RESEARCH REACTOR**

Under Alternative 4, a new research reactor would be used for target irradiation for the evaluation period of 35 years. The new research reactor, to be constructed at an existing DOE site, would be used to irradiate all targets (i.e., for the production of plutonium-238, isotopes for medical and industrial uses, and materials testing for civilian nuclear energy research and development). Ongoing operations at existing facilities as described in Chapter 3, Affected Environment, would continue.

The targets for plutonium-238 production would be fabricated in one of the three candidate facilities at ORNL, INEEL, or Hanford. The material needed for the target fabrication (neptunium-237) would be transported from SRS to the fabrication facilities. The targets would be irradiated at the new research reactor facility and transported back to the target fabrication facilities for postirradiation processing.

Targets for medical and industrial isotope production would be fabricated in a new support facility located at the same site as the new research reactor. The targets would be irradiated in the new research reactor and returned to the new support facility for postirradiation processing.

Alternative 4 site selection is not evaluated as part of this NI PEIS. Because Alternative 4 is evaluated at a generic DOE site, no credit was taken for any existing support infrastructure existing at the site and it was postulated that a new support facility would be required to support operation of the new research reactor and its missions. While this approach bounds the environmental impact assessment for the implementation of Alternative 4, it overstates the impacts because this NI PEIS integrates the impacts associated with constructing a new support facility and infrastructure that may be available at the existing DOE site. In the event that Alternative 4 is selected by the Record of Decision for subsequent consideration, follow-up NEPA assessments would evaluate potential locations for the new research reactor. It is unlikely that DOE would consider locating the new research reactor on a DOE site that does not have existing infrastructure capable of supporting all or most of the medical and industrial isotope production and civilian nuclear energy research and development mission requirements. If the reactor were built on a DOE site with existing support facilities, the environmental impacts of such implementation could be determined by subtracting the construction and decommissioning impacts associated with the new support facility from the total impacts given for this alternative.

Under Alternative 4, nonirradiated targets, irradiated targets, and processed materials would be transported between the locations selected for storage, target fabrication, target irradiation, postirradiation processing, and the final destination of the plutonium-238. Alternative 4 also would include the decontamination and decommissioning of both the research reactor and the support facility when the missions are over, as well as deactivation of FFTF at Hanford.

The proposed new research reactor would provide ample neutrons for the production of plutonium-238 and for many of the isotopes listed in Table 1–1. The thermal flux would limit the new research reactor's ability to produce a number of isotopes requiring fast or high-energy neutrons. Its lower flux levels ( $10^{13}$  neutrons per square centimeter per second) and predominantly thermal flux would limit its ability to support many of the projected nuclear-based research and development needs.

The three options under this alternative and their associated target fabrication, postirradiation processing, and transportation activities are discussed below.

- **Option 1.** REDC at ORNL would be used to fabricate and process the neptunium-237 targets associated with plutonium-238 production. The neptunium-237 transported from SRS to ORNL would be stored at REDC. The plutonium-238 product would be transported from ORNL to LANL.

A new support facility at an existing DOE site would be used to fabricate and process the targets required for the production of medical and industrial and research isotopes and to store the materials needed for target fabrication.

- **Option 2.** FDPF at INEEL would be used to fabricate and process the neptunium-237 targets associated with plutonium-238 production. The neptunium-237 transported from SRS to INEEL would be stored in FDPF or Building CPP-651. The plutonium-238 product would be transported from INEEL to LANL. A new support facility at an existing DOE site would be used to fabricate and process the targets required for the production of medical and industrial and research isotopes and to store the materials needed for target fabrication.
- **Option 3.** FMEF at Hanford would be used to fabricate and process neptunium-237 targets for plutonium-238 production. The neptunium-237 transported from SRS to Hanford would be stored in FMEF. The plutonium-238 product would be transported from Hanford to LANL. A new support facility at an existing DOE site would be used to fabricate and process the targets required for the production of medical and industrial and research isotopes and to store the materials needed for target fabrication.

The incremental environmental impacts associated with each option are presented separately for the research reactor and the support facility because both facilities may not be selected together. This segmentation assists in the selection of facilities from the two possible combinations, that is, research reactor plus support facility or research reactor only.

As described in Section 1.2.3, the civilian nuclear energy research and development initiatives requiring an enhanced DOE nuclear infrastructure fall into three basic categories: materials research, nuclear fuels research, and advanced reactor development.

- Materials research involves irradiating materials in a high-flux field to determine the radiation effect during reactor normal operating conditions or to perform accelerated life-cycle testing. This form of testing would not introduce material into the research reactor that would result in additional releases during normal operation or accident conditions.
- Nuclear fuels research involves irradiating test fuel pellets, fuel pins, and fuel assemblies in high-temperature environments expected in future reactor designs. When the test specimens are inserted into the research reactor, there would be no significant increase of fissile material in the reactor core inventory that would result in additional releases during normal operation or accident conditions.
- Advanced reactor development involves test loop experiments under prototypical reactor conditions. When the test loop is operating in the research reactor core, there would be no significant increase of fissile material in the reactor core inventory that would result in additional releases during normal operation or accident conditions.

The environmental impacts associated with implementation of the proposed civilian nuclear energy research and development mission cannot be distinguished from the impacts of operating the new research reactor without the civilian nuclear energy research and development mission.

#### **4.6.1 Alternative 4 (Construct New Research Reactor)—Option 1**

Option 1 involves constructing and operating the research reactor to irradiate all targets associated with plutonium-238 production, medical and industrial isotope production, and research and development; operating

REDC at ORR to fabricate and process neptunium-237 targets and to process the plutonium-238 product; and constructing and operating the support facility to fabricate and process the other targets and materials and to process the associated products. This option includes storage in REDC of the neptunium-237 transported to ORR from SRS and storage in the new support facility of the other target materials transported to the generic site from other offsite facilities.

The transportation of the low-enriched uranium fuel for use in the research reactor, the transportation of the neptunium-237 to ORR and then to the generic site, the transportation of the other target materials to the generic site, and the transportation of all product materials following irradiation and postirradiation processing are also part of the option.

All options under this alternative include the decontamination and decommissioning of the research reactor and support facility at the generic DOE site following their operating lifetimes, and also the permanent deactivation of FFTF at Hanford.

#### **4.6.1.1 Construction of the New Research Reactor and Support Facility**

The environmental impacts associated with the construction of a new research reactor and support facility at the generic DOE site are assessed in this section. If the research reactor were built on a site with existing support facilities, there would be no impacts associated with constructing a new support facility.

##### **4.6.1.1.1 Land Resources**

**LAND USE.** The construction of a research reactor and support facility at a generic DOE site would disturb 1.6 hectares (4 acres) and 2.4 hectares (6 acres), respectively. Since the exact nature of the construction site is not known at this time (e.g., whether it has been previously disturbed or not), potential effects on land use cannot be determined. In general, if a location in a previously developed portion of a generic DOE site were selected, impacts on land use would be minimal. However, if an undisturbed location were chosen, land use would change from its present designation to industrial. If the reactor alternative were selected, tiered NEPA documentation would permit an exact determination of impacts on land use.

**VISUAL RESOURCES.** Impacts from construction of a research reactor and support facility to visual resources at a generic DOE site would depend on the specific location selected. Impacts could include a change in the present Visual Resource Management rating of the site and/or increase in visibility of the site from offsite locations due to the presence of new structures. If construction took place on undeveloped land, the Visual Resource Management rating could change from Class II or III (ratings typical of undeveloped portions of many DOE sites) to Class IV. If a previously developed location were chosen for the reactor, the Visual Resource Management rating would remain Class IV. In either case, new facilities may impact the view from off site locations by increasing the industrial nature of the viewshed. This impact would be more likely at a western site due to the generally level terrain and sparse vegetation. Specific impacts on visual resources would be determined in tiered NEPA documentation if the reactor alternative were selected.

##### **4.6.1.1.2 Noise**

Construction of a research reactor and support facility would result in some increase in noise levels from the use of earthmoving, materials handling, and impact equipment; employee vehicles; and truck traffic. Noise from construction activities, especially impulsive noise, would be expected to disturb wildlife in the immediate area of the construction site. The change in noise levels in areas outside the DOE site would be dependent on the location selected and the exact nature of the construction location and activities required. However, generally if the location selected were within one of the larger DOE sites and more centrally located within

the site, offsite noise impacts from construction activities can be expected to be small. Construction employee vehicles and truck traffic would result in an increase in traffic noise along roads used to access the site. However, this increase in traffic noise would be small unless the construction traffic volume is as large as the existing site traffic. Site-specific analysis would be conducted in tiered NEPA documentation if the reactor alternative were selected.

#### 4.6.1.1.3 Air Quality

Construction of the new research reactor and support facility would result in an increase in employee vehicles and truck traffic. Criteria pollutants were modeled and compared to the most stringent standards (**Table 4–140**). The maximum ground-level concentrations that would result from reactor construction would be below the ambient air quality standards, although concentrations of some pollutants (i.e., PM<sub>10</sub>) would be relatively high. Therefore, if the reactor were in an area that already had high background pollutant concentrations, resultant pollutant concentrations could approach or exceed the ambient standards. As a result, regulatory compliance would need to be assessed on case-by-case basis. Hazardous chemical emissions from construction have not been identified.

**Table 4–140 Incremental Concentrations Associated with Research Reactor Construction Under All Options of Alternative 4 (Construct New Research Reactor)**

Pollutant	Averaging Period	Most Stringent Standard or Guideline (microgram per cubic meter) <sup>a</sup>	Modeled Increment (microgram per cubic meter)
Carbon monoxide	8 hours	10,000	72
	1 hour	40,000	103
Nitrogen oxide	Annual	100	1
PM <sub>10</sub>	Annual	50	3
	24 hours	150	88

a. The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50), other than those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM<sub>10</sub> standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standards.

**Source:** Modeled increments are based on the SCREEN3 computer code (EPA 1995); data from Appendix E.

#### 4.6.1.1.4 Water Resources

The impacts on key water resource indicators associated with constructing the new research reactor and support facility are presented in **Table 4–141**. Water is expected to be required for such uses as mixing concrete, dust control, washing activities, and potable and sanitary needs. These estimates are annual average values over the forecasted construction periods; these values do not include dewatering of excavations that could be required at some sites. The exact impact of these withdrawals on the resource would depend on the water source (surface water or groundwater) and its relative abundance. These factors would be used to determine the impact on the local and/or regional availability of the resource. Impacts would be expected to be small to negligible due to the relatively small volumes of water required for construction compared to expected site availability.

Sanitary wastewater would be generated by construction personnel and also by facility staff during preoperational testing. Process wastewater could also be generated during construction associated with facility cold-startup and testing of auxiliary systems as construction progresses (e.g., cooling towers). Site selection would make use of existing infrastructure and nearby wastewater treatment facilities would be used to the

**Table 4–141 Estimated Water Use and Wastewater Generation Associated with Constructing a New Research Reactor and Support Facility Under All Options of Alternative 4 (Construct New Research Reactor)**

Indicator (million liters per year)	New Research Reactor <sup>a</sup>	New Support Facility <sup>a</sup>
Water use	11.7	14.6
Sanitary wastewater generation	11.4	3.6

a. These estimates are annualized values based on projected construction/preoperational testing periods for the new research reactor and the new support facility of 4 years and 4.5 years, respectively.

**Note:** To convert from liters per year to gallons per year, multiply by 0.264.

**Source:** Appendix E; SAIC 2000.

extent possible and would be supplemented by portable or temporary facilities during construction as necessary. The potential impact on water resources would depend on the availability and capacity of appropriate treatment facilities. All wastewater would be disposed of in accordance with applicable regulatory requirements with discharges to surface waters in accordance with NPDES effluent limitations.

Ground disturbance and runoff from denuded areas could potentially impact surface water quality near construction areas (Section 4.6.1.1.6). However, appropriate spill prevention practices and soil erosion and sediment control measures (e.g., silt fences, mulching disturbed areas) would be employed during construction to minimize water quality impacts.

Some locations on a generic DOE site could potentially be affected by flooding requiring appropriate siting decisions (refer to Section 3.6.4). Applicable regulatory requirements would be followed in siting facilities including Executive Order 11988, *Floodplain Management*.

Although specific impacts on water resources cannot be determined at this time, site-specific analysis would be conducted in tiered NEPA documentation if the research reactor alternative were selected.

#### 4.6.1.1.5 Geology and Soils

Construction of the research reactor would disturb a total of approximately 1.6 hectares (4 acres) of land. Construction of the support facility would disturb an additional 2.4 hectares (6 acres) of land (Appendix E; Herrington 2000; SAIC 2000). Related impacts on geologic and soil resources cannot be determined at this time since they are site specific in nature. However, impacts would be expected to be less if previously disturbed land were used than if an undeveloped area were selected for construction. In general, construction activities would likely require appreciable quantities of sand and gravel and possibly other geologic materials and, depending on the site chosen, could temporarily deplete local deposits or stockpiles of these materials. Soil erosion potential is also closely related to the amount of land disturbed.

As discussed in Section 3.6.5, the proposed facilities could be located at a generic DOE site with seismic activity ranging from low to moderate. Known capable faults could be located within 19 kilometers (12 miles). However, no known large-scale geologic conditions are present at any generic DOE site that would preclude the construction and operation of properly designed facilities. Appropriate activities and subsurface investigations would be conducted to identify geologic hazards including seismic and volcanic features and other natural hazards (landslide areas, sinkholes, unstable soils) as part of the site selection process. 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. 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 (NEHRP) 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 (UBC), into the International Building Code (ICC 2000). The DOE requirements for seismic engineering have followed the UBC, unless the importance of achieving a high level of protection warrants the use of more demanding methods and criteria (DOE Guide 420.1-2). Thus, new facilities would be designed and sited in accordance with DOE Order 420.1.

Site-specific analysis would be conducted in tiered NEPA documentation if the research reactor alternative were selected.

#### **4.6.1.1.6 Ecological Resources**

If the research reactor alternative were selected, tiered NEPA documentation would be undertaken to determine the exact nature of construction impacts on ecological resources. During that process, impacts on individual species and habitats that are sensitive to disturbance would be determined. This would include consideration of wetlands and threatened and endangered species. Wetland delineations and consultation with the U.S. Fish and Wildlife Service and state wildlife agency would take place, as necessary, to ensure that these resources would be protected.

Construction impacts on ecological resources are site specific. The nature of these impacts would be expected to vary depending on whether the site was located in the eastern or western portion of the United States. In fact, depending on the site location, impacts on some resources may not occur. Additionally, construction impacts on ecological resources would depend on whether the selected location was within an already disturbed portion of the site. In general impacts on terrestrial resources, wetlands, aquatic resources, and threatened and endangered species described below are applicable to an undeveloped site.

**Terrestrial Resources.** Construction of a research reactor and support facility would disturb 1.6 hectares (4 acres) and 2.4 hectares (6 acres), respectively, of terrestrial habitat. If these facilities were constructed at an undeveloped location, it is likely that woodland habitat would be lost at an eastern generic DOE site and shrubland would be disturbed at a western site. Land clearing activities would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Construction activities and noise would cause larger mammals and birds in the construction and adjacent areas to move to similar habitat nearby. If the area to which they moved was below its carrying capacity, these animals would be expected to survive. However, if the area were already supporting the maximum number of individuals, the additional animals would compete for limited resources that could lead to habitat degradation and eventual loss of the excess population. Nests and young animals living within the disturbed area may not survive.

**Wetlands.** Clearing and grading operations could result in the direct loss of wetlands, although proper placement of the research reactor and support facility within the overall generic DOE site would eliminate or reduce the potential for such loss. Indirect impacts could also result from stormwater runoff carrying sediments to wetlands located adjacent to the site. Changes in hydrology, water quality, and soils could occur as a result of alterations in water levels, runoff, and the buildup of sediments. These changes could, in turn, alter the vegetative composition of the wetland. In general, both direct and indirect impacts would be more likely to occur at an eastern site due to the greater abundance of wetlands. If preliminary analysis determined that wetlands could be impacted by development, a wetland delineation would be required. Impacts on wetlands could also lead to the implementation of mitigation measures.

**Aquatic Resources.** During construction of a research reactor and support facility, impacts on aquatic resources could result from stormwater runoff. Runoff could alter flow rates, increase turbidity, and lead to sedimentation of streambeds. These impacts could, in turn, cause temporary and permanent changes in species composition and density, and alter breeding habitats. The implementation of erosion and sediment control procedures would lessen construction impacts.

**Threatened and Endangered Species.** Construction of a research reactor and support facility would have the potential to impact threatened and endangered species. Sources of impacts would be similar to those discussed above for terrestrial resources, wetlands, and aquatic resources. The primary difference is that the resource of concern involves individual species that are sensitive to disturbance and whose existence may be threatened by development. Consultations with the U. S. Fish and Wildlife Service and appropriate state agency would be conducted at the site-specific level, as appropriate.

#### **4.6.1.1.7 Cultural and Paleontological Resources**

The construction of a research reactor and support facility at a generic DOE site would disturb 1.6 hectares (4 acres) and 2.4 hectares (6 acres), respectively. Since the exact nature of the construction site is not known at this time (e.g., whether it has previously been disturbed or not), potential effects on cultural resources cannot be determined. In general, if a location in a previously developed portion of a DOE generic site were selected, impacts on cultural resources may not occur. However, if an undisturbed location were chosen, cultural resources could be impacted. If the reactor alternative were selected, prehistoric and historic resources, including those that are or may be eligible for listing on the National Register of Historic Places, would be identified. These resources would be identified through site surveys and consultation with the State Historic Preservation Officer. Specific concerns about the presence, type, and location of Native American resources would be addressed through consultation with the potentially affected tribes in accordance with the *National Historic Preservation Act*, the *Native American Graves Protection and Repatriation Act*, and the *American Indian Religious Freedom Act*.

#### **4.6.1.1.8 Socioeconomics**

It is estimated that 160 workers would be needed each of the 4 years required to construct the research reactor and support facility at a generic DOE site. The impact of this influx of workers upon the site's region of influence and regional economic area would depend on whether the site were located near a large urbanized area or in a remote rural area. Since the population for the region of influence for a generic site could range from nearly 2.0 million people for a site in a large metropolitan area, to less than 200,000 for a site in a small rural community, the socioeconomic impacts of constructing a new research reactor and support facility would vary greatly. Therefore, if DOE were to select the new research reactor alternative, additional NEPA documentation would be required to select the specific DOE site to locate the new research reactor and support facility. In that document, DOE would perform a thorough evaluation of the socioeconomic impacts of the sites under consideration.

#### **4.6.1.1.9 Public and Occupational Health and Safety—Normal Construction Activities**

**RADIOLOGICAL IMPACTS.** During construction operations, it is not anticipated that there would be any resulting radiological releases to the environment; therefore, no additional dose to the public is expected. Furthermore, construction workers are not expected to receive exposures above natural background levels that exist within the construction areas. However, as a precautionary measure, workers would be badged as deemed appropriate.

**HAZARDOUS CHEMICAL IMPACTS.** No hazardous chemical releases have been identified from construction activities. Therefore, minimal hazardous chemical impacts would be associated with construction.

#### **4.6.1.1.10 Public and Occupational Health and Safety—Construction Accidents**

There are no radiological or hazardous chemical accidents postulated during the construction phases of the new research reactor or support facility. Workers could experience industrial accidents commonly associated with the construction of large facilities.

#### **4.6.1.1.11 Environmental Justice**

Section 4.6.1.1 addresses environmental effects due to construction activities that would be expected to occur at an unspecified reactor and support facility site. The analysis shows that radiological and nonradiological risks to persons residing in the (hypothetical) potentially affected areas are not significant. Unless there are patterns of food consumption among minority or low-income residents surrounding the actual site (yet to be determined) that would result in a significant ingestion of radiologically contaminated food, it is plausible that construction activities would pose no significant risks to minority and low-income persons. However, evaluations of environmental justice are necessarily site-specific and cannot be performed in detail for unspecified locations. In the event that this option were selected for implementation and a specific site selected for the new research reactor and support facility, an additional evaluation of environmental justice at the research reactor and support facility site during construction would be performed prior to implementation.

#### **4.6.1.1.12 Waste Management**

The expected generation rates of waste at a generic DOE site that would be associated with the construction of a new research reactor to irradiate targets and a support facility to fabricate and process medical and industrial isotope targets and to meet research and development needs are provided in **Table 4-142**. These estimates represent the total amount of waste generated during the construction period. These generation rates cannot be compared at this time with site treatment, storage, and disposal capacities because a DOE site has not yet been chosen for these facilities. Site-specific analyses would be conducted if this alternative were chosen, and appropriate NEPA documentation would be prepared.

Section 3.6.11.1 provides DOE site ranges for each waste type that include volume currently stored, projected generation, and for some types of waste, disposal volume. 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 4.6.1.1.9 through 4.6.1.1.11.

#### **4.6.1.2 Operations and Transportation**

The environmental impacts associated with storage, processing, and irradiation operations, and with all transportation activities, are assessed in this section.

##### **4.6.1.2.1 Land Resources**

**LAND USE.** The operation of a research reactor and support facility at a generic DOE site would not be expected to affect land use. This is because none of the anticipated operational impacts (e.g., air emissions) are expected to affect this resource.

**Table 4–142 Estimated Waste Generation Associated with Constructing a New Research Reactor and Support Facility Under All Options of Alternative 4 (Construct New Research Reactor)**

Waste Type <sup>a</sup>	Estimated Waste Generation for New Research Reactor (total cubic meters)	Estimated Waste Generation for New Support Facility (total cubic meters)
<b>High-level radioactive</b>	0	0
<b>Transuranic</b>	0	0
<b>Low-level radioactive</b>		
Liquid	0	0
Solid	0	0
<b>Mixed low-level radioactive</b>	0	0
<b>Hazardous</b>		
Liquid	1	1
Solid	3	3
<b>Nonhazardous</b>		
Process wastewater	0	0
Sanitary wastewater	44,000	16,000
Solid (kilograms)	1,230,000	230,000

a. See definitions in Section G.9.

**Note:** To convert from cubic meters to cubic yards, multiply by 1.308.

**Source:** Appendix E; SAIC 2000.

REDC would be used for neptunium-237 storage, target fabrication, and processing. The use of REDC for this purpose would not change land use at the site since REDC is currently operating and its proposed use would be compatible with its present mission.

**VISUAL RESOURCES.** The primary source of impacts on visual resources from the operation of a research reactor and support facility would be air emissions. Releases from stacks associated with this alternative would be controlled and, therefore, would be unlikely to exceed Bureau of Land Management Visual Resource Management objectives. However, the operation of cooling towers could result in a visible plume. The extent and visibility of the plume would depend on site meteorological conditions and terrain features. While plume formation would be favored by meteorological conditions at an eastern generic DOE site, terrain features would tend to mask it from offsite locations; the opposite would tend to be true at a western site. If the reactor alternative were selected, the visual impact of the cooling tower plume would be determined in tiered NEPA documentation.

All activities associated with neptunium-237 storage, target fabrication, and processing would take place within REDC. Operations associated with the proposed activities would not result in any impact on visual resources or change in the current Visual Resource Management Class IV rating of the 7900 Area. This is because none of the anticipated operational impacts (e.g., air emissions) would be expected to affect this resource.

#### 4.6.1.2.2 Noise

The operation of a reactor and support facility at a generic DOE site would result in some increase in noise levels from equipment (e.g., cooling systems, vents, motors, generators, compressors, pumps, and material-handling equipment), employee vehicles, and truck traffic. Noise from operation activities could disturb wildlife outside the facility fence line. The change in noise levels in areas outside the DOE site would be dependent on the location selected and the equipment. However, generally if the location selected is within one of the larger DOE sites and is more centrally located within the site, offsite noise impacts from operation can be expected to be small. Operation employee vehicles and truck traffic would result in an increase in traffic noise along roads used to access the site. However, this increase in traffic noise would be small unless

the operation traffic volume were as large as the existing site traffic. Site-specific analysis would be conducted in tiered NEPA documentation if the reactor alternative were selected.

This option also involves using REDC for neptunium-237 target material storage, target fabrication, and processing. Interior modifications of these facilities in the 7900 Area of ORNL would be expected to result in little change in noise impacts on wildlife around this area. The operation of REDC would not be expected to result in any change in noise impacts on wildlife around the 7900 Area and offsite noise impacts would be small because the nearest site boundary is 2.5 kilometers (1.6 miles) to the southeast. Operation would be expected to result in a minimal change in noise impacts on people near ORR as a result of changes in employee and truck traffic levels.

#### 4.6.1.2.3 Air Quality

The operation of a new research reactor and support facility would result in some increase in air quality impacts due to operation of emergency diesel generators. Criteria pollutants were modeled and compared to the most stringent standards (**Table 4–143**). The maximum ground-level pollutant concentrations that would result from reactor operation would be well below the ambient air quality standards. However, if the reactor were in an area that already had high background pollutant concentrations, resultant pollutant concentrations could approach or exceed the ambient standards for some pollutants. As a result, regulatory compliance would need to be assessed on case-by-case basis. Hazardous chemical impacts are addressed in Section 4.6.1.2.9.

**Table 4–143 Incremental Concentrations Associated with Research Reactor Operation<sup>a</sup> Under Alternative 4 (Construct New Research Reactor)—Option 1**

Criteria Pollutant	Averaging Period	Most Stringent Standard or Guideline (micrograms per cubic meter) <sup>b</sup>	Modeled Increment (micrograms per cubic meter)
Carbon monoxide	8 hours	10,000	89.5
	1 hour	40,000	128
Nitrogen oxide	Annual	100	0.198
PM <sub>10</sub>	Annual	50	0.0035
	24 hours	150	3.46
Sulfur dioxide	Annual	80	0.062
	24 hours	365	61.2
	3 hours	1,300	138

a. From operation of two emergency diesel generators.

b. The more stringent of the Federal and state standards is presented if both exist for the averaging period. The National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50), other than those based on annual averages, are not to be exceeded more than once per year. The annual arithmetic mean PM<sub>10</sub> standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

**Source:** Modeled increments are based on the SCREEN3 computer code (EPA 1995); data from Appendix E.

Air quality impacts associated with this option at ORR were determined to be the same as under Option 1 of Alternative 2 (Section 4.4.1.1.3).

The air quality impacts of transportation are presented in Section 4.6.1.2.11.

#### 4.6.1.2.4 Water Resources

The estimated impacts on key water resource indicators associated with operating the new research reactor and support facility are presented in **Table 4–144**. Operation of the research reactor at a generic DOE site would have the highest water demand under this alternative and the second highest of any production facility

considered, requiring 807 million liters (213.2 million gallons) of water per year. In general, water would be required by the new research reactor and support facility to support such uses as process cooling, potable, and sanitary needs. For the new research reactor, the single largest system use would be for cooling tower operation and associated evaporative losses. The exact impact of these withdrawals on the resource would depend on the water source (surface water or groundwater) and its relative abundance. These factors would be used to determine the impact on the local and/or regional availability of the resource. For surface water, a dedicated surface water intake may have to be constructed if the generic site’s existing distribution system is inadequate to meet the increased demands of the facilities. For groundwater, additional wells may have to be developed to supply the facilities directly or to provide increased production capacity for the generic site’s existing supply system.

**Table 4–144 Estimated Water Use and Wastewater Generation Associated with Operating a New Research Reactor and Support Facility Under Alternative 4 (Construct New Research Reactor)—Option 1**

Indicator (million liters per year)	New Research Reactor <sup>a</sup>	New Support Facility <sup>a</sup>
Water use	807	6.92
Process wastewater generation	7.9	0.016 <sup>a</sup>
Sanitary wastewater generation	11.6	6.91

a. Assume process wastewater generated at the same incremental rate as the Hanford 300 Area facilities (RPL/306–E).

**Note:** To convert from liters per year to gallons per year, multiply by 0.264.

**Source:** Appendix E; SAIC 2000.

The operation of the research reactor is estimated to generate approximately 7.9 million liters (2.1 million gallons) of process wastewater per year. It is expected that this process effluent would mainly consist of cooling tower blowdown. The support facility would generate a very small amount of process wastewater, mainly as a result of material processing. There would be no radiological liquid effluent discharge to the environment from either facility under normal operations. Sanitary wastewater would be generated as a result of operations of the new research reactor and support facility based on facility staff use of lavatory, shower, and kitchen facilities and from miscellaneous potable and sanitary uses. Waste management activities and their effects are further detailed in Section 4.6.1.2.13. The potential impact on water resources would depend on the availability and capacity of appropriate treatment facilities. Process and sanitary wastewater would be discharged to either existing site wastewater treatment facilities or to new facilities constructed specifically to serve the proposed facilities. All wastewater would be disposed of in accordance with applicable regulatory requirements with discharges to surface waters in accordance with NPDES effluent limitations.

Although specific impacts on water resources cannot be determined at this time, site-specific analysis would be conducted in tiered NEPA documentation if the research reactor alternative were selected.

REDC, an existing facility in the 7900 Area of ORNL at ORR, would be used for neptunium-237 storage, target fabrication, and processing in support of plutonium-238 production with impacts on ORR water resources indicators the same as those described in Section 4.3.1.1.4. In summary, a small increase in water use and sanitary wastewater generation is anticipated, mainly attributable to increased staffing levels. Also, there would be a very small increase in process wastewater generation, but there would be no radiological liquid effluent discharge to the environment under normal operations.

#### **4.6.1.2.5 Geology and Soils**

The operation of a research reactor and support facility would not be expected to result in impacts on geologic and soils resources at a generic DOE site. If cooling towers are used, the potential exists for salt deposition

to alter soil chemistry. While high rainfall at an eastern site would tend to keep salt from accumulating in the soil, the potential exists that salt could accumulate at a western site where rainfall is sparse. If the reactor alternative were selected, impacts on geology and soils would be determined in tiered NEPA documentation. As discussed in Section 4.6.1.1.5, the proposed facilities would be designed and constructed in accordance with DOE Order 420.1 and sited to minimize the risk from geologic hazards. Thus, site geologic conditions would be unlikely to affect the facilities.

The use of REDC for neptunium-237 storage, target fabrication, and processing would not be expected to impact either geologic or soil resources, nor be jeopardized by large-scale geologic conditions. Hazards from large-scale geologic conditions at ORR, such as earthquakes, volcanoes, and sinkholes, were previously evaluated in the *Storage and Disposition PEIS* (DOE 1996a:4-260) as discussed in Section 4.2.2.2.5. The analysis determined that these hazards present a low risk to long-term storage facilities. Further review of the data and analyses presented in that 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 operations.

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.

#### **4.6.1.2.6 Ecological Resources**

If the new research reactor alternative were selected, tiered NEPA documentation would be undertaken to determine the exact nature of operational impacts on ecological resources. During this process, impacts on individual species and habitats that are sensitive to disturbance would be determined. This would include consideration of wetlands and threatened and endangered species.

While the exact nature of operational impacts on ecological resources cannot be determined until a specific site is selected, certain general types of impacts are possible. The nature and extent of these impacts would be expected to vary depending on whether the selected site was located in the eastern or western portion of the United States.

**Terrestrial Resources.** Activities associated with operations, such as noise and human presence, could affect wildlife living adjacent to the research reactor and support facility. These disturbances could cause some species to move from the area. Preventing workers from entering undisturbed areas would minimize impacts on wildlife living adjacent to the facilities. Emissions to the air and water, both nonradiological and radiological, could impact both plants and animals. Plants and animals could be exposed to pollutants via a number of pathways including direct exposure, contact with contaminated soil, ingestion, and inhalation. Further, bioaccumulation could affect species that consume exposed plants or animals. While regulatory limits would act to limit the effects of air emissions and effluent discharges, impacts would be analyzed once site and facility specific information became available.

**Wetlands.** Impacts from the operation of a research reactor and support facility at a western generic DOE site would not be expected to affect wetlands since discharges would be to an evaporation pond. At an eastern site, wastewater and cooling tower blowdown would be discharged to an onsite waterbody. While these discharges would be through permitted outfalls, the potential exists that wetlands could be affected. Potential impacts, such as changes in water levels and plant species composition, would depend on outfall location, water volume, discharge temperature, and water chemistry. Since these factors depend on site location and facility engineering design, operational impacts on site wetlands would have to be analyzed once these factors are known.

**Aquatic Resources.** Operational impacts on aquatic resources at a western site would not be expected since groundwater would be used and wastewater and cooling tower blowdown would be discharged to an evaporation pond. At an eastern site, potential impacts on aquatic resources could occur as a result of water withdrawal and discharge. Water withdrawal could lead to the loss of aquatic organisms through impingement and entrainment. The discharge of cooling water could result in alterations in aquatic communities. Alterations could include changes in aquatic vegetation and the loss of fish and benthic macroinvertebrates. Additionally, radionuclides and chemicals in the discharge water have the potential to impact aquatic organisms. The extent of potential impacts on the aquatic environment would depend upon site and facility specific information.

**Threatened and Endangered Species.** The operation of a research reactor and support facility would have the potential to impact threatened and endangered species. Sources of impacts would be similar to those discussed above for terrestrial resources, wetlands, and aquatic resources. The primary difference is that the resources of concern involve individual species that are sensitive to disturbance and whose existence may be threatened by development.

REDC would be used for neptunium-237 storage, target fabrication, and processing. As noted in Section 4.6.1.2.2, there would be little change in noise impacts on wildlife. There would be no change in impacts on wetlands or aquatic resources because additional water usage and wastewater discharge would be small fractions of current values. Further, this option would not result in any new contaminants in existing discharges (Section 4.6.1.2.4). Threatened and endangered species would not be affected by operation because an existing facility within an already developed area would be used.

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.

#### **4.6.1.2.7 Cultural and Paleontological Resources**

Impacts on cultural and paleontological resources from the operation of a research reactor and support facility at a generic DOE site would depend on the relative location of such resources to the site and/or transportation routes. While impacts would be expected to be nonexistent or small, they cannot be ruled out. For example, noise related to plant operation or traffic to and from the facility or alterations in the viewshed could adversely affect visitor enjoyment of an historic site. Since impacts on cultural resources are site dependent, specific operational impacts cannot be determined until a site were selected. The operation of a reactor and support facility would not be expected to impact paleontological resources.

The operation of REDC for neptunium-237 storage, target fabrication, and processing would not change the status of cultural and paleontological resources at ORR. The Graphite Reactor, which is located within ORNL, 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 within or near ORNL. However, neither the Graphite Reactor nor any of the other structures is located within the 7900 Area; thus, the use of REDC for target fabrication and processing would not change their status.

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.

#### 4.6.1.2.8 Socioeconomics

It is estimated that 220 workers would be needed each year to operate the research reactor and support facility at a generic DOE site. The impact of this influx of workers upon the site's region of influence and regional economic area would depend on whether the site were located near a large urbanized area or in a remote rural area. Since the population for the region of influence for a generic site could range from nearly 2.0 million people for a site in a large metropolitan area, to less than 200,000 for a site in a small rural community, the socioeconomic impacts of operating a new research reactor and support facility would vary greatly. Therefore, if DOE were to select this option, additional NEPA documentation would be required to determine the specific socioeconomic impacts.

The socioeconomic impacts associated with neptunium-237 target fabrication and processing at ORR are addressed in Section 4.3.1.1.8.

#### 4.6.1.2.9 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.

During normal operations, there would be incremental radiological and hazardous chemical releases to the environment and also incremental direct in-plant exposures. The resulting doses and potential health effects to the public and workers for this option are described below.

**RADIOLOGICAL IMPACTS.** Incremental radiological doses to three receptor groups from startup and operations are given in **Table 4-145** for the generic DOE site and ORR: the population within 80 kilometers (50 miles) in the year 2020, the maximally exposed member of the public, and the average exposed member of the public. Radiological impacts from startup operations prior to fuel loading would be zero. After fuel loading, these impacts would be expected to be bounded by normal operation impacts. Therefore, startup impacts have not been treated separately from normal operational impacts. 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  $5 \times 10^{-4}$  latent cancer fatality per rem is applied for the public, and a coefficient of  $4 \times 10^{-4}$  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.

As a result of annual operations of the research reactor facilities and REDC, the projected incremental total population dose in the year 2020 would be 0.14 person-rem; the corresponding number of latent cancer fatalities in the populations surrounding the generic DOE site and ORR from 35 years of operations would be 0.0025. The incremental total dose to the maximally exposed member of the public from annual operations of the research reactor and support facility at the generic DOE site would be 0.0026 millirem; from 35 years of operations, the corresponding risk of a latent cancer fatality to this individual would be  $4.5 \times 10^{-8}$ .

**Table 4–145 Incremental Radiological Impacts on the Public Around the Generic DOE Site and ORR from Operational Facilities Under Alternative 4 (Construct New Research Reactor)—Option 1**

Receptor	ORR REDC	Generic Site			Two-Site Total
		Research Reactor Operations	Reactor Support Facility Operations	Total	
<b>Population within 80 kilometers (50 miles) in the year 2020</b>					
Dose (person-rem)	$8.8 \times 10^{-5}$	0.0023	0.14	0.14	0.14
35-year latent cancer fatalities	$1.5 \times 10^{-6}$	$4.0 \times 10^{-5}$	0.0025	0.0025	0.0025
<b>Maximally exposed individual</b>					
Annual dose (millirem)	$1.9 \times 10^{-6}$	$6.8 \times 10^{-5}$	0.0025	0.0026	NA <sup>a</sup>
35-year latent cancer fatality risk	$3.3 \times 10^{-11}$	$1.2 \times 10^{-9}$	$4.4 \times 10^{-8}$	$4.5 \times 10^{-8}$	NA <sup>a</sup>
<b>Average exposed individual within 80 kilometers (50 miles)</b>					
Annual dose <sup>b</sup> (millirem)	$7.8 \times 10^{-8}$	$1.5 \times 10^{-6}$	$9.1 \times 10^{-5}$	$9.3 \times 10^{-5}$	NA <sup>a</sup>
35-year latent cancer fatality risk	$1.4 \times 10^{-12}$	$2.6 \times 10^{-11}$	$1.6 \times 10^{-9}$	$1.6 \times 10^{-9}$	NA <sup>a</sup>

- a. A “Total” cannot be given in this case because the same individual cannot be located at two different sites simultaneously.  
 b. Obtained by dividing the population dose by the number of people projected to live within 80 kilometers (50 miles) of REDC or the generic site in the year 2020 (1,134,200 and 1,538,100, respectively).

**Key:** NA, not applicable.

**Source:** Appendix E; model results, using the GENII computer code (Napier et al. 1988).

Incremental doses to involved workers from normal operations are given in **Table 4–146**; these workers are defined as those directly associated with all process activities. The incremental annual average dose to research reactor workers during startup and operations would be 100 millirem; for support facility workers, the incremental annual average dose during startup and operations would be 114 millirem; for REDC workers, the incremental annual average dose would be approximately 170 millirem. The incremental annual dose received by the total site workforce for each of these facilities is estimated to be 12, 11, and 12 person-rem, respectively. The risks and numbers of latent cancer fatalities among the different workers from 35 years of operations are included in Table 4–146. Doses to individual workers would be kept to minimal levels by instituting badged monitoring and ALARA programs.

**Table 4–146 Incremental Radiological Impacts on Involved Workers at the Generic DOE Site and ORR from Operational Facilities Under Alternative 4 (Construct New Research Reactor)—Option 1**

Receptor—Involved Workers <sup>a</sup>	ORR REDC	Generic Site		Two-Site Total
		Research Reactor Operations	Reactor Support Facility Operations	
Total dose (person-rem per year)	12 <sup>b</sup>	12 <sup>b</sup>	11 <sup>b</sup>	36
35-year latent cancer fatalities	0.17	0.17	0.16	0.50
Average worker dose (millirem per year)	170	100	114	NA <sup>c</sup>
35-year latent cancer fatality risk	0.0023	0.0014	0.0016	NA <sup>c</sup>

- 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 operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (DOE 1999j). Further, DOE recommends that each facility 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 75 badged workers at REDC, 120 research reactor workers, and 100 workers at the reactor support facility.

**Key:** NA, not applicable.

**Source:** Nielsen 1999; Wham 1999b, 2000.

**HAZARDOUS CHEMICALS IMPACTS.** The operation of a new reactor and associated support facility would result in some increase in emissions of hazardous chemicals due to diesel fuel burning from different sources of equipment used for operation. The operation of the reactor would require the emergency diesel generators to be tested approximately 1 hour each month and 24 hours once a year to ensure operability. Chemical releases were modeled based on 72 hours of operation. Resulting concentrations were determined to be very small and would have no incremental impact on the site current conditions (**Table 4-147**).

**Table 4-147 Incremental Hazardous Chemical Impacts from New Research Reactor Diesel Generator Operation Under Alternative 4 (Construct New Research Reactor)—Option 1**

Chemicals	Modeled Annual Increment (micrograms per cubic meter)	RfC (micrograms per cubic meter)	Unit Cancer Risk (risk per micrograms per cubic meter)	Hazard Quotient	Cancer Risk
Benzene	$4.83 \times 10^{-5}$	NA	0.0000078	NA	$3.77 \times 10^{-10}$
Naphthalene	$6.83 \times 10^{-6}$	3	NA	$2.28 \times 10^{-6}$	NA
Toluene	$1.75 \times 10^{-5}$	400	NA	$4.38 \times 10^{-8}$	NA
Propylene	$1.73 \times 10^{-4}$	NA	0.0000037	NA	$6.42 \times 10^{-10}$

**Note:** Propylene oxide cancer unit was used for propylene.

**Key:** NA, not applicable (the chemical is not a known carcinogen, or it is a carcinogen and only unit cancer would apply); RfC, Reference Concentration.

**Source:** Data from Appendix E; EPA 1999; modeled increments are based on the SCREEN3 computer code (EPA 1995).

Hazardous chemicals impacts for this option at ORR were determined to be the same as described in Alternative 2, Option 1 (Section 4.4.1.1.9).

#### 4.6.1.2.10 Public and Occupational Health and Safety—Facility Accidents

Impacts from postulated accidents associated with research reactor target irradiation; support facility medical, industrial, and research and development isotope fabrication and processing; and REDC neptunium-237 target fabrication and processing are presented in this section. Detailed descriptions of the accident analyses are provided in Appendix I.

Consequences and associated risks are presented in **Tables 4-148** and **4-149**, respectively.

For 35 years of research reactor target irradiation, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be  $2.49 \times 10^{-9}$  and  $8.41 \times 10^{-9}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be  $2.26 \times 10^{-5}$ .

For 35 years of support facility medical, industrial, and research and development target fabrication and processing, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be  $3.26 \times 10^{-5}$  and  $9.85 \times 10^{-5}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.056.

For 35 years of REDC neptunium-237 target fabrication and processing, the increased risk of a latent cancer fatality to the maximally exposed individual and of an early fatality to a noninvolved worker would be  $5.71 \times 10^{-5}$  and  $3.50 \times 10^{-4}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.157.

For 35 years under this option, the increased risk of a latent cancer fatality to the maximally exposed individual and of a fatality to a noninvolved worker would be  $8.98 \times 10^{-5}$  and  $4.49 \times 10^{-4}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.213.

**Table 4–148 New Research Reactor, Support Facility, and REDC Accident Consequences Under Alternative 4 (Construct New Research Reactor)—Option 1**

Accident	Maximally Exposed Individual		Population to 80 Kilometers (50 Miles)		Noninvolved Worker	
	Dose (rem)	Latent Cancer Fatality <sup>a</sup>	Dose (person-rem)	Latent Cancer Fatalities <sup>b</sup>	Dose (rem)	Latent Cancer Fatality <sup>a</sup>
<b>New research reactor accidents</b>						
Design-basis accident	1.33×10 <sup>-6</sup>	6.65×10 <sup>-10</sup>	0.00241	1.20×10 <sup>-6</sup>	5.49×10 <sup>-6</sup>	2.20×10 <sup>-9</sup>
Beyond-design-basis earthquake	0.00373	1.87×10 <sup>-6</sup>	27.6	0.0138	0.0531	2.12×10 <sup>-5</sup>
Fuel-handling accident	1.90×10 <sup>-9</sup>	9.50×10 <sup>-13</sup>	6.79×10 <sup>-6</sup>	3.40×10 <sup>-9</sup>	5.83×10 <sup>-9</sup>	2.33×10 <sup>-12</sup>
Neptunium-237 target-handling accident	5.42×10 <sup>-8</sup>	2.71×10 <sup>-11</sup>	8.95×10 <sup>-5</sup>	4.47×10 <sup>-8</sup>	2.43×10 <sup>-7</sup>	9.72×10 <sup>-11</sup>
Medical isotope target-handling accident	1.04×10 <sup>-5</sup>	5.20×10 <sup>-9</sup>	0.101	5.06×10 <sup>-5</sup>	6.76×10 <sup>-6</sup>	2.70×10 <sup>-9</sup>
<b>Support facility accidents</b>						
Medical and industrial isotopes localized solvent fire	0.0194	9.72×10 <sup>-6</sup>	31.1	0.0156	0.00530	2.12×10 <sup>-6</sup>
Medical and industrial isotopes unlikely seismic event	0.0750	3.75×10 <sup>-5</sup>	136	0.0680	0.510	2.04×10 <sup>-4</sup>
Medical and industrial isotopes glovebox explosion	2.50	0.00125	4,600	2.30	17.0	0.00680
<b>REDC accidents</b>						
Ion exchange explosion during neptunium-237 target fabrication	6.13×10 <sup>-9</sup>	3.06×10 <sup>-12</sup>	8.58×10 <sup>-5</sup>	4.29×10 <sup>-8</sup>	5.60×10 <sup>-10</sup>	2.24×10 <sup>-13</sup>
Target dissolver tank failure during plutonium-238 separation	1.76×10 <sup>-7</sup>	8.79×10 <sup>-11</sup>	0.00196	9.82×10 <sup>-7</sup>	1.69×10 <sup>-8</sup>	6.74×10 <sup>-12</sup>
Ion exchange explosion during plutonium-238 separation	4.68×10 <sup>-4</sup>	2.34×10 <sup>-7</sup>	5.23	0.00261	4.49×10 <sup>-5</sup>	1.79×10 <sup>-8</sup>
Plutonium-238 processing facility beyond-design-basis earthquake	163	0.163	8.91×10 <sup>5</sup>	445	1,310	1.00 <sup>c</sup>

a. Likelihood of a latent cancer fatality.

b. Number of latent cancer fatalities.

c. Early fatality due to radiation dose. A radiation dose of 450 to 500 rem causes fatalities in 50 percent of those exposed. Early fatalities are expected for exposures greater than 600 rem.

**Source:** Model results, using the MACCS2 (Chanin and Young 1997) and GENII (Napier et al. 1988) computer codes.

**Table 4-149 New Research Reactor, Support Facility, and REDC Accident Risks Under Alternative 4 (Construct New Research Reactor)—Option 1**

Accident (Frequency)	Maximally Exposed Individual <sup>a</sup>	Population to 80 Kilometers (50 Miles) <sup>b</sup>	Noninvolved Worker <sup>a</sup>
<b>Annual new research reactor risks</b>			
Design-basis accident ( $1 \times 10^{-4}$ )	$6.65 \times 10^{-14}$	$1.20 \times 10^{10}$	$2.20 \times 10^{-13}$
Beyond-design-basis earthquake ( $1 \times 10^{-5}$ )	$1.87 \times 10^{-11}$	$1.38 \times 10^{-7}$	$2.12 \times 10^{-10}$
Fuel-handling accident (0.01)	$9.50 \times 10^{-15}$	$3.40 \times 10^{-11}$	$2.33 \times 10^{-14}$
Neptunium-237 target-handling accident (0.01)	$2.71 \times 10^{-13}$	$4.47 \times 10^{-10}$	$9.72 \times 10^{-13}$
Medical isotope target-handling accident (0.01)	$5.20 \times 10^{-11}$	$5.06 \times 10^{-7}$	$2.70 \times 10^{-11}$
<b>35-year new research reactor risk</b>	$2.49 \times 10^{-9}$	$2.26 \times 10^{-5}$	$8.41 \times 10^{-9}$
<b>Annual support facility risks</b>			
Medical and industrial isotopes localized solvent fire (0.044)	$4.32 \times 10^{-7}$	$6.91 \times 10^{-4}$	$9.41 \times 10^{-8}$
Medical and industrial isotopes unlikely seismic event (0.01)	$3.75 \times 10^{-7}$	$6.80 \times 10^{-4}$	$2.04 \times 10^{-6}$
Medical and industrial isotopes glovebox explosion (0.01)	$1.25 \times 10^{-7}$	$2.30 \times 10^{-4}$	$6.80 \times 10^{-7}$
<b>35-year support facility risk</b>	$3.26 \times 10^{-5}$	0.056	$9.85 \times 10^{-5}$
<b>Annual REDC risks</b>			
Ion exchange explosion during neptunium-237 target fabrication (0.01)	$3.06 \times 10^{-14}$	$4.29 \times 10^{-10}$	$2.24 \times 10^{-15}$
Target dissolver tank failure during plutonium-238 separation (0.01)	$8.79 \times 10^{-13}$	$9.82 \times 10^{-9}$	$6.74 \times 10^{-14}$
Ion exchange explosion during plutonium-238 separation (0.01)	$2.34 \times 10^{-9}$	$2.61 \times 10^{-5}$	$1.79 \times 10^{-10}$
Plutonium-238 processing facility beyond-design-basis earthquake ( $1 \times 10^{-5}$ )	$1.63 \times 10^{-6}$	0.00445	$1.00 \times 10^{-5(c)}$
<b>35-year REDC risk</b>	$5.71 \times 10^{-5}$	0.157	$3.50 \times 10^{-4(c)}$
<b>35-year Option risk</b>	$8.98 \times 10^{-5}$	0.213	$4.49 \times 10^{-4}$

a. Increased likelihood of a latent cancer fatality.

b. Increased number of latent cancer fatalities.

c. Risk of an early fatality.

**Source:** Model results, using the MACCS2 (Chanin and Young 1997) and GENII (Napier et al. 1988) computer codes.

There are no hazardous chemical accidents associated with the new research reactor or new support facility. The irradiation of neptunium-237, medical, industrial, and research and development isotopes in the new research reactor would not require the use of hazardous chemicals in amounts that exceed the Threshold Planning Quantities on the Extremely Hazardous Substances List (EPA 1998).

The fabrication and processing of medical, industrial, and research and development isotopes at the new support facility would not require the use of hazardous chemicals in amounts that exceed the Threshold Planning Quantities on the Extremely Hazardous Substances List (EPA 1998).

The hazardous chemical accident impacts at REDC are the same as those presented in Section 4.4.4.1.10.

#### **4.6.1.2.11 Public and Occupational Health and Safety—Transportation**

DOE would transport neptunium-237 from storage at SRS to the REDC target fabrication facility at ORR. DOE would transport the unirradiated neptunium-237 targets from REDC to the reactor site. Following irradiation in the reactor, the targets would be returned to REDC for processing. After this processing, the plutonium-238 product would be shipped to LANL. The reactor would receive low enriched uranium fuel from a U.S. fuel fabrication facility. Additionally, medical and industrial isotopes would be shipped from the reactor site to a local airport, and from there to locations throughout the country.

Approximately 37,000 shipments of radioactive materials would be made by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be 7.5 million kilometers (4.7 million miles); and in the air carrying medical isotopes, 23 million kilometers (14 million miles).

The transportation impact 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 28.6 person-rem; the dose to the public, 308 person-rem. Accordingly, incident-free transportation of radioactive material associated with this option would result in 0.011 latent cancer fatality among transportation workers and 0.15 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 would be 0.026. About half of the crew risk, about 2 percent of the public risk, and most of the emissions risk would result from shipping medical and industrial isotopes.

**IMPACTS OF ACCIDENTS DURING TRANSPORTATION.** The maximum foreseeable offsite transportation accident under this option (probability of occurrence: 1 in 10 million per year) is a shipment of irradiated neptunium-237 targets to FDPF with a severity Category V accident in an urban population zone under neutral (average) weather conditions. The accident could result in a dose of 0.61 person-rem to the public with an associated  $3.1 \times 10^{-4}$  latent cancer fatality, and 2.6 millirem to the hypothetical maximally exposed individual with a latent cancer fatality risk of  $1.3 \times 10^{-6}$ . No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of the accident, or occurrence while carrying neptunium-237 (unirradiated) or plutonium-238 was also evaluated and estimated to have a probability of less than 1 in 10 million per year.

Estimates of the total transportation accident risks under this option are as follows: a radiological dose to the population of 1,063 person-rem, resulting in 0.53 latent cancer fatality; and traffic accidents resulting in 0.19 traffic fatality. Nearly all of the radiological and about 59 percent of the traffic accident risk would result from shipping medical and industrial isotopes.

#### **4.6.1.2.12 Environmental Justice**

Under this option, neptunium-237 targets would be irradiated in a new reactor that would be constructed at a site yet to be specified. Fabrication and processing of neptunium-237 targets for plutonium-238 production would be performed at REDC located at ORR. A new support facility would be constructed at an unspecified site for fabrication and processing targets not used for plutonium-238 production.

Activities at REDC were evaluated under other alternatives and options in this NI PEIS (e.g., Section 4.4.1.1.12) and found to pose no significant radiological or other risks to minority and low-income populations. The environmental analysis of operations at the new research reactor and support facility site shows that radiological and nonradiological risks to persons residing in the (hypothetical) potentially affected

area would not be significant. Unless there are patterns of food consumption among minority or low-income resident surrounding the actual site (yet to be determined) that would result in a significant ingestion of radiologically contaminated food, it is plausible that operations at the site would pose no significant risks to minority and low-income persons. However, evaluations of environmental justice are necessarily site-specific and cannot be performed in detail for unspecified locations. In the event that this option were selected for implementation and a specific site selected for the new research reactor and support facility, an additional evaluation of environmental justice at the reactor and support facility site during operation would be performed prior to implementation.

#### 4.6.1.2.13 Waste Management

The expected annual generation of waste that would be generated from the operation of a new research reactor to irradiate targets and a support facility to fabricate and process medical and industrial isotope targets and to meet research and development needs are provided in **Table 4–150**. These generation rates cannot be compared at this time with site treatment, storage, and disposal capacities because a DOE site has not yet been chosen for these facilities. Section 3.6.11.1 provides DOE site ranges for each waste type that include volume currently stored, projected generation, and for some types of waste, disposal volume. 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 4.6.1.2.9 through 4.6.1.2.11.

**Table 4–150 Estimated Waste Generation Rates of Operating a New Research Reactor and Support Facility Under Alternative 4 (Construct New Research Reactor)—Option 1**

Waste Type <sup>a</sup>	Estimated Waste Generation for New Research Reactor (cubic meters per year)	Estimated Waste Generation for New Support Facility (cubic meters per year)
High-level radioactive	0	0
Transuranic	0	0
<b>Low-level radioactive</b>		
Liquid	<6	0
Solid	50	20
Mixed low-level radioactive	<0.5	4
Hazardous	4	<1
<b>Nonhazardous</b>		
Process wastewater	7,950	16 <sup>b</sup>
Sanitary wastewater	11,600	6,900
Solid	250	80

a. See definitions in Section G.9.

b. Assumes process wastewater generated at the same incremental rate as Hanford 300 facilities.

**Note:** To convert from cubic meters per year to cubic yards per year, multiply by 1.308; < means “less than.”

**Source:** Appendix E; SAIC 2000.

Depending in part on decisions in the Records of Decision for the *Waste Management PEIS* (DOE 1997a), waste could be treated and disposed of on site or at other DOE sites or commercial facilities. No high-level radioactive waste or transuranic waste would be generated from irradiating targets in the new research reactor or from target fabrication or processing in the new support facility.

Currently, DOE sites that manage low-level radioactive waste treat and/or dispose of the waste on site or off site, either at another DOE facility or a commercial facility. The low-level radioactive waste and mixed low-level radioactive waste Record of Decision issued on February 18, 2000 (65 FR 10061), states that for the management of low-level radioactive waste, minimal treatment will be performed at all sites, and disposal will

continue, to the extent practicable, on site at INEEL, LANL, ORR, and SRS. In addition, Hanford and the Nevada Test Site will be available to all DOE sites for low-level radioactive waste disposal. Less than 210 cubic meters (275 cubic yards) of liquid low-level radioactive waste and 1,750 cubic meters (2,300 cubic yards) of solid low-level radioactive waste would be generated over a 35-year period as a result of target irradiation at the new research reactor. Target fabrication and processing at the new support facility would generate about 700 cubic meters (920 cubic yards) of solid low-level radioactive waste. The minor amounts of low-level radioactive waste (less than 10 cubic meters [13.1 cubic yards]) (Brunson 1999a) generated from the decontamination of the shipping containers used to transport neptunium-237 from SRS to REDC (or FDPF or FMEF, depending on the option) for storage could easily be managed under the existing waste management practices and are not included in the table.

Most of DOE's mixed low-level radioactive waste is being stored on site awaiting the development of treatment methods. DOE is subject to the requirements mandated by the Federal Facility Compliance Act of 1992, and most DOE facilities that currently store or generate mixed low-level radioactive waste have either a state-approved or EPA region-approved site treatment plan or another type of agreement. Each site treatment plan or agreement requires the treatment of mixed waste, including mixed low-level radioactive waste, in accordance with its provisions. The low-level radioactive waste and mixed low-level radioactive waste Record of Decision, issued on February 18, 2000 (65 FR 10061), states that mixed low-level radioactive waste will be treated at Hanford, INEEL, ORR, and SRS and disposed of at Hanford and the Nevada Test Site. Over the 35-year operational period, less than 18 cubic meters (24 cubic yards) of mixed low-level radioactive waste would be generated as a result of target irradiation at the new research reactor. Target fabrication and processing at the new support facility would generate about 140 cubic meters (180 cubic yards) of mixed low-level radioactive waste.

The hazardous waste Record of Decision, issued on August 5, 1998 (63 FR 41810), states that most DOE sites will continue to use offsite facilities for the treatment and disposal of major portions of nonwastewater hazardous waste, with ORR and SRS continuing to treat some of their own nonwastewater hazardous waste on site in existing facilities where this is economically favorable. Wastewater, which is about 99 percent of DOE's hazardous waste, is treated on site. An estimated 140 cubic meters (180 cubic yards) of hazardous waste would be generated during the 35-year operational period at the research reactor and less than 35 cubic meters (46 cubic yards) at the new support facility.

DOE currently manages sanitary and industrial waste on a site-by-site basis. Some DOE sites dispose of this waste in onsite landfills that have permits issued by appropriate state agencies, while other sites use commercial landfills (DOE 1997a:1-29). 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. Over the 35-year operational period, an estimated 280,000 cubic meters (370,000 cubic yards) of process wastewater, 406,000 cubic meters (531,000 cubic yards) of sanitary wastewater, and 8,800 cubic meters (12,000 cubic yards) of solid nonhazardous waste would be generated as a result of target irradiation at the new research reactor. Target fabrication and processing at the new support facility would generate about 560 cubic meters (730 cubic yards) of process wastewater, 241,500 cubic meters (316,000 cubic yards) of sanitary wastewater, and 2,800 cubic meters (3,700 cubic yards) of solid nonhazardous waste.

The impacts of managing waste associated with fabricating and processing neptunium-237 targets for plutonium-238 production in REDC at ORR are assumed to be the same as for Option 1 under Alternative 1 (Section 4.3.1.1.13). As shown in that section, the impacts on the waste management systems at ORR would be minimal.

#### **4.6.1.2.14 Spent Nuclear Fuel Management**

The operation of the proposed new research reactor would generate about 0.31 metric ton heavy metal (682 pounds) of spent nuclear fuel per year, a total of about 11 metric tons heavy metal (24,200 pounds) from 35 years of operation. This spent nuclear fuel would be stored at the spent nuclear fuel pool at the reactor site. The spent nuclear fuel pool would be designed to provide enough capacity for 35 years of operation, that is, have a total capacity of about 11 metric tons (24,200 pounds). No dry fuel storage is anticipated at the site; therefore there are no environmental impacts associated with the construction of a dry fuel storage facility. The environmental impacts associated with the normal operation of the proposed new research reactor (which includes spent nuclear fuel storage) would result in an annual dose to the maximally exposed individual member of the public of  $6.8 \times 10^{-5}$  millirem from total site operations. This dose is well below the EPA's Clean Air Act standard of 10 millirem per year that is cited in DOE Order 5400.5. The environmental impacts associated with spent nuclear fuel management would be small.

#### **4.6.1.3 Decontamination and Decommissioning of the Research Reactor and Support Facility**

The environmental impacts associated with the decontamination and decommissioning of the research reactor and support facility at the generic DOE site are assessed in this section. If the research reactor were built on a site with existing support facilities, there would be no impacts associated with decommissioning a “new” support facility.

##### **4.6.1.3.1 Land Resources**

**LAND USE.** Decontamination and decommissioning of a research reactor and support facility would not involve the removal of any major structures, although some smaller facilities and pieces of equipment could be removed. Thus, the industrial nature of the land would not change.

**VISUAL RESOURCES.** Decontamination and decommissioning of a research reactor and support facility would not impact visual resources since no major structures would be removed. Thus, the Visual Resource Management Class IV rating of the site would remain unchanged.

##### **4.6.1.3.2 Noise**

Decontamination and decommissioning of a reactor and support facility would result in some increase in noise levels from the use of construction type equipment, materials handling and impact equipment, employee vehicles, and truck traffic. Actual noise levels would depend on the decontamination and decommissioning activities selected. Noise from these activities, especially impulsive noise, would be expected to disturb wildlife in the immediate area of the facilities. The change in noise levels in areas outside the DOE site would depend on the location selected and the exact nature of the activities required. However, generally if the reactor and support facility location were within one of the larger DOE sites and were more centrally located within the site, offsite noise impacts from decontamination and decommissioning activities would be expected to be small. Employee vehicles and truck traffic would result in an increase in traffic noise along roads used to access the site. However, this increase in traffic noise would be small unless the decontamination and decommissioning traffic volume were as large as the traffic from facility operation and other site activities. Site-specific analysis would be conducted in tiered NEPA documentation if the reactor alternative were selected.

#### **4.6.1.3.3 Air Quality**

Deactivation and decommissioning of the new reactor and support facility would result in some change in the air quality impacts. However, they would not be expected to be higher than the impacts associated with construction and operation.

#### **4.6.1.3.4 Water Resources**

Decontamination and decommissioning of the research reactor and support facility would involve permanent shutdown, stabilization, and monitoring of the deactivated facilities. As a result, processing and auxiliary systems would be shutdown and process and sanitary wastewater discharges would cease from the vacated facilities. This would eliminate the annual discharge of approximately 7.9 million liters (2.1 million gallons) of nonradioactive process wastewater from the research reactor and 0.016 million liters (0.004 million gallons) from the support facility on an annual basis. The discharge of 11.6 million liters (3.07 million gallons) per year of sanitary wastewater from the research reactor and 6.91 million liters (1.82 million gallons) from the support facility would be eliminated to onsite treatment facilities. The effects of decontamination and decommissioning on waste management are further detailed in Section 4.6.1.3.13. Site water withdrawals to supply the facilities would also be reduced by approximately 807 million liters (213.2 million gallons) per year for the research reactor and 6.92 million liter (1.83 million gallons) annually for the support facility (Appendix E; SAIC 2000).

#### **4.6.1.3.5 Geology and Soils**

No major structures would be demolished to effect decontamination and decommissioning of the research reactor and support facility. Some ground disturbance could occur associated with removal of some smaller facilities and pieces of equipment. However, ground disturbance would be confined to previously disturbed areas immediately adjacent to the reactor complex and support facility, with the impact on geologic and soil resources expected to be negligible overall.

#### **4.6.1.3.6 Ecological Resources**

Since no major structures would be demolished during decontamination and decommissioning of a research reactor and support facility, the area would continue to be of limited value to wildlife. Noise from decontamination and decommissioning activities would be expected to disturb wildlife in the immediate area; however, this disturbance would be of limited duration. Water use would decrease at the generic site with the decommissioning of a research reactor and support facility. This would result in a decrease in impingement and entrainment of aquatic organisms, as well as a decrease in impacts from effluent discharge at a site where surface water bodies are used. At a site where water is withdrawn from groundwater and discharged to an evaporation pond, the cessation of discharge from a reactor and support facility could result in a reduction in the size of the pond or its possible elimination. This could, in turn, result in the loss (or elimination) of associated aquatic and terrestrial wildlife, as well as wetland habitat. The response of any threatened or endangered species to decontamination and decommissioning of a reactor and support facility could vary from positive (e.g., due to a decrease in human presence and emissions) to negative (e.g., due to the elimination of aquatic or wetland habitat), depending on the species involved.

#### **4.6.1.3.7 Cultural and Paleontological Resources**

Decontamination and decommissioning of a research reactor and support facility would not change the status of cultural and paleontological resources. Any required ground disturbance would be confined to previously disturbed areas immediately adjacent to the reactor and support facility.

#### 4.6.1.3.8 Socioeconomics

Decommissioning of the research reactor and support facility would result in a negative impact on the socioeconomic characteristics of the DOE site at which they were located. This impact would depend on whether the candidate site was located near a large urbanized area or in a remote rural area. Since the population for the region of influence for a generic DOE site could range from nearly 2.0 million people for a site in a large metropolitan area, to less than 200,000 for a site in a small rural community, the socioeconomic impacts of decommissioning would vary greatly. If DOE were to select the new research reactor alternative, additional NEPA documentation would be required to evaluate the specific socioeconomic impacts of the decommissioning.

#### 4.6.1.3.9 Public and Occupational Health and Safety—Normal Decontamination and Decommissioning Activities

Assessments of incremental radiological and chemical impacts associated with the decontamination and decommissioning of the research reactor and support facility are presented in this section. Supplemental information is provided in Appendix H.

During decontamination and decommissioning operations, there would be incremental radiological and hazardous chemical releases to the environment and also incremental direct in-plant exposures. The resulting doses and potential health effects to the public and workers are described below.

**RADIOLOGICAL IMPACTS.** In the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586, (NRC 1988), NRC determined that the health impact to the public from the decommissioning of research reactors was “negligible.” This statement was based on the analysis of a 60-megawatt thermal light water pool reactor fueled with TRIGA fuel. The generic reactor facility used in the analysis of generic research reactor environmental impacts is a 50-megawatt thermal light water pool reactor fueled with TRIGA fuel. In the same NUREG, NRC also concluded that the public health impact from radiological releases associated with the decommissioning and decontamination of process facilities similar to the generic research reactor support facility was also “negligible.” Based on these NRC conclusions, the environmental impact on the public health and safety from the routine release of radionuclides during the decontamination and decommissioning of the generic research reactor and its support facility addressed in this NI PEIS are deemed to be negligible.

Incremental doses to involved workers from decontamination and decommissioning operations are given in **Table 4-151**; these workers are defined as those directly associated with all decontamination and decommissioning activities. The incremental annual average dose to involved workers during decontamination and decommissioning operations at the research reactor would be 275 millirem; for support facility workers, the incremental annual average dose during decontamination and decommissioning operations would be 25 millirem. The incremental annual dose received by the total site workforce for each of these facilities is estimated to be 11 and 1 person-rem, respectively. The risks and numbers of latent cancer fatalities among the different workers from annual decontamination and decommissioning operations are included in Table 4-151; a probability coefficient of  $4 \times 10^{-4}$  latent cancer fatality per rem was applied for workers (ICRP 1991). Doses to individual workers would be kept to minimal levels by instituting badged monitoring and ALARA programs.

**Table 4–151 Incremental Radiological Impacts on Involved Workers at the Generic DOE Site from the Research Reactor and Support Facility Decontamination and Decommissioning Activities Under All Options of Alternative 4 (Construct New Research Reactor)**

Receptor—Involved Workers <sup>a</sup>	Generic Site Decontamination and Decommissioning Activities		
	Research Reactor	Research Reactor Support Facility	Total
Total dose (person-rem per year)	11 <sup>b</sup>	1 <sup>b</sup>	12
4-year latent cancer fatalities	0.018	0.0016	0.019
Average worker dose (millirem per year)	275	25	150
4-year latent cancer fatality risk	$4.4 \times 10^{-4}$	$4.0 \times 10^{-5}$	$2.4 \times 10^{-4}$

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 operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (DOE 1999j). Further, DOE recommends that each facility 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 40 badged workers.

Source: NRC 1988.

**HAZARDOUS CHEMICAL IMPACTS.** Limited impacts would result from hazardous chemicals associated with deactivation and decommissioning activities.

#### 4.6.1.3.10 Public and Occupational Health and Safety—Decontamination and Decommissioning Accidents

Impacts from postulated accidents associated with the decontamination and decommissioning of the research reactor and support facility are presented in this section. Detailed descriptions of the accident analyses are provided in Appendix I.

Consequences and associated risks are presented in **Tables 4–152** and **4–153**, respectively.

**Table 4–152 Research Reactor and Support Facility Decontamination and Decommissioning Accident Consequences Under All Options of Alternative 4 (Construct New Research Reactor)**

Accident	Maximally Exposed Individual		Population to 80 Kilometers (50 Miles)		Noninvolved Worker	
	Dose (rem)	Latent Cancer Fatality <sup>a</sup>	Dose (person-rem)	Latent Cancer Fatalities <sup>b</sup>	Dose (rem)	Latent Cancer Fatality <sup>a</sup>
Spent nuclear fuel cask drop	$7.01 \times 10^{-12}$	$3.51 \times 10^{-15}$	$2.78 \times 10^{-8}$	$1.39 \times 10^{-11}$	$1.30 \times 10^{-11}$	$5.20 \times 10^{-15}$
Reactor core tank vaporization	$1.55 \times 10^{-5}$	$7.75 \times 10^{-9}$	0.346	$1.73 \times 10^{-4}$	$5.23 \times 10^{-5}$	$2.09 \times 10^{-8}$

a. Likelihood of a latent cancer fatality.

b. Number of latent cancer fatalities.

Source: Model results using MACCS2 (Chanin and Young 1997).

**Table 4–153 Research Reactor and Support Facility Decontamination and Decommissioning Accident Risks Under All Options of Alternative 4 (Construct New Research Reactor)**

Accident (Frequency)	Maximally Exposed Individual <sup>a</sup>	Population to 80 Kilometers (50 Miles) <sup>b</sup>	Noninvolved Worker <sup>a</sup>
Spent nuclear fuel cask drop ( $5.0 \times 10^{-6}$ )	$1.75 \times 10^{-20}$	$6.95 \times 10^{-17}$	$2.60 \times 10^{-20}$
Reactor core tank vaporization ( $1.0 \times 10^{-4}$ )	$7.75 \times 10^{-13}$	$1.73 \times 10^{-8}$	$2.09 \times 10^{-12}$

a. Increased likelihood of a latent cancer fatality.

b. Increased number of latent cancer fatalities.

Source: Model results using MACCS2 (Chanin and Young 1997).

For a spent nuclear fuel cask drop, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be  $1.75 \times 10^{-20}$  and  $2.60 \times 10^{-20}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be  $6.95 \times 10^{-17}$ .

For a reactor core tank vaporization accident, the increased risk of a latent cancer fatality to the maximally exposed individual and of an early fatality to a noninvolved worker would be  $7.75 \times 10^{-13}$  and  $2.09 \times 10^{-12}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be  $1.73 \times 10^{-8}$ .

There are no hazardous chemical accidents postulated during the decontamination and decommissioning phases of the new research reactor or the new support facility. Involved workers could experience industrial accidents commonly associated with these types of activities.

#### 4.6.1.3.11 Environmental Justice

Environmental effects due to decontamination and decommissioning activities that would be expected to occur at the unspecified reactor and support facility site are addressed in Section 4.6.1.3. The environmental analysis of decontamination and decommissioning activities at the new reactor and support facility site shows that radiological and nonradiological risks to persons residing in the (hypothetical) potentially affected area are not significant. Unless there are patterns of food consumption among minority or low-income residents surrounding the actual site (yet to be determined) that would result in a significant ingestion of radiologically contaminated food, it is plausible that decontamination and decommissioning activities at the site would pose no significant risks to minority and low-income persons. However, evaluations of environmental justice are necessarily site-specific and cannot be performed in detail for unspecified locations. In the event that this option were selected for implementation and a specific site selected for the new research reactor and support facility, an additional evaluation of environmental justice at the reactor and support facility site during decontamination and decommissioning would be performed prior to implementation.

#### 4.6.1.3.12 Waste Management

The decontamination and decommissioning of the new research reactor and support facility would generate numerous types of waste. The materials that may be removed or stabilized as a result of decontamination and decommissioning would be managed and reused, recycled, or disposed of in accordance with applicable Federal and state regulations. No analysis of waste management impacts, however, can be formulated at this time. Once proposals concerning decontamination and decommissioning activities are developed, DOE will undertake any additional NEPA analysis that may be necessary or appropriate.

#### **4.6.1.3.13 Spent Nuclear Fuel Management**

The Nuclear Waste Policy Act of 1982, as amended, assigned to the Secretary of Energy the responsibility for the development of a geologic repository for the ultimate disposal of high-level radioactive waste and spent nuclear fuel. When such a repository is available, spent nuclear fuel would be transferred from nuclear reactor sites to the repository for disposal. Until a repository becomes available, spent nuclear fuel associated with the operation of the research reactor would be stored in the reactor pool. Upon cessation of research reactor operations, the reactor would be decontaminated and decommissioned. At that time, spent nuclear fuel stored in the pool would be packaged in acceptable containers and shipped to the geologic repository for disposal.

#### **4.6.1.4 Permanent Deactivation of FFTF**

The environmental impacts associated with permanently deactivating FFTF are addressed in Section 4.4.1.2.

#### **4.6.2 Alternative 4 (Construct New Research Reactor)—Option 2**

Option 2 involves constructing and operating the research reactor to irradiate all targets associated with plutonium-238 production, medical and industrial isotope production, and research and development; operating FDPF at INEEL to fabricate and process neptunium-237 targets and to process the plutonium-238 product; and constructing and operating the support facility to fabricate and process the other targets and materials and to process the associated products. This option includes storage in Building CPP-651 or FDPF of the neptunium-237 transported to INEEL from SRS and storage in the new support facility of the other target materials transported to the generic site from other offsite facilities.

The transportation of the low enriched uranium fuel for use in the research reactor, the transportation of the neptunium-237 to INEEL and then to the generic site, the transportation of the other target materials to the generic site, and the transportation of all product materials following irradiation and postirradiation processing are also part of this option.

All options under this alternative include the decontamination and decommissioning of the research reactor and support facility at the generic site following their operating lifetimes, and also the permanent deactivation of FFTF at Hanford.

##### **4.6.2.1 Construction of the New Research Reactor and Support Facility**

The environmental impacts associated with the construction of a new research reactor and support facility at the generic DOE site are assessed in Section 4.6.1.1.

##### **4.6.2.2 Operations and Transportation**

The environmental impacts associated with storage, processing, and irradiation operations, and with all transportation activities, are assessed in this section.

###### **4.6.2.2.1 Land Resources**

**LAND USE.** Impacts on land use associated with the operation of a research reactor and support facility are addressed in Section 4.6.1.2.1.

Building CPP-651 and/or FDPF, which are located at INTEC, would be used for neptunium-237 storage, and FDPF would be used for target fabrication and processing. Use of these facilities would not change land use

at the site since both are currently operating and their proposed use would be compatible with their present mission.

**VISUAL RESOURCES.** Impacts on visual resources associated with the operation of a research reactor and support facility are addressed in Section 4.6.1.2.1.

All activities associated with neptunium-237 storage would take place within Building CPP-651 and/or FDPF, and target fabrication and processing in FDPF. Operations associated with the proposed activities would not result in any impact on visual resources or change in the current Visual Resource Management Class IV rating of INTEC. This is because none of the anticipated operational impacts (e.g., air emissions) would be expected to affect this resource.

#### **4.6.2.2.2 Noise**

Noise impacts associated with operation of a research reactor and support facility are addressed in Section 4.6.1.2.2.

This option also involves using the Building CPP-651 and/or FDPF, both in the INTEC area of INEEL, for neptunium-237 target material storage, and FDPF for target fabrication and processing. Interior modifications of these facilities would be expected to result in little change in noise impacts on wildlife around this area. The operation of this facility would not be expected to result in any change in noise impacts on wildlife around the INTEC area and offsite noise impacts would be small because the nearest site boundary is 12 kilometers (7.5 miles) to the south. Operation would be expected to result in minimal change in noise impacts on people near the INEEL as a result of changes in employee and truck traffic levels.

#### **4.6.2.2.3 Air Quality**

Air quality impacts associated with the operation of a research reactor and support facility are addressed in Section 4.6.1.2.3.

Impacts associated with this option at INEEL were determined to be the same as under Option 2 of Alternative 2 (Section 4.4.2.1.3).

The air quality impacts of transportation are presented in Section 4.6.2.2.11.

#### **4.6.2.2.4 Water Resources**

Impacts on water resources associated with the operation of a research reactor and support facility are addressed in Section 4.6.1.2.4.

Building CPP-651 and/or FDPF, existing facilities in the INTEC area of INEEL, would be used for neptunium-237 storage; FDPF would also be used for the fabrication and processing of targets in support of plutonium-238 production. Impacts on water resources indicators at INEEL would be the same as those described in Section 4.3.2.1.4. In summary, a small increase in water use and sanitary wastewater generation would be anticipated, mainly attributable to increased staffing levels. Also, there would be a very small increase in process wastewater generation, but there would be no radiological liquid effluent discharge to the environment under normal operations.

#### 4.6.2.2.5 Geology and Soils

Impacts on geology and soils associated with the operation of a research reactor and support facility are addressed in Section 4.6.1.2.5. As discussed in Section 4.6.1.1.5, the proposed facilities would be designed and constructed in accordance with DOE Order 420.1 and sited to minimize the risk from geologic hazards. Thus, site geologic conditions would be unlikely to affect the facilities.

The use of Building CPP-651 and/or FDPF for neptunium-237 storage, and FDPF for target fabrication and processing would not be expected to impact geologic resources, nor be jeopardized by large-scale geologic conditions. 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) as discussed in Section 4.2.3.2.5. 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 use of the INTEC facilities. 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.

#### 4.6.2.2.6 Ecological Resources

Impacts on ecological resources associated with the operation of a research reactor and support facility are addressed in Section 4.6.1.2.6.

Building CPP-651 and/or FDPF would be used for neptunium-237 storage, and FDPF for target fabrication and processing. As noted in Section 4.6.2.2.2, there would be no change in noise impacts on wildlife. Because additional water usage and wastewater discharge would be small fractions of current values, there would be no impact on aquatic resources (Section 4.6.2.2.4). Threatened and endangered species would not be affected by operation because an existing facility(s) within an already developed area would be used.

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 its 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.

#### 4.6.2.2.7 Cultural and Paleontological Resources

Impacts on cultural and paleontological resources associated with the operation of a research reactor and support facility are addressed in Section 4.6.1.2.7.

Although six historic structures are associated with INTEC, their status would not be affected by operation of Building CPP-651 and/or FDPF for neptunium-237 storage, and FDPF for target fabrication and processing. Also, the status of Native American and paleontological resources occurring in the vicinity of INTEC would not be affected by the operation of these facilities.

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 and FDPF are likely to be eligible for the National Register of Historic Places as contributory properties 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 these properties. 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.

#### 4.6.2.2.8 Socioeconomics

The socioeconomic impacts associated with the operation of the new research reactor and support facility at a generic DOE site are addressed in Section 4.6.1.2.8.

The socioeconomic impacts associated with neptunium-237 target fabrication and processing at INEEL are addressed in Section 4.3.2.1.8.

#### 4.6.2.2.9 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.

During normal operations, there would be incremental radiological and hazardous chemical releases to the environment and also incremental direct in-plant exposures. The resulting doses and potential health effects to the public and workers for this option are described below.

**RADIOLOGICAL IMPACTS.** Incremental radiological doses to three receptor groups from startup and operations are given in **Table 4–154** for the generic DOE site and INEEL: the population within 80 kilometers (50 miles) in the year 2020, the maximally exposed member of the public, and the average exposed member of the public.

Radiological impacts from startup operations prior to fuel loading would be zero. After fuel loading, these impacts would be expected to be bounded by the normal operation impacts. Therefore, startup impacts have not been treated separately from normal operational impacts. 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  $5 \times 10^{-4}$  latent cancer fatality per rem is applied for the public, and a coefficient of  $4 \times 10^{-4}$  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.

As a result of annual operations of the research reactor facilities and FDPF, the projected incremental total population dose in the year 2020 would be 0.14 person-rem; the corresponding number of latent cancer fatalities in the populations surrounding the generic DOE site and INEEL from 35 years of operations would be 0.0025. The incremental total dose to the maximally exposed member of the public from annual operations of the research reactor and support facility at the generic DOE site would be 0.0026 millirem; from 35 years of operations, the corresponding risk of a latent cancer fatality to this individual would be  $4.5 \times 10^{-8}$ .

**Table 4–154 Incremental Radiological Impacts on the Public Around the Generic DOE Site and INEEL from Operational Facilities Under Alternative 4 (Construct New Research Reactor)—Option 2**

Receptor	INEEL FDPF	Generic Site			Two-Site Total
		Research Reactor Operations	Reactor Support Facility Operations	Total	
<b>Population within 80 kilometers (50 miles) in the year 2020</b>					
Dose (person-rem)	$3.9 \times 10^{-6}$	0.0023	0.14	0.14	0.14
35-year latent cancer fatalities	$6.7 \times 10^{-8}$	$4.0 \times 10^{-5}$	0.0025	0.0025	0.0025
<b>Maximally exposed individual</b>					
Annual dose (millirem)	$2.6 \times 10^{-7}$	$6.8 \times 10^{-5}$	0.0025	0.0026	NA <sup>a</sup>
35-year latent cancer fatality risk	$4.6 \times 10^{-12}$	$1.2 \times 10^{-9}$	$4.4 \times 10^{-8}$	$4.5 \times 10^{-8}$	NA <sup>a</sup>
<b>Average exposed individual within 80 kilometers (50 miles)</b>					
Annual dose <sup>b</sup> (millirem)	$2.0 \times 10^{-8}$	$1.5 \times 10^{-6}$	$9.1 \times 10^{-5}$	$9.3 \times 10^{-5}$	NA <sup>a</sup>
35-year latent cancer fatality risk	$3.6 \times 10^{-13}$	$2.6 \times 10^{-11}$	$1.6 \times 10^{-9}$	$1.6 \times 10^{-9}$	NA <sup>a</sup>

- a. A “Total” cannot be given in this case because the same individual cannot be located at two different sites simultaneously.  
 b. Obtained by dividing the population dose by the number of people projected to live within 80 kilometers (50 miles) of FDPF or the generic site in the year 2020 (188,400 and 1,538,100, respectively).

**Key:** NA, not applicable.

**Source:** Appendix E; model results, using the GENII computer code (Napier et al. 1988).

Incremental doses to involved workers from normal operations are given in **Table 4–155**; these workers are defined as those directly associated with all process activities. The incremental annual average dose to research reactor workers during operations would be 100 millirem; for support facility workers, the incremental annual average dose during operations would be 114 millirem; for FDPF workers, the incremental annual average dose would be approximately 170 millirem. The incremental annual dose received by the total site workforce for each of these facilities is estimated to be 12, 11, and 12 person-rem, respectively. The risks and numbers of latent cancer fatalities among the different workers from 35 years of operations are included in Table 4–155. Doses to individual workers would be kept to minimal levels by instituting badged monitoring and ALARA programs.

**Table 4–155 Incremental Radiological Impacts on Involved Workers at the Generic DOE Site and INEEL from Operational Facilities Under Alternative 4 (Construct New Research Reactor)—Option 2**

Receptor—Involved Workers <sup>a</sup>	INEEL FDPF	Generic Site		Two-Site Total
		Research Reactor Operations	Reactor Support Facility Operations	
Total dose (person-rem per year)	12 <sup>b</sup>	12 <sup>b</sup>	11 <sup>b</sup>	36
35-year latent cancer fatalities	0.17	0.17	0.16	0.50
Average worker dose (millirem per year)	170	100	114	NA <sup>c</sup>
35-year latent cancer fatality risk	0.0023	0.0014	0.0016	NA <sup>c</sup>

- 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 operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (DOE 1999j). Further, DOE recommends that each facility 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 75 badged workers at FDPF, 120 research reactor workers, and 100 workers at the reactor support facility.  
 c. Values cannot be given for the average worker because the workers would be in three different facilities at two different sites.

**Key:** NA, not applicable.

**Source:** Wham 1999b, 2000.

**HAZARDOUS CHEMICAL IMPACTS.** Hazardous chemical impacts associated with the operation of the research reactor and support facility are addressed in Section 4.6.1.2.9.

Impacts from hazardous chemicals at INEEL were determined to be the same as in Alternative 2, Option 2 (Section 4.4.2.1.9).

#### 4.6.2.2.10 Public and Occupational Health and Safety—Facility Accidents

Impacts from postulated accidents associated with research reactor target irradiation; support facility medical, industrial, and research and development isotope fabrication and processing; and FDPF neptunium-237 target fabrication and processing are presented in this section. Detailed descriptions of the accident analyses are provided in Appendix I.

Consequences and associated risks are presented in **Tables 4–156** and **4–157**, respectively.

**Table 4–156 New Research Reactor, Support Facility, and FDPF Accident Consequences Under Alternative 4 (Construct New Research Reactor)—Option 2**

Accident	Maximally Exposed Individual		Population to 80 Kilometers (50 Miles)		Noninvolved Worker	
	Dose (rem)	Latent Cancer Fatality <sup>a</sup>	Dose (person-rem)	Latent Cancer Fatalities <sup>b</sup>	Dose (rem)	Latent Cancer Fatality <sup>a</sup>
<b>New research reactor accidents</b>						
Design-basis accident	$1.33 \times 10^{-6}$	$6.65 \times 10^{-10}$	0.00241	$1.20 \times 10^{-6}$	$5.49 \times 10^{-6}$	$2.20 \times 10^{-9}$
Beyond-design-basis earthquake	0.00373	$1.87 \times 10^{-6}$	27.6	0.0138	0.0531	$2.12 \times 10^{-5}$
Fuel-handling accident	$1.90 \times 10^{-9}$	$9.50 \times 10^{-13}$	$6.79 \times 10^{-6}$	$3.40 \times 10^{-9}$	$5.83 \times 10^{-9}$	$2.33 \times 10^{-12}$
Neptunium-237 target-handling accident	$5.42 \times 10^{-8}$	$2.71 \times 10^{-11}$	$8.95 \times 10^{-5}$	$4.47 \times 10^{-8}$	$2.43 \times 10^{-7}$	$9.72 \times 10^{-11}$
Medical isotope target-handling accident	$1.04 \times 10^{-5}$	$5.20 \times 10^{-9}$	0.101	$5.06 \times 10^{-5}$	$6.76 \times 10^{-6}$	$2.70 \times 10^{-9}$
<b>Support facility accidents</b>						
Medical and industrial isotopes localized solvent fire	0.0194	$9.72 \times 10^{-6}$	31.1	0.0156	0.00530	$2.12 \times 10^{-6}$
Medical and industrial isotopes unlikely seismic event	0.0750	$3.75 \times 10^{-5}$	136	0.0680	0.510	$2.04 \times 10^{-4}$
Medical and industrial isotopes glovebox explosion	2.50	0.00125	4,600	2.30	17.0	0.00680
<b>FDPF accidents</b>						
Ion exchange explosion during neptunium-237 target fabrication	$2.01 \times 10^{-9}$	$1.01 \times 10^{-12}$	$2.49 \times 10^{-5}$	$1.24 \times 10^{-8}$	$7.26 \times 10^{-9}$	$2.91 \times 10^{-12}$
Target dissolver tank failure during plutonium-238 separation	$6.11 \times 10^{-8}$	$3.05 \times 10^{-11}$	$5.65 \times 10^{-4}$	$2.82 \times 10^{-7}$	$2.17 \times 10^{-7}$	$8.69 \times 10^{-11}$
Ion exchange explosion during plutonium-238 separation	$1.63 \times 10^{-5}$	$8.13 \times 10^{-9}$	0.150	$7.51 \times 10^{-5}$	$5.79 \times 10^{-5}$	$2.31 \times 10^{-8}$
Plutonium-238 processing facility beyond-design-basis earthquake	42.5	0.0425	$1.64 \times 10^5$	82.0	1,200	1.0 <sup>c</sup>

a. Likelihood of a latent cancer fatality.

b. Number of latent cancer fatalities.

c. Early fatality due to radiation dose. A radiation dose of 450 to 500 rem causes fatalities in 50 percent of those exposed. Early fatalities are expected for exposures greater than 600 rem.

**Source:** Model results, using the MACCS2 (Chanin and Young 1997) and GENII (Napier et al. 1988) computer codes.

**Table 4-157 New Research Reactor, Support Facility, and FDPF Accident Risks Under Alternative 4 (Construct New Research Reactor)—Option 2**

Accident (Frequency)	Maximally Exposed Individual <sup>a</sup>	Population to 80 Kilometers (50 Miles) <sup>b</sup>	Noninvolved Worker <sup>a</sup>
<b>Annual new research reactor risks</b>			
Design-basis accident ( $1 \times 10^{-4}$ )	$6.65 \times 10^{-14}$	$1.20 \times 10^{-10}$	$2.20 \times 10^{-13}$
Beyond-design-basis earthquake ( $1 \times 10^{-5}$ )	$1.87 \times 10^{-11}$	$1.38 \times 10^{-7}$	$2.12 \times 10^{-10}$
Fuel-handling accident (0.01)	$9.50 \times 10^{-15}$	$3.40 \times 10^{-11}$	$2.33 \times 10^{-14}$
Neptunium-237 target-handling accident (0.01)	$2.71 \times 10^{-13}$	$4.47 \times 10^{-10}$	$9.72 \times 10^{-13}$
Medical isotope target-handling accident (0.01)	$5.20 \times 10^{-11}$	$5.06 \times 10^{-7}$	$2.70 \times 10^{-11}$
<b>35-year new research reactor risk</b>	$2.49 \times 10^{-9}$	$2.26 \times 10^{-5}$	$8.41 \times 10^{-9}$
<b>Annual support facility risks</b>			
Medical and industrial isotopes localized solvent fire (0.044)	$4.32 \times 10^{-7}$	$6.91 \times 10^{-4}$	$9.41 \times 10^{-8}$
Medical and industrial isotopes unlikely seismic event (0.01)	$3.75 \times 10^{-7}$	$6.80 \times 10^{-4}$	$2.04 \times 10^{-6}$
Medical and industrial isotopes glovebox explosion ( $1.00 \times 10^{-4}$ )	$1.25 \times 10^{-7}$	$2.30 \times 10^{-4}$	$6.80 \times 10^{-7}$
<b>35-year support facility risk</b>	$3.26 \times 10^{-5}$	0.056	$9.85 \times 10^{-5}$
<b>Annual FDPF risks</b>			
Ion exchange explosion during neptunium-237 target fabrication (0.01)	$1.01 \times 10^{-14}$	$1.24 \times 10^{-10}$	$2.91 \times 10^{-14}$
Target dissolver tank failure during plutonium-238 separation (0.01)	$3.05 \times 10^{-13}$	$2.82 \times 10^{-9}$	$8.69 \times 10^{-13}$
Ion exchange explosion during plutonium-238 separation (0.01)	$8.13 \times 10^{-11}$	$7.51 \times 10^{-7}$	$2.31 \times 10^{-10}$
Plutonium-238 processing facility beyond-design-basis earthquake ( $1 \times 10^{-5}$ )	$4.25 \times 10^{-7}$	$8.20 \times 10^{-4}$	$1.00 \times 10^{-5(c)}$
<b>35-year FDPF risk</b>	$1.49 \times 10^{-5}$	0.0287	$3.50 \times 10^{-4(c)}$
<b>35-year Option risk</b>	$4.75 \times 10^{-5}$	0.0848	$4.49 \times 10^{-4}$

a. Increased likelihood of a latent cancer fatality.

b. Increased number of latent cancer fatalities.

c. Risk of an early fatality.

**Source:** Model results, using the MACCS2 (Chanin and Young 1997) and GENII (Napier et al. 1988) computer codes.

For 35 years of research reactor target irradiation, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be  $2.49 \times 10^{-9}$  and  $8.41 \times 10^{-9}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be  $2.26 \times 10^{-5}$ .

For 35 years of support facility medical, industrial, and research and development target fabrication and processing, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be  $3.26 \times 10^{-5}$  and  $9.85 \times 10^{-5}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.056.

For 35 years of FDPF neptunium-237 target fabrication and processing, the increased risk of a latent cancer fatality to the maximally exposed individual and of an early fatality to a noninvolved worker would be

$1.49 \times 10^{-5}$  and  $3.50 \times 10^{-4}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.0287.

For 35 years under this option, the increased risk of a latent cancer fatality to the maximally exposed individual and of a fatality to a noninvolved worker would be  $4.75 \times 10^{-5}$  and  $4.49 \times 10^{-4}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.0848.

There are no hazardous chemical accidents associated with the new research reactor or new support facility. The irradiation of neptunium-237, medical, industrial, and research and development isotopes in the new research reactor would not require the use of hazardous chemicals in amounts that exceed the Threshold Planning Quantities on the Extremely Hazardous Substances List (EPA 1998).

The fabrication and processing of medical, industrial, and research and development isotopes at the new support facility would not require the use of hazardous chemicals in amounts that exceed the Threshold Planning Quantities on the Extremely Hazardous Substances List (EPA 1998).

The hazardous chemical accident impacts at FDPF are the same as those presented in Section 4.4.5.1.10.

#### 4.6.2.2.11 Public and Occupational Health and Safety—Transportation

DOE would transport neptunium-237 from storage at SRS to the FDPF target fabrication facility at INEEL. DOE would transport the unirradiated neptunium-237 targets from FDPF to the reactor site. Following irradiation in the reactor, the targets would be returned to FDPF for processing. After this processing, the plutonium-238 product would be shipped to LANL. The reactor would receive low enriched uranium fuel from a U.S. fuel fabrication facility. Additionally, medical and industrial isotopes would be shipped from the reactor site to a local airport, and from there to locations throughout the country.

Approximately 37,000 shipments of radioactive materials would be made by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be 7.5 million kilometers (4.7 million miles); and in the air carrying medical isotopes, 23 million kilometers (14 million miles).

The transportation impact 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 29.2 person-rem; the dose to the public, 315 person-rem. Accordingly, incident-free transportation of radioactive material associated with this option would result in 0.012 latent cancer fatality among transportation workers and 0.16 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 would be 0.026. About half of the crew risk, about 2 percent of the public risk, and most of the emissions risk would result from shipping medical and industrial isotopes.

**IMPACTS OF ACCIDENTS DURING TRANSPORTATION.** The maximum foreseeable offsite transportation accident under this option (probability of occurrence: 1 in 10 million per year) is a shipment of irradiated neptunium-237 targets to FDPF with a severity Category V accident in an urban population zone under neutral (average) weather conditions. The accident could result in a dose of 0.61 person-rem to the public with an associated  $3.1 \times 10^{-4}$  latent cancer fatality, and 2.6 millirem to the hypothetical maximally exposed individual with a latent cancer fatality risk of  $1.3 \times 10^{-6}$ . No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of the accident, or occurrence while carrying

neptunium-237 (unirradiated) or plutonium-238 was also evaluated and estimated to have a probability of less than 1 in 10 million per year.

Estimates of the total transportation accident risks under this option are as follows: a radiological dose to the population of 1,063 person-rem, resulting in 0.53 latent cancer fatality; and traffic accidents resulting in 0.19 traffic fatality. Nearly all of the radiological and about 59 percent of the traffic accident risk would result from shipping medical and industrial isotopes.

#### **4.6.2.2.12 Environmental Justice**

Under this option, neptunium-237 targets would be irradiated in a new reactor that would be constructed at a site yet to be specified. Fabrication and processing of neptunium-237 targets for plutonium-238 production would be performed at FDPF at INEEL. A new support facility would be constructed at an unspecified site for fabrication and processing targets not used for plutonium-238 production.

Activities at FDPF were evaluated under other alternatives and options in this NI PEIS (e.g., Section 4.4.2.1.12) and found to pose no significant radiological or other risks to minority and low-income populations. The environmental analysis of operations at the new research reactor and support facility site shows that radiological and nonradiological risks to persons residing in the (hypothetical) potentially affected areas would not be significant. Unless there are patterns of food consumption among minority or low-income resident surrounding the actual site (yet to be determined) that would result in a significant ingestion of radiologically contaminated food, it is plausible that operations at the site would pose no significant risks to minority and low-income persons. However, evaluations of environmental justice are necessarily site-specific and cannot be performed in detail for unspecified locations. In the event that this option were selected for implementation and a specific site selected for the new research reactor and support facility, an additional evaluation of environmental justice at the reactor and support facility site during operation would be performed prior to implementation.

#### **4.6.2.2.13 Waste Management**

The impacts of managing waste generated from the operation of a new research reactor to irradiate targets and a support facility to fabricate and process medical and industrial isotope targets and to meet research and development needs are assumed to be the same as for Option 1 (Section 4.6.1.2.13). 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 4.6.2.2.9 through 4.6.2.2.11.

The impacts of managing waste associated with fabricating and processing neptunium-237 targets for plutonium-238 production in FDPF at INEEL are assumed to be the same as for Option 2 under Alternative 1 (Section 4.3.2.1.13). As shown in that section, the impacts on the waste management systems at INEEL would be minimal.

#### **4.6.2.2.14 Spent Nuclear Fuel Management**

The impacts associated with spent nuclear fuel management under this option would be the same as for Option 1, and are given in Section 4.6.1.2.14.

### **4.6.2.3 Decontamination and Decommissioning of the Research Reactor and Support Facility**

The environmental impacts associated with the decontamination and decommissioning of the research reactor and support facility at the generic DOE site are assessed in Section 4.6.1.3.

#### **4.6.2.4 Permanent Deactivation of FFTF**

The environmental impacts associated with permanently deactivating FFTF are addressed in Section 4.4.1.2.

#### **4.6.3 Alternative 4 (Construct New Research Reactor)—Option 3**

Option 3 involves construction and operating the research reactor to irradiate all targets associated with plutonium-238 production, medical and industrial isotope production, and research and development; operating FMEF at Hanford to fabricate and process neptunium-237 targets and to process the plutonium-238 product; and constructing and operating the support facility to fabricate and process the other targets and materials and to process the associated products. This option includes storage in FMEF of the neptunium-237 transported to Hanford from SRS and storage in the new support facility of the other target materials transported to the generic site from other offsite facilities.

The transportation of the low enriched uranium fuel for use in the research reactor, the transportation of the neptunium-237 to Hanford and then to the generic site, the transportation of the other target materials to the generic site, and the transportation of the product materials following irradiation and postirradiation processing are also part of this option.

All options under this alternative include the contamination and decommissioning of the research reactor and support facility at the generic DOE site following their operating lifetimes, and also the permanent deactivation of FFTF at Hanford.

##### **4.6.3.1 Construction of the New Research Reactor and Support Facility**

Environmental impacts associated with the construction of a new research reactor and support facility at the generic DOE site are assessed in Section 4.6.1.1.

##### **4.6.3.2 Operations and Transportation**

The environmental impacts associated with storage, processing, and irradiation operations, and with all transportation activities, are assessed in this section.

###### **4.6.3.2.1 Land Resources**

**LAND USE.** Impacts on land use associated with the operation of a reactor and support facility are addressed in Section 4.6.1.2.1.

FMEF would be used for neptunium-237 storage, target fabrication, and processing. Land use within the 400 Area would not change since the use of FMEF would be compatible with the mission for which it was designed.

**VISUAL RESOURCES.** Impacts on visual resources associated with the operation of a reactor and support facility are addressed in Section 4.6.1.2.1.

All activities associated with neptunium-237 storage, target fabrication, and processing would take place within FMEF. Operations associated with the proposed activities would not result in any impact on visual resources or change in the current Visual Resource Management Class IV rating of the 400 Area. This is because none of the anticipated operational impacts (e.g., air emissions) would be expected to affect this resource.

#### **4.6.3.2.2 Noise**

Noise impacts associated with the operation of a research reactor and support facility are addressed in Section 4.6.1.2.2.

This option also involves using FMEF for target material storage, target fabrication, and processing. Activities associated with construction of a new stack would be typical of small construction projects and would result in some temporary increase in noise. Noise sources associated with this construction would not be expected to be loud impulsive sources and would not be expected to result in disturbance of wildlife around the 400 Area. The operation of FMEF would not be expected to result in any change in noise impacts on wildlife around the 400 Area and offsite noise impacts would also be minor because the nearest site boundary is 7 kilometers (4.3 miles) to the east. Operation would be expected to result in minimal change in noise impacts on people near Hanford as a result of changes in employee and truck traffic levels.

#### **4.6.3.2.3 Air Quality**

Air quality impacts associated with the operation of the new research reactor and support facility are addressed in Section 4.6.1.2.3.

Air quality impacts at Hanford associated with this option were determined to be the same as in Alternative 2, Option 3 (Section 4.4.3.1.3).

The air quality impacts of transportation are presented in Section 4.6.3.2.11.

#### **4.6.3.2.4 Water Resources**

Impacts on water resources associated with the operation of a research reactor and support facility are addressed in Section 4.6.1.2.4.

FMEF in the 400 Area of Hanford would be used for neptunium-237 storage, target fabrication, and processing in support of plutonium-238 production. The operation of FMEF for this purpose is projected to require approximately 19 million liters (5 million gallons) of groundwater annually. This includes approximately 15 million liters (4 million gallons) per year to support FMEF cooling needs and an additional 3.8 million liters (1 million gallons) per year for potable and sanitary water demands due to increased staffing. However, no impact on regional groundwater levels would be expected from increased withdrawals. FMEF groundwater usage would constitute an increase of about 10 percent over the 197 million liters (52 million gallons) withdrawn annually in the 400 Area during standby operations. Sanitary wastewater discharges from FMEF would also increase by roughly 3.8 million liters (1 million gallons) per year to the Energy Northwest treatment system, which has sufficient capacity. Also, the operation of FMEF for target fabrication and processing would generate approximately 15 million liters (4 million gallons) per year of process wastewater. This wastewater would be discharged to the 400 Area process sewer system and ultimately to the 400 Area Pond (i.e., 4608 B/C percolation ponds) (DOE 2000a:B-3; Nielsen 1999:38, 39, 41). As discharges to the pond are regulated under State Waste Discharge Permit No. ST-4501 and there are no radiological liquid effluent pathways to the environment from FMEF, the impact on groundwater quality would be negligible.

It should be noted that the increase in water use and sanitary and process wastewater discharge for FMEF operations would essentially be negated by the larger reductions in water use and wastewater discharge associated with the permanent deactivation of FFTF (see Section 4.4.1.2.4).

#### 4.6.3.2.5 Geology and Soils

Impacts on geology and soils associated with the operation of a research reactor and support facility are addressed in Section 4.6.1.2.5. As discussed in Section 4.6.1.1.5, the proposed facilities would be designed and constructed in accordance with DOE Order 420.1 and sited to minimize the risk from geologic hazards. Thus, site geologic conditions would be unlikely to affect the facilities.

The use of FMEF for neptunium-237 storage, target fabrication, and processing would not be expected to impact geologic resources, nor be jeopardized by large-scale geologic conditions. 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) as discussed in Section 4.2.4.2.5. 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 operations. 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.

#### 4.6.3.2.6 Ecological Resources

Impacts on ecological resources associated with the operation of a research reactor and support facility are addressed in Section 4.6.1.2.6.

This option also involves using FMEF for neptunium-237 storage, target fabrication, and processing. As noted in Section 4.6.3.2.2, there would be no loud noises that would disturb wildlife. Because additional water usage and wastewater discharge would be small fractions of current values, there would be no change in impacts on aquatic habitat or wetlands associated with the Columbia River (Section 4.6.3.2.4). Threatened and endangered species would not be affected by operation because an existing facility within an already developed area would be used.

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.

#### 4.6.3.2.7 Cultural and Paleontological Resources

Impacts on cultural and paleontological resources associated with the operation of a research reactor and support facility are addressed in Section 4.6.1.2.7.

Neptunium-237 storage, target fabrication, and processing would take place at FMEF, which is in the 400 Area. No prehistoric, historic, or paleontological sites have been identified either within the 400 Area or within 2 kilometers (1.2 miles) of the 400 Area. Six buildings located within the 400 Area, including two

FFTF structures (the Reactor Containment Building and FFTF Control Building), have been determined to be eligible for the National Register as contributing properties within the Historic District recommended for mitigation. The operation of FMEF would not affect the status of these structures. No Native American resources are known to occur within 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.

#### **4.6.3.2.8 Socioeconomics**

The socioeconomic impacts associated with the operation of a new research reactor and support facility at a generic DOE site are addressed in Section 4.6.1.2.8.

The socioeconomic impacts associated with neptunium-237 target fabrication and processing at Hanford are the same as those addressed in Section 4.4.3.1.8.

#### **4.6.3.2.9 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.

During normal operations, there would be incremental radiological and hazardous chemical releases to the environment and also incremental direct in-plant exposures. The resulting doses and potential health effects to the public and workers for this option are described below.

**RADIOLOGICAL IMPACTS.** Incremental radiological doses to three receptor groups from startup and operations are given in **Table 4–158** for the generic DOE site and Hanford: the population within 80 kilometers (50 miles) in the year 2020, the maximally exposed member of the public, and the average exposed member of the public. Radiological impacts from startup operations prior to fuel loading would be zero. After fuel loading, these impacts would be expected to be bound by the normal operational impacts. Therefore, startup impacts have not been treated separately from normal operational impacts. 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  $5 \times 10^{-4}$  latent cancer fatality per rem is applied for the public, and a coefficient of  $4 \times 10^{-4}$  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.

As a result of annual operations of the research reactor facilities and FMEF, the projected incremental total population dose in the year 2020 would be 0.14 person-rem; the corresponding number of latent cancer fatalities in the populations surrounding the generic DOE site and Hanford from 35 years of operations would be 0.0025. The incremental total dose to the maximally exposed member of the public from annual operations of the research reactor and support facility at the generic DOE site would be 0.0026 millirem; from 35 years of operations, the corresponding risk of a latent cancer fatality to this individual would be  $4.5 \times 10^{-8}$ .

**Table 4–158 Incremental Radiological Impacts on the Public Around the Generic DOE Site and Hanford from Operational Facilities Under Alternative 4 (Construct New Research Reactor)—Option 3**

Receptor	Hanford FMEF	Generic Site			Two-Site Total
		Research Reactor Operations	Reactor Support Facility Operations	Total	
<b>Population within 80 kilometers (50 miles) in the year 2020</b>					
Dose (person-rem)	$4.4 \times 10^{-5}$	0.0023	0.14	0.14	0.14
35-year latent cancer fatalities	$7.7 \times 10^{-7}$	$4.0 \times 10^{-5}$	0.0025	0.0025	0.0025
<b>Maximally exposed individual</b>					
Annual dose (millirem)	$4.7 \times 10^{-7}$	$6.8 \times 10^{-5}$	0.0025	0.0026	NA <sup>a</sup>
35-year latent cancer fatality risk	$8.3 \times 10^{-12}$	$1.2 \times 10^{-9}$	$4.4 \times 10^{-8}$	$4.5 \times 10^{-8}$	NA <sup>a</sup>
<b>Average exposed individual within 80 kilometers (50 miles)</b>					
Annual dose <sup>b</sup> (millirem)	$8.9 \times 10^{-8}$	$1.5 \times 10^{-6}$	$9.1 \times 10^{-5}$	$9.3 \times 10^{-5}$	NA <sup>a</sup>
35-year latent cancer fatality risk	$1.6 \times 10^{-12}$	$2.6 \times 10^{-11}$	$1.6 \times 10^{-9}$	$1.6 \times 10^{-9}$	NA <sup>a</sup>

a. A “Total” cannot be given in this case because the same individual cannot be located at two different sites simultaneously.

b. Obtained by dividing the population dose by the number of people projected to live within 80 kilometers (50 miles) of FMEF or the generic site in the year 2020 (494,400 and 1,538,100, respectively).

**Key:** NA, not applicable.

**Source:** Appendix E; model results, using the GENII computer code (Napier et al. 1988).

Incremental doses to involved workers from normal operations are given in **Table 4–159**; these workers are defined as those directly associated with all process activities. The incremental annual average dose to research reactor workers during operations would be 100 millirem; for support facility workers, the incremental annual average dose during startup and operations would be 114 millirem; for FMEF workers, the incremental annual average dose would be approximately 170 millirem. The incremental annual dose received by the total site workforce for each of these facilities is estimated to be 12, 11, and 12 person-rem, respectively. The risks and numbers of latent cancer fatalities among the different workers from 35 years of operations are included in Table 4–159. Doses to individual workers would be kept to minimal levels by instituting badged monitoring and ALARA programs.

**Table 4–159 Incremental Radiological Impacts on Involved Workers at the Generic DOE Site and Hanford from Operational Facilities Under Alternative 4 (Construct New Research Reactor)—Option 3**

Receptor—Involved Workers <sup>a</sup>	Hanford FMEF	Generic Site		One- or Two-Site Total
		Research Reactor Operations	Reactor Support Facility Operations	
Total dose (person-rem per year)	12 <sup>b</sup>	12 <sup>b</sup>	11 <sup>b</sup>	36
35-year latent cancer fatalities	0.17	0.17	0.16	0.50
Average worker dose (millirem per year)	170	100	114	NA <sup>c</sup>
35-year latent cancer fatality risk	0.0023	0.0014	0.0016	NA <sup>c</sup>

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 operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (DOE 1999j). Further, DOE recommends that each facility 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 75 badged workers at FMEF, 120 research reactor workers, and 100 workers at the reactor support facility.

c. Values cannot be given for the average worker because the workers would be in three different facilities at two different sites.

**Key:** NA, not applicable.

**Source:** Wham 1999b, 2000.

**HAZARDOUS CHEMICAL IMPACTS.** Hazardous chemical impacts associated with the operation of the research reactor and support facility are addressed in Section 4.6.1.2.9.

Impacts from hazardous chemicals at Hanford were determined to be the same as in Alternative 2, Option 3 (Section 4.4.3.1.9).

#### **4.6.3.2.10 Public and Occupational Health and Safety—Facility Accidents**

Impacts from postulated accidents associated with research reactor target irradiation; support facility medical, industrial, and research and development isotope fabrication and processing; and FMEF neptunium-237 target fabrication and processing are presented in this section. Detailed descriptions of the accident analyses are provided in Appendix I.

Consequences and associated risks are presented in **Tables 4–160** and **4–161**, respectively.

For 35 years of research reactor target irradiation, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be  $2.49 \times 10^{-9}$  and  $8.41 \times 10^{-9}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be  $2.26 \times 10^{-5}$ .

For 35 years of support facility medical, industrial, and research and development target fabrication and processing, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be  $3.26 \times 10^{-5}$  and  $9.85 \times 10^{-5}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.056.

For 35 years of FMEF neptunium-237 target fabrication and processing, the increased risk of a latent cancer fatality to the maximally exposed individual and of an early fatality to a noninvolved worker would be  $2.88 \times 10^{-6}$  and  $3.50 \times 10^{-4}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.112.

For 35 years under this option, the increased risk of a latent cancer fatality to the maximally exposed individual and of a fatality to a noninvolved worker would be  $3.55 \times 10^{-5}$  and  $4.49 \times 10^{-4}$ , respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.168.

There are no hazardous chemical accidents associated with the new research reactor or new support facility. The irradiation of neptunium-237, medical, industrial, and research and development isotopes in the new research reactor would not require the use of hazardous chemicals in amounts that exceed the Threshold Planning Quantities on the Extremely Hazardous Substances List (EPA 1998).

The fabrication and processing of medical, industrial, and research and development isotopes at the new support facility would not require the use of hazardous chemicals in amounts that exceed the Threshold Planning Quantities on the Extremely Hazardous Substances List (EPA 1998).

The hazardous chemical accident impacts at FMEF are the same as those presented in Section 4.4.6.1.10.

**Table 4–160 New Research Reactor, Support Facility, and FMEF Accident Consequences Under Alternative 4 (Construct New Research Reactor)—Option 3**

Accident	Maximally Exposed Individual		Population to 80 Kilometers (50 Miles)		Noninvolved Worker	
	Dose (rem)	Latent Cancer Fatality <sup>a</sup>	Dose (person-rem)	Latent Cancer Fatalities <sup>b</sup>	Dose (rem)	Latent Cancer Fatality <sup>a</sup>
<b>New research reactor accidents</b>						
Design-basis accident	$1.33 \times 10^{-6}$	$6.65 \times 10^{-10}$	0.00241	$1.20 \times 10^{-6}$	$5.49 \times 10^{-6}$	$2.20 \times 10^{-9}$
Beyond-design-basis earthquake	0.00373	$1.87 \times 10^{-6}$	27.6	0.0138	0.0531	$2.12 \times 10^{-5}$
Fuel-handling accident	$1.90 \times 10^{-9}$	$9.50 \times 10^{-13}$	$6.79 \times 10^{-6}$	$3.40 \times 10^{-9}$	$5.83 \times 10^{-9}$	$2.33 \times 10^{-12}$
Neptunium-237 target-handling accident	$5.42 \times 10^{-8}$	$2.71 \times 10^{-11}$	$8.95 \times 10^{-5}$	$4.47 \times 10^{-8}$	$2.43 \times 10^{-7}$	$9.72 \times 10^{-11}$
Medical isotope target-handling accident	$1.04 \times 10^{-5}$	$5.20 \times 10^{-9}$	0.101	$5.06 \times 10^{-5}$	$6.76 \times 10^{-6}$	$2.70 \times 10^{-9}$
<b>Support facility accidents</b>						
Medical and industrial isotopes localized solvent fire	0.0194	$9.72 \times 10^{-6}$	31.1	0.0156	0.00530	$2.12 \times 10^{-6}$
Medical and industrial isotopes unlikely seismic event	0.0750	$3.75 \times 10^{-5}$	136	0.0680	0.510	$2.04 \times 10^{-4}$
Medical and industrial isotopes glovebox explosion	2.50	0.00125	4,600	2.30	17.0	0.00680
<b>FMEF accidents</b>						
Ion exchange explosion during neptunium-237 target fabrication	$2.02 \times 10^{-9}$	$1.01 \times 10^{-12}$	$7.26 \times 10^{-5}$	$3.63 \times 10^{-8}$	$6.65 \times 10^{-10}$	$2.66 \times 10^{-13}$
Target dissolver tank failure during plutonium-238 separation	$4.64 \times 10^{-8}$	$2.32 \times 10^{-11}$	0.00169	$8.47 \times 10^{-7}$	$1.95 \times 10^{-8}$	$7.81 \times 10^{-12}$
Ion exchange explosion during plutonium-238 separation	$1.24 \times 10^{-5}$	$6.18 \times 10^{-9}$	0.451	$2.25 \times 10^{-4}$	$5.20 \times 10^{-6}$	$2.08 \times 10^{-9}$
Plutonium-238 processing facility beyond-design-basis earthquake	16.5	0.00823	$6.41 \times 10^5$	321	921	1.0 <sup>c</sup>

a. Likelihood of a latent cancer fatality.

b. Number of latent cancer fatalities.

c. Early fatality due to radiation dose. A radiation dose of 450 to 500 rem causes fatalities in 50 percent of those exposed. Early fatalities are expected for exposures greater than 600 rem.

**Source:** Model results, using the MACCS2 (Chanin and Young 1997) and GENII (Napier et al. 1988) computer codes.

**Table 4–161 New Research Reactor, Support Facility, and FMEF Accident Risks Under Alternative 4 (Construct New Research Reactor)—Option 3**

Accident (Frequency)	Maximally Exposed Individual <sup>a</sup>	Population to 80 Kilometers (50 Miles) <sup>b</sup>	Noninvolved Worker <sup>a</sup>
<b>Annual new research reactor risks</b>			
Design-basis accident ( $1 \times 10^{-4}$ )	$6.65 \times 10^{-14}$	$1.20 \times 10^{-10}$	$2.20 \times 10^{-13}$
Beyond-design-basis earthquake ( $1 \times 10^{-5}$ )	$1.87 \times 10^{-11}$	$1.38 \times 10^{-7}$	$2.12 \times 10^{-10}$
Fuel-handling accident (0.01)	$9.50 \times 10^{-15}$	$3.40 \times 10^{-11}$	$2.33 \times 10^{-14}$
Neptunium-237 target-handling accident (0.01)	$2.71 \times 10^{-13}$	$4.47 \times 10^{-10}$	$9.72 \times 10^{-13}$
Medical isotope target-handling accident (0.01)	$5.20 \times 10^{-11}$	$5.06 \times 10^{-7}$	$2.70 \times 10^{-11}$
<b>35-year new research reactor risk</b>	$2.49 \times 10^{-9}$	$2.26 \times 10^{-5}$	$8.41 \times 10^{-9}$
<b>Annual support facility risks</b>			
Medical and industrial isotopes localized solvent fire (0.044)	$4.32 \times 10^{-7}$	$6.91 \times 10^{-4}$	$9.41 \times 10^{-8}$
Medical and industrial isotopes unlikely seismic event (0.01)	$3.75 \times 10^{-7}$	$6.80 \times 10^{-4}$	$2.04 \times 10^{-6}$
Medical and industrial isotopes glovebox explosion (0.01)	$1.25 \times 10^{-7}$	$2.30 \times 10^{-4}$	$6.80 \times 10^{-7}$
<b>35-year support facility risk</b>	$3.26 \times 10^{-5}$	0.056	$9.85 \times 10^{-5}$
<b>Annual FMEF risks</b>			
Ion exchange explosion during neptunium-237 target fabrication (0.01)	$1.01 \times 10^{-14}$	$3.63 \times 10^{-10}$	$2.66 \times 10^{-15}$
Target dissolver tank failure during plutonium-238 separation (0.01)	$2.32 \times 10^{-13}$	$8.47 \times 10^{-9}$	$7.81 \times 10^{-14}$
Ion exchange explosion during plutonium-238 separation (0.01)	$6.18 \times 10^{-11}$	$2.25 \times 10^{-6}$	$2.08 \times 10^{-11}$
Plutonium-238 processing facility beyond-design-basis earthquake ( $1 \times 10^{-5}$ )	$8.23 \times 10^{-8}$	0.00321	$1.00 \times 10^{-5(c)}$
<b>35-year FMEF risk</b>	$2.88 \times 10^{-6}$	0.112	$3.50 \times 10^{-4(c)}$
<b>35-year Option risk</b>	$3.55 \times 10^{-5}$	0.168	$4.49 \times 10^{-4}$

a. Increased likelihood of a latent cancer fatality.

b. Increased number of latent cancer fatalities.

c. Risk of an early fatality.

Source: Model results, using the MACCS2 (Chanin and Young 1997) and GENII (Napier et al. 1988) computer codes.

#### 4.6.3.2.11 Public and Occupational Health and Safety—Transportation

DOE would transport neptunium-237 from storage at SRS to the FMEF target fabrication facility at Hanford. DOE would transport the unirradiated neptunium-237 targets from FMEF to the reactor site. Following irradiation in the reactor, the targets would be returned to FMEF for processing. After this processing, the plutonium-238 product would be shipped to LANL. The reactor would receive low enriched uranium fuel from a U.S. fuel fabrication facility. Additionally, medical and industrial isotopes would be shipped from the reactor site to a local airport, and from there to locations throughout the country.

Approximately 37,000 shipments of radioactive materials would be made by DOE. The total distance traveled on public roads by trucks carrying radioactive materials would be 7.9 million kilometers (4.9 million miles); and in the air carrying medical isotopes, 23 million kilometers (14 million miles).

The transportation impact 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 31 person-rem; the dose to the public, 354 person-rem. Accordingly, incident-free transportation of radioactive material associated with this option would result in 0.012 latent cancer fatality among transportation workers and 0.18 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 would be 0.027. About half of the crew risk, about 2 percent of the public risk, and most of the emissions risk would result from shipping medical and industrial isotopes.

**IMPACTS OF ACCIDENTS DURING TRANSPORTATION.** The maximum foreseeable offsite transportation accident under this option (probability of occurrence: 1 in 10 million per year) is a shipment of irradiated neptunium-237 targets to FDFP with a severity Category V accident in an urban population zone under neutral (average) weather conditions. The accident could result in a dose of 0.61 person-rem to the public with an associated  $3.1 \times 10^{-4}$  latent cancer fatality, and 2.6 millirem to the hypothetical maximally exposed individual with a latent cancer fatality risk of  $1.3 \times 10^{-6}$ . No fatalities would be expected to occur. The probability of more severe accidents, different weather conditions at the time of the accident, or occurrence while carrying neptunium-237 (unirradiated) or plutonium-238 was also evaluated and estimated to have a probability of less than 1 in 10 million per year.

Estimates of the total transportation accident risks under this option are as follows: a radiological dose to the population of 1,063 person-rem, resulting in 0.53 latent cancer fatality; and traffic accidents resulting in 0.19 traffic fatality. Nearly all of the radiological and about 58 percent of the traffic accident risk would result from shipping medical and industrial isotopes.

#### 4.6.3.2.12 Environmental Justice

Under this option, neptunium-237 targets would be irradiated in a new reactor that would be constructed at a site yet to be specified. Fabrication and processing of neptunium-237 targets for plutonium-238 production would be performed at FMEF at Hanford. A new support facility would be constructed at an unspecified site for fabrication and processing targets not used for plutonium-238 production.

Activities at FMEF were evaluated under other alternatives and options in this NI PEIS (e.g., Section 4.4.3.1.12) and were found to pose no significant radiological or other risks to minority and low-income populations. The environmental analysis of operations at the new research reactor and support facility site shows that radiological and nonradiological risks to persons residing in the (hypothetical) potentially affected areas would not be significant. Unless there are patterns of food consumption among minority or low-income residents surrounding the actual site (yet to be determined) that would result in a significant ingestion of radiologically contaminated food, it is plausible that operations at the site would pose no significant risks to minority and low-income persons. However, evaluations of environmental justice are necessarily site-specific and cannot be performed in detail for unspecified locations. In the event that this option were selected for implementation and a specific site selected for the new research reactor and support facility, then an additional evaluation of environmental justice at the reactor and support facility site during operation would be performed prior to implementation.

#### **4.6.3.2.13 Waste Management**

The impacts of managing waste generated from the operation of a new research reactor to irradiate targets and a support facility to fabricate and process medical and industrial isotope targets and to meet research and development needs are assumed to be the same as for Option 1 (Section 4.6.1.2.13). 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 4.6.3.2.9 through 4.6.3.2.11.

The impacts of managing waste associated with fabricating and processing neptunium-237 targets for plutonium-238 production in FMEF at Hanford are assumed to be the same as for Option 3 under Alternative 1 (Section 4.3.3.1.13). As shown in that section, the impacts on the waste management systems at Hanford would be minimal.

#### **4.6.3.2.14 Spent Nuclear Fuel Management**

The impacts associated with spent nuclear fuel management under this option would be the same as for Option 1, and are given in Section 4.6.1.2.14.

#### **4.6.3.3 Decontamination and Decommissioning of the Research Reactor and Support Facility**

The environmental impacts associated with the decontamination and decommissioning of the research reactor and support facility at the generic DOE site are assessed in Section 4.6.1.3.

#### **4.6.3.4 Permanent Deactivation of FFTF**

The environmental impacts associated with permanently deactivating FFTF are addressed in Section 4.4.1.2.