4.7 ALTERNATIVE 5—PERMANENTLY DEACTIVATE FFTF (WITH NO NEW MISSIONS)

Under Alternative 5, DOE would permanently deactivate FFTF at Hanford with no new missions. Medical and industrial isotope production and civilian nuclear energy research and development missions at the existing facilities, as described in Chapter 3, Affected Environment, would continue. DOE's nuclear facilities infrastructure would not be enhanced. The environmental impacts associated with FFTF deactivation are addressed in Section 4.4.1.2.

4.8 CUMULATIVE IMPACTS

The projected incremental environmental impacts of (1) constructing (as necessary) and operating the proposed facilities to store, fabricate, irradiate, and process the various targets addressed in this NI PEIS for 35 years, and (2) deactivating FFTF were added to the environmental impacts of other present and reasonably foreseeable future actions at or near the identified candidate sites to obtain cumulative site impacts under normal conditions. The other present and reasonably foreseeable future actions at or near the candidate sites are included in the baseline impacts presented in Chapter 3. Cumulative transportation impacts were determined by analyzing the impacts along the various routes used to transport the materials associated with nuclear infrastructure activities over the 35-year period. The methodology for assessing cumulative impacts is presented in Section G.10.

In this section, cumulative site impacts are presented only for those "resources" at a site that may reasonably be expected to be affected by the storage, fabrication, irradiation, and processing of the various targets. These include site employment, electrical consumption, water usage, air quality, waste management, and public and occupational health and safety. This section also includes the cumulative impacts associated with intersite transportation.

Impacts of the following are considered in the cumulative site impacts assessment:

- Current (baseline) activities at or in the vicinity of the candidate sites
- Other onsite and offsite activities that are reasonably foreseeable and documented
- Construction (as necessary), operation, and deactivation (as necessary) of the proposed nuclear infrastructure facilities to fabricate, irradiate, and process targets

Activities whose impacts are contained in cumulative site impacts include, but are not limited to, operation of the Spallation Neutron Source Facility at ORR, implementation of the Advanced Mixed Waste Treatment Project at INEEL, and remediation of the high-level waste tanks at Hanford.

Details of activities that may be implemented in the foreseeable future at any of the nuclear infrastructure candidate sites and evaluated in the cumulative impact assessment are given in the following documents:

- *Surplus Plutonium Disposition Final Environmental Impact Statement* (DOE 1999a) (Record of Decision issued)

- *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (DOE 1996a) (Record of Decision issued)

- *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (DOE 1996b) (Record of Decision issued)

- *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (DOE 1995b) (Record of Decision issued)

- *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997a) (Final EIS issued; Records of Decision issued for the various waste types)

- *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement* (DOE 1995c) (Record of Decision issued)

- *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel* (DOE 1996c) (Record of Decision issued)

- *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996d) (Record of Decision issued)

- *Final Environmental Impact Statement Management of Spent Nuclear Fuel from the K Basins at the Hanford Site* (DOE 1996h) (Record of Decision issued)

- *Advanced Mixed Waste Treatment Project Final Environmental Impact Statement* (DOE 1999c) (Record of Decision issued)

- *Final Environmental Impact Statement for the Tank Waste Remediation System, Hanford Site, Richland, Washington* (DOE 1996e) (Record of Decision issued)

- *Hanford Reach of the Columbia River Comprehensive River Conservation Study and Environmental Impact Statement* (NPS 1994) (Record of Decision issued)

- *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (DOE 1999d) (Record of Decision issued)

- *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel* (DOE 2000b) (Record of Decision issued)

- *Final Environmental Impact Statement, Construction and Operation of the Spallation Neutron Sources* (DOE 1999e) (Record of Decision issued)

- *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride* (DOE 1999f) (Record of Decision issued)

- *Idaho High-Level Waste and Facilities Disposition Draft Environmental Impact Statement* (DOE 1999g)

- *Final Environmental Impact Statement for Treating Transuranic (TRU)/Alpha Low-Level Waste at the Oak Ridge National Laboratory* (DOE 2000c) (Record of Decision issued)

- *Environmental Assessment Melton Valley Storage Tanks Capacity Increase Project—Oak Ridge National Laboratory* (DOE/EA-1044 and FONSI, DOE 1995d)

- *Management of Spent Nuclear Fuel on the Oak Ridge Reservation* (DOE/EA-1117 and FONSI, DOE 1996f)

- *Environmental Assessment - Management of Hanford Site Non-Defense Production Reactor Spent Nuclear Fuel* (DOE/EA-1185 and FONSI, DOE 1997c)

- *Environmental Assessment for Transportation of Low-Level Radioactive Waste from the Oak Ridge Reservation to Off-Site Treatment or Disposal Facilities* (DOE 2000d)

- *Environmental Assessment for Transportation of Mixed Low-Level Radioactive Waste from the Oak Ridge Reservation to Off-Site Treatment or Disposal Facilities* (DOE 2000e)

- *Environmental Assessment for Selection and Operation of the Proposed Field Research Centers for the Natural and Accelerated Bioremediation Field Research (NABIR) Program* (DOE 2000f) (FONSI issued April 2000).

The related programs included in the cumulative impact assessment for the potentially affected candidate sites are identified in **Table 4–162**.

Table 4–162 Other Present and Reasonably Foreseeable Actions Considered in the Cumulative Impact Assessment

Activities	ORR	INEEL	Hanford
Disposition of Surplus Plutonium	X		
Storage and Disposition of Weapons-Usable Fissile Materials	X	X	X
Disposition of Surplus Highly Enriched Uranium	X		
Waste Management PEIS	X	X	X
Spent Nuclear Fuel Management and INEL Environmental Restoration and Waste Management		X	X
Foreign Research Reactor Spent Nuclear Fuel Management		X	X
Stockpile Stewardship and Management	X		
Tank Waste Remediation			X
Radioactive Releases from WNP Nuclear Power Plant			X
Hanford Reach of the Columbia River Comprehensive River Conservation Study			X
Hanford Comprehensive Land Use Plan			X
K Basins Spent Fuel Management			X
Advanced Mixed Waste Treatment Project		X	
Treatment and Management of Sodium-Bonded Spent Nuclear Fuel		X	
Construction and Operation of the Spallation Neutron Source	X		
Long-Term Management and Use of Depleted Uranium Hexafluoride	X		
Treatment and Shipment of Transuranic Waste	X		
Management of Liquid Low-Level Radioactive Waste	X		
Management of Spent Nuclear Fuel	X		
Transportation of Low-Level Radioactive Waste to Off-Site Treatment or Disposal	X		
Transportation of Mixed Low-Level Radioactive Waste to Off-Site Treatment or Disposal	X		
Natural and Accelerated Bioremediation Field Research Center Assessment	X		
Idaho High-Level Waste and Facilities Disposition		X	

Source: Literature review.

In the tables that are included in the following sections, all relevant activities at each site are identified to the extent possible. They include existing and reasonably foreseeable activities, and those associated with nuclear infrastructure operations. The impacts associated with the latter are specifically shown as "New Nuclear Infrastructure Operations." They include the impacts from construction (as necessary), operation, and deactivation (as necessary) of the proposed target fabrication, irradiation, and processing facilities assessed in this NI PEIS.

A bounding option was analyzed for each site. The bounding option is the option that would involve the greatest amounts of operational activities and associated environmental impacts at the candidate site. For example, the bounding option for ORR is Option 7 of Alternative 2, under which both HFIR and REDC operations would be involved in plutonium-238 production.

In addition to reasonably foreseeable site activities, other activities within the regions of the candidate sites were considered in the cumulative impact analysis for the selected resources. However, because of the distances between the candidate sites and these other existing and planned facilities, there is little opportunity for interactions among them.

4.8.1 Cumulative Impacts at ORR

For ORR, the bounding option for this NI PEIS is Option 7 of Alternative 2. This option calls for the operation of HFIR to irradiate neptunium-237 targets and the operation of REDC to fabricate and process these targets and other neptunium-237 targets irradiated in ATR. The impacts associated with HFIR and REDC operations for other missions are included under "existing site activities."

4.8.1.1 Resource Requirements

Cumulative impacts on resource requirements at ORR are presented in **Table 4–163**. ORR would remain within its site capacity for all major resources. If Option 7 of Alternative 2 were implemented, the proposed nuclear infrastructure facilities would require essentially no change in the site's use of electricity or water. Cumulatively, ORR would use approximately 10 percent of its electrical capacity and 37 percent of its water capacity. Site employment would increase by approximately 41 workers.

Table 4–163 Maximum Cumulative Resource Use and Impacts at ORR

Activities[a]	Site Employment	Electrical Consumption (megawatt-hours per year)	Water Usage (million liters per year)
Existing site activities[b]	14,215	726,000	14,210
Storage and Disposition PEIS	Included above	7,260	0.24
Waste Management PEIS	1,259	84,160	394
Spallation Neutron Source	744	543,120	1,592
Treatment and Shipment of Transuranic Waste	17	3,000	3.8
New nuclear infrastructure operations[c]	41[d]	Negligible[e]	2.86
Total	16,276	~1,363,540	16,203
Total site capacity	NA	13,880,000	44,348

a. See Section 4.8 and Table 4–162 for a listing of past, present, and reasonably foreseeable actions considered.
b. Reflects current sitewide activities that are anticipated to continue during all or part of the 35-year period evaluated for proposed nuclear infrastructure operations.
c. Nuclear infrastructure activities from Alternative 2, Option 7.
d. Some, or all, of these worker requirements may be filled by the reassignment of the existing site workforce.
e. Additional electricity consumption associated with this option would be negligible compared to that associated with existing facility activities.

Note: To convert from liters per year to gallons per year, multiply by 0.264; to convert from megawatt-hours to British thermal units, multiply by 3.42×10^6; ~ means "approximately" and indicates that new nuclear infrastructure operations would contribute only minimally.
Key: NA, not applicable.
Source: DOE 1996a:4-246, 4-255; 1997a:10-18, 10-32, 10-45, 10-58; 1999a:3-185; 1999e:4-45, 5-21, 5-177; 2000c:S-34, 4-60, 4-93; LMER 1997; Wham 1999a; Sections 4.4.7.1.4 and 4.4.7.1.8 of this NI PEIS.

4.8.1.2 Air Quality

Cumulative impacts on air quality at ORR are presented in **Table 4–164**. ORR is currently in compliance with all Federal and State ambient air quality standards, and would continue to be in compliance even if the cumulative effects of all activities are included. As shown in the table, the contributions of nuclear infrastructure operations to overall site concentrations would be very small.

Table 4–164 Maximum Cumulative Air Pollutant Concentrations at ORR for Comparison with Ambient Air Quality Standards

Parameter	Carbon Monoxide		Nitrogen Dioxide	PM_{10}		Sulfur Dioxide		
Averaging Period	8 hours	1 hour	Annual	Annual	24 hours	Annual	24 hours	3 hours
Activities								
Existing site activities[a] (micrograms per cubic meter)	7.75	26.5	0.98	1.6	12.6	4.76	33.4	106.4
HEU disposition[b] (micrograms per cubic meter)	11.5	53	1.33	0.03	0.37	2.46	29.3	161
Waste management program (micrograms per cubic meter)	0	0	0	3	9	2.4	11	39
Spallation Neutron Source (micrograms per cubic meter)	69	99	16	1.9	23	0.1	1	2.4
New nuclear infrastructure operations[c] (micrograms per cubic meter)	0	0	1.99×10^{-4}	0	0	0.04	0.31	0.7
Total concentration (micrograms per cubic meter)	88.3	179	18.3	6.53	45	9.76	75	310
Standard								
Most stringent standard[d] (micrograms per cubic meter)	10,000	40,000	100	50	150	80	365	1,300

a. Environmental impacts associated with existing site activities (based on 1998 emissions from the *Oak Ridge Reservation Annual Site Environmental Report 1998* [Hamilton et al. 1999]) that are anticipated to continue during part or all of the 35-year period evaluated for proposed nuclear infrastructure operations. The values in this row reflect a curtailment of stockpile stewardship management activities during this time period.
b. Highly enriched uranium disposition activities.
c. Nuclear infrastructure activities from Alternative 2, Option 7.
d. The more stringent of the Federal and state standards is presented if both exist for the averaging period.

Source: DOE 1996b; 1996d; 1997a; 1999e:5-27; Hamilton et al. 1999; modeled results from nuclear infrastructure operations are based on the SCREEN3 computer code (EPA 1995); Sections 4.4.1.1.3 and 4.4.7.1.3 of this NI PEIS.

4.8.1.3 Public and Occupational Health and Safety—Normal Operations

Cumulative impacts in terms of radiation exposure to the public and workers at ORR are presented in **Table 4–165**. There would be no increase expected in the number of latent cancer fatalities in the population from ORR site operations if nuclear infrastructure operations were to occur at HFIR and REDC. The dose limits for individual members of the public are given in DOE Order 5400.5. As discussed in that order, the dose limit from airborne emissions is 10 millirem per year, as required by the Clean Air Act; the dose limit from drinking water is 4 millirem per year, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 millirem per year. Therefore, as is evident in Table 4–165, the dose to the maximally exposed individual would be expected to remain well within the regulatory limits. Onsite workers would be expected to see an increase of approximately 0.17 latent cancer fatality due to radiation from nuclear infrastructure operations over the 35-year operational period.

Table 4–165 Maximum Cumulative Radiation Impacts at ORR

Impact	Maximally Exposed Individual		Population Dose Within 80 Kilometers (50 Miles) (Year 2020)		Total Site Workforce	
	Annual Dose (millirem per year)	Risk of a Latent Cancer Fatality[a]	Dose (person-rem)	Number of Latent Cancer Fatalities[a]	Dose (person-rem per year)	Number of Latent Cancer Fatalities[a]
Existing site activities[b]	4.4	7.7×10^{-5}	60.3	1.1	103	1.4
HEU disposition	0.039	6.8×10^{-7}	0.16	0.0028	11	0.16
Stockpile stewardship and management	0.2	3.5×10^{-6}	0.6	0.011	-1.8	-0.025
Waste management	0.35	6.1×10^{-6}	1.2	0.021	0.45	0.0063
New nuclear infrastructure operations at ORR[c]	1.9×10^{-6}	3.3×10^{-11}	8.8×10^{-5}	1.5×10^{-6}	12	0.168
Total	5.0[d]	8.7×10^{-5}[(d)]	62	1.1	125	1.7

a. These values are calculated based on a 35-year exposure period.

b. Environmental impacts associated with present activities at ORR that are anticipated to continue during all or part of the 35-year period evaluated for proposed nuclear infrastructure operations.

c. Impacts are bounded by Option 7 of Alternative 2.

d. The same individual would not be expected to be the maximally exposed individual for all activities at ORR. The location of the maximally exposed individual depends upon where on the site an activity is performed. However, to provide an upper bound of the cumulative impacts to the maximally exposed individual, the impacts from each activity have been summed.

Source: (1) Hamilton et al. 1999:chap. 6 for impacts to the public from existing site activities and DOE 1999k:table B-1c for impacts to the site workforce from existing site activities; (2) DOE 1996a:chap. 4 and DOE 1997a:chap. 11 for all impacts associated with each of the other activities listed in the first column, except nuclear infrastructure operations; and (3) Section 4.4.7.1.9 of this NI PEIS for all impacts associated with nuclear infrastructure operations. Impacts presented in the source documents have been adjusted, as appropriate, to reflect the Records of Decision for waste management, as discussed in Chapter 3.

4.8.1.4 Waste Management

Cumulative amounts of waste generated at ORR are presented in **Table 4–166**. It is unlikely that there would be major impacts on waste management at ORR because sufficient capacity would exist to manage the site wastes. As discussed in Section 4.3.1.1.13, irrespective of how the waste from processing irradiated neptunium-237 targets is classified (i.e., transuranic or high-level radioactive), the waste composition and characteristics are the same, and the management (i.e., treatment and onsite storage), as described in this NI PEIS, would be the same. In addition, either waste type would require disposal in a suitable repository. None of the options assessed in this NI PEIS would generate more than a small amount of additional waste at ORR.

4.8.2 Cumulative Impacts at INEEL

For INEEL, the bounding option for this NI PEIS is Option 2 of Alternative 2. This option calls for the operation of ATR to irradiate neptunium-237 targets and the operation of FDPF to fabricate and process these targets. The impacts associated with ATR and FDPF operations for other missions are included under “existing site activities.”

Table 4–166 Cumulative Impacts on Waste Management Activities at ORR Over 35-Year Period (cubic meters)

Waste Type	Existing Site Activities[a]	Treatment and Shipment of Transuranic Waste[b]	Surplus Plutonium Disposition[c]	Spallation Neutron Source[d]	New Nuclear Infra-structure Operations[e]	Total	Site Capacity[f]		
							Treatment (cubic meters/ year)	Storage	Disposal
Transuranic (High-level radioactive)[g]	766 (0)	607 (0)	11 (0)	0 (0)	385 (385)	1,769 (385)	4,050/5 years (0)	2,845 (0)	NA (NA)
Low-level radioactive	335,755	2,778	140	612,000	<2,145	~952,818	440,405	87,776	NA
Mixed low-level radioactive	28,035	23	1	623	<175	~28,857	263,560	234,226	NA
Hazardous[h] (kilograms)	1,260,000	0	1	1,435,000	227,500	2,922,501	1,738,803	7,312	NA
Nonhazardous									
Liquid	23,845,500	1,560	1,500	2,415	99,925	23,950,900	3,395,918	NA	NA
Solid	2,590,000	5,500	130	47,215	5,180	2,648,025	NA	NA	1,219,000

a. Total 35-year waste generation estimate was derived from annual waste generation rates based on historical data obtained from Wham 1999c.
b. Data from the *Final Environmental Impact Statement for Treating Transuranic (TRU)/Alpha Low-Level Waste at the Oak Ridge National Laboratory* (DOE 2000c:S-31) Low-Temperature Drying Alternative and selected in the Record of Decision (65 FR 48683).
c. Data from the *Surplus Plutonium Disposition Final EIS* (DOE 1999a: 4-394) postirradiation examination (2006 through 2009) and selected in Record of Decision (65 FR 1608).
d. Data from the *Spallation Neutron Source Final EIS* (DOE 1999e:3-31).
e. Option 7 of Alternative 2. This alternative would generate the most waste for all waste types.
f. Total 35-year and annual capacity derived from Table 3–13.
g. Refer to Section 4.3.1.1.13 for a discussion on the classification of waste from processing irradiated neptunium-237 targets. Volumes in parentheses represent high-level radioactive waste.
h. Assumes for hazardous waste that 353 kilograms equal 1 cubic meter (22 pounds equal 1 cubic foot).

Note: To convert from cubic meters to cubic yards, multiply by1.308; < means "less than"; ~ means "approximately;" NA, not applicable (i.e., the majority of the waste is not routinely treated, stored, or disposed of on site).

Source: DOE 1999a:4-394; 65 FR 1608; DOE 1999e:3-31; DOE 2000c:S-31; 65 FR 48683; Wham 1999c; Sections 4.3.1.1.13 and 4.4.7.1.13 of this NI PEIS.

4.8.2.1 Resource Requirements

Cumulative impacts on resource requirements at INEEL are presented in **Table 4–167**. INEEL would remain within its site capacity for all major resources. If Option 2 of Alternative 2 were implemented, the proposed nuclear infrastructure facilities would require essentially no change in the site's use of electricity or water.

Cumulatively, INEEL would use 80 percent of its electrical capacity and 13 percent of its water capacity. Site employment would increase by approximately 24 workers.

Table 4–167 Maximum Cumulative Resource Use and Impacts at INEEL

Activities[a]	Site Employment	Electrical Consumption (megawatt-hours per year)	Water Usage (million liters per year)
Existing site activities[b]	7,993	232,500	4,830
SNF Management and INEL Environmental Restoration and Waste Management	–	2,200	2
Foreign Research Reactor SNF Management	–	1,000	2
Waste Management PEIS	–	13,980	194
Advanced Mixed Waste Treatment Project	–	33,000	16
High-Level Waste and Facilities Disposition	–	33,000	351
New nuclear infrastructure operations[c]	24[d]	Negligible[e]	1.68
Total	8,017	~315,680	5,397
Total site capacity	NA	394,200	43,000

a. See Section 4.8 and Table 4–162 for descriptions of past, present, and reasonably foreseeable actions considered.
b. Reflects current sitewide activities (except that "Site Employment" value also reflects projected employment from other activities) that are anticipated to continue during all or part of the 35-year period evaluated for proposed nuclear infrastructure operations.
c. Nuclear infrastructure activities from Alternative 2, Option 2.
d. Some, or all, of those worker requirements may be filled by the reassignment of the existing workforce.
e. Additional electricity consumption associated with this option would be negligible compared to that associated with existing facility activities.

Note: To convert from liters per year to gallons per year, multiply by 0.264; to convert from megawatt-hours to British thermal units, multiply by 3.42×10^6; ~ means "approximately," and indicates that new nuclear infrastructure operations would contribute only minimally.

Key: NA, not applicable; SNF, spent nuclear fuel.

Source: DOE 1995c:K-16; 1996c:4-53, 4-54, F-164; 1997a:6-18, 6-32, 6-45, 6-55, 6-67; 1999a:3-85, 4-379; 1999c:5.13-2; 1999g:5-86; French, Tallman, and Taylor 1999:v; Sections 4.4.2.1.4 and 4.4.2.1.8 of this NI PEIS.

4.8.2.2 Air Quality

Cumulative impacts on air quality at INEEL are presented in **Table 4–168**. INEEL is currently in compliance with all Federal and state ambient air quality standards, and would continue to remain in compliance, even with consideration of the cumulative effects of all activities. The contributions of nuclear infrastructure operations to overall site concentrations are expected to be very small.

Table 4–168 Maximum Cumulative Air Pollutant Concentrations at INEEL for Comparison with Ambient Air Quality Standards

Parameter	**Carbon Monoxide**		**Nitrogen Dioxide**	**PM_{10}**		**Sulfur Dioxide**		
Averaging Period	8 hours	1 hour	Annual	Annual	24 hours	Annual	24 hours	3 hours
Activities								
Existing site activities[a] (micrograms per cubic meter)	78	206	0.46	0.49	12	0.14	5.3	24
ANL–W contribution[b] (micrograms per cubic meter)	41	59	13	0.14	1.1	3.3	27	60
Advanced Mixed Waste Treatment Project[c] (micrograms per cubic meter)	0.85	115	0.34	0.006	4.6	0.012	4.5	25
HLW & FD[d] (micrograms per cubic meter)	4.2	10	0.19	0.02	0.28	0.57	8.9	42
New nuclear infrastructure operations[e] (micrograms per cubic meter)	0	0	3.66×10^{-4}	0	0	0.024	0.19	0.43
Total concentration (micrograms per cubic meter)	124	390	14	0.656	18	4.05	45.9	151
Standard								
Most stringent standard[f] (micrograms per cubic meter)	10,000	40,000	100	50	150	80	365	1,300

a. Environmental impacts associated with existing site activities (excluding activities at ANL–W) as shown in the *Idaho High-Level Waste and Facilities Disposition Draft EIS*, Table C.2-14 (DOE 1999g) and in the *Final EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*, Table 3–2 (DOE 2000b). The activities whose concentrations are given in this row, are anticipated to continue during part or all of the 35-year period evaluated for proposed nuclear infrastructure operations.
b. The contribution from existing ANL–W sources as shown the *Final EIS for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel*, Table 3–2 (DOE 2000b).
c. *Advanced Mixed Waste Treatment Project Final EIS* activities—proposed action with microencapsulation or vitrification, Table 5.7-6 (DOE 1999c).
d. High-level waste and facilities disposition site boundary contribution for planning basis option, Table C.2-14 (DOE 1999g).
e. Nuclear infrastructure activities from Alternative 2, Option 2.
f. The more stringent of the Federal and state standards is presented if both exist for the averaging period.

Key: HLW & FD = high-level waste and facilities disposition.

Source: DOE 1999c:5.7-15, 1999g, 2000b:sec. 4.11; modeled results for nuclear infrastructure operations are based on the SCREEN3 computer code (EPA 1995); Section 4.4.2.1.3 of this NI PEIS.

4.8.2.3 Public and Occupational Health and Safety—Normal Operations

Cumulative impacts in terms of radiation exposure to the public and workers at INEEL are presented in **Table 4–169**. There would be no increase expected in the number of latent cancer fatalities in the population from INEEL site operations if nuclear infrastructure operations were to occur at ATR and FDPF. The dose limits for individual members of the public are given in DOE Order 5400.5. As discussed in that order, the dose limit from airborne emissions is 10 millirem per year, as required by the Clean Air Act; the dose limit from drinking water is 4 millirem per year, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 millirem per year. Therefore, as is evident in Table 4–169, the dose to the maximally exposed individual would be expected to remain well within the regulatory limits. Onsite workers would be expected to see an increase of approximately 0.17 latent cancer fatality due to radiation from nuclear infrastructure operations over the 35-year operational period.

Table 4–169 Maximum Cumulative Radiation Impacts at INEEL

Impact	Maximally Exposed Individual		Population Dose Within 80 Kilometers (50 Miles) (Year 2020)		Total Site Workforce	
	Annual Dose (millirem per year)	Risk of a Latent Cancer Fatality[a]	Dose (person-rem)	Number of Latent Cancer Fatalities[a]	Dose (person-rem per year)	Number of Latent Cancer Fatalities[a]
Existing site activities[b]	0.008	1.7×10^{-7}	0.075	0.0013	64.9	0.91
Storage and disposition	1.6×10^{-6}	2.8×10^{-11}	1.8×10^{-5}	3.2×10^{-7}	25	0.35
Foreign research reactor spent nuclear fuel	5.6×10^{-4}	9.8×10^{-9}	0.0045	7.9×10^{-5}	33	0.46
Spent nuclear fuel	0.008	1.4×10^{-7}	0.19	0.0033	5.4	0.076
Advanced Mixed Waste Treatment Project	0.022	3.9×10^{-7}	0.009	1.6×10^{-4}	4.1	0.057
High-level waste and facilities disposition	0.002	3.5×10^{-8}	0.10	0.0018	59	0.83
Sodium-bonded spent nuclear fuel	0.002	3.5×10^{-8}	0.012	2.1×10^{-4}	22	0.31
New nuclear infrastructure operations at ATR and FDPF[c]	2.6×10^{-7}	4.6×10^{-12}	3.9×10^{-6}	6.8×10^{-8}	12	0.17
Total	0.043[d]	7.4×10^{-7}(d)	0.39	0.0068	225.4	3.16

a. These values are calculated based on a 35-year exposure period.
b. Environmental impacts associated with present activities at INEEL that are anticipated to continue during all or part of the 35-year period evaluated for proposed nuclear infrastructure operations.
c. Impacts are bounded by Option 2 of Alternative 2.
d. The same individual would not be expected to be the maximally exposed individual for all activities at INEEL. The location of the maximally exposed individual depends upon where on the site an activity is performed. However, to provide an upper bound of the cumulative impacts to the maximally exposed individual, the impacts from each activity have been summed.

Source: (1) Saffle et al. 2000 for impacts to the public from existing site activities and DOE 1999k for impacts to the workforce from existing site activities; (2) DOE 1995c and DOE 1996a for all impacts associated with storage and disposition activities, foreign research reactor spent nuclear fuel activities, spent nuclear fuel activities, advanced mixed waste treatment activities, and high-level waste activities; (3) DOE 2000b for all impacts associated with sodium-bonded spent nuclear fuel activities; and (4) Section 4.4.2.1.9 of this NI PEIS for all impacts associated with infrastructure operations.

4.8.2.4 Waste Management

Cumulative amounts of waste generated at INEEL are presented in **Table 4–170**. It is unlikely that there would be major impacts on waste management at INEEL because sufficient capacity would exist to manage the site waste. As discussed in Section 4.3.2.1.13, irrespective of how the waste from processing of irradiated neptunium-237 targets is classified (i.e., transuranic or high-level radioactive), the waste composition and characteristics are the same, and the management (i.e., treatment and onsite storage), as described in this NI PEIS, would be the same. In addition, either waste type would require disposal in a suitable repository. None of the alternatives assessed in this NI PEIS would generate more than a small amount of additional waste at INEEL.

Table 4–170 Cumulative Impacts on Waste Management Activities at INEEL Over 35-Year Period (cubic meters)

Waste Type	Existing Site Activities[a]	Idaho HLW and Facility Disposition EIS[b]	Treatment and Management of Sodium-Bonded SNF[c]	New Nuclear Infrastructure Operations[d]	Total	Site Capacity[e]		
						Treatment (cubic meters/ year)	Storage	Disposal (cubic meter/ year)
Transuranic (High-level[f] radioactive)	65,000[g] (0)	110 (0)	14 (0)	245 (245)	65,369 (245)	57,794 (6,434)	190,319 (19,483)	NA (NA)
Low-level radioactive	135,600	15,325	862	<2,320	~154,107	42,363	177,493	69,530
Mixed low-level radioactive	3,767	12,837	40	<175	~16,819	157,092	187,761	NA
Hazardous	1,180	2,457	0	227,500 kilograms (644 cubic meters)[h]	4,281	NA	9,619	NA
Nonhazardous	124,905	145,262	4,960	64,015	339,142	3,200,000	NA	3,062,000

a. DOE 2000b:table 4–67 and figures 5.4–1 through 5.4–3 and input values for those figures through year 2035.
b. DOE 2000b:table 4–67, Separations Alternative. Maximum quantities for any alternative.
c. DOE 2000b:table 4–18, Alternative 1, electrometallurgically treat blanket and driver fuel at ANL–W; 12 years of operation and selected in the Record of Decision (65 FR 56565).
d. Option 2 of Alternative 2 would generate the most waste for all waste types.
e. Total 35-year and annual capacity derived from Table 3–27.
f. Refer to Section 4.3.2.1.13 for a discussion on the classification of waste from processing irradiated neptunium-237 targets. Volumes in parentheses represent high-level radioactive waste.
g. This 65,000 cubic meters is in storage at the Radioactive Waste Management Complex.
h. Assumes for hazardous waste that 353 kilograms equals 1 cubic meter (22.0 pounds equals 1 cubic foot).

Note: To convert from cubic meters to cubic yards, multiply by 1.308; HLW means high-level radioactive waste; SNF means spent nuclear fuel; < means "less than"; ~ means "approximately;" NA, not applicable (i.e., the majority of the waste is not routinely treated, stored, or disposed of on site).
Source: DOE 2000b:table 4–67 and figures 5.4–1 through 5.4–3 and input values for those figures through year 2035; Sections 4.3.2.1.13 and 4.4.1.1.13 of this NI PEIS.

4.8.3 Cumulative Impacts at Hanford

For Hanford, the bounding option for this NI PEIS depends on the parameter assessed. For example, under Public and Occupational Health and Safety, the highest radiological doses and associated latent cancer fatalities to the public would be associated with Option 1 of Alternative 1, whereas the highest doses and latent cancer fatalities to workers would be associated with Option 3 of this same alternative. Processing of targets in RPL versus processing in FMEF accounts for there being different bounding options (refer to Tables 4–41, 4–42, 4–17, and 4–18). For each of the parameters addressed in this section, a footnote is included in each of the cumulative impact tables, as necessary, to indicate the bounding alternative/option.

4.8.3.1 Resource Requirements

Cumulative impacts on resource requirements at Hanford are presented in **Table 4–171**. Hanford would remain within its site capacity for all major resources. If any of the options under Alternative 1 were implemented, the proposed nuclear infrastructure facilities would require a small increase in the site's use of electricity and water. For the bounding options identified in Table 4–171, this would reflect an increase of about 2 and 1 percent, respectively, over current baseline utilization for these resources. There would be no additional land disturbance or development. Cumulatively, Hanford would use approximately 23 percent of its electrical capacity and 38 percent of its water capacity. Site employment would increase by approximately 130 workers.

Table 4–171 Maximum Cumulative Resource Use and Impacts at Hanford

Activities[a]	Site Employment	Electrical Consumption (megawatt-hours per year)	Water Usage (million liters per year)
Existing site activities[b]	16,005	323,128	2,754[c]
Tank Waste Remediation System	–	170,000	200
Waste Management PEIS	–	13,920	133
New nuclear infrastructure operations[d]	130[e]	55,000	80
Total	16,135	562,048	3,167
Total site capacity	NA	2,484,336	8,263[c]

a. See Section 4.8 and Table 4–162 for descriptions of past, present, and reasonably foreseeable actions considered.
b. Reflects current sitewide activities. The "Site Employment" value also reflects projected employment from other activities that are anticipated to continue during all or part of the 35-year period evaluated for proposed nuclear infrastructure operations.
c. Reflects domestic/potable water only and not raw water usage or availability.
d. Electrical consumption and water usage are bounded by Option 3 or 6 of Alternative 1, with the values reflecting the increase over standby operations from restart of FFTF and associated support activities in FMEF.
e. Some, or all, of these worker requirements may be filled by the reassignment of the existing site workforce.

Note: To convert from liters per year to gallons per year, multiply by 0.264; to convert from megawatt-hours to British thermal units, multiply by 3.42×10^6.

Key: NA, not applicable.

Source: DOE 1996e:5-284; 1997a:5-18, 5-32, 5-45, 5-55, 5-67; 1999a:3-45, 4-376; Sections 4.3.3.1.4 and 4.3.3.1.8 of this NI PEIS.

4.8.3.2 Air Quality

Cumulative impacts on air quality at Hanford are presented in **Table 4–172**. Hanford is currently in compliance with all Federal and state ambient air quality standards, and would continue to be in compliance even with consideration of the cumulative effects of all activities. The nuclear infrastructure contributions to overall site concentrations are expected to be very small.

4.8.3.3 Public and Occupational Health and Safety—Normal Operations

Cumulative impacts in terms of radiation exposure to the public and workers at Hanford are presented in **Table 4–173**. There would be no increase expected in the number of latent cancer fatalities in the population from Hanford site operations if nuclear infrastructure operations were to occur at FMEF. The dose limits for individual members of the public are given in DOE Order 5400.5. As discussed in that order, the dose limit from airborne emissions is 10 millirem per year, as required by the Clean Air Act; the dose limit from drinking water is 4 millirem per year, as required by the Safe Drinking Water Act; and the dose limit from all pathways combined is 100 millirem per year. Therefore, as is evident in Table 4–173, the dose to the maximally exposed individual would be expected to remain well within the regulatory limits. Onsite workers would be expected to see an increase of approximately 0.26 latent cancer fatality due to radiation from nuclear infrastructure operations over the 35-year operational period.

Radiation doses listed under site activities in Table 4–173 include exposures due to activities associated with waste management (as estimated in the *Hanford Comprehensive Land-Use Plan* (DOE 1999d), the tank waste remediation system (DOE 1996e), management of spent nuclear fuel from the K Basins (DOE 1996h), disposal of decommissioned naval reactor plants (Navy 1996), and the Plutonium Finishing Plant Stabilization (DOE 1996g).

Table 4–172 Maximum Cumulative Air Pollutant Concentrations at Hanford for Comparison with Ambient Air Quality Standards

Parameter	**Carbon Monoxide**		**Nitrogen Dioxide**	**PM_{10}**		**Sulfur Dioxide**			
Averaging Period	8 hours	1 hour	Annual	Annual	24 hours	Annual	24 hours	3 hours	1 hour
Activities									
Existing site activities[a] (micrograms per cubic meter)	27.3	63.3	0.666	0.0182	1.01	0.175	30.17	69.4	79.4
Hanford tank waste remediation[b] (micrograms per cubic meter)	34	48	0.12	0.0079	0.75	0.020	1.6	3.6	4
Spent nuclear fuel management[c] (micrograms per cubic meter)	0	0	0.1	0	0	0	0	0	0
New nuclear infrastructure FFTF operations[d] (micrograms per cubic meter)	52.1	74.4	0.0118	8.39×10^{-4}	9.84	0.00785	9.11	20.5	22.8
New nuclear infrastructure FMEF operations[d] (micrograms per cubic meter)	0	0	4.43×10^{-5}	0	0	0.0087	0.069	0.16	0.17
Total concentration (micrograms per cubic meter)	113.4	185.7	0.90	0.027	11.6	0.212	40.9	93.7	106
Standard									
Most stringent standard[e] (micrograms per cubic meter)	10,000	40,000	100	50	150	50	260	1,300	660

a. Environmental impacts associated with existing site activities as described in Section 3.4.3 of this NI PEIS. The values listed are the summed values presented in Table 3–29. These activities are anticipated to continue during part or all of the 35-year period evaluated for proposed nuclear infrastructure operations.
b. *Hanford Tank Waste Remediation Final EIS* activities, vitrification facilities from Table 5.3-1, Phased Implementation – Phase II Operation (DOE 1996e).
c. *Spent Nuclear Fuel Management* – regionalization alternative (DOE 1995c:vol. 1, app. A, p. 5-43).
d. Nuclear infrastructure contributions are bounded by Alternative 1, Option 3. Periodic testing of emergency diesel generators would result in higher values for certain pollutants and time periods (Section 4.3.3.1.3).
e. The more stringent of the Federal and State standards is presented if both exist for the averaging period.

Note: The contribution from activities in the *Final Waste Management Programmatic EIS* (DOE 1997a) are small and are not shown.
Source: DOE 1995c, 1996e, 1997a; Wisness 2000; modeled results for nuclear infrastructure operations are based on the SCREEN3 computer code (EPA 1995); Sections 3.4.3 and 4.3.3.1.3 of this NI PEIS.

Table 4–173 Maximum Cumulative Radiation Impacts at Hanford

Impact	Maximally Exposed Individual		Population Dose Within 80 Kilometers (50 Miles) (Year 2020)		Total Site Workforce	
	Annual Dose (millirem per year)	Risk of a Latent Cancer Fatality[a]	Dose (person-rem)	Number of Latent Cancer Fatalities[a]	Dose (person-rem per year)	Number of Latent Cancer Fatalities[a]
Existing site activities[b]	0.02	3.5×10^{-7}	0.60	0.011	181	2.5
Waste management	0.0057	2.9×10^{-9}	0.28	0.0014	1,300	5.2
Tank remediation	(c)	2.4×10^{-6}	(c)	0.19	(c)	3.27
Spent nuclear fuel management	(c)	1.4×10^{-8}	(c)	8.0×10^{-4}	(c)	0.057
Burial of low-level waste	0	0	0	0	1,018	0.41
Plutonium Finishing Plant stabilization	0.13	3.9×10^{-7}	2.3	0.007	157	0.38
New nuclear infrastructure operations at FFTF and FMEF or RPL[d]	0.0054	9.5×10^{-8}	0.25	0.0044	18	0.26
Total	(e)	3.3×10^{-6} (f)	(e)	0.21	(e)	12

a. These values are calculated based on a 35-year exposure period except for waste management (project duration for waste transfer of 10 years) and Plutonium Finishing Plant stabilization (a 6-year project).
b. Environmental impacts associated with present activities at Hanford (including activities at other non-DOE facilities at, or near, Hanford) that are anticipated to continue during all or part of the 35-year period evaluated for proposed nuclear infrastructure operations.
c. Source document provides project total; annual values are not constant.
d. Impacts on the public are bounded by Option 1 of Alternative 1; impacts on workers are bounded by Option 3 of Alternative 1.
e. Some source documents did not provide dose values, only expected latent cancer fatalities. Therefore, total dose estimates have not been developed.
f. The same individual would not be expected to be the maximally exposed individual for all activities at Hanford. The location of the maximally exposed individual depends upon where an activity is performed on the site. However, to provide an upper bound cumulative impact for the maximally exposed individual, the impacts from each activity have been summed.

Source: (1) Dirkes, Hanf, and Poston 1999:chap. 5 and DOE 1997a for impacts to the public from existing site activities and DOE 1999k:table B-1c for impacts to the workforce from existing site activities; (2) DOE 1996a:chap. 4, 1996e:table 5.11.1, 1996g:table 3-12a, 1997a:table 11.6-2, 1999d:sec. 5.6.4; Navy 1996:sec. 4.3.3.5 for impacts associated with each of the other activities listed in the first column, except nuclear infrastructure operations; and (3) Sections 4.3.1.1.9 and 4.3.3.1.9 of this NI PEIS for all impacts associated with nuclear infrastructure operations.

4.8.3.4 Waste Management

Cumulative amounts of waste generated at Hanford are presented in **Table 4–174**. It is unlikely that there would be major impacts on waste management at Hanford because sufficient capacity would exist to manage the site waste. As discussed in Sections 4.3.3.1.13 and 4.4.3.1.13, irrespective of how the waste from processing of irradiated neptunium-237 targets is classified (i.e., transuranic or high-level radioactive), the waste composition and characteristics are the same, and the management (i.e., treatment and onsite storage), as described in this NI PEIS, would be the same. In addition, either waste type would require disposal in a suitable repository. None of the alternatives assessed in this NI PEIS would generate more than a relatively small amount of additional waste at Hanford.

Table 4–174 Cumulative Impacts on Waste Management Activities at Hanford Over 35-Year Period (cubic meters)

Waste Type	Existing Site Activities[a]	New Nuclear Infrastructure Operations	Total	Site Capacity[b]		
				Treatment (cubic meters/ year)	Storage	Disposal
Transuranic (High-level radioactive)[c]	9,880 (0)	385[d] (385)	10,265 (385)	98,520 (50,000)	17,216 (146,000)	NA (NA)
Low-level radioactive	95,666	5,015[d]	100,681	398,112	99,910	1,970,000
Mixed low-level radioactive	46,207	315[d]	46,522	413,211	100,483	14,200
Hazardous	19,600	3,100[e]	22,700	NA	NA	NA
Nonhazardous						
Liquid	7,000,000	1,494,500[d]	8,494,500	120,000	NA	4,807,720
Solid	1,505,000	10,500[d]	1,515,500	NA	NA	NA

a. Total 35-year waste generation derived from DOE 1999h, except for hazardous and nonhazardous waste, which were derived from Table 3–34.
b. Total 35-year and annual capacity derived from Table 3–36.
c. Refer to Section 4.3.3.1.13 and 4.4.3.1.13 for a discussion on the classification of waste from processing irradiated neptunium-237 targets. Volumes in parentheses represent high-level radioactive waste.
d. The bounding alternative for this waste type is Alternative 1, Option 3 or 6.
e. The bounding alternative for this waste type is Alternative 2, Option 3, 6, or 9; Alternative 3, Option 3; or Alternative 4, Option 3; which all include the deactivation of FFTF and neptunium-237 target fabrication and processing at FMEF. The inventory of bulk metallic sodium (Section 4.4.1.2.13) is not included because alternative sponsors and/or users will be found for its disposition.
Note: To convert from cubic meters to cubic yards, multiply by1.308.
Source: DOE 1996a; DOE 1999h; Sections 4.3.3.1.13 and 4.4.1.2.13 of this NI PEIS.

4.8.3.5 Spent Nuclear Fuel Management

As discussed in Section 4.3.1.1.14, the operation of FFTF for the proposed activities at 100 megawatts for 35 years under Alternative 1 would produce a total of about 16 metric tons of heavy metal (35,200 pounds) of spent nuclear fuel. The existing spent nuclear fuel at Hanford is about 2,133 metric tons of heavy metal (4,700,000 pounds) (DOE 1995c). The environmental impacts associated with the existing spent nuclear fuel management at Hanford are addressed in the following documents:

- DOE 1996a—*Storage and Disposition of Weapons-Usable Fissile Materials Fuel Programmatic Environmental Impact Statement*
- DOE 1995c—*Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho Nuclear Engineering Laboratory Environmental Restoration and Waste Management Final Environmental Impact Statement*
- DOE 1997c—*Environmental Assessment - Management of Hanford Site, Non-Defense Production Reactor Spent Nuclear Fuel*
- DOE 1996h—*Final Environmental Impact Statement, Management of Spent Nuclear Fuel from the K Basins at the Hanford Site*

The management of the existing spent fuel at Hanford results in a dose of less than 0.1 millirem per year to the maximally exposed member of the public. This dose is well within the DOE dose limits cited in

Section 4.8.3.3. DOE has committed to remove the spent fuel at Hanford for ultimate disposition in a geologic repository. The restart of FFTF under Alternative 1 would generate 16 metric tons of heavy metal of spent nuclear fuel, which is less than 1 weight-percent of the total spent nuclear fuel inventory presently at Hanford. Only a small fraction of the dose shown for nuclear infrastructure operations would be attributable to the management of this spent fuel at FFTF. The doses at Hanford, including those associated with spent nuclear fuel management, would remain within the DOE dose limits.

4.8.4 Cumulative Impacts at the Generic CLWR Site

No incremental environmental impacts at the generic site would be expected from the normal operation of a CLWR to irradiate targets (refer to Sections 4.4.4 through 4.4.6). Therefore, the cumulative impacts at the generic CLWR site would not be affected by any action assessed in this NI PEIS, and are not addressed further.

4.8.5 Cumulative Impacts at the New Accelerator(s) Generic DOE Site

Cumulative impacts cannot be presented for a generic site. If Alternative 3 were selected for implementation, a subsequent site-specific analysis would be conducted for the DOE site chosen for the combination of new accelerator(s) and support facility (refer to Section 4.5), and appropriate NEPA documentation would be prepared to address the cumulative impacts for that site.

4.8.6 Cumulative Impacts at the New Research Reactor Generic DOE Site

Cumulative impacts cannot be presented for a generic site. If Alternative 4 were selected for implementation, a subsequent site-specific analysis would be conducted for the DOE site chosen for the new research reactor and support facility or research reactor only (refer to Section 4.6), and appropriate NEPA documentation would be prepared to address the cumulative impacts for that site.

4.8.7 Cumulative Impacts of Transportation

The cumulative impacts from transportation associated with nuclear infrastructure activities are identified in Appendix J. Because likely transportation routes cross many states, cumulative impacts are compared on a national basis. Under all alternatives assessed in this NI PEIS, occupational radiation exposure to transportation workers and exposure to the public are estimated to each represent less than 0.05 percent of the cumulative exposures from nationwide transportation (DOE 1999i) over the 35-year period of nuclear infrastructure activities. No additional traffic fatality is expected; the incremental increase in traffic fatalities would be less than 0.0001 percent per year.

4.9 MITIGATION MEASURES

As shown throughout Chapter 4, the impacts of all the alternatives would be small. No specific mitigation measures would be necessary because all potential environmental impacts would be below acceptable levels or applicable standards.

Nevertheless, DOE would maintain all public and worker exposures, both direct exposures and indirect exposures via airborne emissions, as low as is reasonably achievable. This is a long-standing DOE policy to control or manage radiation exposures and releases of radioactive material to the environment as low as social, technical, economic, practical, and public policy considerations permit. This DOE policy is not a dose limit but rather a process that has as its objective the attainment of dose levels as far below the applicable limits as practical.

Similarly, DOE has a long-standing policy to minimize waste generation. Thus, DOE would conduct all operations in a manner that generates the smallest amount of waste practical. This policy applies to all types of waste, including solid and liquid radioactive waste, hazardous waste, and mixed waste.

Alternatives 3 and 4 involve the construction of major new facilities. In these alternatives, DOE would employ modern construction practices that minimize the environmental impacts.

4.10 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

Regardless of the option selected by DOE, there may be some associated unavoidable adverse environmental impacts, although the impacts would be small. Some health risks to workers and the public would be unavoidable were the option implemented. Workers at operating sites and involved in truck shipments would be subject to the same types and frequencies of injuries and accidental deaths that workers experience across the industrial sector of the nation. Workers would also be exposed to the specific health risks of exposures to radiation and hazardous chemicals. The public would generally be at a lower risk than any of the workers involved in processing activities. During processing operations, air quality would be unavoidably affected as the result of criteria and hazardous and toxic air pollutant emissions at the site, and from worker vehicles and truck shipment vehicles. Nonradiological air quality impacts at any particular site are not expected to affect attainment status of the site's air quality control region for each criteria air pollutant.

Construction activities associated with several options (including construction of a new 76-meter (250-foot) stack at Hanford, one or two new DOE accelerators and support facility, and a new DOE nuclear research reactor and support facility) would result in short term elevated levels of particulate matter in localized areas. In addition, portions of nonsensitive terrestrial habitats would be lost when these new facilities were constructed. None of these habitat losses is expected to constitute a significant impact on the resident plant and animal species because these species have broad ranges and the amount of lost habitat would comprise only a small fraction of these communities.

If an alternative were selected which involved a DOE site not yet selected for implementation (generic DOE site), the issue of unavoidable adverse environmental impacts would be assessed as part of the site selection process. Appropriate NEPA documentation would be prepared.

4.11 Relationship Between Short-Term Use of the Environment and Long-Term Productivity

Short-term environmental impacts are those that would occur during construction and operation of target fabrication, storage, irradiation, or processing facilities. Impacts that extend beyond the period of facility operations are considered to be long-term impacts.

The implementation of any of the options assessed in this NI PEIS would result either in the short-term use of existing facilities and environmental resources, or in the construction of new facilities and their operation and ultimate decontamination and decommissioning. Facility modifications would be required for the implementation of neptunium-237 target fabrication and postirradiation plutonium-238 processing technologies at ORR, INEEL, and Hanford. In addition, facility modifications would be required at Hanford to support target fabrication and postirradiation processing for civilian nuclear energy research and industrial and medical isotope production in FFTF and perhaps at other DOE sites for targets irradiated in either one or two new DOE accelerators or a new DOE research reactor. Some new target fabrication and postirradiation processing facilities might be required to support targets irradiated in either one or two new DOE accelerators or a new DOE research reactor.

The implementation of options that require construction of new facilities would require short-term use of the environment and a variety of resources such as land, construction materials, and labor. Development of these facilities would commit lands to those uses from the beginning of the construction period through the duration of the operation period and until such facility would be fully decommissioned. Depending upon the specific locations at sites selected for these facilities, some terrestrial habitat may be lost when the area is cleared for construction. Disturbance of this acreage would eliminate the natural productivity of the land. At the end of the operational period, these facilities could be converted to other uses or decontaminated and decommissioned and the land returned to its original use or a condition compatible with future uses.

Transportation between SRS and the candidate neptunium-237 target fabrication sites; between the candidate sites for neptunium-237 target fabrication and processing and the irradiation sites; between the candidate postirradiation plutonium-238 processing sites and LANL; between an east coast port and Hanford for shipment of mixed oxide fuel; and between a U.S. fuel fabrication facility and Hanford for shipment of highly enriched uranium fuel would occur on existing roadways. Most target fabrication and postirradiation processing for industrial and medical isotopes and for civilian nuclear energy research and development would occur on the same site as the irradiation of those targets; however, there would be air and truck transport of the irradiation products to certain distribution centers. There would also be some transport of targets containing hazardous materials to the irradiation sites. These activities would result in emissions to the atmosphere that would not measurably affect regional or global air quality. Short-term uses of the environment would have no appreciable beneficial or adverse effects on long-term productivity of the environment on, or in the vicinity of, any of the sites assessed in this NI PEIS.

4.12 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section describes the major irreversible and irretrievable commitments of resources that can be identified at this programmatic level of analysis. A commitment of resources is irreversible when primary or secondary impacts limit the future options for a resource. An irretrievable commitment refers to the use or consumption of resources neither renewable nor recoverable for future use.

Processing activities related to the production of plutonium-238 described in this NI PEIS would be conducted at existing facilities. In addition, the fabrication and processing of targets used to produce industrial and medical isotopes and to conduct civilian nuclear energy research and development using FFTF at Hanford would also be conducted in existing facilities. Modifications to existing facilities would consist of improvements required to meet current environmental standards or the installation of new processing equipment. In addition, the use of FMEF at Hanford would require construction of a 76-meter (250-foot) stack.

The implementation of several alternatives described in this NI PEIS would require the construction of new facilities to fabricate, irradiate, or process targets to produce plutonium-238 for space missions, industrial and medical isotopes, or to conduct civilian nuclear energy research and development. These alternatives would include those using one or two new accelerators or a new research reactor to irradiate the targets. To limit the cost and environmental impacts of these alternatives, DOE would consider modifying existing appropriate facilities at the irradiation sites rather than constructing new facilities.

The land that is currently occupied by either existing or new processing or irradiation facilities could ultimately be returned to open space uses if buildings, roads, and other structures were removed, areas cleaned up, and the land revegetated. Alternatively, the facilities could be modified for use in other DOE programs. The commitment of such land is irreversible in the short term, but not necessarily irreversible in the long term.

The irreversible and irretrievable commitment of material resources during the life-cycles of the activities described in this NI PEIS includes construction materials that cannot be recovered or recycled, materials that are rendered radioactive and cannot be decontaminated, and materials consumed or reduced to unrecoverable forms of waste. Where construction would be necessary, materials required include wood, concrete, sand, gravel, plastics, steel, aluminum, and other metals. These construction resources, except for those that can be recovered and recycled with present technology, would be irretrievably lost. However, none of those identified construction resources is in short supply, and all are readily available in the vicinity of locations being considered for new facilities. Materials required for the processing equipment, utilities, and fuel required for transportation options comprise the irretrievable resources required to implement the various options that use either new or existing facilities. None of the alternatives requires resources that would noticeably affect local or national supplies, or that would noticeably affect the quality of the local or global environment.

4.13 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.

The average occupational total recordable cases and fatality rates for construction and operation activities are presented in **Table 4–175**.

Table 4–175 Average Occupational Total Recordable Cases and Fatality Rates (per worker-year)

Labor Category	Total Recordable Cases	Fatalities
Construction	0.053	1.39×10^{-4}
Operation	0.033	1.3×10^{-5}

Source: Section I.3.

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 4–176**.

Table 4–176 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 at these facilities for the proposed activities evaluated in this NI PEIS.
Source: Section I.3.

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

4.14 REFERENCES

Code of Federal Regulations

10 CFR Part 20, "Standards for Protection Against Radiation," U.S. Nuclear Regulatory Commission.

10 CFR Part 100, "Reactor Site Criteria," U.S. Nuclear Regulatory Commission.

10 CFR Part 835, "Occupational Radiation Protection," U.S. Department of Energy.

40 CFR Part 50, "National Primary and Secondary Ambient Air Quality Standards," Environmental Protection Agency.

DOE Orders

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, January 7, 1993.

DOE Order 420.1, *Facility Safety,* change 2, October 24, 1996.

DOE Guide 420.1-2, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Nonnuclear Facilities*, March 28, 2000.

DOE Order 435.1, "Radioactive Waste Management," July 9, 1999.

Federal Register

44 FR 1957, Executive Office of the President, 1979, "Executive Order 12114 - Environmental Effects Abroad of Major Federal Actions," January 4.

62 FR 61099, U.S. Department of Energy, 1997, "Supplemental Record of Decision for the Final Environmental Impact Statement; Interim Management of Nuclear Materials at the Savannah River Site," November 14.

63 FR 3629, U.S. Department of Energy, 1998, "Record of Decision for the Department of Energy's Waste Management Program: Treatment and Storage of Transuranic Waste," January 23.

63 FR 41810, U.S. Department of Energy, 1998, "Record of Decision for the Department of Energy Waste Management Programs: Treatment of Nonwastewater Hazardous Waste," August 5.

65 FR 1608, U.S. Department of Energy, 2000, "Record of Decision for the Surplus Plutonium Disposition Final Environmental Impact Statement," January 11.

65 FR 10061, U.S. Department of Energy, 2000, "Record of Decision for the Department of Energy's Waste Management Program: Treatment and Disposal of Low-Level Waste and Mixed Low-Level Waste; Amendment of the Record of Decision for the Nevada Test Site, February 25.

65 FR 48683, U.S. Department of Energy, 2000, "Record of Decision on Treating Transuranic (TRU)/Alpha Low-Level Waste at the Oak Ridge National Laboratory," August 9.

65 FR 56565, U.S. Department of Energy, 2000, "Record of Decision for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel," September 19.

Other References

BGE (Baltimore Gas and Electric Company), 1989, *Calvert Cliffs Independent Spent Fuel Storage Installation Environmental Report*, Lusby, MD, December 21.

Brunson, R., 1999a, Oak Ridge National Laboratory, Oak Ridge, TN, personal communications to R. L. Schlegel, Science Applications International Corporation, Germantown, MD, *Waste Associated with Shipping Neptunium from the Savannah River Site*, June 17.

Brunson, R., 1999b, Oak Ridge National Laboratory, Oak Ridge, TN, personal communications to R.L. Schlegel, Science Applications International Corporation, Germantown, MD, *NonHazardous Waste*, June.

BSSC (Building Seismic Safety Council), 1997, *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures*, FEMA 302 and 303, Washington, DC.

BWHC (B & W Hanford Company), 1999, *Hanford Data Request for FFTF Operational Support Facilities (FMEF Excluded)*, Richland, WA, November 12.

Chanin, D.I, and M.L. Young, 1997, *Code Manual for MACCS2: Volume 1, User's Guide,* SAND97-0594, Albuquerque, NM, March.

Chapin, D.H., 2000, Richland Operations Office, Richland, WA, personal communications to M.A. Spivey, Science Applications International Corporation, Germantown, MD, *Additional FMEF Waste Stream Data and Information*, June 28.

Dirkes, R.L., R.W. Hanf, and T.M. Poston, eds., 1999, *Hanford Site Environmental Report for Calendar Year 1998*, PNNL-12088, Pacific Northwest National Laboratory, Richland, WA, September.

DOE (U.S. Department of Energy),1993a, *Environmental Assessment of the Import of Russian Plutonium-238*, DOE/EA-0841, Office of Nuclear Energy, Washington, DC, June.

DOE (U.S. Department of Energy), 1993b, *Finding of No Significant Impact for Import of Russian Plutonium-238 Fuel*, 6450-01, Environment, Safety and Health, Washington, DC, June 25.

DOE (U.S. Department of Energy), 1995a, *Environmental Assessment, Shutdown of the Fast Flux Test Facility, Hanford Site, Richland, Washington*, DOE/EA-0993, Richland Operations Office, Richland, WA, May.

DOE (U.S. Department of Energy), 1995b, *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling*, DOE/EIS-0161, Office of Reconfiguration, Washington, DC, October.

DOE (U.S. Department of Energy), 1995c, *Department of Energy Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement,* DOE/EIS-0203, Office of Environmental Management, Idaho Operations Office, Idaho Falls, ID, April.

DOE (U.S. Department of Energy), 1995d, *Environmental Assessment, Melton Valley Storage Tanks Capacity Increase Project–Oak Ridge National Laboratory Oak Ridge*, *Tennessee*, DOE/EA-1044, Oak Ridge Operations Office, Oak Ridge, TN, April.

DOE (U.S. Department of Energy), 1996a, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, Office of Fissile Materials Disposition, Washington, DC, December.

DOE (U.S. Department of Energy), 1996b, *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement*, DOE/EIS-0240, Office of Fissile Materials Disposition, Washington, DC, June.

DOE (U.S. Department of Energy), 1996c, *Final Environmental Impact Statement on a Proposed Nuclear Weapons Nonproliferation Policy Concerning Foreign Research Reactor Spent Nuclear Fuel*, DOE/EIS-0218F, Assistant Secretary of Environmental Management, Washington, DC, February.

DOE (U.S. Department of Energy), 1996d, *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*, DOE/EIS-0236, Office of Technical and Environmental Support, DOE/EIS-0236, Washington, DC, September.

DOE (U.S. Department of Energy), 1996e, *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* DOE/EIS-0189, Richland Operations Office, Richland, WA, August.

DOE (U.S. Department of Energy), 1996f, *Environmental Assessment and FONSI for Management of Spent Nuclear Fuel on the Oak Ridge Reservation Oak Ridge, Tennessee*, DOE/EA-1117, Oak Ridge Operations, Oak Ridge, TN, February.

DOE (U.S. Department of Energy), 1996g, *Final Environmental Impact Statement - Plutonium Finishing Plant Stabilization,* DOE/EIS-0244F, Richland, WA, May.

DOE (U.S. Department of Energy), 1996h, *Final Environmental Impact Statement, Management of Spent Nuclear Fuel from the K Basins at the Hanford Site, Richland, Washington*, DOE/EIS-0245F, Richland, WA, January.

DOE (U.S. Department of Energy), 1997a, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, Washington, DC, May.

DOE (U.S. Department of Energy), 1997b, *Draft Technical Information Document for Interim Tritium/Long-Term Medical Isotope Production Mission at the Fast Flux Test Facility,* draft B, HNF-1855, Richland, WA, November.

DOE (U.S. Department of Energy), 1997c, *Environmental Assessment, Management of Hanford Site Non-Defense Production Reactor Spent Nuclear Fuel,* DOE/EA-1185, Richland, WA, March 1997.

DOE (U.S. Department of Energy), 1999a, *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283, Office of Fissile Materials Disposition, Washington, DC, November.

DOE (U.S. Department of Energy) 1999b, *Final Environmental Impact Statement for the Production of Tritium in a Commercial Light Water Reactor,* DOE/EIS-0288, Office of Defense Programs, Washington, DC, March.

DOE (U.S. Department of Energy), 1999c, *Idaho National Engineering and Environmental Laboratory Advanced Mixed Waste Treatment Project Final Environmental Impact Statement*, DOE/EIS-0290, Office of Environmental Management, Idaho Operations Office, Idaho Falls, ID, January.

DOE (U.S. Department of Energy), 1999d, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, DOE/EIS-0222F, Richland Operations Office, Richland, WA, September.

DOE (U.S. Department of Energy), 1999e, *Final Environmental Impact Statement, Construction and Operation of the Spallation Neutron Source,* DOE/EIS-0247, Office of Science, Washington, DC, April.

DOE (U.S. Department of Energy), 1999f, *Final Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride,* DOE/EIS-0269, Office of Nuclear Energy, Science and Technology, Germantown, MD, April.

DOE (U.S. Department of Energy), 1999g, *Idaho High-Level Waste and Facilities Disposition Draft Environmental Impact Statement,* DOE/EIS-0287D, Idaho Operations Office, Idaho Falls, ID, December.

DOE (U.S. Department of Energy), 1999h, *Solid Waste Integrated Forecast Technical (SWIFT) Report 2000.0; FY2000 to FY2046,* rev. 6, HNF-EP-0918, hanford.gov/docs/ep0918/index.htm, Richland, WA, August 31.

DOE (U.S. Department of Energy), 1999i, *Draft Environmental Impact Statement for a Geological Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada,* DOE/EIS-02500, Office of Civilian Radioactive Waste Management, North Las Vegas, NV, July.

DOE (U.S. Department of Energy), 1999j, *Radiological Control,* DOE-STD-1098-99, Washington, DC, July.

DOE (U.S. Department of Energy), 1999k, "Operations Office/Site Dose Data (1998)," *DOE Occupational Radiation Exposure, 1998 Report*, DOE/EH-0608, Office of Environment, Health and Safety, Office of Worker Health and Safety, rems.eh.doe.gov.

DOE (U.S. Department of Energy), 2000a, *Waste Minimization and Management Plan for the Fast Flux Test Facility, Hanford Site, Richland, Washington,* Revised Draft, Office of Nuclear Energy, Science and Technology, Washington, DC, May.

DOE (U.S. Department of Energy), 2000b, *Final Environmental Impact Statement for the Treatment and Management of Sodium-Bonded Spent Nuclear Fuel,* DOE/EIS-0306, Office of Nuclear Energy, Science and Technology, Washington, DC, July.

DOE (U.S. Department of Energy), 2000c, *Final Environmental Impact Statement (EIS) for Treating Transuranic (TRU)/Alpha Low-Level Waste at the Oak Ridge National Laboratory, Oak Ridge, Tennessee*, DOE/EIS-0305-F, Oak Ridge Operations Office, Oak Ridge, TN, June.

DOE (U.S. Department of Energy), 2000d, *Environmental Assessment for Transportation of Low-Level Radioactive Waste from the Oak Ridge Reservation to Off-Site Treatment or Disposal Facilities*, DOE/EA-1315, Office of Environmental Management, Oak Ridge, TN, April.

DOE (U.S. Department of Energy), 2000e, *Draft Environmental Assessment for Transportation of Low-Level Radioactive Mixed Waste from the Oak Ridge Reservation to Off-Site Treatment or Disposal Facilities*, DOE/EA-1317, Office of Environmental Management, Oak Ridge, TN, July.

DOE (U.S. Department of Energy), 2000f, *Environmental Assessment for Selection and Operation of the Proposed Field Research Centers for the Natural and Accelerated Bioremediation Research (NABIR) Program,* DOE/EA-1196, Office of Science , Washington, DC, March.

Duke (Duke Power Company), 1988, Oconee Nuclear Station, *Independent Spent Fuel Storage Installation Safety Analysis Report,* Charlotte, NC, March 31.

EPA (U.S. Environmental Protection Agency), Ecology (Washington State Department of Ecology), and DOE (U.S. Department of Energy), 1989, *Hanford Federal Facility Agreement and Consent Order,* Amendment 6, February.

EPA (U.S. Environmental Protection Agency), 1995, *SCREEN3 Model User's Guide,* EPA-454/B-95-004, Office of Air Quality Planning and Standards, Research Triangle Park, NC, September.

EPA (U.S. Environmental Protection Agency), 1998, *Title III List of Lists, Consolidated List of Chemicals Subject to the Emergency Planning and Community Right-to-Know Act (EPCRA) and Section 112 (r) of the Clean Air Act, as Amended,* EPA 550-B-98-017, Office of Solid Waste and Emergency Response, November.

EPA (U.S. Environmental Protection Agency), 1999, "Phosphoric Acid," "Methanol," "Benzene," and Ethylbenzene," *Integrated Risk Information System,* www.epa.gov/iris, Washington, DC, March 5.

French, D.L., R.E. Tallman, and K.A. Taylor, 1999, *Idaho National Engineering and Environmental Laboratory Nonradiological Waste Management Information for 1998 and Record-to-Date*, DOE/ID-10054(98), Lockheed Martin Idaho Technologies, Waste Generator Services, Idaho Falls, ID, July.

Hamilton, L.V., S.D. Thompson, L.W. McMahon, and M.L. Coffey, 1999, *Oak Ridge Reservation Annual Site Environmental Report for 1998*, DOE/ORO/2091, Oak Ridge National Laboratory, Oak Ridge, TN, December.

Herrington, W.N., 2000, Science Applications International Corporation, Richland, WA, personal communication to K. Folk, Science Applications International Corporation, Germantown, MD, *GSF Questions,* June 16.

Hill, T.J., J. Christian, R. Henry, R. Kirkham, N. Chipman, K. Moor, D. Mecham, and B. Schnitzler, 1999, *Comments on the Draft Environmental Impact Statement for the Proposed Production of Plutonium-238 for Use in Advanced Radioisotope Power Systems for Future Space Missions, July 1999*, Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID, July.

Hoyt, R.C., R.J. Venetz, J.A. Teal, D.C. Lini, R.E. Barker, L. Rodgers, C. Hawk, M.D. Crippen, and J.M. Tingey, 1999, *Summary of Strategy for Implementing Plutonium-238 Production Support Activities in FMEF*, Richland, WA, May 12.

ICC (International Code Council, Inc.), 2000, *International Building Code,* Falls Church, VA, March.

ICRP (International Commission on Radiological Protection), 1991, *1990 Recommendations of the International Commission on Radiological Protection,* ICRP Publication 60, Pergamon Press, Elmsford, NY.

ID DHW (Idaho Department of Health and Welfare), 1998, *Rules for the Control of Air Pollution in Idaho:* 577, "Ambient Air Quality Standards for Specific Air Pollutants"; 585, "Toxic Air Pollutants Non-Carcinogenic Increments"; 586, "Toxic Air Pollutants Carcinogenic Increments", IDAPA 16, Title 01, Chapter 01, Boise, ID.

Johnson, P.E., D.S. Joy, D.B. Clark, and J.M. Jacobi, 1993, *HIGHWAY 3.1—An Enhanced Highway Routing Model: Program Description, Methodology, and Revised User's Manual,* ORNL/TM-12124, Oak Ridge National Laboratory, Chemical Technology Division, Oak Ridge, TN, March.

Kirkham, R.J., 1999, *Plutonium-238 Process Sequence Summary Using the Fluorinel (FDP) Cell*, June 7.

LMER (Lockheed Martin Energy Research Corporation), 1997, *Comparative Review of Isotope Production Projects and Radiochemical Processing Activities at the Oak Ridge National Laboratory's Melton Valley 7900 Complex*, High Flux Isotope Reactor and Radiochemical Engineering Development Center, Oak Ridge, TN, updated April 18.

Mecham, D.C., 1999, Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID, personal communication to G. Waldman, Science Applications International Corporation, Germantown, MD, *Information on Normal Radiological Impacts*, February 17.

Moor, K.S., and H.K. Peterson, 1999, *INEEL Affected Environment: Supplemental Data Report in Support of the Preparation of the Plutonium-238 Production at ATR Environmental Impact Statement,* INEL/EXT-99-Draft, Lockheed Martin Idaho Technologies Company, Idaho National Engineering and Environmental Laboratory, Idaho Falls, ID, February.

Napier et al. 1988, *GENII-The Hanford Environmental Radiation Dosimetry Software System*, Vol. 2: User's Manual, PNL-6584, Richland, WA, November.

Navy (U.S. Department of the Navy), 1996, *Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Cruiser, Ohio Class, and Los Angeles Class Naval Reactor Plants,* DOE/EIS-0259, Bremerton, WA, April.

Neuhauser, K.S., and F.L. Kanipe, 2000, *RADTRAN 5 User Guide*, (SAND2000-1257), Sandia National Laboratories, Albuquerque, NM, April 24.

Nielsen, D.L., 1999, *Fast Flux Test Facility Data Request in Response to Data Call for Nuclear Infrastructure Programmatic Environmental Impact Statement*, BWHC-9958233, B&W Hanford Company, Richland, WA, December 21.

Nielsen, D.L., 2000, "December 17, 1999 Questions from Constance Haga," *Data Call Response Regarding FFTF Operational Support Facilities (FMEF Excluded),* January 24.

NPS (U.S. National Park Service), 1994, *Hanford Reach of the Columbia River Comprehensive River Conservation Study and Environmental Impact Statement, Final*, Pacific Northwest Region, Seattle, WA, June.

NRC (U.S. Nuclear Regulatory Commission), 1985, *Environmental Assessment Related to the Construction and Operation of the Surry Dry Cask Independent Fuel Storage Installation*, Office of Nuclear Material Safety and Safeguards, Washington, DC, April.

NRC (U.S. Nuclear Regulatory Commission), 1986, *Environmental Assessment Related to the Construction and Operation of the H.B. Robinson Independent Spent Fuel Storage Installation*, Office of Nuclear Material Safety and Safeguards, Washington, DC, March.

NRC (U.S. Nuclear Regulatory Commission), 1988, *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586, Office of Nuclear Regulatory Research, Washington, DC, August.

Saffle, T.R., R.B. Evans, R.G. Mitchell, and D.B. Martin, 2000, *Idaho National Engineering and Environmental Site Environmental Report for Calendar Year 1998*, DOE/ID-12082(98), esrf.org/pdf/98aser_rpt.htm, Environmental Science and Research Foundation, Idaho Falls, ID, July.

SAIC (Science Applications International Corporation), 2000, *Response to the Data Request for the Generic Facility to Support the DOE Accelerator or Research Reactor Alternatives*, Richland, WA, July 13.

Snead, L., 2000, TechSource, Inc., Santa Fe, NM, personal communication to D. Hirrlinger, Science Applications International Corporation, Germantown, MD, *GSF Questions*, July 26.

TechSource (TechSource, Inc.), 2000, *Nuclear Infrastructure PEIS Data Submittal for Accelerators*, Santa Fe, NM, July 24.

WDEC (Washington Department of Ecology), 1998, *Washington Administrative Code, Title 173:* Chapter 173-470, "Ambient Air Quality Standards for Particulate Matter"; Chapter 173-474, "Ambient Air Quality Standards for Sulfur Oxides"; Chapter 173-475, "Ambient Air Quality Standards for Carbon Monoxide, Ozone, and Nitrogen Dioxide"; Chapter 173-481, "Ambient Air Quality and Environmental Standards for Fluorides"; Chapter 173-490, "Emission Standards and Controls for Sources Emitting Volatile Organic Compounds (VOC)," July 21.

Wham, R.M. W.D. Bond, E.D. Collins, L.K. Felker, W.D. Garrett, J.B. Knauer, J.H. Miller, F.L. Peishal, R.G. Stacy, R.J. Vedder, and O.O. Yarbro, 1998, *Preconceptual Design Planning for Chemical Processing to Support Plutonium-238 Production*, rev. 0, Oak Ridge National Laboratory, Oak Ridge, TN, September.

Wham, R. M., 1999a, Oak Ridge National Laboratory, Oak Ridge, TN, personal communications to C. Haga, Science Applications International Corporation, Germantown, MD, *Response to Air Emission Question for Np Storage*, February 12, *Response to Air/Water Questions for Plutonium-238 Processing*, March 4, and *Response to Water Issues at REDC*, June 4.

Wham, R.M.,1999b, Oak Ridge National Laboratory, Oak Ridge, TN, personal communication to G. Waldman, Science Applications International Corporation, Germantown, MD, *Population Dose*, February 18.

Wham, R.M., 1999c, Oak Ridge National Laboratory, Oak Ridge, TN, personal communication to R.L. Schlegel, Science Applications International Corporation, Germantown, MD, *Existing ORR Waste Management Activities*, March 2.

Wham, R.M., 1999d, Oak Ridge National Laboratory, Oak Ridge, TN, personal communications to R.L. Schlegel, Science Applications International Corporation, Germantown, MD, *Existing ORR Waste Management Activities*, February 16.

Wham, R.M., 1999e, Oak Ridge National Laboratory, Oak Ridge, TN, personal communication to R.L. Schlegel, Science Applications International Corporation, Germantown, MD, *Clarification of Waste Generation Data*, March 31.

Wham, R.M., 2000, Oak Ridge National Laboratory, Oak Ridge, TN, personal communication to J.R. Schinner, Science Applications International Corporation, Germantown, MD, *Data for Estimating Radworker Dose*, September 18.

WHC (Westinghouse Hanford Company), 1994, *Fast Flux Test Facility Shutdown Program Plan*, rev. 1, WHC-SD-FF-SSP-004, Westinghouse Hanford Company, Richland, WA.

Wisness, S.H., 2000, U.S. Department of Energy, Richland Operations Office, Richland, WA, personal communication to S. Otterson, State of Washington, Department of Ecology, Olympia, WA, *Calendar Year 1999 Nonradioactive Inventory of Airborne Emissions Report*, correspondence number 2241, April 17.