S.6 SUMMARY OF ENVIRONMENTAL IMPACTS AND MISSION EFFECTIVENESS

The following section summarizes the environmental impacts associated with the alternatives and options and compares the impacts among the alternatives described in Chapter 4 of the NI PEIS. Chapter 4 shows construction impacts that would result from implementation of Alternatives 3 and 4, as well as operational impacts for all of the alternatives.

As discussed in Section S.2, tables and text in this section have been revised in response to comments about the difficulty of comparing environmental impacts among the alternatives in the Draft NI PEIS. Tables and figures in this section now focus on estimated environmental impacts that would result from implementation of the alternatives. Baseline environmental data for the sites and for the candidate facilities are now given in Chapter 3 of the NI PEIS. In the NI PEIS, Option 1 of the No Action Alternative is used as a basis for the comparison of impacts at candidate sites.

Numerical values are assigned to environmental impacts that include radiological and nonradiological risks to the public and workers at the candidate sites and along representative transportation routes, potential quantities of waste generated, and potential quantities of spent nuclear fuel generated. These numerical values reflect the degree to which the proposed activities would increase the environmental impacts of current activities and operations at the candidate sites. It should be noted that most of the options being considered under the various alternatives involve the use of more than one site, so the numerical values presented are the sums of the values for all of the relevant sites or transportation routes. There are two exceptions—the health risks to the maximally exposed individual and the noninvolved worker. For these two exceptions, the numerical value presented is the maximum value among all relevant sites.

Radiological and Hazardous Chemical Impacts

Radiological Impacts. Table S–4 summarizes radiological and hazardous chemical risks that could occur under implementation of the alternatives from operations at fabrication, processing, and irradiation facilities. Radiological risks to the maximally exposed individual are listed in columns 2 and 5 for normal operations and accidents, respectively. Similarly, columns 3 and 6 display radiological risks to the public for normal operations and accidents, and columns 4 and 7 show radiological risks to workers at candidate irradiation facilities and processing and fabrication facilities. As indicated in the table, Option 1 of the No Action Alternative is the basis for comparing impacts that would result from implementation of the other alternatives and options. Impact values for Option 1 of the No Action Alternative are set to zero and provide a reference point for comparing impacts that would result from implementation of the other alternatives and options. Negative values in the table indicate a decrease in risk with respect to Option 1 of the No Action Alternative.

The risk values presented are the sum of individual risk values from operational activities in the fabrication, processing, and irradiation facilities used under each alternative and option. For Alternatives 2 through 4, where FFTF would be permanently deactivated, the values presented also include the reduction in risk from FFTF deactivation, where applicable. For example, the radiological risk to the population from normal operations for Option 3 of Alternative 2 (i.e., irradiation at ATR, fabrication and processing at FMEF, and deactivation of FFTF) is given as -4.7×10^{-4} latent cancer fatality. This value was calculated by adding the population risks from fabrication and processing at FMEF and irradiation at ATR, 7.7×10^{-7} latent cancer fatality, and Alternative 5 (Permanently Deactivate FFTF [with No New Missions]), -4.7×10^{-4} latent cancer fatality. The latter risk is the sum of the population risk associated with the activities during permanent deactivation of FFTF, 1.8×10^{-5} latent cancer fatality, and that resulting from not keeping FFTF in standby for 35 years, -4.9×10^{-4} latent cancer fatality (the negative value reflects the reduction in risk). The radiological risks for accident conditions are the sum of accident risks evaluated for each option. For each accident, the

Table S–4 Comparison Among Alternatives: Impacts on Occupational and Public Health and Safety from Baseline Conditions

	Radiological Risks from Normal Operations over 35 Years			Radiological Risks[b] from Accidents over 35 Years			Hazardous Chemical Risks from Normal Operations over 35 Years	
Options[a]	Maximally Exposed Individual (LCF Risk)	Population (LCF)	Workforce (LCF)	Maximally Exposed Individual (LCF Risk)	Population (LCF)	Workforce (LCF)	Maximum Cancer Risk[c]	Hazard Index[d]
No Action Alternative								
1[e]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	3.0×10^{-12}	1.4×10^{-7}	0.017	0.00	0.00	0.00	0.00	0.00
3	4.2×10^{-13}	6.1×10^{-9}	0.017	0.00	0.00	0.00	0.00	0.00
4	7.0×10^{-13}	7.5×10^{-8}	0.017	0.00	0.00	0.00	0.00	0.00
Alternative 1: Restart FFTF								
1 or 4	9.3×10^{-8}	0.0039	0.25	4.5×10^{-4}	0.54	3.5×10^{-4}	2.6×10^{-7}	0.0064
2 or 5	9.3×10^{-8}	0.0039	0.25	4.5×10^{-4}	0.41	3.5×10^{-4}	1.3×10^{-7}	0.0031
3 or 6	9.6×10^{-9}	0.0018	0.25	6.8×10^{-6}	0.21	4.2×10^{-4}	4.7×10^{-8}	0.0011
Alternative 2: Use Only Existing Operational Facilities[f, g]								
1	3.3×10^{-11}	-4.7×10^{-4}	0.16	5.7×10^{-5}	0.16	3.5×10^{-4}	2.6×10^{-7}	0.0064
2	4.6×10^{-12}	-4.7×10^{-4}	0.16	1.5×10^{-5}	0.03	3.5×10^{-4}	1.3×10^{-7}	0.0031
3	-2.3×10^{-9}	-4.7×10^{-4}	0.16	2.9×10^{-6}	0.11	3.5×10^{-4}	4.7×10^{-8}	0.0011
4	3.3×10^{-11}	-4.7×10^{-4}	0.16	5.7×10^{-5}	0.16	3.5×10^{-4}	2.6×10^{-7}	0.0064
5	4.6×10^{-12}	-4.7×10^{-4}	0.16	1.5×10^{-5}	0.03	3.5×10^{-4}	1.3×10^{-7}	0.0031
6	-2.3×10^{-9}	-4.7×10^{-4}	0.16	2.9×10^{-6}	0.12	3.5×10^{-4}	4.7×10^{-8}	0.0011
7	3.3×10^{-11}	-4.7×10^{-4}	0.16	5.7×10^{-5}	0.16	3.5×10^{-4}	2.6×10^{-7}	0.0064
8	4.6×10^{-12}	-4.7×10^{-4}	0.16	1.5×10^{-5}	0.03	3.5×10^{-4}	1.3×10^{-7}	0.0031
9	-2.3×10^{-9}	-4.7×10^{-4}	0.16	2.9×10^{-6}	0.11	3.5×10^{-4}	4.7×10^{-8}	0.0011
Alternative 3: Construct New Accelerator(s)[f, g]								
1	6.1×10^{-8}	0.0030	0.95	9.2×10^{-5}	0.22	5.0×10^{-4}	1.6×10^{-9}	1.1×10^{-7}
2	6.1×10^{-8}	0.0030	0.95	5.0×10^{-5}	0.09	5.0×10^{-4}	1.6×10^{-9}	1.1×10^{-7}
3	6.1×10^{-8}	0.0030	0.95	3.8×10^{-5}	0.18	5.0×10^{-4}	1.6×10^{-9}	1.1×10^{-7}
Alternative 4: Construct New Research Reactor[f, g]								
1	4.5×10^{-8}	0.002	0.49	9.0×10^{-5}	0.21	4.5×10^{-4}	6.4×10^{-10}	2.3×10^{-6}
2	4.5×10^{-8}	0.002	0.49	4.8×10^{-5}	0.08	4.5×10^{-4}	6.4×10^{-10}	2.3×10^{-6}
3	4.5×10^{-8}	0.002	0.49	3.6×10^{-5}	0.17	4.5×10^{-4}	6.4×10^{-10}	2.3×10^{-6}
Alternative 5: Permanently Deactivate FFTF (with No New Missions)								
	-2.3×10^{-9}	-4.7×10^{-4}	-0.0097	-2.2×10^{-13}	-1.6×10^{-8}	-1.3×10^{-13}	0.00	0.00

a. For detailed descriptions of the options under each alternative, see Section 2.5 of the NI PEIS.
b. Accident risks include accident likelihood over 35 years and the consequences.
c. Probability that an individual would develop cancer from exposure to hazardous (carcinogenic) chemicals.
d. A measure of hazard from exposure to multiple toxic (noncarcinogenic) chemicals. If this value is less than 1, the exposure is unlikely to produce an adverse toxic effect.
e. Baseline conditions for the comparison of impacts is Option 1 of the No Action Alternative.
f. These alternatives include FFTF deactivation impacts. The deactivation would lead to negative impacts (reduced risk); see Alternative 5.
g. The reduction in impacts from deactivating FFTF would affect the impacts to the population and workforce for Alternatives 2 through 4 and to the maximally exposed individual only for those options within Alternatives 2 through 4 that use FMEF.

Note: Refer to the text for a discussion on how the risk values in this table have been generated.

Key: LCF, latent cancer fatalities.

risk value is the product of the accident consequences and its occurrence likelihood over 35 years of operation. Chapter 4, Appendix H, and Appendix I of the NI PEIS provide the details on public and occupational risk calculations.

A comparison of radiological risks estimated to result from normal operations over 35 years (columns 2 and 3 of Table S–4) shows that implementation of the alternatives would result in a small risk of a latent cancer fatality among the general public. Radiological accident risks to the public over 35 years (columns 5 and 6 of Table S–4) are estimated to be less than one latent cancer fatality. **Figure S–4** shows estimated latent cancer fatalities among the population at risk from potential accidents at candidate sites. Each bar in Figure S–4 represents the estimated latent cancer fatalities for a given option.

For example, there are six bars shown above the alternative labeled "Restart FFTF." The first of the six bars represents the estimated latent cancer fatalities for implementation of Option 1, the second bar represents the estimated latent cancer fatalities for implementation of Option 2, etc. Storage containers for neptunium-237 targets would not be expected to rupture under the most severe accident evaluated in the NI PEIS. Therefore, no latent cancer fatalities would be expected under implementation of the No Action Alternative. Deactivation of FFTF (with no new missions) would result in a small reduction in radiological accident risks in comparison with the No Action Alternative. Differences in the radiological accident risks among alternatives and among options within a given alternative are driven by accident risks at the target fabrication and processing facilities. This point is illustrated in **Figure S–5**.

Figure S–5 shows risks to the public that would result from radiological accidents at candidate fabrication and processing facilities and candidate irradiation facilities. Latent cancer fatalities estimated for candidate fabrication and processing facilities are shown to the left of the dividing line in Figure S–5, and the estimated latent cancer fatalities for candidate irradiation facilities appear on the right side of the dividing line. The estimated latent cancer fatalities for FMEF under Options 3 and 6 of Alternative 1 are labeled "FMEF (Hanford)." Under Options 3 and 6 of Alternative 1, FMEF would serve as the fabrication and processing facility for all targets. If FMEF were selected to fabricate and process neptunium-237 targets only, the radiological risk to the public would be reduced by approximately a factor of two, as shown by the bar labeled "FMEF (Hanford, neptunium-237 targets only)" in Figure S–5. Among the candidate fabrication and processing facilities, accident risks to the public range from a low of 0.029 latent cancer fatality at FDPF (INEEL) to 0.377 latent cancer fatality at RPL (Hanford). Although all of the accident risks shown in Figure S–5 are less than one latent cancer fatality, risks to the public that would be expected from radiological accidents at candidate fabrication and processing facilities are relatively large in comparison to those for candidate irradiation facilities.

Prevailing weather conditions, the geographical distribution of the population at risk, and the type of target(s) processed (neptunium-237 only, other isotopes only, or both) all contribute to variations in the radiological risk to the public. Calculations of accident consequences and risks include populations residing within 80 kilometers (50 miles) of the accident site, although the consequences and risks decrease noticeably with increasing distance from the accident site. As shown in **Figure S–6**, RPL (Hanford) and REDC (ORR) have the largest populations residing within 16 kilometers (10 miles) of candidate sites, while FDPF (INEEL) has the smallest. Because the total population residing within 16 kilometers (10 miles) of FDPF is relatively small, the curve representing populations residing near FDPF is nearly coincident with the horizontal axis in Figure S–6. Comparing Figures S–5 and S–6, it is clear that accident risks due to fabrication and processing activities are driven by both the type of processing activities and the total population residing near the facilities. In turn, variations in accident risks among the alternatives, as well as variations among options within an alternative, are driven by the selection of fabrication and processing facilities. The choice for irradiation facility would have little effect on radiological accident risks to the public.

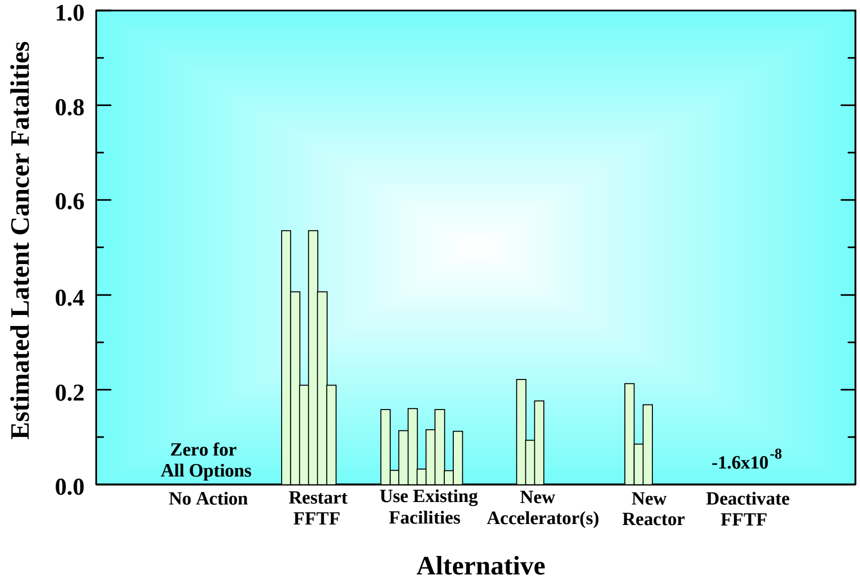

Figure S–4 Public Risks Due to Radiological Accidents at Candidate Sites (35 Years)

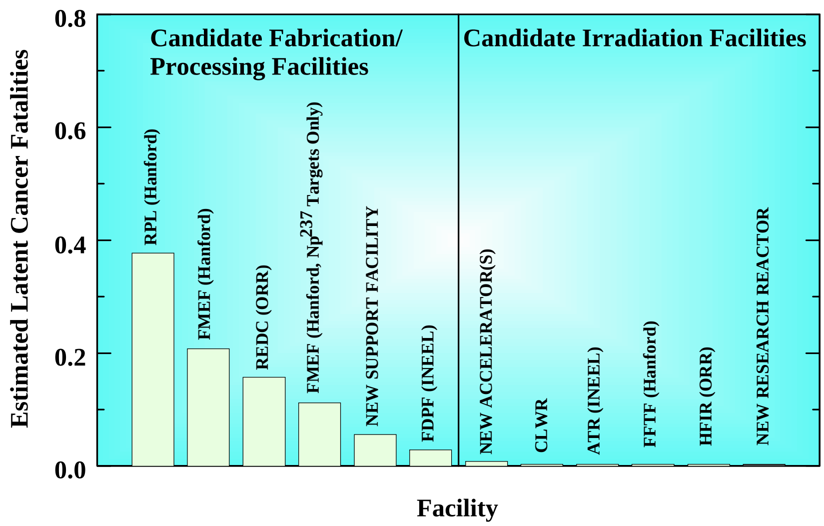

Figure S–5 Public Risks Due to Radiological Accidents at Candidate Facilities (35 Years)

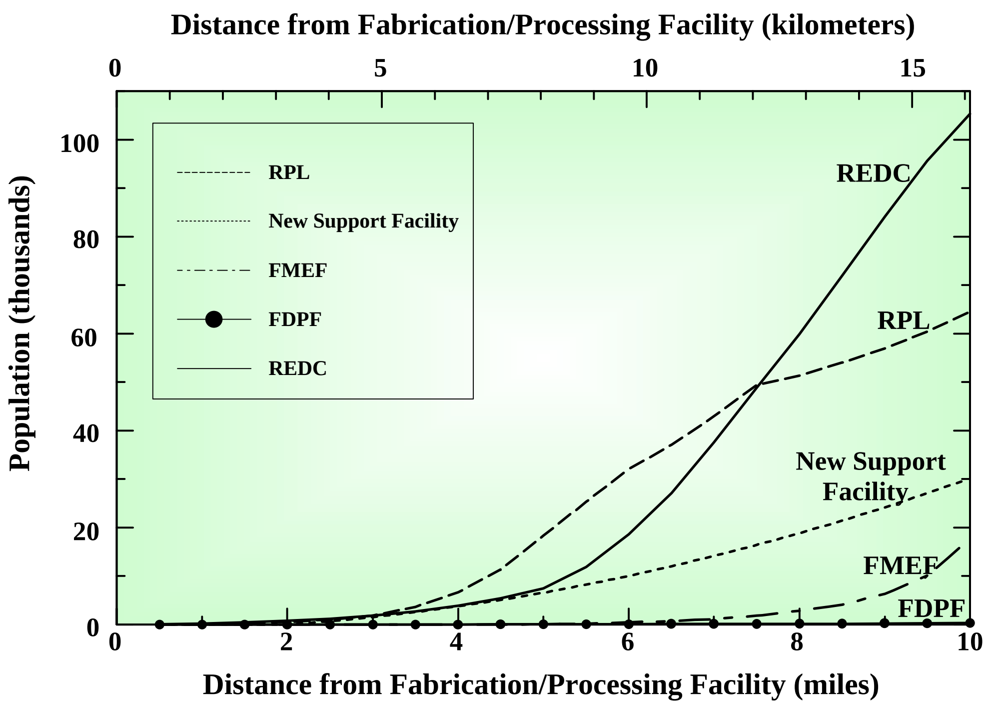

Figure S–6 Population Residing Within 16 Kilometers (10 Miles) of Candidate Fabrication and Processing Facilities

Hazardous Chemical Impacts. Columns 8 and 9 of Table S–4 display cancer risks and hazard indexes that could result from airborne emissions of hazardous chemicals from candidate processing facilities. Cancer risk factors listed in column 8 of Table S–4 are estimates of an upper-bound lifetime probability of an individual developing cancer due to exposure to carcinogenic chemicals. For all alternatives and options, the maximum cancer risk factor is 2.6×10^{-7} (or a likelihood of approximately 1 in 3,800,000) or less. Different carcinogens can cause or promote different forms of cancer. In general, cancer risk factors for different carcinogens are not additive because there are potential synergistic or antagonistic chemical interactions in multiple-substance exposures (EPA 1989). Therefore, column 8 of the table lists the maximum cancer risk factor for each alternative. Hazard indexes listed in column 9 of Table S–4 estimate the potential for adverse toxic (noncancerous) health effects due to exposure to hazardous chemicals. If the hazard index is less than one, adverse (noncancerous) health effects would not be expected. For all of the alternatives and options, hazard indexes are 0.0064 or less. The results (presented in columns 8 and 9 of Table S–4) indicate that no adverse toxic health or cancer effects would be expected from exposure to hazardous chemicals released under the implementation of any of the alternatives.

Generation and Disposition of Waste and Spent Nuclear Fuel

Table S–5 summarizes the estimated amount of waste and spent nuclear fuel that would be generated under implementation of the nuclear infrastructure alternatives. Waste that would result from implementation of the alternatives would be relatively small in comparison to current waste generation at the candidate sites. Current waste management practices at the candidate sites would be sufficient to manage waste that would result from the nuclear infrastructure alternatives.

Table S–5 Comparison of Waste and Spent Nuclear Fuel Generation Among Alternatives

Options[a]	Waste Generation in Cubic Meters (35 Years)					Spent Nuclear Fuel in Metric Tons
	Transuranic/ High-Level	Low-Level	Mixed Low-Level	Hazardous	Nonhazardous	
No Action						
1	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	<10	0.0	0.0	0.0	0.0
3	0.0	<10	0.0	0.0	0.0	0.0
4	0.0	<10	0.0	0.0	0.0	0.0
Alternative 1: Restart FFTF						
1	380	5,000	320	680	943,000	16
2	240	5,200	320	680	902,000	16
3	380	5,000	320	670	1.5×10^6	16
4	380	5,000	320	680	943,000	16
5	240	5,200	320	680	902,000	16
6	380	5,000	320	670	1.5×10^6	16
Alternative 2: Use Only Existing Operational Facilities						
1	380	2,100	<180[b]	3,100[c]	105,000	0
2	240	2,300	<180[b]	3,100[c]	64,000	0
3	380	2,100	<180[b]	3,100[c]	660,000	0
4	380	2,100	<180[b]	3,100[c]	105,000	0
5	240	2,300	<180[b]	3,100[c]	64,000	0
6	380	2,100	<180[b]	3,100[c]	660,000	0
7	380	2,100	<180[b]	3,100[c]	105,000	0
8	240	2,300	<180[b]	3,100[c]	64,000	0
9	380	2,100	<180[b]	3,100[c]	660,000	0
Alternative 3: Construct New Accelerator(s)						
1	380	5,000	430[b]	3,200[c]	1.1×10^7	NA
2	240	5,200	430[b]	3,200[c]	1.1×10^7	NA
3	380	5,000	430[b]	3,200[c]	1.1×10^7	NA
Alternative 4: Construct New Research Reactor						
1	380	4,800	330[b]	3,300[c]	1.1×10^6	11
2	240	4,900	330[b]	3,300[c]	1.0×10^6	11
3	380	4,800	330[b]	3,300[c]	1.7×10^6	11
Alternative 5: Permanently Deactivate FFTF (with No New Missions)						
	0.0	0.0	(b)	2,500[d]	0.0	0

a. For detailed descriptions of the options under each alternative, see Section 2.5 of the NI PEIS.
b. The deactivation of FFTF would result in the removal of approximately 980,000 liters (260,000 gallons) of sodium. This sodium would be evaluated for alternate uses and is therefore not included in mixed low-level radioactive waste for Alternatives 2 through 5.
c. 2,500 cubic meters of these materials would be evaluated for radioactive contamination and would be reused or recycled if possible.
d. These materials would be evaluated for radioactive contamination and would be reused or recycled if possible.
Key: NA, not applicable.

Transuranic Waste/High-Level Radioactive Waste. The analysis for the Draft NI PEIS assumed that the waste generated from the processing of irradiated neptunium-237 targets is transuranic waste. However, as a result of comments received during the public comment period, DOE is considering whether the waste from processing of irradiated neptunium-237 targets should be classified as high-level radioactive waste. Irrespective of how the waste is classified (i.e., transuranic or high-level radioactive), the waste composition and characteristics are the same, and the waste management (i.e., treatment and onsite storage) as described in the NI PEIS would be the same. In addition, either waste type would require disposal in a suitable repository. As shown in column 2 of Table S–5, between 240 and 380 cubic meters (314 and 497 cubic yards) of transuranic waste or high-level radioactive waste would result from implementation of Alternatives 1 through 4. This waste would result from processing irradiated neptunium-237 targets to harvest plutonium-238. Approximately 380 cubic meters (497 cubic yards) of this waste per year for 35 years would be generated for all options under Alternatives 1 through 4, except those for which target fabrication and processing would be conducted at FDPF at INEEL. If FDPF were selected for neptunium target fabrication and processing, then approximately 240 cubic meters (314 cubic yards) of waste would be generated during the program.

Low-Level and Mixed Low-Level Waste. Columns 3 and 4 of Table S–5 summarize the total low-level radioactive waste and mixed low-level radioactive waste generation that would be expected from implementation of the alternatives. Low-level radioactive waste would be generated at the irradiation facilities and at the fabrication and processing facilities. As shown, the low-level radioactive waste generation that would result under Alternative 2 would be less than half of that for Alternatives 1, 3, and 4, and mixed low-level radioactive waste generation would be almost half. This is because under Alternative 2 currently operational facilities would be used for target irradiation and these facilities would generate little additional low-level and mixed low-level radioactive waste. Also under Alternative 2, no waste generation would result from production of additional medical and industrial isotopes.

DOE's approach for managing low-level and mixed low-level radioactive waste is provided in the Record of Decision for its Waste Management Program (65 FR 10061). The Record of Decision 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. The Record of Decision does not preclude the use of commercially licensed low-level radioactive waste disposal facilities. Low-level radioactive waste generated at Hanford would be disposed of on site. However, if DOE determines that use of the Hanford waste management infrastructure or other DOE sites is not practical or cost effective, DOE may issue an exemption under DOE Order 435.1 for the use of non-DOE facilities (i.e., commercial facilities) to store, treat, and dispose of such waste generated from the restart and operation of FFTF.

Solid low-level radioactive waste generated at ORR eventually would have to be disposed of off site due to lack of low-level waste disposal capacity at ORR. Low-level radioactive waste generated at INEEL would be disposed of on site. At some future time, low-level radioactive waste would be disposed of off site.

In compliance with the Waste Management Program Record of Decision, DOE's mixed low-level radioactive waste will be treated at: Hanford, INEEL, ORR, and SRS, and disposed of at Hanford and the Nevada Test Site. Existing candidate sites analyzed in the NI PEIS all have treatment facilities for mixed low-level radioactive waste. Solid mixed low-level radioactive waste generated at ORR and INEEL would have to eventually be disposed of off site due to lack of onsite mixed low-level radioactive waste disposal capacity.

Hazardous Waste. Hazardous waste that would result from implementation of the nuclear infrastructure alternatives is shown in column 5 of Table S–5. The amount of hazardous waste generated under the alternatives is relatively small in comparison to hazardous waste currently generated at the candidate sites. Estimated amounts of hazardous waste that would be generated under Alternatives 2 through 4 include the hazardous waste that would be generated under Alternative 5 (Permanently Deactivate FFTF [with No New Missions]).

Based on the Record of Decision for hazardous waste issued on August 5, 1998 (63 FR 41810), nonwastewater hazardous waste would be treated and disposed of at offsite commercial facilities. Hazardous waste generated under the nuclear infrastructure alternatives would be stored in onsite facilities permitted under the Resource Conservation and Recovery Act or generator accumulation areas prior to shipment to a commercial facility permitted to manage hazardous waste.

Nonhazardous Waste. Nonhazardous waste that would be expected from implementation of the nuclear infrastructure alternatives is listed in column 6 of Table S–5. Nonhazardous waste that would be expected under implementation of Alternative 3 (Construct New Accelerator[s]) is at least a factor of six larger than the nonhazardous waste estimated for the other alternatives. Nonhazardous waste that would be produced under Alternative 3 would be driven by sanitary waste and process wastewater resulting from construction and operation of accelerators and the new support facility.

Nonhazardous solid waste that would be generated at ORR and INEEL would represent less than 0.5 percent of the generating site's onsite nonhazardous waste disposal capacity. Nonhazardous solid waste that would be generated at Hanford under the nuclear infrastructure alternatives would be recycled or sent off site for disposal as industrial waste. Nonhazardous process wastewater at the candidate sites would represent a small fraction of the generating sites capacity and would be treated on site. Sanitary wastewater would be treated on site as necessary prior to offsite disposition.

Spent Nuclear Fuel. Changes in the generation of spent nuclear fuel would occur only under implementation of Alternatives 1 (Restart FFTF) and 4 (Construct New Research Reactor). Spent nuclear fuel that would be generated under Alternative 1 would be less than 1 percent (by weight) of the current spent nuclear fuel inventory at Hanford. Spent nuclear fuel that would be generated at Hanford under implementation of Alternative 1 would be placed in facility storage vessels and onsite dry storage pending ultimate disposal in a geologic repository. Spent nuclear fuel generated under Alternative 4 would be stored on site in wet storage pending ultimate disposal in a geologic repository.

Water Use

Construction. For construction of new facilities under Alternatives 3 (Construct New Accelerator[s]) and 4 (Construct New Research Reactor), water is expected to be required for such uses as mixing concrete, dust control, washing activities, and potable and sanitary needs. Water use for facility construction is estimated at 22.7 million liters (6 million gallons) for the high-energy accelerator, 14 million liters (3.7 million gallons) for the low-energy accelerator, 11.7 million liters (3.1 million gallons) for the new research reactor, and 14.6 million liters (3.85 million gallons) for the new support facility on an annualized (construction-year) basis.

Operations. Figure S–7 shows the annual water use that would be expected to occur under the nuclear infrastructure alternatives. Under the No Action Alternative, FFTF would remain in standby and DOE's nuclear infrastructure would not be enhanced. In standby condition, the FFTF uses approximately 197 million liters (52 million gallons) of groundwater per year. In Figure S–7, the No Action Alternative is used as a basis for comparison of water use among the alternatives. Therefore, water use for the No Action Alternative is shown as zero. The water use shown in Figure S–7 for Alternative 1 (Restart FFTF) is the additional

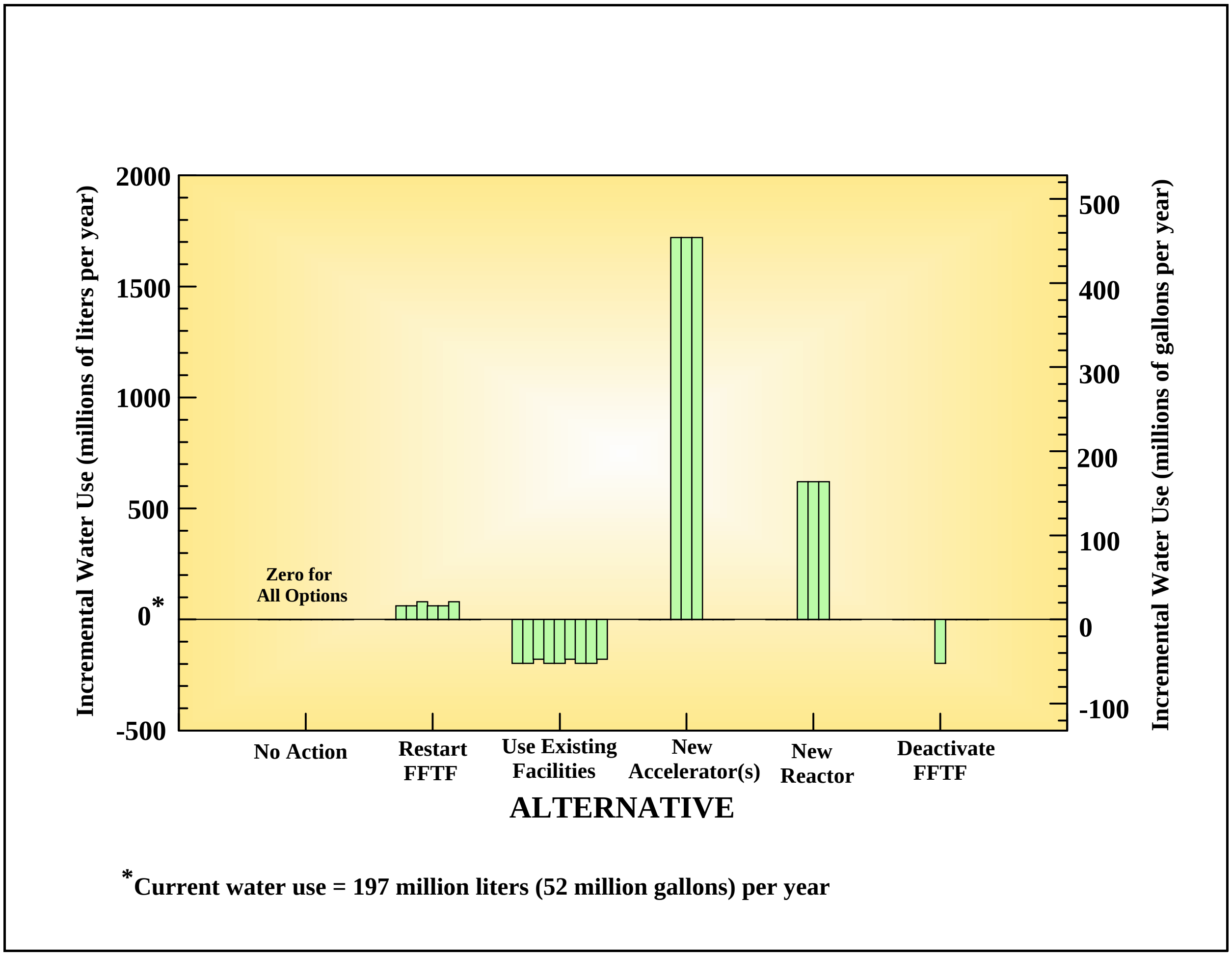

Figure S–7 Annual Water Use Under the Nuclear Infrastructure Alternatives

groundwater use that would result from operation of the FFTF. Under Alternatives 2 through 5, FFTF would be deactivated, thus saving approximately 197 million liters (52 million gallons) per year in groundwater required for maintaining FFTF in standby. As a result, the water use is negative for Alternatives 2 (Use Only Existing Operational Facilities) and 5 (Permanently Deactivate FFTF [with No New Missions]). The negative increment in water use would be more than offset by the increase in water use estimated for Alternatives 3 (Construct New Accelerator[s]) and 4 (Construct New Research Reactor).

Air Quality

Construction. Under Alternatives 3 (Construct New Accelerator[s]) and 4 (Construct New Research Reactor), new irradiation and support facilities would be constructed to support DOE's nuclear missions. Facility construction would not be required under the other alternatives. Since no specific site has yet been selected for the new accelerator[s] or the new research reactor, Federal standards are used to evaluate estimated concentrations of air pollutants. The effects of constructing the new high-energy accelerator were used to characterize air quality impacts under Alternative 3 (Construct New Accelerator[s]). Construction impacts of the low-energy accelerator and support facilities would add relatively small concentrations of air pollutants. If Alternative 3 and/or Alternative 4 were selected for implementation, site-specific environmental documentation would be prepared prior to site selection.

Construction of the new irradiation and support facilities would not be expected to exceed Federal standards and guidelines for ambient air quality. However, in comparison with air pollutant concentrations expected from facility operations, concentrations of air pollutants that would be expected during construction are relatively large. If the new facilities were constructed in an area with existing high background concentrations, construction activities could produce enough air pollutant emissions to exceed ambient air quality standards.

Operations—No Action Alternative. Under the No Action Alternative, FFTF would remain in standby and DOE's nuclear infrastructure would not be enhanced to meet the nuclear infrastructure missions. Air quality effects that would be expected from transportation of neptunium-237 oxide to REDC (Option 2), FDPF (Option 3), or FMEF (Option 4) are summarized in transportation discussion later in this section.

Operations—Alternatives 1 through 5. ***Oak Ridge Reservation*****:** Under Alternatives 1 (Options 1 and 4), 2 (Options 1, 4, and 7), 3 (Option 1), and 4 (Option 1), air quality impacts at ORR would result from the production of plutonium-238 at REDC. All of the expected concentrations are small in comparison with the most stringent ambient air quality standards. Operation of REDC in support of plutonium-238 production would not be expected to significantly affect air quality or to result in air pollutant concentrations in excess of ambient air quality standards. No air quality impacts would result from operation of HFIR under Alternative 2 (Use Only Existing Operational Facilities).

Idaho National Engineering and Environmental Laboratory**:** Under Alternatives 1 (Options 2 and 5), 2 (Options 2, 5, and 8), 3 (Option 2) and 4 (Option 2), air quality impacts at INEEL would result from the production of plutonium-238 at FDPF. All of the expected concentrations are small in comparison with the most stringent ambient air quality standards. Operation of FDPF in support of plutonium-238 production would not be expected to significantly affect air quality or to result in air pollutant concentrations in excess of ambient air quality standards. No air quality impacts would result from operation of ATR under Alternative 2 (Use Only Existing Operational Facilities).

Hanford Site**:** If Alternative 1 were selected for implementation, impacts on air quality at Hanford would result from operation of FFTF (all options), RPL (Options 1, 2, 4, and 5), and FMEF (Options 3 and 6). FMEF could also be used for production of plutonium-238 under Alternatives 2 (Options 3, 6, and 9), 3 (Option 3), and 4 (Option 3). FFTF would be deactivated under Alternatives 2 through 5. Deactivation would, in turn, result in the shutdown of diesel-driven fire pumps, oil-fired preheaters, and a gas turbine that currently support FFTF's standby condition. If any of Alternatives 2 through 5 were selected for implementation, emissions from this supporting equipment would cease, thereby improving the air quality near FFTF. Emissions of air pollutants from FMEF are relatively small in comparison to those associated with FFTF supporting equipment.

Air quality concentrations for FFTF and FMEF were calculated with the SCREEN3 model developed by EPA. The model is intended to provide conservative estimates of the concentrations of air pollutants emitted from point or extended sources. Concentrations shown under Alternatives 2 through 5 were obtained by summing estimated emissions from the diesel-driven oil pumps, the oil-fired preheaters, and the gas turbine. Because these sources operate intermittently and do not necessarily operate at the same time, estimates of the concentrations of air pollutants are conservative because they were obtained under the assumption that all supporting equipment for FFTF would operate simultaneously, which is considered a worst-case scenario.

Generic Site for the New Accelerator(s): Under Alternative 3 (all options), air quality impacts at the site for the new accelerator(s) would result from the operation of emergency diesel generators for the high-energy accelerator and any support facilities. The low-energy accelerator would not require emergency diesel power, and it was assumed in the analysis that air quality effects of the low-energy accelerator could be ignored. Air quality impacts of the support facilities would be assessed if Alternative 3 (Construct New Accelerator[s]) were selected for implementation. In comparison with the air quality concentrations that would be expected during construction, air quality impacts resulting from operation of the diesel generators would be relatively small. All of the expected concentrations resulting from operation of emergency generators would be small in comparison with the most stringent ambient air quality standards, and would not be expected to result in air pollutant concentrations in excess of ambient air quality standards. If the new accelerator(s) were located in an area that has high background pollutant concentrations, diesel emissions could result in pollutant concentrations in excess of the ambient standards. If Alternative 3 were selected for implementation, site-specific environmental documentation would be prepared prior to site selection.

Generic Site for the New Research Reactor: Under Alternative 4 (all options), air quality impacts at the site for the new research reactor would result from the operation of emergency diesel generators for the reactor. In comparison with the air quality concentrations that would be expected during construction, air quality impacts resulting from operation of the diesel generator would be relatively small. All of the expected concentrations resulting from operation of the emergency generator would be small in comparison with the most stringent ambient air quality standards and would not be expected to result in air pollutant concentrations in excess of ambient air quality standards. If the new research reactor were located in an area that has high background pollutant concentrations, diesel emissions could result in pollutant concentrations in excess of the ambient standards. If Alternative 4 were selected for implementation, site-specific environmental documentation would be prepared prior to site selection.

Socioeconomics

Implementation of the nuclear infrastructure alternatives would have no significant impact on regional economic areas or community services at Hanford, INEEL, and ORR. Socioeconomic impacts at the generic sites could not be evaluated in detail because areas potentially affected under Alternatives 3 and 4 could vary widely in demographic and economic composition. If Alternative 3 or 4 were selected for implementation, site-specific environmental analysis would be conducted prior to site selection. **Table S–6** shows the number of direct jobs that would be generated under implementation of the nuclear infrastructure alternatives. Deactivation of the FFTF under Alternatives 2 through 5 would result in the loss of 242 jobs that are required to keep the facility in standby condition. That loss would be offset under alternatives and options for which the FMEF would support the production of plutonium-238 (62 direct jobs).

Transportation Impacts

The transportation impacts for Option 1 of the No Action Alternative are those resulting from transporting 175 kilograms (385 pounds) (5 kilograms [11 pounds] per year for the 35-year evaluation period) of plutonium-238 from Russia to LANL. The impacts were obtained by extrapolating the impact analysis presented in the *Environmental Assessment of the Import of Russian Plutonium-238* (DOE 1993) for the purchase of 40 kilograms (88.2 pounds) of plutonium-238. The impacts presented for the other options of the No Action Alternative include those of Option 1 plus the impact from transporting neptunium oxide from SRS to the selected facilities at ORNL, INEEL, and Hanford. Because the assumptions and data used to assess the transportation impacts in the above environmental assessment are different from those used in this NI PEIS, incremental transportation impacts compared to the baseline condition (Option 1 of the No Action Alternative) can only be presented for the options under the No Action Alternative. Therefore, the transportation impacts presented in this section are not compared to the baseline condition.

Table S–6 Comparisons Among Alternatives: Change in Direct Jobs Under the Nuclear Infrastructure Alternatives

Options[a]	Oak Ridge Reservation	Idaho National Engineering and Environmental Laboratory	Hanford Site	Generic Accelerator(s) Site(Construction/ Operation)	Generic Research Reactor Site(Construction/ Operation)
No Action Alternative					
All	0	0	0	0	0
Alternative 1: Restart FFTF					
1 & 4	41	0	218	0	0
2 & 5	0	24	218	0	0
3 & 6	0	0	292	0	0
Alternative 2: Use Only Existing Operational Facilities					
1, 4, & 7	41	0	-242	0	0
2, 5, & 8	0	24	-242	0	0
3, 6, & 9	0	0	-180	0	0
Alternative 3: Construct New Accelerator(s)					
1	41	0	-242	410/225	0
2	0	24	-242	410/225	0
3	0	0	-180	410/225	0
Alternative 4: Construct New Research Reactor					
1	41	0	-242	0	160/120
2	0	24	-242	0	160/120
3	0	0	-180	0.00	160/120
Alternative 5: Permanently Deactivate FFTF (with No New Missions)					
	0	0	-242	0	0

a. For detailed descriptions of the options under each alternative, see Section 2.5 of the NI PEIS.

Radiological and nonradiological transportation impacts over the 35-year program duration are summarized in **Table S–7**. Risks to the public and workers due to incident-free transportation are shown in columns 3 through 5 of the table. Columns 6 and 7 summarize radiological and nonradiological risks to the public that could result from transportation accidents. Chapter 4 and Appendix J of the NI PEIS discuss transportation impacts in more detail.

Radiological Transportation Risks. Figure S–8 illustrates the data listed in column 6 of Table S–7. The results indicate a large risk to the public due to transportation accidents that could occur over 35 years under implementation of Alternatives 1 (Restart of FFTF), 3 (Construct New Accelerator[s]), and 4 (Construct New Research Reactor) as compared to those from implementation of Alternative 2 (Use Only Existing Operational Facilities). This large difference is due to the more than 8,000 medical isotope shipments by air transport considered under Alternatives 1, 3, and 4, and not under Alternative 2. Nearly all of the radiological and traffic accident risk are due to those involving medical and industrial isotope shipments. No enhancement of medical and industrial isotope production is considered under Alternative 2.

Implementation of Alternative 5 (Permanently Deactivate FFTF [with No New Mission]) would not result in any new transportation activities.

Table S–7 Comparison Among Alternatives: Impacts of Transportation on Occupational and Public Health and Safety

Options[a]	Transportation Distance (millions of kilometers)	Incident-Free Transportation over 35 Years: Public: Radiological (LCF)	Incident-Free Transportation over 35 Years: Workers: Radiological (LCF)	Incident-Free Transportation over 35 Years: Public: Vehicle Emissions (fatalities)	Transportation Accidents over 35 Years: Public: Radiological (LCF)	Transportation Accidents over 35 Years: Public: Vehicle Collisions[b] (fatalities)
No Action Alternative						
1	0.11	0.010	0.0046	4.7×10^{-4}	4.4×10^{-4}	0.014
2	0.13	0.011	0.0047	5.9×10^{-4}	4.4×10^{-4}	0.014
3	0.20	0.014	0.0049	8.9×10^{-4}	4.4×10^{-4}	0.014
4	0.22	0.014	0.0050	9.2×10^{-4}	4.4×10^{-4}	0.014
Alternative 1: Restart FFTF						
1 and 4	8.0	0.149	0.012	0.030	0.53	0.19
2 and 5	6.2	0.044	0.008	0.024	0.53	0.13
3 and 6	5.6	0.009	0.007	0.023	0.53	0.12
Alternative 2: Use Only Existing Operational Facilities						
1	2.2	0.120	0.005	0.0064	4.4×10^{-5}	0.059
2	0.15	0.004	0.001	0.0007	2.1×10^{-5}	6.0×10^{-4}
3	0.83	0.040	0.002	0.0014	3.0×10^{-5}	0.017
4	2.6	0.150	0.006	0.0056	4.4×10^{-5}	0.074
5	3.1	0.179	0.007	0.0066	2.1×10^{-5}	0.088
6	3.6	0.205	0.008	0.0075	3.0×10^{-5}	0.100
7	1.8	0.096	0.004	0.0052	4.4×10^{-5}	0.048
8	0.99	0.052	0.002	0.0030	4.4×10^{-5}	0.024
9	1.6	0.084	0.004	0.0037	3.0×10^{-5}	0.039
Alternative 3: Construct New Accelerator(s)						
1	5.7	0.054	0.008	0.023	0.53	0.14
2	5.8	0.057	0.008	0.023	0.53	0.14
3	5.9	0.065	0.009	0.023	0.53	0.14
Alternative 4: Construct New Research Reactor						
1	7.5	0.154	0.011	0.026	0.53	0.19
2	7.5	0.157	0.012	0.026	0.53	0.19
3	7.9	0.177	0.012	0.027	0.53	0.19
Alternative 5: Permanently Deactivate FFTF (with No New Missions)						
	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]

a. For detailed descriptions of the options under each alternative, see Section 2.5 of the NI PEIS.
b. No radiological spill.
c. No new transportation activities would occur under Alternative 5.
Key: LCF, latent cancer fatalities.

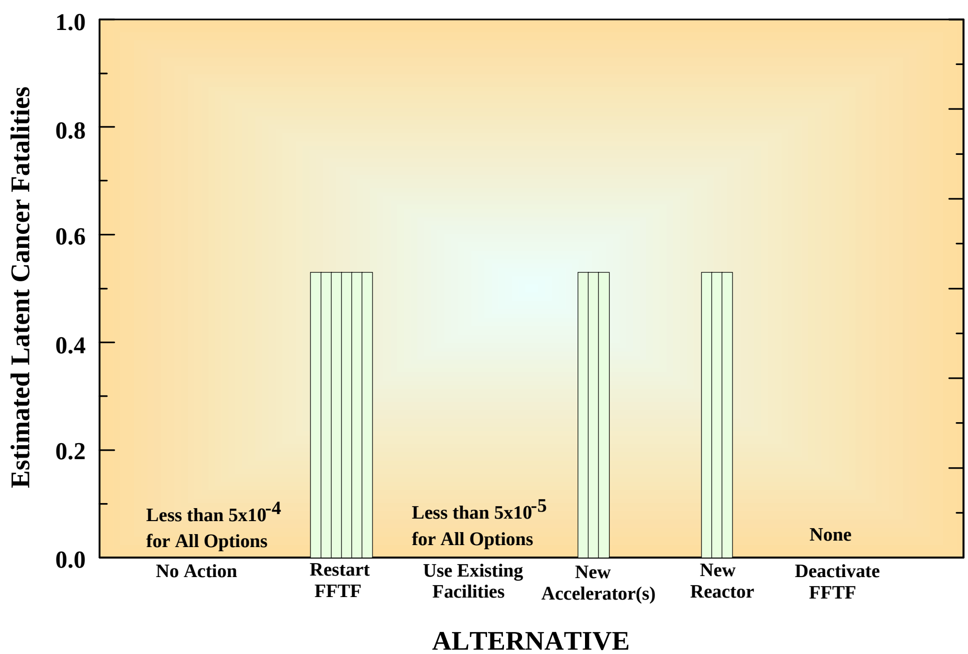

Figure S–8 Public Risks Due to Radiological Transportation Accidents (35 Years)

Figure S–9 shows the radiological risks to the public that could result from incident-free transportation over 35 years (column 3 of Table S–7). For all of the alternatives and options, incident-free radiological transportation risks are approximately 0.2 latent cancer fatality over 35 years. As shown in column 4 of Table S–7, radiological risks to workers due to incident-free transportation are less than approximately 0.012 latent cancer fatality for all alternatives and options.

Nonradiological Transportation Risks. Column 7 of Table S–7 shows the risks of traffic fatalities that would be expected to result from vehicular collisions in which there is no radiological spill. Under all alternatives and options, the expected number of traffic fatalities would be less than approximately 0.2. Data listed in column 5 of the same table indicates that less than approximately 0.03 fatality would be expected from vehicular exhaust emissions. Fatalities that would be expected to result from both vehicular collisions and exhaust emissions are closely correlated with the estimated highway mileage that would be traveled under implementation of the alternatives (see column 2 of Table S–7 and **Figure S–10**). Traffic accident rates depend on the type of carrier. Both commercial trucks and DOE's safe, secure trailer/SafeGuards Transports (SST/SGTSs) would be used for the highway transport of isotopes. Accident rates for the safe, secure trailer system are less than those for commercial trucks by at least a factor of five. As a result, expected collision fatalities for any option would increase the total distance traveled, but the impacts would also depend on relative amounts of transportation by commercial truck and the SST/SGTs.

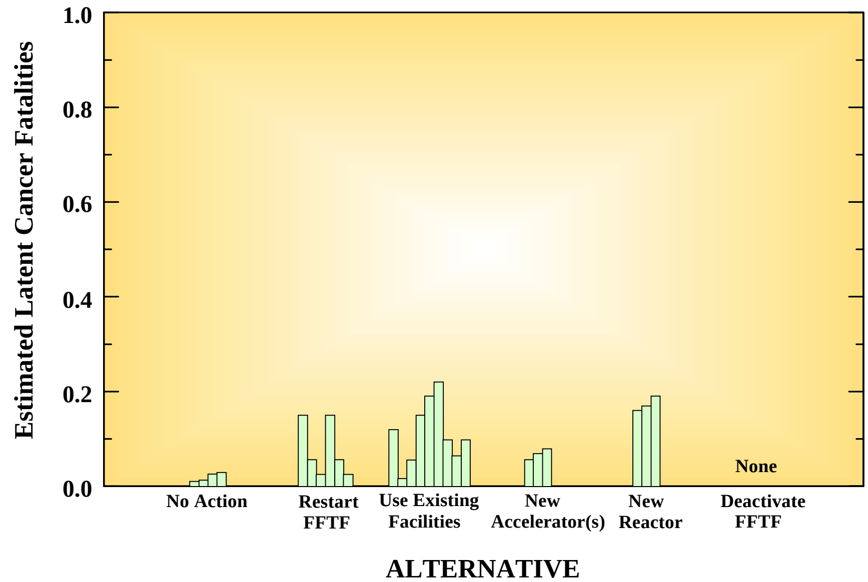

Figure S–9 Radiological Risks to the Public Due to Incident-Free Transportation (35 Years)

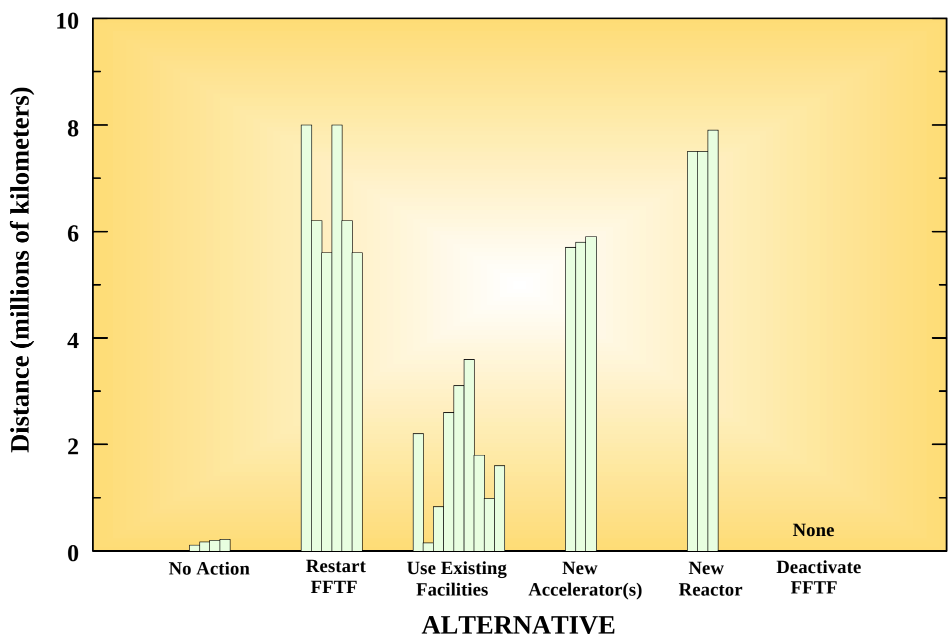

Figure S–10 Highway Distances That Would Be Traveled Under the Alternatives (35 Years)

Resource Areas Discussed in Less Detail

Implementation of the nuclear infrastructure alternatives at existing candidate sites would be expected to have little effect on land use, visual resources, noise, water quality, geology and soils, ecology, cultural resources, and environmental justice. Implementation of the alternatives at one or more generic sites could potentially result in significant impacts in one or more of these resource areas. However, these impacts are site-specific and could not be evaluated in detail in this programmatic document. If Alternative 2 (Options 4, 5, and 6), 3, or 4 were selected for implementation, site-specific environmental documentation would be prepared prior to site selection.

Land Use. Implementation of the nuclear infrastructure alternatives at existing operational candidate sites at Hanford, INEEL, and ORR would be consistent with ongoing activities and current land use at these sites. Irradiation of neptunium targets at an existing CLWR would also be consistent with the land use at the reactor site. If Alternative 3 or 4 were selected for implementation, a site-specific evaluation of land use would be conducted prior to site selection. Deactivation of the FFTF under Alternatives 2 through 5 would have no effect on ongoing land use in the 400 Area of Hanford.

Visual Resources. Existing sites that are candidates for implementation of the nuclear infrastructure alternatives are rated Class IV under the U.S. Bureau of Land Management classification guidelines for visual resources (DOI 1986). Selection of one or more of the existing candidate sites for implementation would not affect their visual resource classification as areas in which industrial development dominates the landscape. Use of a CLWR for irradiation of neptunium targets would not alter the appearance of the reactor or the surrounding landscape. Implementation of Alternative 3 (Construct New Accelerator[s]) or 4 (Construct New Research Reactor) could result in reclassification under U.S. Bureau of Land Management guidelines. If Alternative 3 or 4 were selected for implementation, a site-specific evaluation of visual resources would be conducted prior to site selection. Deactivation of FFTF under Alternatives 2 through 5 would not significantly alter the overall landscape in the 400 Area of Hanford.

Noise. Noise associated with target fabrication and processing and irradiation at existing candidate sites would be similar to currently existing onsite noise and would not be audible beyond site boundaries. These activities would not produce sudden, loud noises that would startle wildlife. Noise levels that would be generated at a CLWR under Alternative 2 (options 4, 5, and 6) would be the same as those currently existing at the reactor site. Implementation of Alternative 3 (Construct New Accelerator[s]) or 4 (Construct New Research Reactor) would result in construction activities that could disturb nearby residents or wildlife. If Alternative 3 or 4 were selected for implementation, a site-specific NEPA review would be prepared, and an evaluation of potential noise impacts would be conducted prior to site selection. Deactivation of FFTF under Alternative 5 would not significantly alter the noise levels in the 400 Area of Hanford.

Water Quality. Under Alternative 1 (Restart FFTF), there would be no liquid radiological effluent pathways to the environment from FFTF. Process wastewater from cooling tower blow-down would be ultimately discharged to the 400 Area Pond (i.e., the 4608 B/C percolation ponds). No impact on the quality of ground or surface water would be expected. Irradiation of neptunium targets at existing reactors and a generic CLWR would have no measurable effect on the quantity or quality of discharged effluents. Use of existing facilities for target fabrication and processing would not result in direct effluent discharge to the environment, and additional wastewater generation would be relatively small in comparison to existing wastewater treatment volumes at the sites. If Alternative 3 (Construct New Accelerator[s]) or 4 (Construct New Research Reactor) were selected for implementation, construction and operation of new facilities would not be anticipated to significantly impact water quality. While the water quality impacts are expected to be small, a site-specific environmental evaluation of potential water quality impacts and mitigation measures would be conducted prior to site selection. Sodium removal during deactivation of FFTF under Alternatives 2 through 5 would result in approximately 7,600 liters (2,000 gallons) of wastewater that would be disposed of in existing wastewater treatment facilities at Hanford. Deactivation of FFTF would not be expected to impact water quality.

Geology and Soils. Except for Alternatives 3 (Construct New Accelerator[s]) and 4 (Construct New Research Reactor), activities conducted under the nuclear infrastructure alternatives would not require construction of new facilities. No soil would be disturbed, and there would be no impacts on the geology of potentially affected sites. Construction of new accelerators and support facilities under Alternative 3 would be expected to disturb up to approximately 27 hectares (66 acres) of soil. If Alternative 4 were selected for implementation, construction of the new reactor and support facility would be expected to disturb approximately 4 hectares (10 acres) of soil. If Alternative 3 or 4 were selected for implementation, a site-specific environmental evaluation would be conducted prior to site selection. Deactivation of FFTF under Alternatives 2 through 5 would take place on previously disturbed land. Impacts of deactivation on geology and soils would be negligible.

Ecology. Activities that would be conducted under the nuclear infrastructure alternatives at candidate existing facilities and the generic CLWR would not involve construction of new facilities or significant changes in traffic, noise, air quality, or water quality. In addition, irradiation and processing activities would take place in established industrial areas. Impacts on terrestrial resources and wetlands would be negligible. Consultations concerning threatened and endangered species were conducted with appropriate Federal and state agencies. No major issues were raised as a result of these consultations. (Chapter 4 of the NI PEIS provides detailed discussions of the results of these consultations.)

Under Alternatives 3 (Construct New Accelerator[s]) and 4 (Construct New Research Reactor), construction of new facilities at a yet-to-be-determined site could potentially have a significant effect on wildlife and wetlands. If Alternative 3 or 4 were selected for implementation, site-specific ecological evaluations would be conducted prior to site selection. The evaluation would include consultation with the U.S. Fish and Wildlife Service and appropriate state authorities concerning threatened and endangered species. Deactivation of FFTF under Alternatives 2 through 5 would take place on previously disturbed land in the 400 Area. No threatened or endangered species are known to reside in the 400 Area, and noise impacts on local wildlife would be temporary.

Cultural Resources. Existing candidate facilities that would host activities under the nuclear infrastructure alternatives are located within areas that contain National Historic Landmarks or structures that are eligible for nomination to the National Register of Historic Places. Several candidate facilities are eligible for nomination to the National Register, including the Reactor Containment Building and the Control Building for FFTF at Hanford, RPL at Hanford, and ATR at INEEL. Selection of these facilities to support the nuclear infrastructure missions would not alter their eligibility.

Under the nuclear infrastructure alternatives, activities at candidate existing sites and the generic CLWR would be conducted within existing facilities. Use of the FMEF at Hanford for target fabrication and processing would require construction of a 76-meter-high (250-feet-high) stack on previously disturbed land. Similarly, construction of a support facility for deactivation of the FFTF would take place on previously disturbed land in the 400 Area. Thus, except for Alternatives 3 (Construct New Accelerator[s] and 4 (Construct New Research Reactor), no disturbance of archeological resources would be expected under the nuclear infrastructure alternatives. Consultations with the State Historic Preservation Offices and potentially affected Native American tribes have been conducted for the candidate existing sites. No major issues were raised as a result of these consultations. (Chapter 4 of the NI PEIS provides detailed discussion of the results of these consultation.)

Implementation of Alternative 3 or 4 would require construction on potentially undisturbed lands. If Alternative 3 or 4 were selected for implementation, a site-specific NEPA review would be prepared, and an environmental evaluation of cultural resources would be conducted prior to site selection. The evaluation would include consultation with State Historic Preservation Offices and potentially affected Native American tribes.

Environmental Justice. The objective of the environmental justice analysis was to determine whether or not implementation of the nuclear infrastructure alternatives would result in significant environmental impacts that disproportionately affect low-income or minority populations. Normal operations at the candidate sites and incident-free transportation pose no significant radiological risks to the public or to maximally exposed offsite individuals among the public.

Portions of the Fort Hall Indian Reservation and the Yakama Indian Reservation lie within potentially affected areas surrounding INEEL and Hanford, respectively. As discussed in Appendixes H and I of the NI PEIS, calculations of radiological risks considered human exposures due to inhalation and ingestion of radioactive materials. Ingestion of contaminated fish, vegetation, and/or wildlife is an environmental justice consideration due to potential patterns of subsistence consumption for minority or low-income populations. Radiological health models used in the environmental evaluation assumed accidents at the irradiation facilities or the fabrication and processing facilities would contaminate all of the food produced in the area, and that all of the contaminated food would be consumed by persons residing in the potentially affected area. The expected risk that would result from ingestion of radiologically contaminated food for persons residing near Hanford would be approximately 0.004 latent cancer fatality and essentially zero for persons residing near the INEEL or ORR. Thus, no credible pattern of food consumption would be expected to result in a significant health risk to low-income or minority populations residing within potentially affected areas surrounding the existing candidate sites. Implementation of the alternatives would not be expected to result in significant environmental impacts in any of the environmental resource areas. Thus, no disproportionately high and adverse impacts on minority and low-income populations would be expected to result from implementation of the alternatives.

Accidents at candidate fabrication and processing facilities and during transportation of radioisotopes by aircraft were found to pose the largest risks to the public. Under conservative assumptions described in Appendix I of the NI PEIS, no latent cancer fatalities due to accidents would be expected at the existing sites. Accidents during air transport of radioisotopes could occur anywhere along the flight path and would not place any identifiable group within the general population at disproportionate risk.

The density and distribution of total, low-income, and minority populations varies from site to site, so that evaluations of environmental justice are necessarily site-specific. If Alternatives 3 (Construct New Accelerator[s]) or 4 (Construct New Research Reactor) were selected for implementation, a site-specific NEPA review would be prepared, and an evaluation of environmental justice would be conducted prior to site selection. The evaluation would include patterns of food consumption that could result in disproportionately high and adverse effects on low-income or minority populations at risk.

Industrial Safety

Estimates of potential industrial impacts to workers during construction, irradiation, fabrication and processing were evaluated based on DOE and Bureau of Labor Statistics data. Impacts are classified into two groups: total recordable cases and fatalities. A recordable case includes work-related death, illness, or injury which resulted in loss of consciousness, restriction of work or motion, transfer to another job, or required medical treatment beyond first aid. The industrial safety evaluation is discussed in more detail in Section I.3 of the NI PEIS.

The average occupational total recordable cases and fatality rates for construction and operation activities are presented in **Table S–8**.

Table S–8 Average Occupational Total Recordable Cases and Fatality Rates (per worker-year)

Labor Category	Total Recordable Cases	Fatalities
Construction	0.053	1.3×10^{-4}
Operation	0.033	1.3×10^{-5}

The expected impacts (both annual and for the duration of the activity) to workers at each facility for construction and operation are presented in **Table S–9**.

Table S–9 Industrial Safety Impacts from Construction and Operation

Facility	Estimated Number of Workers	Construction or Operation Duration (years)	Expected Annual Total Recordable Cases	Expected Activity Duration Total Recordable Cases	Annual Fatalities	Activity Duration Fatalities
Construction						
Low-energy accelerator	75	3	4.0	12	0.010	0.030
High-energy accelerator	410	5	22	110	0.057	0.285
New research reactor	160	7	8.5	59.5	0.022	0.154
Operation						
ATR[a]	0	35	–	–	–	–
HFIR[a]	0	35	–	–	–	–
CLWR[a]	0	35	–	–	–	–
FFTF	242	35	8.0	280	0.0031	0.109
Low-energy accelerator	13	35	0.4	14	1.7×10^{-4}	0.00595
High-energy accelerator	225	35	7.4	259	0.0029	0.102
New research reactor	120	35	4.0	140	0.0016	0.056
REDC	116	35	3.8	133	0.0015	0.0525
FDPF	75	35	2.5	87.5	9.8×10^{-4}	0.0343
FMEF	105	35	3.5	123	0.0014	0.049
RPL/306–E	30	35	1.0	35	3.9×10^{-4}	0.0137
New support facility	100	35	3.3	116	0.0013	0.0455

a. No additional workers would be required for the proposed activities evaluated in the NI PEIS.

No fatalities would be expected from either construction or operation of any facility.

Comparison of Mission Effectiveness Among Alternatives

This section compares the effectiveness of Alternatives 1, 2, 3, and 4 in supporting the three missions evaluated in the NI PEIS:

- Medical and industrial isotope production
- Plutonium-238 production to support NASA space missions
- Nuclear energy research and development for civilian applications

Table S–10 lists the medical isotopes that were included in the Expert Panel's forecast of future demands (Wagner et al. 1998), and identifies their means of production using accelerators, reactors, or separation from existing stockpiles of radioisotopes. Consistent with the panel's report, the list of isotopes is presented in three categories: proven medical isotopes currently used in clinical applications, those under development for clinical applications, and radioisotopes that have shown promise during medical research. Some are most suited for production in an accelerator, some in a nuclear reactor, and some are harvested by chemical separation from existing stockpiles of long-lived radioactive isotopes. Those isotopes that can be harvested from existing stockpiles of radioactive isotopes require only hot cells for the extraction process; neither accelerators or nuclear reactors are necessary for their production.

Table S–10 Medical Isotopes and Their Means of Production

Isotope[a]	Accelerator-Produced	Reactor-Produced	Separation from Existing Stockpiles of Radioactive Isotopes
Proven Isotopes Currently Used in Clinical Applications That Face Supply and Cost Concerns			
Yttrium-90	(b)	●	
Molybdenum-99[c]	(b)	●	
Indium-111	●		
Iodine-123	●		
Rhenium-186	(b)	●	
Developmental Isotopes for Clinical Applications That Face Availability and Cost Concerns			
Fluorine-18	●		
Phosphorus-32	(b)	●	
Krypton-81m	●		
Strontium-89	(b)	●	
Palladium-103	(b)	●	
Tin-117m	(b)	●	
Xenon-127	(b)	●	
Iodine-125	(b)	●	
Iodine-131	(b)	●	
Samarium-153	(b)	●	
Promising Research Isotopes That Are Not Being Explored Due to Lack of Availability or Cost			
Scandium-47	(b)	●	
Zinc-62	●		
Copper-64	●	●	
Copper-67	●	●	
Germanium-68	●		
Gadolinium-153	(b)	●	
Holmium-166	●	●	
Lutetium-177	(b)	●	
Rhenium-188	(b)	●	
Astatine-211	α		
Bismuth-212		●	●[d]
Bismuth-213	(b)	●	●[e]
Radium-223	(b)	●	●[f]

a. Wagner et al. 1998.
b. These isotopes are produced by neutron capture and could be produced in a high-energy accelerator. However, this capability has not been included in the design, analysis, or cost estimates of Alternative 3.
c. Sufficient supplies of this isotope are available from Canadian suppliers.
d. Bismuth-212 is a progeny of thorium-232.
e. Bismuth-213 is a progeny of uranium-233.
f. Radium-233 is a progeny of protactinium-231.

Key: α, efficient means of production with an alpha particle accelerator; ●, efficient means of production.

No single production method would satisfy all of the Expert Panel's projected requirements for medical isotopes. Isotopes produced by neutron capture are typically provided by a reactor, but could be produced by a high-energy accelerator with a spallation neutron source. Accelerator production of these isotopes would be relatively inefficient, and might not be practical to provide the large quantities needed to meet clinical demands. The proposed high-energy accelerator described in the NI PEIS could be modified to provide such capability, but this would add to the design, construction, and operating complexity, would require an increase in particle energy greater than 1 gigaelectron volts, and would increase the capital and operating costs.

Bismuth and radium isotopes, which were identified as promising medical isotopes by the Expert Panel, are currently harvested from existing stockpiles of long-lived radioisotopes and can also be readily produced in a reactor.

Alternative 1—Restart FFTF. FFTF would produce high-energy neutrons and a large flux level (10^{15} neutrons per square centimeter per second) that can be tailored to nearly any desired energy level. FFTF would provide the greatest flexibility for both isotope production and nuclear-based research and development among the baseline configurations for all of the proposed alternatives. Due to its large core size, flux spectrum, demonstrated testing capability, and rated power level, it would be able to concurrently support the projected plutonium-238 needs, production of medical and industrial isotopes, and civilian nuclear energy research and development related to a broad range of materials, advanced reactors, advanced fuels, and waste transmutation.

Alternative 2—Use Only Existing Operational Facilities. Due to current mission commitments at the existing DOE facilities, a large portion of the reactor irradiation space is committed to existing users. The existing reactors are able to provide for the current plutonium-238 needs. However, fulfilling this requirement with these facilities would use most, if not all, excess capacity, and may require some non-Federal missions to be terminated. The ability to expand medical and industrial isotope production would require some current missions to be postponed or terminated. If the CLWR were used for plutonium-238 production, then the existing facilities would gain additional margin for medical and industrial isotope production and limited civilian nuclear energy research and development activities. These facilities have primary missions with sponsors who reserve the right to dictate to what degree and the times the facility could be used.

Alternative 3—Construct New Accelerator(s). Two accelerators, a low-energy accelerator and a high-energy accelerator, are proposed for Alternative 3. 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 the representative isotopes discussed in Section S.1, it has no ability to satisfy the plutonium-238 needs, and a limited ability to support the proposed nuclear-based research and development needs. The preconceptual design of the high-energy accelerator 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 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.