4.5 ALTERNATIVE 3—CONSTRUCT NEW ACCELERATOR(S)

Under Alternative 3, one or two new accelerators would be used for target irradiation for the evaluation period of 35 years. The new accelerator(s) which would be constructed at an existing DOE site,[1] would be used to irradiate all of the targets (i.e., for production of plutonium-238, isotopes for medical and industrial uses, and materials testing for 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 high-energy accelerator 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 low-energy accelerator. The targets would be irradiated in the low-energy accelerator and returned to the new support facility for postirradiation processing. Site selection for Alternative 3 is not evaluated as part of this NI PEIS. Because Alternative 3 is evaluated at a generic DOE site, no credit was taken for any support infrastructure existing at the site and it was postulated that a new support facility would be required to support operation of the low-energy accelerator and its missions and the high-energy accelerator civilian nuclear energy research and development missions if both accelerators are located on the same site. While this approach bounds the environmental impact assessment for the implementation of Alternative 3, 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 3 or the low-energy accelerator alone is selected by the Record of Decision for subsequent consideration, follow-on NEPA assessments would evaluate potential locations for either both accelerators or one of the accelerators. It is unlikely that DOE would consider locating the new low-energy or high-energy accelerator on a DOE site that does not have existing infrastructure capable of supporting all or most of the mission requirements. If the accelerator(s) 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 3, 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 3 also would include decontamination and decommissioning of the accelerator(s) and the support facility when the missions are over, as well as deactivation of FFTF at Hanford.

The low-energy accelerator would serve as a dedicated isotope production facility. Due to the nature of this type of accelerator, it could only produce a limited number of isotopes (listed in Table 1–1), has no ability to satisfy the plutonium-238 needs, and a very limited ability to support the proposed nuclear-based research and development needs. The preconceptual design of the high-energy accelerator presented in Appendix F focused on supporting the plutonium-238 production mission. The design of the high-energy accelerator could be refined and expanded to perform additional missions such as the production of a select set of medical and industrial radioisotopes. In addition, DOE is aware of longer-term concepts that would apply high-energy accelerators to produce "tuneable" neutrons in a subcritical assembly. Such a facility could be used to address some of the missions more familiar to reactor facilities and may hold considerable promise for future science

[1] If two accelerators were constructed, they could be located at different sites. However, to bound the environmental impacts at a generic site, the assessments in this section assume their location at a single site.

and technology research. A facility of this nature could provide unique capabilities in areas such as the testing of many different nuclear system coolant, fuel, and material interactions. The changes required to add additional capability to the high-energy accelerator could be provided, but they would increase the size of the facility, add complexity to the facility design and operation, increase the cost of construction and operation, and potentially require more time for design and construction.

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 required for 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 for use in radioisotope power systems for future U.S. space missions. 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 at INEEL. The plutonium-238 product would be transported from INEEL to LANL for use in radioisotope power systems for future U.S. space missions. A new support facility at an existing DOE site would be used to fabricate and process the targets required to produce 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 the 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 high-energy accelerator, the low-energy accelerator, and the support facility because combinations of these facilities may be selected for implementation. This segmentation assists in the selection of facilities from any of the possible combinations.

4.5.1 Alternative 3 (Construct New Accelerator[s])—Option 1

Option 1 involves constructing and operating one or two accelerators 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 conducting 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 neptunium-237 from SRS to ORR and then to the generic site, the transportation of the other target materials to the generic site, and the transportation of plutonium-238 and other product materials following irradiation and postirradiation processing constitute part of this option.

All options under this alternative include the decontamination and decommissioning of the accelerator(s) and support facility at the generic site following their operational lifetimes, and also the permanent deactivation of FFTF at Hanford.

4.5.1.1 Construction of the New Accelerator(s) and Support Facility

The environmental impacts associated with the construction of one or two new accelerators and a support facility at the generic DOE site are assessed in this section. If the accelerator(s) were built on a site with existing support facilities, there would be no impacts associated with constructing a new support facility.

4.5.1.1.1 Land Resources

LAND USE. The construction of a low-energy accelerator, a high-energy accelerator, and a support facility would require 4 hectares (10 acres), 20.2 hectares (50 acres), and 2.4 hectares (6 acres), respectively (TechSource 2000; Herrington 2000; SAIC 2000). Since the exact nature of the construction site for any of these facilities 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 accelerator(s) alternative were selected, tiered NEPA documentation would permit an exact determination of impacts on land use.

VISUAL RESOURCES. Impacts from construction of one or two accelerators and a 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 accelerator(s), the Visual Resource Management rating would remain Class IV. In either case, new facilities may impact the view from offsite 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 accelerator(s) alternative were selected.

4.5.1.1.2 Noise

The construction of high-energy and/or low-energy accelerators 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 would 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 were as large as the existing site traffic. Site-specific analysis would be conducted in tiered NEPA documentation if the accelerator(s) alternative were selected.

The construction of a 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 would 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 were as large as the existing site traffic. Site-specific analysis would be conducted in tiered NEPA documentation if the accelerator(s) alternative were selected.

4.5.1.1.3 Air Quality

High-Energy Accelerator. Construction of the high-energy accelerator would result in an increase in air quality impacts from employee vehicles, trucks, and construction equipment. Criteria pollutant concentrations for construction of the high-energy accelerator were modeled and compared to the most stringent standards (**Table 4–120**). The maximum ground-level concentrations that would result from high-energy accelerator construction would be well below the ambient air quality standards, although concentrations of some pollutants (i.e., PM_{10} and nitrogen oxide) would be relatively high. Therefore, if the accelerator were in an area that already had high background pollutant concentrations, resultant pollutant concentrations could approach or exceed the ambient standards. Regulatory compliance would need to be assessed on a case-by-case basis. Hazardous chemical emissions from construction activities have not been identified.

Table 4–120 Incremental Concentrations Associated with High-Energy Accelerator Construction Under All Options of Alternative 3 (Construct New Accelerator[s])

Pollutant	Averaging Period	Most Stringent Standard or Guideline (microgram per cubic meter)[a]	Modeled Increment (microgram per cubic meter)
Carbon monoxide	8 hours 1 hour	10,000 40,000	436 623
Nitrogen oxide	Annual	100	42
PM_{10}	Annual 24 hours	50 150	3 69
Sulfur dioxide	Annual 24 hours 3 hours	80 365 1,300	3 64 143

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_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to the standard.

Source: Modeled increments are based on SCREEN3 computer code (EPA 1995); data from TechSource 2000.

Modeling was based on a construction area of 100,000 square meters (1,080,000 square feet). The site was modeled as an area source with emissions occurring at a height of 3 meters (9.8 feet). A boundary limit of 3,200 meters (2 miles) was assumed for a generic site.

Low-Energy Accelerator. Given the small size of the low-energy accelerator (about 20 percent of the construction size of the high-energy accelerator), emissions of air pollutants from construction would be very small in comparison with the high-energy accelerator. The maximum ground level concentrations that would result from low-energy accelerator construction would be well below the ambient air quality standards. Nevertheless, regulatory compliance would need to be assessed on a case-by-case basis.

Support Facility for Accelerator(s). Given the small size of the support facility in comparison with the accelerators (about 10 percent of the construction size of the high-energy accelerator), emissions of air pollutants from construction would be very small in comparison with the high-energy accelerator construction. The maximum ground level concentrations that would result from accelerator support facility construction would be 10 percent of the values given in Table 4–120.

4.5.1.1.4 Water Resources

The estimated effects on key water resource indicators associated with constructing the new accelerator(s) and support facility are presented in **Table 4–121.**

Table 4–121 Estimated Water Use and Wastewater Generation Associated with Constructing New Accelerator(s) and Support Facility Under All Options of Alternative 3 (Construct New Accelerator[s])

Indicator (million liters per year)	Accelerators[a]		
	Low-Energy	High-Energy	New Support Facility[a]
Water use	14.0	22.7	14.6
Sanitary wastewater generation	1.5	11.4	3.6

a. These estimates are annualized values based on projected construction/preoperational testing periods for the low-energy accelerator, high-energy accelerator, and new support facility of 3 years, 4.5 years, and 4.5 years, respectively.

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

Source: SAIC 2000; Snead 2000; TechSource 2000.

Water would be expected to be required for such uses as mixing concrete, dust control, washing activities, and for 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). The site selected would use existing infrastructure; nearby wastewater treatment facilities would be used to the extent possible, 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 National Pollutant Discharge Elimination System (NPDES) effluent limitations.

Ground disturbance and runoff from denuded areas could potentially impact surface water quality near construction areas (Section 4.5.1.1.6). 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 (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 accelerator(s) alternative were selected.

4.5.1.1.5 Geology and Soils

Construction of the high-energy accelerator would disturb a total of approximately 20.2 hectares (50 acres) of land, with construction of the low-energy accelerator disturbing about 4 hectares (10 acres) of land (TechSource 2000). Construction of the support facility would disturb an additional 2.4 hectares (6 acres) of land (Herrington 2000; SAIC 2000). Construction 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 1997 provisions (BSSC 1997). In addition, DOE Guide 420.1-2 was recently issued to recognize the consolidation of the three previous U.S. model building codes, including the Uniform Building Code, into the *International Building Code* (ICC 2000). The DOE requirements for seismic engineering have followed the Uniform Building Code, unless the importance of achieving a high level of protection warrants the use of more demanding methods and criteria (DOE Guide 420.1-2). 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 accelerator(s) alternative were selected.

4.5.1.1.6 Ecological Resources

If the accelerator(s) 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. The construction of a low-energy accelerator, a high-energy accelerator, and a support facility would require 4 hectares (10 acres), 20.2 hectares (50 acres), and 2.4 hectares (6 acres), respectively (Herrington 2000; TechSource 2000; SAIC 2000). 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 accelerator(s) 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 the accelerator(s) and a 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. The construction of one or two accelerators and a 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.

4.5.1.1.7 Cultural and Paleontological Resources

The construction of a low-energy accelerator, a high-energy accelerator, and a support facility would require 4 hectares (10 acres), 20.2 hectares (50 acres), and 2.4 hectares (6 acres), respectively (SAIC 2000; TechSource 2000). Since the exact nature of the construction site for any of these facilities 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 accelerator(s) 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*.

4.5.1.1.8 Socioeconomics

It is estimated that 410 workers would be needed to construct the new accelerator(s) and a support facility at a generic DOE site during the peak year of construction. The impact from 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 new accelerator(s) and a support facility would vary greatly. Therefore, if DOE were to select the new accelerator(s) alternative, additional NEPA documentation would be required to select the specific DOE site to locate the new accelerator(s) and support facility. In that document, DOE would perform a thorough evaluation of the socioeconomic impacts of the sites under consideration.

4.5.1.1.9 Public and Occupational Health and Safety—Normal Construction Activities

Assessments of incremental radiological and chemical impacts associated with the construction of the new accelerator(s) and support facility are presented in this section. Supplemental information is provided in Appendix H.

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 which 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 for construction activities. The painting activities would result in very small emissions of noncarcinogenic chemicals, which would produce minimal impact. Therefore, minimal hazardous chemical impacts are associated with construction.

4.5.1.1.10 Public and Occupational Health and Safety—Construction Accidents

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

4.5.1.1.11 Environmental Justice

Environmental effects due to construction activities that would be expected to occur at an unspecified accelerator(s) and support facility site are addressed in Section 4.5.1.1. The analysis 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 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 accelerator(s) and support facility, an additional evaluation of environmental justice at the accelerator(s) and support facility site during construction would be performed prior to implementation.

4.5.1.1.12 Waste Management

The expected generation rates of waste at a generic DOE site that would be associated with the construction of new accelerator(s) 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 4–122**. 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 alterative were chosen, and appropriate NEPA documentation would be prepared.

Table 4–122 Estimated Waste Generation Associated with Constructing New Accelerator(s) and Support Facility Under All Options of Alternative 3 (Construct New Accelerator[s])

Waste Type[a]	Estimated Waste Generation for New Accelerator(s) (total cubic meters)		Estimated Waste Generation for New Support Facility (total cubic meters)
	Low-Energy	High-Energy	
High-level radioactive	0	0	0
Transuranic	0	0	0
Low-level radioactive			
Liquid	0	2	0
Solid	0	115	0
Mixed low-level radioactive	0	6	0
Hazardous			
Liquid	0	4	1
Solid	0	7	3
Nonhazardous			
Process wastewater	0	0	0
Sanitary wastewater	4,500	51,000	16,000
Solid	500	3,900	650

a. See definitions in Section G.9.
Note: To convert from cubic meters to cubic yards, multiply by 1.308.
Source: SAIC 2000; TechSource 2000.

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 4.5.1.1.9 through 4.5.1.1.10.

4.5.1.2 Operations and Transportation

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

4.5.1.2.1 Land Resources

Land Use. The operation of one or two accelerators and a 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.

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 one or two accelerators and a 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 accelerator(s) 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.

4.5.1.2.2 Noise

The operation of high-energy and/or low-energy accelerators 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 were within one of the larger DOE sites and were more centrally located within the site, offsite noise impacts from operation would 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 accelerator(s) alternative were selected.

The operation of a 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 were within one of the larger DOE sites and were more centrally located within the site, offsite noise impacts from operation would 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 accelerator(s) 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 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 the ORR as a result of changes in employee and truck traffic levels.

4.5.1.2.3 Air Quality

High-Energy Accelerator. The operation of a new high-energy accelerator would result in some increase in air quality impacts due to the operation of emergency diesel generators. Criteria pollutants were modeled and compared to the most stringent standards (**Table 4–123**). The maximum ground-level pollutant concentrations that would result from high-energy accelerator operation would be well below the ambient air quality standards. However, if the accelerator is 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 4.5.1.2.9.

Table 4–123 Incremental Concentrations Associated with High-Energy Accelerator Operation[a] Under Alternative 3 (Construct New Accelerator[s])—Option 1

Pollutant	Averaging Period	Most Stringent Standard or Guideline (microgram per cubic meter)[b]	Modeled Increment (microgram per cubic meter)
Carbon monoxide	8 hours 1 hour	10,000 40,000	94 135
Nitrogen oxide	Annual	100	0.47
PM_{10}	Annual 24 hours	50 150	0.03 17.7
Sulfur dioxide	Annual 24 hours 3 hours	80 365 1,300	0.03 16.5 37.2

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_{10} 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); TechSource 2000.

Modeling was based on design consideration of two emergency diesel generators. These were modeled as a point source with emissions occurring at a stack height of 3 meters (9.8 feet). A boundary limit of 3,200 meters (2 miles) was assumed for a generic site.

Air quality impacts at ORR from target fabrication and processing associated with this option were determined to be the same as described for Alternative 2, Option 1 (Section 4.4.1.1.3).

Low-Energy Accelerator. The operation of a low-energy accelerator would not require emergency diesel generators. Thus, there would be no increase in air quality impacts due to the operation of the low-energy accelerator.

Support Facility for Accelerator(s). The operation of the support facility would result in air pollutant emissions similar to FMEF operating in support of FFTF. Thus, there would be an increase in air quality impacts that would be assessed and appropriate NEPA documentation prepared if this option were selected for implementation.

4.5.1.2.4 Water Resources

The estimated effects on key water resource indicators associated with operating the new accelerator(s) and support facility are presented in **Table 4–124.** Operation of the high-energy accelerator at a generic DOE site would have the highest estimated water demand of any facility considered, requiring 1,904 million liters (503 million gallons) of water per year. In general, water would be required by the high-energy accelerator and other facilities to support such uses as process cooling, material processing, and potable and sanitary needs with the high water use of the high-energy accelerator attributable to cooling tower operation. 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 (particularly the high-energy accelerator) directly or to provide increased production capacity for the generic site's existing supply system.

Table 4–124 Estimated Water Use and Wastewater Generation Associated with Operating Accelerator(s) and Support Facility Under Alternative 3 (Construct New Accelerator[s])—Option 1

Indicator (million liters per year)	Accelerators		
	Low-Energy	High-Energy	New Support Facility
Water use	1.9	1,904	6.92
Process wastewater generation	0	284	0.016[a]
Sanitary wastewater generation	0.9	11.4	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: SAIC 2000; TechSource 2000.

The operation of the high-energy accelerator is estimated to generate approximately 284 million liters (75 million gallons) of process wastewater per year. This process effluent would mainly consist of cooling tower blowdown. The operation of the low-energy accelerator would not generate process wastewater as process cooling water would be recirculated within a closed-loop system. The support facility would generate a very small quantity of process wastewater mainly as a result of material processing. There would be no radiological liquid effluent discharge to the environment under normal operations. Sanitary wastewater would be generated as a result of operation of the accelerator(s) 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 4.5.1.2.13. 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 accelerator(s) 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.

4.5.1.2.5 Geology and Soils

The operation of the accelerator(s) 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 accelerator(s) alternative were selected, impacts on geology and soils would be determined in tiered NEPA documentation. As discussed in Section 4.5.1.1.5, 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 will be assessed in accordance with DOE Order 420.1, which is described in Section 4.2.1.2.5.

4.5.1.2.6 Ecological Resources

If the accelerator(s) 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 accelerator(s) 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 one or two accelerators and a 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 water body. 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 onsite 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 because 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 on site and facility specific information.

Threatened and Endangered Species. The operation of one or two accelerators and a 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 4.5.1.2.2, wildlife would not be adversely affected by noise associated with facility operation. 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 4.5.1.2.4). No threatened and endangered species have been identified within the 7900 Area; therefore, operational impacts on this resource are not expected.

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.

4.5.1.2.7 Cultural and Paleontological Resources

Impacts on cultural and paleontological resources from the operation of one or two accelerators and a 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 the accelerator(s) 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 affect 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.

4.5.1.2.8 Socioeconomics

It is estimated that 325 workers would be needed to operate the new accelerator(s) and support facility at a generic DOE site. The impact from 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 accelerator 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.

4.5.1.2.9 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 4–125** 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. The projected number of latent cancer fatalities in the surrounding population and the latent cancer fatality risk to the maximally and average exposed individuals are also presented in the table.

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

Table 4–125 Incremental Radiological Impacts on the Public Around the Generic DOE Site and ORR from Operational Facilities Under Alternative 3 (Construct New Accelerator[s])—Option 1

Receptor	ORR REDC	Accelerators Preoperational Startup[a]		Generic Site Operations				Two-Site Total
		Low-Energy	High-Energy	Accelerators Low-Energy	Accelerators High-Energy	Accelerator(s) Support Facility	Total	
Population within 80 kilometers (50 miles) in the year 2020								
Dose (person-rem)	8.8×10^{-5}	0.0024	0.035	0.0043	0.055	0.14	0.20	0.20
35-year latent cancer fatalities	1.5×10^{-6}	2.4×10^{-6}(b)	3.5×10^{-5}(b)	7.5×10^{-5}	9.6×10^{-4}	0.0025	0.0035	0.0035
Maximally exposed individual								
Annual dose (millirem)	1.9×10^{-6}	1.4×10^{-5}	1.8×10^{-4}	1.1×10^{-4}	8.7×10^{-4}	0.0025	0.0035	NA[c]
35-year latent cancer fatality risk	3.3×10^{-11}	1.4×10^{-11}(b)	1.8×10^{-10}(b)	1.9×10^{-9}	1.5×10^{-8}	4.4×10^{-8}	6.1×10^{-8}	NA[c]
Average exposed individual within 80 kilometers (50 miles)								
Annual dose[d] (millirem)	7.8×10^{-8}	1.6×10^{-6}	2.3×10^{-5}	2.8×10^{-6}	3.6×10^{-5}	9.1×10^{-5}	1.3×10^{-4}	NA[c]
35-year latent cancer fatality risk	1.4×10^{-12}	1.6×10^{-12}(b)	2.3×10^{-11}(b)	4.9×10^{-11}	6.3×10^{-10}	1.6×10^{-9}	2.3×10^{-9}	NA[c]

a. For conservatism as well as consistency with other radiological impacts evaluated in this NI PEIS, these values were assessed for the year 2020 even though these activities would commence prior to that year.
b. Preoperational activities last 2 years. Number is a 2-year latent cancer fatality risk.
c. A "Total" cannot be given in this case because the same individual cannot be located at two different sites simultaneously.
d. 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: SAIC 2000; TechSource 2000; model results, using the GENII computer code (Napier et al. 1988).

As a result of annual operations of the accelerator facilities (a high-energy accelerator, a low-energy accelerator, and an accelerator support facility) and REDC, the projected incremental total population dose in the year 2020 would be 0.20 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 0.0035. The incremental total dose to the maximally exposed member of the public from annual operations of the accelerator(s) and support facility at the generic site would be 0.0035 millirem; from 35 years of operations, the corresponding risk of a latent cancer fatality to this individual would be 6.1×10^{-8}. Estimated annual risks are also presented for preoperational testing and startup phase activities anticipated for the accelerator(s) and support facility. The incremental dose to the maximally exposed member of the public from annual REDC operations would be 1.9×10^{-6} millirem; from 35 years of operations, the corresponding risk of a latent cancer fatality to this individual would be 3.3×10^{-11}.

Incremental doses to involved workers from normal operations are given in **Table 4–126**; these workers are defined as those directly associated with all process activities. The incremental annual average dose to the high-energy and low-energy accelerator workers during startup and operations would be 150 millirem; for support facility workers, the incremental annual average dose 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 30 (high-energy accelerator startup and operation), 15 (low-energy accelerator startup and operation), 11 (support facility operation), and 12 person-rem (REDC operation). The risks and numbers of latent cancer fatalities among the different workers from 35 years of operations are included in Table 4–126. Doses to individual workers would be kept to minimal levels by instituting badged monitoring and ALARA programs.

Table 4–126 Incremental Radiological Impacts on Involved Workers at the Generic DOE Site and ORR from Operational Facilities Under Alternative 3 (Construct New Accelerator[s])—Option 1

Receptor—Involved Workers[a]	ORR REDC	Accelerators Preoperational Startup		Generic Site Operations			Two-Site Total
				Accelerators		Accelerator(s) Support Facility	
		Low-Energy	High-Energy	Low-Energy	High-Energy		
Total dose (person-rem per year)	12[b]	23[b]	45[b]	15[b]	30[b]	11[b]	69
35-year latent cancer fatalities	0.17	0.018[c]	0.036[c]	0.21	0.42	0.16	0.96
Average worker dose (millirem per year)	170	150	150	150	150	114	NA[d]
35-year latent cancer fatality risk	0.0023	1.2×10^{-4}(c)	1.2×10^{-4}(c)	0.0021	0.0021	0.0016	NA[d]

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 facilities adopt a more limiting, 500 millirem per year, Administrative Control Level (DOE 1999j). To reduce doses to levels that are as low as is reasonably achievable (ALARA), an effective ALARA program would be enforced.

b. Based on an estimated 75 badged workers at ORR REDC, 90 radiological workers (and 100 total workers) at the accelerator(s) support facility, 200 workers at the high-energy accelerator (300 during startup), and 100 workers at the low-energy accelerator (150 during startup).

c. Preoperational startup testing lasts 2 years. Number is a 2-year latent cancer fatality risk.

d. 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: DOE 1999b; Nielsen 1999; Wham 1999b, 2000.

HAZARDOUS CHEMICALS IMPACTS

High-Energy Accelerator. The operation of a high-energy accelerator would result in some increase in emissions of hazardous chemicals from diesel fuel burning equipment used for operation. The operation of the accelerator would require the emergency diesel generators to be tested approximately 1 hour each month and 12 hours once a year to ensure operability. Chemical releases were modeled based on 48 hours of operation. The source was modeled as a point source with emissions occurring at a stack height of 3 meters (9.8 feet). A boundary limit of 3,200 meters (2 miles) was assumed for a generic site. Resulting concentrations were determined to be very small and would have no incremental impact on the current conditions at the site (**Table 4–127**).

Hazardous chemical impacts at ORR from target fabrication and processing associated with this option were determined to be the same as described in Option 1 under Alternative 2 (Section 4.4.1.1.9).

Low-Energy Accelerator. The operation of a low-energy accelerator would not require emergency diesel generators. Thus, there would be no increase in hazardous chemical impacts due to the operation of the low-energy accelerator.

Support Facility for Accelerator(s). The operation of the support facility would result in air pollutant emissions similar to FMEF operating in support of FFTF. Thus, there would be an increase in hazardous chemical impacts that would be assessed and appropriate NEPA documentation prepared if this option were selected for implementation.

Table 4–127 Incremental Hazardous Chemical Impacts on the Public Around a Generic Site from High-Energy Accelerator Operation Under Alternative 3 (Construct New Accelerator[s])—Option 1

Chemicals	Modeled Annual Increment (microgram per cubic meter)	RfC (microgram per cubic meter)	Unit Cancer Risk (Risk per Microgram per cubic meter)	Hazard Quotient	Cancer Risk
Acetaldehyde	0.0000811	NA	2.20×10^{-6}	NA	1.79×10^{-10}
Benzene	0.0000987	NA	7.80×10^{-6}	NA	7.70×10^{-10}
Formaldehyde	0.000125	NA	1.30×10^{-5}	NA	1.62×10^{-9}
Toluene	0.0000433	400	NA	1.08×10^{-7}	NA
Propylene	0.000273	NA	3.70×10^{-6}	NA	1.01×10^{-9}

Note: Propylene oxide cancer unit was used for propylene.
Key: RfC, Reference concentration; NA, not applicable; The chemical is not a known carcinogen, or it is a carcinogen and only unit cancer will apply.
Source: Data from TechSource 2000; EPA 1999; modeled increments are based on the SCREEN3 computer code (EPA 1995).

4.5.1.2.10 Public and Occupational Health and Safety—Facility Accidents

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

Consequences and associated risks are presented in **Tables 4–128** and **4–129**, respectively.

For 35 years of high-energy accelerator target irradiation, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be 2.05×10^{-6} and 5.15×10^{-5}, respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.0063.

For 35 years of low-energy accelerator target irradiation, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be 2.45×10^{-9} and 3.07×10^{-8}, respectively. The increased number of latent cancer fatalities in the surrounding population would be 3.66×10^{-5}.

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

For 35 years of neptunium-237 target fabrication and processing at REDC, the increased risk of a latent cancer fatality to the maximally exposed individual and of an early fatality to a noninvolved worker would be 5.71×10^{-5} and 3.50×10^{-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 9.18×10^{-5} and 5.00×10^{-4}, respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.219.

Table 4–128 New Accelerator(s), Support Facility, and REDC Accident Consequences Under Alternative 3 (Construct New Accelerator[s])—Option 1

Accident	Maximally Exposed Individual		Population to 80 kilometers (50 miles)		Noninvolved Worker	
	Dose (rem)	Latent Cancer Fatality[a]	Dose (person-rem)	Latent Cancer Fatalities[b]	Dose (rem)	Latent Cancer Fatality[a]
High-energy accelerator accidents						
Design-basis target accident	2.93×10^{-4}	1.47×10^{-7}	0.980	4.90×10^{-4}	9.35×10^{-4}	3.74×10^{-7}
Beyond-design-basis earthquake	11.7	0.00585	3.01×10^{4}	18	184	0.147
Low-energy accelerator accidents						
Design-basis target accident	8.05×10^{-5}	4.03×10^{-8}	17.7	0.00885	0.00112	4.48×10^{-7}
Beyond-design-basis earthquake	0.0132	6.60×10^{-6}	32.4	0.0162	0.208	8.32×10^{-5}
Support facility accidents						
Medical and industrial isotopes localized solvent fire	0.0194	9.72×10^{-6}	31.1	0.0156	0.00530	2.12×10^{-6}
Medical and industrial isotopes unlikely seismic event	0.0750	3.75×10^{-5}	136	0.0680	0.510	2.04×10^{-4}
Medical and industrial isotopes glovebox explosion	2.50	0.00125	4,600	2.30	17.0	0.00680
REDC accidents						
Ion exchange explosion during neptunium-237 target fabrication	6.13×10^{-9}	3.06×10^{-12}	8.58×10^{-5}	4.29×10^{-8}	5.60×10^{-10}	$2.24x0^{-13}$
Target dissolver tank failure during plutonium-238 separation	1.76×10^{-7}	8.79×10^{-11}	0.00196	9.82×10^{-7}	1.69×10^{-8}	6.74×10^{-12}
Ion exchange explosion during plutonium-238 separation	4.68×10^{-4}	2.34×10^{-7}	5.23	0.00261	4.49×10^{-5}	1.79×10^{-8}
Processing facility beyond-design-basis earthquake	163	0.163	8.91×10^{5}	445	1,310	1.00[c]

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 4–129 New Accelerator(s), Support Facility, and REDC Accident Risks Under Alternative 3 (Construct New Accelerator[s])—Option 1

Accident (Frequency)	Maximally Exposed Individual[a]	Population to 80 Kilometers (50 Miles)[b]	Noninvolved Worker[a]
Annual high-energy accelerator risks			
Design basis target accident (1×10^{-4})	1.47×10^{-11}	4.90×10^{-8}	3.74×10^{-11}
Beyond-design-basis earthquake (1×10^{-5})	5.85×10^{-8}	1.80×10^{-4}	1.47×10^{-6}
35-year high-energy accelerator risk	2.05×10^{-6}	0.00630	5.15×10^{-5}
Annual low-energy accelerator risks			
Design basis target accident (1×10^{-4})	4.03×10^{-12}	8.85×10^{-7}	4.48×10^{-11}
Beyond-design-basis earthquake (1×10^{-5})	6.60×10^{-11}	1.62×10^{-7}	8.32×10^{-10}
35-year low-energy accelerator risk	2.45×10^{-9}	3.66×10^{-5}	3.07×10^{-8}
Annual support facility risks			
Medical and industrial isotopes localized solvent fire (0.044)	4.32×10^{-7}	6.91×10^{-4}	9.41×10^{-8}
Medical and industrial isotopes unlikely seismic event (0.01)	3.75×10^{-7}	6.80×10^{-4}	2.04×10^{-6}
Medical and industrial isotopes glovebox explosion (1.00×10^{-4})	1.25×10^{-7}	2.30×10^{-4}	6.80×10^{-7}
35-year support facility risk	3.26×10^{-5}	0.056	9.85×10^{-5}
Annual REDC risks			
Ion exchange explosion during neptunium-237 target fabrication (0.01)	3.06×10^{-14}	4.29×10^{-10}	2.24×10^{-15}
Target dissolver tank failure during plutonium-238 separation (0.01)	8.79×10^{-13}	9.82×10^{-9}	6.74×10^{-14}
Ion exchange explosion during plutonium-238 separation (0.01)	2.34×10^{-9}	2.61×10^{-5}	1.79×10^{-10}
Processing facility beyond-design-basis earthquake (1×10^{-5})	1.63×10^{-6}	0.00445	1.00×10^{-5}[(c)]
35-year REDC risk	5.71×10^{-5}	0.157	3.50×10^{-4}[(c)]
35-year Option risk	9.18×10^{-5}	0.219	5.00×10^{-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 accelerator(s) or new support facility. The irradiation of neptunium-237, medical, industrial, and research and development isotopes in the new accelerator(s) 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.

4.5.1.2.11 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 accelerator(s) site. Following irradiation in the accelerator(s), the targets would be returned to REDC for processing. After this processing, the plutonium-238 product would be shipped to LANL. Additionally, medical and industrial isotopes would be shipped from the accelerator(s) 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 in support of the low-energy accelerator. The total distance traveled on public roads by trucks carrying radioactive materials would be 4.8 million kilometers (3.0 million miles); and in the air carrying medical and industrial isotopes, 23 million kilometers (14 million miles).

Approximately 269 shipments of radioactive materials would be made by DOE in support of the high-energy accelerator. The total distance traveled on public roads by trucks carrying radioactive materials would be 0.94 million kilometers (0.59 million miles).

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

IMPACTS OF INCIDENT-FREE TRANSPORTATION FOR THE LOW-ENERGY ACCELERATOR. The dose to transportation workers from all transportation activities entailed by this option has been estimated at 15 person-rem; the dose to the public, 7 person-rem. Accordingly, incident-free transportation of radioactive material associated with this option would result in 0.0059 latent cancer fatality among transportation workers and 0.0037 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 0.02.

IMPACTS OF INCIDENT-FREE TRANSPORTATION FOR THE HIGH-ENERGY ACCELERATOR. The dose to transportation workers from all transportation activities entailed by this option has been estimated at 5 person-rem; the dose to the public, 101 person-rem. Accordingly, incident-free transportation of radioactive material associated with this option would result in 0.0020 latent cancer fatality among transportation workers and 0.050 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 0.0022.

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

Estimates of the total ground transportation accident risks under this option are as follows: a radiological dose to the population of 1,063 person-rem, resulting in 0.53 latent cancer fatality; and traffic accidents resulting 0.11 traffic fatality.

IMPACTS OF ACCIDENTS DURING TRANSPORTATION FOR THE HIGH-ENERGY ACCELERATOR. 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 3.1×10^{-4} latent cancer fatality, and 2.6 millirem to the hypothetical maximally exposed individual with a latent cancer fatality risk of 1.3×10^{-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 0.16 person-rem, resulting in 8.1×10^{-5} latent cancer fatality; and traffic accidents resulting in 0.025 traffic fatality.

4.5.1.2.12 Environmental Justice

Under this option, neptunium-237 targets would be irradiated in one or two new accelerators 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 the same 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 accelerator(s) 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 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 specified site selected for the new accelerator(s) and support facility, an additional evaluation of environmental justice at the accelerator(s) and support facility site during operation would be performed prior to implementation.

4.5.1.2.13 Waste Management

The expected annual generation of waste that would be generated from the operation of new accelerator(s) 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 4–130**. 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 4.5.1.2.9 through 4.5.1.2.11.

In accordance with 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 accelerator(s) or from target fabrication or processing in the new support facility.

Table 4–130 Estimated Waste Generation Rates of Operating New Accelerator(s) and Support Facility Under Alternative 3 (Construct New Accelerator[s])—Option 1

Waste Type[a]	Estimated Waste Generation for New Accelerator(s) (cubic meters per year)		Estimated Waste Generation for New Support Facility (cubic meters per year)
	Low-Energy	High-Energy	
High-level radioactive	0	0	0
Transuranic	0	0	0
Low-level radioactive			
Liquid	0	1	0
Solid	5	54	20
Mixed low-level radioactive	0.20	3	4
Hazardous	0.10	2	<1
Nonhazardous			
Process wastewater	0	280,000	16[b]
Sanitary wastewater	910	11,300	6,900
Solid	8	31	80

a. See definitions in Section G.9.
b. Assume process wastewater generated at the same incremental rate as the Hanford 300 Area facilities (RPL/306–E).
Note: To convert from cubic meters to cubic yards, multiply by 1.308, < mean "less than."
Source: SAIC 2000; TechSource 2000.

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. An estimated 35 cubic meters (46 cubic yards) of liquid low-level radioactive waste and 2,100 cubic meters (2,750 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 accelerator(s). 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, an estimated 110 cubic meters (140 cubic yards) of mixed low-level radioactive waste would be generated as a result of target irradiation at the new accelerator(s). 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 74 cubic meters (97 cubic yards) of hazardous waste would be generated during the 35-year operational period at the accelerator(s) 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 9.8 million cubic meters (12.8 million cubic yards) of process wastewater, 427,000 cubic meters (558,000 cubic yards) of sanitary wastewater, and 1,400 cubic meters (1,800 cubic yards) of solid nonhazardous waste would be generated as a result of target irradiation at the new accelerator(s). 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 small.

4.5.1.3 Decontamination and Decommissioning of the Accelerator(s) and Support Facility

The environmental impacts associated with the decontamination and decommissioning of the accelerator(s) and support facility at the generic DOE site are assessed in this section. If the accelerator(s) were built on a site with existing support facilities, there would be no impacts associated with decommissioning a "new" support facility.

4.5.1.3.1 Land Resources

LAND USE. Decontamination and decommissioning of the accelerator(s) and a 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 the accelerator(s) and a 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.

4.5.1.3.2 Noise

Decontamination and decommissioning of the high-energy and/or low-energy accelerators 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 accelerator(s) and support facility location were within one of the large

DOE sites and were more centrally located within the site, offsite noise impacts from decontamination and decommissioning 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 accelerator(s) alternative were selected.

4.5.1.3.3 Air Quality

The potential for air quality impacts due to decommissioning and deactivation of the accelerator(s) and support facility would not be expected to be any higher than those associated with their construction and operation. Some decrease in air quality impacts may occur when generators and pumps supporting operations of the accelerator(s) are shut down.

4.5.1.3.4 Water Resources

Decontamination and decommissioning of the accelerator(s) 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 284 million liters (75 million gallons) of nonradioactive process wastewater from the high-energy accelerator and 0.016 million liters (0.004 million gallons) from the support facility to onsite treatment facilities. Also, the discharge of sanitary wastewater to onsite treatment facilities would be eliminated, including 11.4 million liters (3 million gallons) per year from the high-energy accelerator, 0.9 million liters (0.24 million gallons) from the low-energy accelerator, and 6.91 million liters (1.82 million gallons) annually from the support facility. The effects of decontamination and decommissioning on waste management are further detailed in Section 4.5.1.3.13. Site water withdrawals to supply the facilities would also be reduced by an estimated 1,904 million liters (503 million gallons) per year for the high-energy accelerator, 1.9 million liters (0.50 million gallons) for the low-energy accelerator, and 6.92 million liters (1.83 million gallons) annually for the support facility (SAIC 2000; TechSource 2000).

4.5.1.3.5 Geology and Soils

No major structures would be demolished to effect decontamination and decommissioning of the accelerator(s) 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 accelerator(s) and support facility, with the impact on geologic and soil resources expected to be negligible overall.

4.5.1.3.6 Ecological Resources

Since no major structures would be demolished during the decontamination and decommissioning of the accelerator(s) and a 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 the accelerator(s) 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 the accelerator(s) 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 the accelerator(s) 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.

4.5.1.3.7 Cultural and Paleontological Resources

Decontamination and decommissioning of the accelerator(s) and a support facility would not change the status of cultural and paleontological resources. This is because any required ground disturbance would be confined to previously disturbed areas immediately adjacent to the accelerator(s) and support facility.

4.5.1.3.8 Socioeconomics

Decommissioning of the accelerator(s) 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. Therefore, if DOE were to select the new accelerator(s) alternative, additional NEPA documentation would be required to evaluate the specific socioeconomic impacts of decommissioning.

4.5.1.3.9 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 accelerator(s) 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 *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.” In the same NUREG, NRC also concluded that the public health impact from radiological releases associated with the decommissioning and decontamination of the research reactor support facility was also “negligible.” Decommissioning and decontamination of the accelerator(s) and support facility would involve less radioactive materials and thus less radioactive emissions, than those associated with the research reactor and support facility. Based on these conclusions, the environmental impact on the public health and safety from the routine release of radionuclides during the decontamination and decommissioning of the accelerator(s) and 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 4–131**; 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 accelerator(s) would be 160 millirem; for support facility workers, the incremental annual average dose during decontamination and decommissioning operations would be 100 millirem. The incremental annual dose received by the total site workforce for each of these facilities is estimated to be 17 (total for both accelerators) and 4 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 4–131; a probability coefficient of 4×10^{-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 4–131 Incremental Radiological Impacts on Involved Workers at the Generic DOE Site from Accelerator(s) and Support Facility Decontamination and Decommissioning Activities Under All Options of Alternative 3 (Construct New Accelerator[s])

Receptor—Involved Workers[a]	Generic Site Decontamination and Decommissioning Activities			
	Accelerators		Accelerator(s) Support Facility	Total
	Low-Energy	High-Energy		
Total dose (person-rem per year)	5.6[b]	11[b]	4[b]	21
1-year latent cancer fatalities	0.0022	0.0045	0.0016	0.0083
Average worker dose (millirem per year)	160	160	100	143
1-year latent cancer fatality risk	6.5×10^{-5}	6.5×10^{-5}	0.0004	5.7×10^{-5}

a. The radiological limit for an individual worker is 5,000 millirem per year (10 CFR Part 835). However, the maximum dose to a worker involved with operations would be kept below the DOE Administrative Control Level of 2,000 millirem per year (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 105 badged workers at the accelerator(s) (35 at low-energy and 70 at high-energy) and 40 badged workers at the support facility.

Source: Calculational results.

HAZARDOUS CHEMICAL IMPACTS. No additional hazardous chemical release is expected from activities associated with decontamination and decommissioning the accelerator(s) and its support facility.

4.5.1.3.10 Public and Occupational Health and Safety—Decontamination and Decommissioning Accidents

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

4.5.1.3.11 Environmental Justice

Environmental effects due to decontamination and decommissioning activities that would be expected to occur at an unspecified accelerator(s) and support facility site are addressed in Section 4.5.1.3. The environmental analysis of decontamination and decommissioning activities at the new accelerator(s) 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 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 accelerator(s) and support facility, an additional evaluation of environmental justice at the accelerator(s) and support facility site during decontamination and decommissioning would be performed prior to implementation.

4.5.1.3.12 Waste Management

The decontamination and decommissioning of the new accelerator(s) and support facility could 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 were developed, DOE would undertake any additional NEPA analysis that may be necessary or appropriate.

4.5.1.4 Permanent Deactivation of FFTF

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

4.5.2 Alternative 3 (Construct New Accelerator[s])—Option 2

Option 2 involves constructing and operating one or two accelerators 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 conducting 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 neptunium-237 from SRS to INEEL and then to the generic site, the transportation of the other target materials to the generic site, and the transportation of plutonium-238 and other product materials following irradiation and postirradiation processing constitute part of this option.

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

4.5.2.1 Construction of the New Accelerator(s) and Support Facility

The environmental impacts associated with the construction of one or two new accelerators and a support facility at the generic DOE site are assessed in Section 4.5.1.1.

4.5.2.2 Operations and Transportation

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

4.5.2.2.1 Land Resources

LAND USE. Impacts on land use associated with the operation of one or two accelerators and a support facility are addressed in Section 4.5.1.2.1.

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 one or two accelerators and a support facility are addressed in Section 4.5.1.2.1.

All activities associated with neptunium-237 storage would take place within Building CPP–651 and/or FDPF, and target fabrication and processing would be 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 designation of INTEC. This is because none of the anticipated operational impacts (e.g., air emissions) would be expected to affect this resource.

4.5.2.2.2 Noise

Noise impacts associated with the operation of the accelerator(s) and support facility are addressed in Section 4.5.1.2.2.

This option also involves using 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 these facilities 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 result in a minimal change in noise impacts on people near the INEEL as a result of changes in employee and truck traffic levels.

4.5.2.2.3 Air Quality

Air quality impacts associated with the operation of the accelerator(s) and support facility are addressed in Section 4.5.1.2.3.

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 4.5.2.2.11.

4.5.2.2.4 Water Resources

Impacts on water resources associated with the operation of the accelerator(s) and support facility are addressed in Section 4.5.1.2.4.

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.

4.5.2.2.5 Geology and Soils

Impacts on geology and soils associated with the operation of the accelerator(s) and support facility are addressed in Section 4.5.1.2.5. As discussed in Section 4.5.1.1.5, 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, at INEEL. 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 will be assessed in accordance with DOE Order 420.1, which is described in Section 4.2.1.2.5.

4.5.2.2.6 Ecological Resources

Impacts on ecological resources associated with the operation of one or two accelerators and a support facility are addressed in Section 4.5.1.2.6.

Building CPP–651 and/or FDPF would be used for neptunium-237 storage, and FDPF for target fabrication and processing. As noted in Section 4.5.2.2.2, there would be little 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 4.5.2.2.4). 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.

4.5.2.2.7 Cultural and Paleontological Resources

Impacts on cultural and paleontological resources associated with the operation of one or two accelerators and a support facility are addressed in Section 4.5.1.2.7.

Although six historic structures are associated with INTEC, their status would not be affected by the 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 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.

4.5.2.2.8 Socioeconomics

The socioeconomic impacts associated with the operation of the accelerator(s) and support facility at a generic DOE site are addressed in Section 4.5.1.2.8.

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

4.5.2.2.9 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 4–132** for the generic DOE accelerator(s) 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. The projected number of latent cancer fatalities in the surrounding population and the latent cancer fatality risk to the maximally and average exposed individuals are also presented in the table.

Table 4–132 Incremental Radiological Impacts on the Public Around the Generic DOE Site and INEEL from Operational Facilities Under Alternative 3 (Construct New Accelerator[s])—Option 2

Receptor	INEEL FDPF	Accelerators Preoperational Startup[a]		Generic Site Operations				Two-Site Total
				Accelerators		Accelerator(s) Support Facility	Total	
		Low-Energy	High-Energy	Low-Energy	High-Energy			
Population within 80 kilometers (50 miles) in the year 2020								
Dose (person-rem)	3.9×10^{-6}	0.0024	0.035	0.0043	0.055	0.14	0.20	0.20
35-year latent cancer fatalities	6.7×10^{-8}	2.4×10^{-6}(b)	3.5×10^{-5}(b)	7.5×10^{-5}	9.6×10^{-4}	0.0025	0.0035	0.0035
Maximally exposed individual								
Annual dose (millirem)	2.6×10^{-7}	1.4×10^{-5}	1.8×10^{-4}	1.1×10^{-4}	8.7×10^{-4}	0.0025	0.0035	NA[c]
35-year latent cancer fatality risk	4.6×10^{-12}	1.4×10^{-11}(b)	1.8×10^{-10}(b)	1.9×10^{-9}	1.5×10^{-8}	4.4×10^{-8}	6.1×10^{-8}	NA[c]
Average exposed individual within 80 kilometers (50 miles)								
Annual dose[d] (millirem)	2.0×10^{-8}	1.6×10^{-6}	2.3×10^{-5}	2.8×10^{-6}	3.6×10^{-5}	9.1×10^{-5}	1.3×10^{-4}	NA[c]
35-year latent cancer fatality risk	3.6×10^{-13}	1.6×10^{-12}(b)	2.3×10^{-11}(b)	4.9×10^{-11}	6.3×10^{-10}	1.6×10^{-9}	2.3×10^{-9}	NA[c]

a. For conservatism as well as consistency with other radiological impacts evaluated in this NI PEIS, these values were assessed for the year 2020 even though these activities would commence prior to that year.
b. Preoperational activities last 2 years. Number is a 2-year latent cancer fatality risk.
c. A "Total" cannot be given in this case because the same individual cannot be located at two different sites simultaneously.
d. 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: SAIC 2000; TechSource 2000; model results, using the GENII computer code (Napier et al. 1988).

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

As a result of annual operations of the accelerator facilities (a high-energy accelerator, a low-energy accelerator, and a support facility) and FDPF, the projected incremental total population dose in the year 2020 would be 0.20 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 0.0035. The incremental total dose to the maximally exposed member of the public from annual operations of the accelerator(s) and support facility at the generic DOE site would be 0.0035 millirem; from 35 years of operations, the corresponding risk of a latent cancer fatality to this individual would be 6.1×10^{-8}. Estimated annual risks are also presented for pre-operational testing/startup phase activities anticipated for the accelerator(s) and support facility. The incremental dose to the maximally exposed member of the public from annual FDPF operations would be 2.6×10^{-7} millirem; from 35 years of operations, the corresponding risk of a latent cancer fatality to this individual would be 4.6×10^{-12}.

Incremental doses to involved workers from normal operations are given in **Table 4–133**; these workers are defined as those directly associated with all process activities. The incremental annual average dose to the high-energy and low-energy accelerator workers during startup and operations would be 150 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 30 (high-energy accelerator startup and operation), 15 (low-energy accelerator startup and operation), 11 (support facility operation), and 12 person-rem (FDPF operation). The risks and numbers of latent cancer fatalities among the different workers from 35 years of operations are included in Table 4–133. Doses to individual workers would be kept to minimal levels by instituting badged monitoring and ALARA programs.

Table 4–133 Incremental Radiological Impacts on Involved Workers at the Generic DOE Site and INEEL from Operational Facilities Under Alternative 3 (Construct New Accelerator[s])—Option 2

Receptor—Involved Workers[a]	INEEL FDPF	Accelerators Preoperational Startup		Generic Site Operations			Two-Site Total
				Accelerators		Accelerator(s) Support Facility	
		Low-Energy	High-Energy	Low-Energy	High-Energy		
Total dose (person-rem per year)	12[b]	23[b]	45[b]	15[b]	30[b]	11[b]	69
35-year latent cancer fatalities	0.17	0.018[c]	0.036[c]	0.21	0.42	0.16	0.96
Average worker dose (millirem per year)	170	150	150	150	150	114	NA[d]
35-year latent cancer fatality risk	0.0023	1.2×10^{-4}[c]	1.2×10^{-4}[c]	0.0021	0.0021	0.0016	NA[d]

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 INEEL FDPF, 200 at the high-energy accelerator (300 during startup), 100 at the low-energy accelerator (150 during startup), and 100 total workers at the accelerator(s) support facility.

c. Preoperational startup testing lasts 2 years. Number is a 2-year latent cancer fatality risk.

d. 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: DOE 1999b; Nielsen 1999; Wham 1999b, 2000.

HAZARDOUS CHEMICAL IMPACTS. Hazardous chemical impacts associated with the operation of the accelerator(s) and support facility are addressed in Section 4.5.1.2.9.

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

4.5.2.2.10 Public and Occupational Health and Safety—Facility Accidents

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

Consequences and associated risks are presented in **Tables 4–134** and **4–135**, respectively.

For 35 years of high-energy accelerator target irradiation, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be 2.05×10^{-6} and 5.15×10^{-5}, respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.0063.

For 35 years of low-energy accelerator target irradiation, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be 2.45×10^{-9} and 3.07×10^{-8}, respectively. The increased number of latent cancer fatalities in the surrounding population would be 3.66×10^{-5}.

Table 4–134 New Accelerator(s), Support Facility, and FDPF Accident Consequences Under Alternative 3 (Construct New Accelerator[s])—Option 2

	Maximally Exposed Individual		Population to 80 Kilometers (50 Miles)		Noninvolved Worker	
Accident	**Dose (rem)**	**Latent Cancer Fatality[a]**	**Dose (person-rem)**	**Latent Cancer Fatalities[b]**	**Dose (rem)**	**Latent Cancer Fatality[a]**
High-energy accelerator accidents						
Design-basis target accident	2.93×10^{-4}	1.47×10^{-7}	0.980	4.90×10^{-4}	9.35×10^{-4}	3.74×10^{-7}
Beyond-design-basis earthquake	11.7	0.00585	3.01×10^{4}	18	184	0.147
Low-energy accelerator accidents						
Design-basis target accident	8.05×10^{-5}	4.03×10^{-8}	17.7	0.00885	0.00112	4.48×10^{-7}
Beyond-design-basis earthquake	0.0132	6.60×10^{-6}	32.4	0.0162	0.208	8.32×10^{-5}
Support facility accidents						
Medical and industrial isotopes localized solvent fire	0.0194	9.72×10^{-6}	31.1	0.0156	0.00530	2.12×10^{-6}
Medical and industrial isotopes unlikely seismic event	0.0750	3.75×10^{-5}	136	0.0680	0.510	2.04×10^{-4}
Medical and industrial isotopes glovebox explosion	2.50	0.00125	4,600	2.30	17.0	0.00680
FDPF accidents						
Ion exchange explosion during neptunium-237 target fabrication	2.01×10^{-9}	1.01×10^{-12}	2.49×10^{-5}	1.24×10^{-8}	7.26×10^{-9}	2.91×0^{-12}
Target dissolver tank failure during plutonium-238 separation	6.11×10^{-8}	3.05×10^{-11}	5.65×10^{-4}	2.82×10^{-7}	2.17×10^{-7}	8.69×10^{-11}
Ion exchange explosion during plutonium-238 separation	1.63×10^{-5}	8.13×10^{-9}	0.150	7.51×10^{-5}	5.79×10^{-5}	2.31×10^{-8}
Processing facility beyond-design-basis earthquake	42.5	0.0425	1.64×10^{5}	82.0	1,200	1.00[c]

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 4–135 New Accelerator(s), Support Facility, and FDPF Accident Risks Under Alternative 3 (Construct New Accelerator[s])—Option 2

Accident (Frequency)	Maximally Exposed Individual[a]	Population to 80 Kilometers (50 Miles)[b]	Noninvolved Worker[a]
Annual high-energy accelerator risks			
Design-basis target accident (1×10^{-4})	1.47×10^{-11}	4.90×10^{-8}	3.74×10^{-11}
Beyond-design-basis earthquake (1×10^{-5})	5.85×10^{-8}	1.80×10^{-4}	1.47×10^{-6}
35-year high-energy accelerator risk	2.05×10^{-6}	0.00630	5.15×10^{-5}
Annual low-energy accelerator risks			
Design-basis target accident (1×10^{-4})	4.03×10^{-12}	8.85×10^{-7}	4.48×10^{-11}
Beyond-design-basis earthquake (1×10^{-5})	6.60×10^{-11}	1.62×10^{-7}	8.32×10^{-10}
35-year low-energy accelerator risk	2.45×10^{-9}	3.66×10^{-5}	3.07×10^{-8}
Annual support facility risks			
Medical and industrial isotopes localized solvent fire (0.044)	4.32×10^{-7}	6.91×10^{-4}	9.41×10^{-8}
Medical and industrial isotopes unlikely seismic event (0.01)	3.75×10^{-7}	6.80×10^{-4}	2.04×10^{-6}
Medical and industrial isotopes glovebox explosion (1.00×10^{-4})	1.25×10^{-7}	2.30×10^{-4}	6.80×10^{-7}
35-year support facility risk	3.26×10^{-5}	0.056	9.85×10^{-5}
Annual FDPF risks			
Ion exchange explosion during neptunium-237 target fabrication (0.01)	1.01×10^{-14}	1.24×10^{-10}	2.91×10^{-14}
Target dissolver tank failure during plutonium-238 separation (0.01)	3.05×10^{-13}	2.82×10^{-9}	8.69×10^{-13}
Ion exchange explosion during plutonium-238 separation (0.01)	8.13×10^{-11}	7.51×10^{-7}	2.31×10^{-10}
Processing facility beyond-design-basis earthquake (1×10^{-5})	4.25×10^{-7}	8.20×10^{-4}	1.00×10^{-5}[(c)]
35-year FDPF risk	1.49×10^{-5}	0.0287	3.50×10^{-4}[(c)]
35-year Option risk	4.95×10^{-5}	0.0911	5.00×10^{-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 medical, industrial, and research and development target fabrication and processing at the support facility, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be 3.26×10^{-5} and 9.85×10^{-5}, respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.056.

For 35 years of neptunium-237 target fabrication and processing at FDPF, the increased risk of a latent cancer fatality to the maximally exposed individual and of an early fatality to a noninvolved worker would be 1.49×10^{-5} and 3.50×10^{-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 4.95×10^{-5} and 5.00×10^{-4}, respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.0911.

There are no hazardous chemical accidents associated with the new accelerator(s) or new support facility. The irradiation of neptunium-237, medical, industrial, and research and development isotopes in the new accelerator(s) 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.

4.5.2.2.11 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 accelerator(s) site. Following irradiation in the accelerator(s), the targets would be returned to REDC for processing. After this processing, the plutonium-238 product would be shipped to LANL. Additionally, medical and industrial isotopes would be shipped from the accelerator(s) 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 in support of the low-energy accelerator. The total distance traveled on public roads by trucks carrying radioactive materials would be 4.8 million kilometers (3.0 million miles); and in the air carrying medical and industrial isotopes, 23 million kilometers (14 million miles).

Approximately 269 shipments of radioactive materials would be made by DOE in support of the high-energy accelerator. The total distance traveled on public roads by trucks carrying radioactive materials would be 0.99 million kilometers (0.62 million miles).

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

IMPACTS OF INCIDENT-FREE TRANSPORTATION FOR THE LOW-ENERGY ACCELERATOR. The dose to transportation workers from all transportation activities entailed by this option has been estimated at 15 person-rem; the dose to the public, 7 person-rem. Accordingly, incident-free transportation of radioactive material associated with this option would result in 0.0059 latent cancer fatality among transportation workers and 0.0037 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 0.02.

IMPACTS OF INCIDENT-FREE TRANSPORTATION FOR THE HIGH-ENERGY ACCELERATOR. The dose to transportation workers from all transportation activities entailed by this option has been estimated at 6 person-rem; the dose to the public, 107 person-rem. Accordingly, incident-free transportation of radioactive material associated with this option would result in 0.002 latent cancer fatality among transportation workers and 0.054 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 0.0023.

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

Estimates of the total ground transportation accident risks under this option are as follows: a radiological dose to the population of 1,063 person-rem, resulting in 0.53 latent cancer fatality; and traffic accidents resulting 0.11 traffic fatality.

IMPACTS OF ACCIDENTS DURING TRANSPORTATION FOR THE HIGH-ENERGY ACCELERATOR. 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 3.1×10^{-4} latent cancer fatality, and 2.6 millirem to the hypothetical maximally exposed individual with a latent cancer fatality risk of 1.3×10^{-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 0.16 person-rem, resulting in 8.1×10^{-5} latent cancer fatality; and traffic accidents resulting in 0.025 traffic fatality.

4.5.2.2.12 Environmental Justice

Under this option, neptunium-237 targets would be irradiated in one or two new accelerators 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 located at INEEL. A new support facility would be constructed at the same 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 accelerator(s) 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 accelerator(s) and support facility, an additional evaluation of environmental justice at the accelerator(s) and support facility site during operation would be performed prior to implementation.

4.5.2.2.13 Waste Management

The impacts of managing waste associated with the operation of new accelerator(s) 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 4.5.1.2.13). 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 4.5.2.2.9 through 4.5.2.2.11.

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 small.

4.5.2.3 Decontamination and Decommissioning of the Accelerator(s) and Support Facility

The environmental impacts associated with the decontamination and decommissioning of the accelerator(s) and support facility at the generic DOE site are assessed in Section 4.5.1.3.

4.5.2.4 Permanent Deactivation of FFTF

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

4.5.3 Alternative 3 (Construct New Accelerator[s])—Option 3

Option 3 involves constructing and operating one or two accelerators 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 conducting 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 neptunium-237 from SRS to Hanford and then to the generic site, the transportation of the other target materials to the generic site, and the transportation of plutonium-238 and other product materials following irradiation and postirradiation processing constitute part of this option.

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

4.5.3.1 Construction of the New Accelerator(s) and Support Facility

Environmental impacts associated with the construction of one or two new accelerators and support facility at the generic DOE site are assessed in Section 4.5.1.1.

4.5.3.2 Operations and Transportation

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

4.5.3.2.1 Land Resources

LAND USE. Impacts on land use associated with the operation of the accelerator(s) and a support facility are addressed in Section 4.5.1.2.1.

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 the accelerator(s) and support facility are addressed in Section 4.5.1.2.1.

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 change to visual resources; thus, 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.

4.5.3.2.2 Noise

Noise impacts associated with the operation of the accelerator(s) and support facility are addressed in Section 4.5.1.2.2.

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 are not 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 a minimal change in noise impacts on people near the Hanford site as a result of changes in employee and truck traffic levels.

4.5.3.2.3 Air Quality

Air quality impacts associated with the operation of the accelerator(s) and support facility are addressed in Section 4.5.1.2.3.

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

The air quality impacts of transportation are presented in Section 4.5.3.2.11.

4.5.3.2.4 Water Resources

Impacts on water resources associated with the operation of the accelerator(s) and support facility are addressed in Section 4.5.1.2.4.

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) (Chapin 2000; 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 generation in the 400 Area associated with the permanent deactivation of FFTF (see Section 4.4.1.2.4).

4.5.3.2.5 Geology and Soils

Impacts on geology and soils associated with the operation of the accelerator(s) and support facility are addressed in Section 4.5.1.2.5. As discussed in Section 4.5.1.1.5, 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 will be assessed in accordance with DOE Order 420.1, which is described in Section 4.2.1.2.5.

4.5.3.2.6 Ecological Resources

Impacts on ecological resources associated with the operation of the accelerator(s) and a support facility are addressed in Section 4.5.1.2.6.

This option also involves using FMEF for neptunium-237 storage, target fabrication, and processing. As noted in Section 4.5.3.2.2, 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 change in impacts on aquatic habitat or wetlands associated with the Columbia River (Section 4.5.3.2.4). 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.

4.5.3.2.7 Cultural and Paleontological Resources

Impacts on cultural and paleontological resources associated with the operation of the accelerator(s) and a support facility are addressed in Section 4.5.1.2.7.

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.

4.5.3.2.8 Socioeconomics

The socioeconomic impacts associated with the operation of the new accelerator(s) and support facility at a generic DOE site are addressed in Section 4.5.1.2.8.

Target fabrication and processing of neptunium-237 targets at FMEF at Hanford would require about 62 additional workers (Hoyt et al. 1999). The socioeconomic impacts at Hanford are the same as those addressed in Section 4.4.3.1.8.

4.5.3.2.9 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 4–136** 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. The projected number of latent cancer fatalities in the surrounding population and the latent cancer fatality risk to the maximally and average exposed individuals are also presented in the table.

Table 4–136 Incremental Radiological Impacts on the Public Around the Generic DOE Site and Hanford from Operational Facilities Under Alternative 3 (Construct New Accelerator[s])—Option 3

Receptor	Hanford FMEF	Accelerators Preoperational Startup[a]		Generic Site Operations				Two-Site Total
				Accelerators		Accelerator(s) Support Facility	Total	
		Low-Energy	High-Energy	Low-Energy	High-Energy			
Population within 80 kilometers (50 miles) in the year 2020								
Dose (person-rem)	4.4×10^{-5}	0.0024	0.035	0.0043	0.055	0.14	0.20	0.20
35-year latent cancer fatalities	7.7×10^{-7}	2.4×10^{-6}(b)	3.5×10^{-5}(b)	7.5×10^{-5}	9.6×10^{-4}	0.0025	0.0035	0.0035
Maximally exposed individual								
Annual dose (millirem)	4.7×10^{-7}	1.4×10^{-5}	1.8×10^{-4}	1.1×10^{-4}	8.7×10^{-4}	0.0025	0.0035	NA[c]
35-year latent cancer fatality risk	8.3×10^{-12}	1.4×10^{-11}(b)	1.8×10^{-10}(b)	1.9×10^{-9}	1.5×10^{-8}	4.4×10^{-8}	6.1×10^{-8}	NA[c]
Average exposed individual within 80 kilometers (50 miles)								
Annual dose[d] (millirem)	8.9×10^{-8}	1.6×10^{-6}	2.3×10^{-5}	2.8×10^{-6}	3.6×10^{-5}	9.1×10^{-5}	1.3×10^{-4}	NA[c]
35-year latent cancer fatality risk	1.6×10^{-12}	1.6×10^{-12}(b)	2.3×10^{-11}(b)	4.9×10^{-11}	6.3×10^{-10}	1.6×10^{-9}	2.3×10^{-9}	NA[c]

a. For conservatism as well as consistency with other radiological impacts evaluated in this NI PEIS, these values were assessed for the year 2020 even though these activities would commence prior to that year.
b. Preoperational activities last 2 years. Number is a 2-year latent cancer fatality risk.
c. A "Total" cannot be given in this case because the same individual cannot be located at two different sites simultaneously.
d. 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: SAIC 2000; TechSource 2000; model results, using the GENII computer code (Napier et al. 1988).

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

As a result of annual operations of the accelerator facilities (the high- and low-energy accelerators and the support facility) and FMEF, the projected incremental total population dose in the year 2020 would be 0.20 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 0.0035. The incremental total dose to the maximally exposed member of the public from annual operations of the accelerator(s) and support facility at the generic DOE site would be 0.0035 millirem; from 35 years of operations, the corresponding risk of a latent cancer fatality to this individual would be 6.1×10^{-8}. Estimated annual risks are also presented for preoperational testing/startup phase activities anticipated for the accelerator(s) and support facility. The incremental dose to the maximally exposed member of the public from annual FMEF operations would be 4.7×10^{-7} millirem; from 35 years of operations, the corresponding risk of a latent cancer fatality to this individual would be 8.3×10^{-12}.

Incremental doses to involved workers from normal operations are given in **Table 4–137**; these workers are defined as those directly associated with all process activities. The incremental annual average dose to the high-energy and low-energy accelerator workers during startup and operations would be 150 millirem; for support facility workers, the incremental annual average dose during 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 45 (total for both accelerators), 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 4–137. Doses to individual workers would be kept to minimal levels by instituting badged monitoring and ALARA programs.

Table 4–137 Incremental Radiological Impacts on Involved Workers at the Generic DOE Site and Hanford from Operational Facilities Under Alternative 3 (Construct New Accelerator[s])—Option 3

Receptor—Involved Workers[a]	Hanford FMEF	Accelerators Preoperational Startup		Generic Site Operations			Two-Site Total
				Accelerators		Accelerator(s) Support Facility	
		Low-Energy	High-Energy	Low-Energy	High-Energy		
Total dose (person-rem per year)	12[b]	23[b]	45[b]	15[b]	30[b]	11[b]	69
35-year latent cancer fatalities	0.17	0.018[c]	0.036[c]	0.21	0.42	0.16	0.96
Average worker dose (millirem per year)	170	150	150	150	150	114	NA[d]
35-year latent cancer fatality risk	0.0023	1.2×10^{-4}[c]	1.2×10^{-4}[c]	0.0021	0.0021	0.0016	NA[d]

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, 200 at the high-energy accelerator (300 during startup), 100 at the low-energy accelerator (150 during startup), and 100 at the accelerator(s) support facility.

c. Preoperational startup testing lasts 2 years. Number is a 2-year latent cancer fatality risk.

d. 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 accelerator(s) and support facility are addressed in Section 4.5.1.2.9.

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

4.5.3.2.10 Public and Occupational Health and Safety—Facility Accidents

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

Consequences and associated risks are presented in **Tables 4–138** and **4–139**, respectively.

For 35 years of high-energy accelerator target irradiation, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be 2.05×10^{-6} and 5.15×10^{-5}, respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.0063.

Table 4–138 New Accelerator(s), Support Facility, and FMEF Accident Consequences Under Alternative 3 (Construct New Accelerator[s])—Option 3

	Maximally Exposed Individual		Population to 80 Kilometers (50 Miles)		Noninvolved Worker	
Accident	Dose (rem)	Latent Cancer Fatality[a]	Dose (person-rem)	Latent Cancer Fatalities[b]	Dose (rem)	Latent Cancer Fatality[a]
High-energy accelerator accidents						
Design-basis target accident	2.93×10^{-4}	1.47×10^{-7}	0.980	4.90×10^{-4}	9.35×10^{-4}	3.74×10^{-7}
Beyond-design-basis earthquake	11.7	0.00585	3.01×10^{4}	18	184	0.147
Low-energy accelerator accidents						
Design-basis target accident	8.05×10^{-5}	4.03×10^{-8}	17.7	0.00885	0.00112	4.48×10^{-7}
Beyond-design-basis earthquake	0.0132	6.60×10^{-6}	32.4	0.0162	0.208	8.32×10^{-5}
Support facility accidents						
Medical and industrial isotopes localized solvent fire	0.0194	9.72×10^{-6}	31.1	0.0156	0.00530	2.12×10^{-6}
Medical and industrial isotopes unlikely seismic event	0.0750	3.75×10^{-5}	136	0.0680	0.510	2.04×10^{-4}
Medical and industrial isotopes glovebox explosion	2.50	0.00125	4,600	2.30	17.0	0.00680
FMEF accidents						
Ion exchange explosion during neptunium-237 target fabrication	2.02×10^{-9}	1.01×10^{-12}	7.26×10^{-5}	3.63×10^{-8}	6.65×10^{-10}	2.66×10^{-13}
Target dissolver tank failure during plutonium-238 separation	4.64×10^{-8}	2.32×10^{-11}	0.00169	8.47×10^{-7}	1.95×10^{-8}	7.81×10^{-12}
Ion exchange explosion during plutonium-238 separation	1.24×10^{-5}	6.18×10^{-9}	0.451	2.25×10^{-4}	5.20×10^{-6}	2.08×10^{-9}
Processing facility beyond-design-basis earthquake	16.5	0.00823	6.41×10^{5}	321	921	1.00[c]

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 4–139 New Accelerator(s), Support Facility, and FMEF Accident Risks Under Alternative 3 (Construct New Accelerator[s])—Option 3

Accident (Frequency)	Maximally Exposed Individual[a]	Population to 80 Kilometers (50 Miles)[b]	Noninvolved Worker[a]
Annual high-energy accelerator risks			
Design-basis target accident (1×10^{-4})	1.47×10^{-11}	4.90×10^{-8}	3.74×10^{-11}
Beyond-design-basis earthquake (1×10^{-5})	5.85×10^{-8}	1.80×10^{-4}	1.47×10^{-6}
35-year high-energy accelerator risk	2.05×10^{-6}	0.00630	5.15×10^{-5}
Annual low-energy accelerator risks			
Design-basis target accident (1×10^{-4})	4.03×10^{-12}	8.85×10^{-7}	4.48×10^{-11}
Beyond-design-basis earthquake (1×10^{-5})	6.60×10^{-11}	1.62×10^{-7}	8.32×10^{-10}
35-year low-energy accelerator risk	2.45×10^{-9}	3.66×10^{-5}	3.07×10^{-8}
Annual support facility risks			
Medical and industrial isotopes localized solvent fire (0.044)	4.32×10^{-7}	6.91×10^{-4}	9.41×10^{-8}
Medical and industrial isotopes unlikely seismic event (0.01)	3.75×10^{-7}	6.80×10^{-4}	2.04×10^{-6}
Medical and industrial isotopes glovebox explosion (1.00×10^{-4})	1.25×10^{-7}	2.30×10^{-4}	6.80×10^{-7}
35-year support facility risk	3.26×10^{-5}	0.056	9.85×10^{-5}
Annual FMEF risks			
Ion exchange explosion during neptunium-237 target fabrication (0.01)	1.01×10^{-14}	3.63×10^{-10}	2.66×10^{-15}
Target dissolver tank failure during plutonium-238 separation (0.01)	2.32×10^{-13}	8.47×10^{-9}	7.81×10^{-14}
Ion exchange explosion during plutonium-238 separation (0.01)	6.18×10^{-11}	2.25×10^{-6}	2.08×10^{-11}
Processing facility beyond-design-basis earthquake (1×10^{-5})	8.23×10^{-8}	0.00321	1.00×10^{-5}[c]
35-year FMEF risk	2.88×10^{-6}	0.112	3.50×10^{-4}[c]
35-year Option risk	3.76×10^{-5}	0.175	5.00×10^{-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 low-energy accelerator target irradiation, the increased risk of a latent cancer fatality to the maximally exposed individual and to a noninvolved worker would be 2.45×10^{-9} and 3.07×10^{-8}, respectively. The increased number of latent cancer fatalities in the surrounding population would be 3.66×10^{-5}.

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

For 35 years of neptunium-237 target fabrication and processing at FMEF, the increased risk of a latent cancer fatality to the maximally exposed individual and of an early fatality to a noninvolved worker would be 2.88×10^{-6} and 3.50×10^{-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 3.76×10^{-5} and 5.00×10^{-4}, respectively. The increased number of latent cancer fatalities in the surrounding population would be 0.175.

There are no hazardous chemical accidents associated with the new accelerator(s) or new support facility. The irradiation of neptunium-237, medical, industrial, and research and development isotopes in the new accelerator(s) 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.

4.5.3.2.11 Public and Occupational Health and Safety—Transportation

DOE would transport neptunium-37 from storage at SRS to the REDC target fabrication facility at ORR. DOE would transport the unirradiated neptunium-237 targets from REDC to the accelerator(s) site. Following irradiation in the accelerator(s), the targets would be returned to REDC for processing. After this processing, the plutonium-238 product would be shipped to LANL. Additionally, medical and industrial isotopes would be shipped from the accelerator(s) 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 in support of the low-energy accelerator. The total distance traveled on public roads by trucks carrying radioactive materials would be 4.8 million kilometers (3.0 million miles); and in the air carrying medical and industrial isotopes, 23 million kilometers (14 million miles).

Approximately 269 shipments of radioactive materials would be made by DOE in support of the high-energy accelerator. The total distance traveled on public roads by trucks carrying radioactive materials would be 1.1 million kilometers (0.71 million miles).

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

IMPACTS OF INCIDENT-FREE TRANSPORTATION FOR THE LOW-ENERGY ACCELERATOR. The dose to transportation workers from all transportation activities entailed by this option has been estimated at 15 person-rem; the dose to the public, 7 person-rem. Accordingly, incident-free transportation of radioactive material associated with this option would result in 0.0059 latent cancer fatality among transportation workers and 0.0037 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 0.02.

IMPACTS OF INCIDENT-FREE TRANSPORTATION FOR THE HIGH-ENERGY ACCELERATOR. The dose to transportation workers from all transportation activities entailed by this option has been estimated at 7 person-rem; the dose to the public, 123 person-rem. Accordingly, incident-free transportation of radioactive material associated with this option would result in 0.003 latent cancer fatality among transportation workers and 0.0061 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 0.0026.

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

Estimates of the total ground transportation accident risks under this option are as follows: a radiological dose to the population of 1,063 person-rem, resulting in 0.53 latent cancer fatality; and traffic accidents resulting 0.11 traffic fatality.

IMPACTS OF ACCIDENTS DURING TRANSPORTATION FOR THE HIGH-ENERGY ACCELERATOR. 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 3.1×10^{-4} latent cancer fatality, and 2.6 millirem to the hypothetical maximally exposed individual with a latent cancer fatality risk of 1.3×10^{-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 0.14 person-rem, resulting in 7.2×10^{-5} latent cancer fatality; and traffic accidents resulting in 0.03 traffic fatality.

4.5.3.2.12 Environmental Justice

Under this option, neptunium-237 targets would be irradiated in one or two new accelerators 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 located at Hanford. A new support facility would be constructed at the same 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 found to pose no significant radiological or other risks to minority and low-income populations. The environmental analysis of operations at the new accelerator(s) 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 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 accelerator(s) and support facility, an additional evaluation of environmental justice at the accelerator(s) and support facility site during operation would be performed prior to implementation.

4.5.3.2.13 Waste Management

The impacts of managing waste associated with the operation of new accelerator(s) 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 4.5.1.2.13). 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 4.5.3.2.9 through 4.5.3.2.11.

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 2 (Section 4.4.3.1.13). As shown in that section, the impacts on the waste management systems at Hanford would be small.

4.5.3.3 Decontamination and Decommissioning of the Accelerator(s) and Support Facility

The environmental impacts associated with the decontamination and decommissioning of the accelerator(s) and support facility at the generic DOE site are assessed in Section 4.5.1.3.

4.5.3.4 Permanent Deactivation of FFTF

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