SECTION

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Table I–31. Tank Closure Alternative 5 Deactivation Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Vacuum-Based Retrieval System (DEA_VBR)							
Radiological workers	258,100	2024	2033	10	25,810	13	13
Nonradiological workers							
On site	N/A						
Off site	N/A						
Sulfate Removal Facility (DEA_SUL)							
Radiological workers	661,368	2034	2035	2	330,684	159	199
Nonradiological workers							
On site	164,000	2034	2035	2	82,000	40	
Off site	N/A						
Contact-Handled Mixed Transuranic Waste Facilities (DEA_CH)							
Radiological workers	100,000	2011	2012	2	50,000	25	25
Nonradiological workers							
On site	N/A						
Off site	N/A						
Remote-Handled Mixed Transuranic Waste Facility (DEA_RH)							
Radiological workers	200,000	2020	2021	2	100,000	49	49
Nonradiological workers							
On site	N/A						
Off site	N/A						
Transuranic Waste Interim Storage Facility (DEA_TRU)							
Radiological workers	N/A						1
Nonradiological workers							
On site	80	2035	2035	1	80	1	
Off site	N/A						
Bulk Vitrification Facility (200-West Area) (DEA_BV)							
Radiological workers	148,000	2034	2035	2	74,000	36	45
Nonradiological workers							
On site	36,000	2034	2035	2	18,000	9	
Off site	N/A						
Solid-Liquid Separations Facility (200-West Area) (DEA_SEPW)							
Radiological workers	122,000	2034	2035	2	61,000	30	39
Nonradiological workers							
On site	37,000	2034	2035	2	18,500	9	
Off site	N/A						
Cast Stone Facility (200-East Area) (DEA_CG)							
Radiological workers	48,000	2034	2035	2	24,000	12	25
Nonradiological workers							
On site	54,000	2034	2035	2	27,000	13	
Off site	N/A						
Effluent Treatment Facility (Original) (DEA_ETFO)							
Radiological workers	77,280	2026	2026	1	77,280	38	48
Nonradiological workers							
On site	19,320	2026	2026	1	19,320	10	
Off site	N/A						

Table I–31. Tank Closure Alternative 5 Deactivation Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Effluent Treatment Facility Replacement (DEA_ETF)							
Radiological workers	77,280	2037	2037	1	77,280	38	48
Nonradiological workers							
On site	19,320	2037	2037	1	19,320	10	
Off site	N/A						
242-A Evaporator (Original) (DEA_EVAO)							
Radiological workers	24,448	2018	2018	1	24,448	12	16
Nonradiological workers							
On site	7,477	2018	2018	1	7,477	4	
Off site	N/A						
242-A Evaporator Replacement (DEA_EVA)							
Radiological workers	24,448	2035	2035	1	24,448	12	16
Nonradiological workers							
On site	7,477	2035	2035	1	7,477	4	
Off site	N/A						
Total	**10,069,683**				**4,699,055**	**2,273**	**2,273**

Notes and Assumptions:

Total number of offsite full-time equivalents = 0.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–32. Tank Closure Alternative 5 Closure Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Tank-Filling Grout Facility Construction (CLO_CONGRO)							
Radiological workers	480	2022	2023	2	240	1	5
Nonradiological workers							
On site	13,360	2022	2023	2	6,680	4	
Off site	4,160	2022	2023	2	2,080	1	
Tank-Filling Grout Facility Operations (CLO_OPSGRO)							
Radiological workers	68,000	2024	2033	10	6,800	4	13
Nonradiological workers							
On site	185,280	2024	2033	10	18,528	9	
Off site	130,000	2024	2033	10	13,000	7	
Tank-Filling Grout Facility Deactivation (CLO_DEAGRO)							
Radiological workers	480	2034	2034	1	480	1	4
Nonradiological workers							
On site	4,320	2034	2034	1	4,320	3	
Off site	1,040	2034	2034	1	1,040	1	
Ancillary Equipment Grouting (CLO_ANCFIL)							
Radiological workers	287,252	2013	2033	21	13,679	7	7
Nonradiological workers							
On site	N/A						
Off site	N/A						

Table I–32. Tank Closure Alternative 5 Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Hanford Barrier Construction (CLO_HAN)							
Radiological workers	2,383,333	2029	2039	11	216,667	105	418
Nonradiological workers							
On site	7,150,000	2029	2039	11	650,000	313	
Off site	N/A						
Decontamination and Decommissioning of 10 Selected Facilities (CLO_D&DTEN)							
Radiological workers	44,418	2012	2022	11	4,038	2	9
Nonradiological workers							
On site	146,679	2012	2022	11	13,334	7	
Off site	78,970	2012	2022	11	7,179	4	
Postclosure Care (CLO_POST)							
Radiological workers	N/A						3
Nonradiological workers							
On site	471,262	2040	2139	100	4,713	3	
Off site	N/A						
Total	**10,969,033**				**962,777**	**472**	**459**

Notes and Assumptions:

Total number of offsite full-time equivalents = 13.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

I.2.9 Tank Closure Alternative 6A: All Vitrification/No Separations; Clean Closure–Base Case

Table I–33. Tank Closure Alternative 6A, Base Case, Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Canister Storage Building (CON_CSB)							
Radiological workers	115,500	2006	2016	11	10,500	6	12
Nonradiological workers							
On site	135,929	2006	2016	11	12,357	6	
Off site	50,286	2006	2016	11	4,571	3	
Immobilized High-Level Radioactive Waste Shipping/Transfer Facility (CON_STF)							
Radiological workers	N/A						380
Nonradiological workers							
Onsite construction	1,757,000	2011	2013	3	585,667	282	
Onsite exempt	610,000	2011	2013	3	203,333	98	
Offsite design	748,000	2011	2013	3	249,333	120	
Immobilized High-Level Radioactive Waste Interim Storage Modules (CON_ISM)							
Radiological workers	N/A						309
Nonradiological workers							
Onsite construction	56,995,392	2014	2157	144	395,801	191	
Onsite exempt	35,200,000	2014	2157	144	244,444	118	
Offsite design	43,200,000	2014	2157	144	300,000	145	

Table I–33. Tank Closure Alternative 6A, Base Case, Construction Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Other Infrastructure Upgrades (CON_OIU)							
Radiological workers	782,094	2006	2034	29	26,969	13	45
Nonradiological workers							
On site	1,918,531	2006	2034	29	66,156	32	
Off site	743,125	2006	2034	29	25,625	13	
Tank Upgrades (CON_TU)							
Radiological workers	1,195,652	2006	2025	20	59,783	29	104
Nonradiological workers							
On site	3,112,174	2006	2025	20	155,609	75	
Off site	1,179,130	2006	2025	20	58,957	29	
Underground Transfer Lines (CON_UTL)							
Radiological workers	N/A						61
Nonradiological workers							
On site	126,005	2009	2009	1	126,005	61	
Off site	17,400	2009	2009	1	17,400	9	
Waste Treatment Plant (CON_WTP)							
Radiological workers	N/A						906
Nonradiological workers							
On site	22,612,500	2006	2017	12	1,884,375	906	
Off site	7,537,500	2006	2017	12	628,125	302	
Cesium and Strontium Capsule Processing Facility (CON_CSC)							
Radiological workers	N/A						190
Nonradiological workers							
On site	1,578,029	2158	2161	4	394,507	190	
Off site	465,683	2158	2161	4	116,421	56	
Tank Risers (CON_RIS)							
Radiological workers	188,760	2013	2016	4	47,190	23	54
Nonradiological workers							
On site	254,540	2013	2016	4	63,635	31	
Off site	N/A						
Double-Shell Tank Replacements (CON_DST)[a]							
Radiological workers	N/A						1,005
Nonradiological workers							
On site	37,590,000	2029	2114	18	2,088,333	1,005	
Off site	13,524,000	2029	2114	18	751,333	362	
Mobile Retrieval System (CON_MRS)							
Radiological workers	33,070,100	2013	2162	150	220,467	106	224
Nonradiological workers							
On site	36,507,695	2013	2162	150	243,385	118	
Off site	19,575,745	2013	2162	150	130,505	63	
Vacuum-Based Retrieval System (CON_VBR)							
Radiological workers	9,686,600	2013	2162	150	64,577	32	66
Nonradiological workers							
On site	10,344,950	2013	2162	150	68,966	34	
Off site	5,898,200	2013	2162	150	39,321	19	

Table I–33. Tank Closure Alternative 6A, Base Case, Construction Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Chemical Wash System (CON_CHW)							
Radiological workers	3,063,830	2013	2162	150	20,426	10	12
Nonradiological workers							
On site	607,453	2013	2162	150	4,050	2	
Off site	817,719	2013	2162	150	5,451	3	
High-Level Radioactive Waste Melter Interim Storage Facilities (CON_PAD)[b]							
Radiological workers	N/A						1
Nonradiological workers							
On site	19,656	2017	2138	14	1,404	1	
Off site	N/A						
Underground Transfer Line Replacements (CON_UTLU)							
Radiological workers	N/A						61
Nonradiological workers							
On site	126,005	2064	2064	1	126,005	61	
Off site	17,400	2064	2064	1	17,400	9	
Waste Treatment Plant Replacement (CON_WTPU)[c]							
Radiological workers	N/A						678
Nonradiological workers							
On site	33,800,000	2067	2138	24	1,408,333	678	
Off site	11,300,000	2067	2138	24	470,833	227	
Immobilized High-Level Radioactive Waste Shipping/Transfer Facility Replacement (CON_STFU)[d]							
Radiological workers	N/A						380
Nonradiological workers							
Onsite construction	5,271,000	2076	2198	9	585,667	282	
Onsite exempt	1,830,000	2076	2198	9	203,333	98	
Offsite design	2,244,000	2076	2198	9	249,333	120	
Immobilized High-Level Radioactive Waste Interim Storage Module Replacement (CON_ISMU)							
Radiological workers	N/A						838
Nonradiological workers							
Onsite construction	129,130,185	2078	2197	120	1,076,085	518	
Onsite exempt	79,750,000	2078	2197	120	664,583	320	
Offsite design	97,875,000	2078	2197	120	815,625	393	
High-Level Radioactive Waste Debris Storage Facilities (CON_HLWST)							
Radiological workers	N/A						4
Nonradiological workers							
On site	577,280	2041	2110	70	8,247	4	
Off site	N/A						
Effluent Treatment Facility Replacement (CON_ETF)							
Radiological workers	N/A						329
Nonradiological workers							
On site	2,047,400	2023	2025	3	682,467	329	
Off site	703,895	2023	2025	3	234,632	113	

Table I–33. Tank Closure Alternative 6A, Base Case, Construction Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Effluent Treatment Facility Replacement (CON_ETFU)[e]							
Radiological workers	N/A						329
Nonradiological workers							
On site	8,189,600	2053	2145	12	682,467	329	
Off site	865,168	2053	2145	12	72,097	35	
242-A Evaporator Replacement (CON_EVA)							
Radiological workers	N/A						102
Nonradiological workers							
On site	635,400	2015	2017	3	211,800	102	
Off site	217,918	2015	2017	3	72,639	35	
242-A Evaporator Replacement (CON_EVAU) Five 3-year construction periods[f]							
Radiological workers	N/A						102
Nonradiological workers							
On site	3,177,000	2040	2142	15	211,800	102	
Off site	1,145,741	2040	2142	15	76,383	37	
Total	**730,132,170**				**17,184,712**	**8,285**	**6,192**

[a] CON_DST activities are conducted over three 6-year periods, totaling 18 years.
Period 1, 2029–2034
Period 2, 2069–2074
Period 3, 2109–2114

[b] CON_PAD activities are conducted over seven 2-year periods, totaling 14 years.
Period 1, 2017–2018
Period 2, 2037–2038
Period 3, 2057–2058
Period 4, 2077–2078
Period 5, 2097–2098
Period 6, 2117–2118
Period 7, 2137–2138

[c] CON_WTPU activities are conducted over two 12-year periods, totaling 24 years.
Period 1, 2067–2078
Period 2, 2127–2138

[d] CON_STFU activities are conducted over three 3-year periods, totaling 9 years.
Period 1, 2076–2078
Period 2, 2136–2138
Period 3, 2196–2198

[e] CON_EFTU activities are conducted over four 3-year periods, totaling 12 years.
Period 1, 2053–2055
Period 2, 2083–2085
Period 3, 2113–2115
Period 4, 2143–2145

[f] CON_EVAU activities are conducted over five 3-year periods, totaling 15 years.
Period 1, 2040–2042
Period 2, 2065–2067
Period 3, 2090–2092
Period 4, 2115–2117
Period 5, 2140–2142

Notes and Assumptions:
Total number of offsite full-time equivalents = 2,093.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–34. Tank Closure Alternative 6A, Base Case, Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Immobilized High-Level Radioactive Waste Interim Storage Facilities (OPS_ISF)							
Radiological workers	427,868,980	2018	2262	245	1,746,404	840	1,310
Nonradiological workers							
On site	239,316,000	2018	2262	245	976,800	470	
Off site	N/A						
Other Infrastructure Upgrades (OPS_OIU)							
Radiological workers	185,545	2006	2162	157	1,182	1	4
Nonradiological workers							
On site	680,333	2006	2162	157	4,333	3	
Off site	485,273	2006	2162	157	3,091	2	
Routine Operations (OPS_ROUT)							
Radiological workers	40,820,000	2006	2162	157	260,000	125	651
Nonradiological workers							
On site	171,601,000	2006	2162	157	1,093,000	526	
Off site	24,335,000	2006	2162	157	155,000	75	
Retrieval Operations (OPS_RET)							
Radiological workers	53,523	2006	2162	157	341	1	28
Nonradiological workers							
On site	8,724,205	2006	2162	157	55,568	27	
Off site	67,795	2006	2162	157	432	1	
Interim Stabilization/Double-Shell Tanks (OPS_IST)							
Radiological workers	5,762,614	2006	2162	157	36,705	18	44
Nonradiological workers							
On site	8,246,068	2006	2162	157	52,523	26	
Off site	9,106,000	2006	2162	157	58,000	28	
Waste Treatment Plant—(OPS_WTP)							
Radiological workers	388,094,815	2018	2162	145	2,676,516	1,287	2,170
Nonradiological workers							
On site	266,176,439	2018	2162	145	1,835,700	883	
Off site	38,970	2018	2162	145	269	1	
Waste Treatment Plant—Cesium and Strontium Capsules (OPS_WTPCSC)							
Radiological workers	2,676,516	2163	2163	1	2,676,516	1,287	2,170
Nonradiological workers							
On site	1,835,700	2163	2163	1	1,835,700	883	
Off site	269	2163	2163	1	269	1	
Cesium and Strontium—Capsule Processing Facility (OPS_CSC)							
Radiological workers	103,334	2162	2163	2	51,667	25	25
Nonradiological workers							
On site	N/A						
Off site	N/A						
Mobile Retrieval System (OPS_MRS)							
Radiological workers	21,108,220	2013	2162	150	140,721	68	130
Nonradiological workers							
On site	19,105,345	2013	2162	150	127,369	62	
Off site	N/A						

Table I–34. Tank Closure Alternative 6A, Base Case, Operations Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Vacuum-Based Retrieval System (OPS_VBR)							
Radiological workers	6,634,012	2013	2162	150	44,227	22	42
Nonradiological workers							
On site	6,004,537	2013	2162	150	40,030	20	
Off site	N/A						
Chemical Wash System (OPS_CHW)							
Radiological workers	13,871,116	2013	2162	150	92,474	45	86
Nonradiological workers							
On site	12,555,102	2013	2162	150	83,701	41	
Off site	N/A						
High-Level Radioactive Waste Melter Interim Storage Facilities (OPS_PAD)							
Radiological workers	N/A	2018	2262	245			0
Nonradiological workers							
On site	N/A						
Off site	N/A						
High-Level Radioactive Waste Debris Storage Facilities (OPS_HLWST)							
Radiological workers	N/A	2042	2262	221			0
Nonradiological workers							
On site	N/A						
Off site	N/A						
Effluent Treatment Facility Replacement (OPS_ETF)							
Radiological workers	24,884,160	2006	2166	161	154,560	75	94
Nonradiological workers							
On site	6,221,040	2006	2166	161	38,640	19	
Off site	N/A						
242-A Evaporator Replacement (OPS_EVA)							
Radiological workers	7,138,758	2018	2163	146	48,896	24	32
Nonradiological workers							
On site	2,183,211	2018	2163	146	14,954	8	
Off site	N/A						
Borrow Area C (OPS_CAREA)							
Radiological workers	N/A						43
Nonradiological workers							
On site	14,482,800	2006	2167	162	89,400	43	
Off site	N/A						
Total	**1,730,366,680**				**14,394,986**	**6,937**	**6,829**

Notes and Assumptions:

Total number of offsite full-time equivalents = 108.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–35. Tank Closure Alternative 6A, Base Case, Deactivation Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Immobilized High-Level Radioactive Waste Interim Storage Facilities (DEA_ISF)							
Radiological workers	N/A						
Nonradiological workers							
On site	3,840	2078	2197	120	32	1	1
Off site	N/A						
Waste Treatment Plant (DEA_WTP)[a]							
Radiological workers	13,470,000	2078	2166	9	1,496,667	720	
Nonradiological workers							1,214
On site	9,240,000	2078	2166	9	1,026,667	494	
Off site	N/A						
Mobile Retrieval System (DEA_MRS)							
Radiological workers	2,775,115	2013	2162	150	18,501	9	
Nonradiological workers							9
On site	N/A						
Off site	N/A						
Vacuum-Based Retrieval System (DEA_VBR)							
Radiological workers	223,300	2013	2162	150	1,489	1	
Nonradiological workers							1
On site	N/A						
Off site	N/A						
Chemical Wash System (DEA_CHW)							
Radiological workers	185,472	2013	2162	150	1,236	1	
Nonradiological workers							1
On site	N/A						
Off site	N/A						
Cesium and Strontium Capsule Processing Facility (DEA_CSC)							
Radiological workers	23,920	2164	2164	1	23,920	12	
Nonradiological workers							12
On site	N/A						
Off site	N/A						
Effluent Treatment Facility Replacement (DEA_ETF)[b]							
Radiological workers	463,680	2026	2167	6	77,280	38	
Nonradiological workers							48
On site	115,920	2026	2167	6	19,320	10	
Off site	N/A						
242-A Evaporator Replacement (DEA_EVA)[c]							
Radiological workers	171,135	2018	2168	7	24,448	12	
Nonradiological workers							16
On site	52,337	2018	2168	7	7,477	4	
Off site	N/A						
Total	**26,724,719**				**2,697,036**	**1,302**	**1,302**

Table I–35. Tank Closure Alternative 6A, Base Case, Deactivation Rollup Workforce Estimate *(continued)*

[a] DEA_WTP activities are conducted over three 3-year periods, totaling 9 years.
Period 1, 2078–2080
Period 2, 2138–2140
Period 3, 2164–2166

[b] DEA_ETF activities are conducted over six 1-year periods, totaling 6 years.
Period 1, 2026–2026
Period 2, 2056–2056
Period 3, 2086–2086
Period 4, 2116–2116
Period 5, 2146–2146
Period 6, 2167–2167

[c] DEA_EVA activities are conducted over seven 1-year periods, totaling 7 years.
Period 1, 2018–2018
Period 2, 2043–2043
Period 3, 2068–2068
Period 4, 2093–2093
Period 5, 2118–2118
Period 6, 2143–2143
Period 7, 2168–2168

Notes and Assumptions:
Total number of offsite full-time equivalents = 0.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–36. Tank Closure Alternative 6A, Base Case, Closure Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Containment Structure Construction (CLO_CONCS)[a]							
Radiological workers	12,000	2038	2141	24	500	1	4
Nonradiological workers							
On site	120,000	2038	2141	24	5,000	3	
Off site	N/A						
Containment Structure Deactivation (CLO_DEACS)[b]							
Radiological workers	12,000	2062	2164	21	571	1	4
Nonradiological workers							
On site	120,000	2062	2164	21	5,714	3	
Off site	N/A						
Decontamination and Decommissioning of 10 Selected Facilities (CLO_D&DTEN)							
Radiological workers	44,418	2018	2028	11	4,038	2	9
Nonradiological workers							
On site	146,679	2018	2028	11	13,334	7	
Off site	78,970	2018	2028	11	7,179	4	
Modified Resource Conservation and Recovery Act Subtitle C Barrier (CLO_RCRA)							
Radiological workers	429,000	2149	2150	2	214,500	104	414
Nonradiological workers							
On site	1,287,000	2149	2150	2	643,500	310	
Off site	N/A						

APPENDIX J
ENVIRONMENTAL JUSTICE

This appendix provides an assessment of the potential for disproportionately high and adverse human health or environmental effects on minority and low-income populations resulting from implementation of the alternatives described in Chapter 2 of this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington.*

J.1 INTRODUCTION

Environmental justice is defined as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group[s,] should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies" (EPA 1998).

The purpose of this appendix is to identify the various populations that could be affected by U.S. Department of Energy (DOE)–proposed actions at the Hanford Site (Hanford) and Idaho National Laboratory (INL), and to present a comparison of the impacts on subpopulations with potential for environmental justice concerns to the impacts on the remainder of the population to identify any disproportionately high and adverse impacts under the alternatives evaluated in this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS).*

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, directs Federal agencies to identify and address, as appropriate, disproportionately high and adverse human health and environmental effects of their programs, policies, and activities on minority populations and low-income populations.

The Council on Environmental Quality (CEQ) has oversight responsibility for documentation prepared in compliance with the National Environmental Policy Act (NEPA). In December 1997, the CEQ released its guidance for analyzing environmental justice issues under NEPA (CEQ 1997). The CEQ guidance was adopted as the basis for analysis of environmental justice in this environmental impact statement (EIS).

J.2 DEFINITIONS

J.2.1 Minority Individuals and Populations

The following definitions of minority individuals and populations were used in this analysis of environmental justice:

Minority individuals. Individuals who are members of the following population groups: Hispanic or Latino, American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, or two or more races. This definition is similar to that given in the CEQ environmental justice guidance (CEQ 1997), except that it has been modified to reflect "Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity" (62 FR 58782) and recent guidance published by the Office of Management and Budget. These revisions were adopted and used by the U.S. Census Bureau in collecting data for the 2000 census (OMB 2000). When data from the 1990 census are used, a minority individual is defined as someone self-identified as: Hispanic; American Indian, Eskimo, or Aleut; Asian or Pacific Islander; or Black. As discussed below, racial and ethnic data from the 1990 census cannot be directly compared with that from the 2000 census.

The Office of Management and Budget also recommends counting a person self-identified as multiracial as a minority individual if at least one of the races is a minority race (OMB 2000). During the 2000 census, approximately 2 percent of the population identified themselves as members of more than one race (Grieco and Cassidy 2001). Approximately two-thirds of those designated themselves as members of at least one minority race.

> **Minority populations.** Minority populations should be identified where either (1) the minority population of the affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. In identifying minority communities, agencies may consider a community as either a group of individuals living in geographic proximity to one another or a geographically dispersed and transient set of individuals (such as migrant workers or American Indians/Alaska Natives), where either type of group experiences common conditions of environmental exposure or effect. The selection of the appropriate unit of geographic analysis may be a governing body's jurisdiction or a neighborhood, census tract, or other similar unit that is chosen to avoid artificially diluting or inflating the affected minority population. A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds.

Data for the analysis of minority populations in 2000 were extracted from the Census Bureau's Summary File 1 (Census 2007a). The CEQ guidance recommends that impacts on the minority population be examined, as well as those specific to American Indian tribes (CEQ 1997). Due to the large number of minority Hispanics, impacts on that specific population were also examined.

In the discussions of environmental justice in this *TC & WM EIS*, people self-designated as Hispanic or Latino are included in the total Hispanic population, regardless of race. For example, the Asian population is composed of people self-designated as Asian regardless of whether they indicated Hispanic or Latino origin. Asians who designated themselves as having Hispanic or Latino origins are also included in the total Hispanic population.

J.2.2 Low-Income Populations and Individuals

Executive Order 12898 specifically addresses disproportionately high and adverse effects on low-income populations. The CEQ recommends that poverty thresholds be used to identify low-income individuals (CEQ 1997).

The following definition of low-income population was used in this analysis:

> "Low-income population: Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the Bureau of Census' Current Population Reports, Series P-60 on Income and Poverty. In identifying low-income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another or a set of individuals (such as migrant workers or American Indians), where either type of group experiences common conditions of environmental exposure or effect (CEQ 1997)."

Thresholds used in the analysis in this EIS are from the Census Bureau's Current Population Reports, Series P60-210 on Consumer Income, Poverty in the United States: 1999 (Dalaker and Proctor 2000).

Data for the analysis of low-income populations were extracted from the Census Bureau's Summary File 3 (Census 2007b).

J.2.3 Disproportionately High and Adverse Human Health Effects

Adverse health effects are measured in risks and rates that could result in latent cancer fatalities (LCFs), as well as other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as defined by NEPA) and appreciably exceeds the risk or exposure rate for the general population or another appropriate comparison group (CEQ 1997).

J.2.4 Disproportionately High and Adverse Environmental Effects

A disproportionately high environmental impact refers to an impact or the risk of an impact on the natural or physical environment in a low-income or minority community that is significant (as defined by NEPA) or appreciably exceeds the environmental impact on the larger community. Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as defined by NEPA). In assessing cultural and aesthetic environmental impacts, impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations, including American Indian tribes, are also considered (CEQ 1997).

J.3 SPATIAL RESOLUTION

For the purposes of enumeration and analysis, the Census Bureau has defined a variety of areal units. Areal units of concern in this document include (in order of increasing spatial resolution) states, counties, census tracts, block groups, and blocks. The block is the smallest geographic entity for which the Census Bureau collects and tabulates data and, therefore, offers the finest spatial resolution. This term refers to a relatively small geographical area bounded on all sides by visible features such as streets or streams or by invisible boundaries such as city limits and property lines. During the 2000 census, the Census Bureau subdivided the United States and its territories into 8,205,582 blocks (Census 2007c). For comparison, the number of counties, census tracts, and block groups used in the 2000 census were 3,141; 65,443; and 208,790; respectively. While blocks offer the finest spatial resolution, economic data required for the identification of low-income populations are not available at the block level of spatial resolution. In the analysis below, block-group-level resolution was used to identify minority and low-income populations.

During preparation of this *TC & WM EIS*, consequences and risks from normal operations and accidents were evaluated for the following potential release locations at Hanford: the Supplemental Treatment Technology Site in the 200-East Area and the 200-West Area (STTS-East and STTS-West), the Waste Treatment Plant (WTP) facilities, in the 200-East Area, and the Fast Flux Test Facility (FFTF) in the 400 Area. The location of the WTP is approximately 600 meters (1,979 feet) northeast of STTS-East. A potential release location at INL, the Materials and Fuels Complex (MFC), was also evaluated. In the analysis of health impacts of normal operations and accidents, all persons living within 80 kilometers (50 miles) of these facilities were assumed to be potentially affected. The same 80-kilometer (50-mile) regions of influence were used in this analysis of environmental justice to identify potentially affected minority and low-income populations.

In general, the boundary of a circle with an 80-kilometer (50-mile) radius centered on the facility site would not coincide with boundaries used by the Census Bureau for enumeration of the population in the potentially affected area. Some blocks or block groups lie completely inside or outside of the radius used for health effects calculation, while others are only partially included. As a result of these partial inclusions, uncertainties were introduced into the estimate of the potentially affected population.

To estimate the populations in the partially included block groups, it was assumed that populations are uniformly distributed throughout the area of each block group. For example, if 30 percent of the area of a block group lies within 80 kilometers (50 miles) of the facility site, it was assumed that 30 percent of the population residing in that block group would be potentially affected.

J.4 MAP DEVELOPMENT

The geographic information system (GIS) statistics maps and diagrams provided in Chapter 3 of this *TC & WM EIS* and Section J.5 were developed using ArcMap 9.0. ArcMap 9.0 allows standard base maps to be projected in a variety of projection systems. In this document, maps and diagrams were developed using the North American Standard 1983 projection. Standard GIS geospatially attributed data sets, known as shapefiles, were downloaded from two public access websites: the Census Bureau, http://www.census.gov,[1] and the Environmental Systems Research Institute, http://www.esri.com/data/download/census2000_tigerline/index.html.[2]

The downloaded shapefiles were re-projected to the North American Standard 1983 projection to prevent potential data misalignment. Additional shapefiles either were developed as necessary using ArcMap 9.0 and actual geographic coordinates (e.g., the facility sites) or were provided by Hanford personnel to show specific site landmarks (e.g., the fence lines of limited-access areas).

Each shapefile stores nontopological geometry and tabular attribute information for spatial features (point, line, or polygon) in a data set. The geometry for a feature is stored as a shape comprising a set of vector coordinates; the attributes, as tabular files in dBASE® format. Each feature in the shapefile represents a single geographic feature and its attributes; that is, each shape record has a one-to-one relationship with an attribute record. Maps and diagrams were developed by importing all shapefiles into the Hanford GIS project. The development of each map involved different combinations of the shapefiles to visually display data on a standard base map of Oregon and Washington.

J.5 ENVIRONMENTAL JUSTICE ANALYSIS

This analysis of environmental justice is based on assessment of the impacts reported in Chapter 4. This analysis was performed to identify any disproportionately high and adverse human health or environmental impacts on minority or low-income populations surrounding the facility sites. Demographic information obtained from the Census Bureau was used to identify the minority populations and low-income communities surrounding the sites (Census 2007a, 2007b). Minority populations and low-income communities were identified where the percentage of minority and low-income population in the impacted areas significantly exceeded the general population percentage in other reasonable geographic areas of comparison, defined here as the potentially affected counties and states in which the impacted areas are located. The U.S. Nuclear Regulatory Commission considers such percentages "significant" when the total minority or low-income population percentage exceeds the general population by 20 points, or when either the minority or low-income population percentage exceeds 50 percent (69 FR 52040). Table J–1 displays the thresholds used to determine minority and low-income populations.

Table J–1. Thresholds for Identifying Minority Populations and Low-Income Communities

Site	Minority (percent)	Low-Income (percent)
Hanford Site	50.0	36.2
Idaho National Laboratory	32.7	33.6

[1] Block Data, Block Group Data, Key Geographical Locations, Landmark Locations, Hydrography, Railroads, County Roads, Federal Lands.

[2] Data for Washington and Oregon.

Chapter 3, Sections 3.2.11 and 3.3.11 discuss the affected environment to be included in the environmental justice analysis. Potentially affected minority and low-income populations are shown graphically within each facility site's 80-kilometer (50-mile) region of influence (see Section J.3). Tables show the potentially affected populations by county, as well as the percentage of the minority or low-income population considered to be potentially affected. In addition, figures are presented that identify minority and low-income populations by block group, and graphs showing cumulative populations by distance are used to visually locate concentrations of minority and low-income populations.

J.5.1 Minority and Low-Income Populations Surrounding the 200-West Area Supplemental Treatment Technology Site

Figure J–1 shows minority and nonminority populations living in block groups surrounding STTS-West. There are 372 block groups within the 80-kilometer (50-mile) potentially affected radius. Out of these block groups, 130 were determined to contain minority populations. The potentially affected counties include eight counties in the state of Washington (Adams, Benton, Franklin, Grant, Kittitas, Klickitat, Walla Walla, and Yakima) and two counties in Oregon (Morrow and Umatilla). As indicated in Table J–2, approximately one-half of the potentially affected minority population resides in Yakima County, and over 90 percent of the potentially affected minority population lives in four Washington counties: Benton, Franklin, Grant, and Yakima.

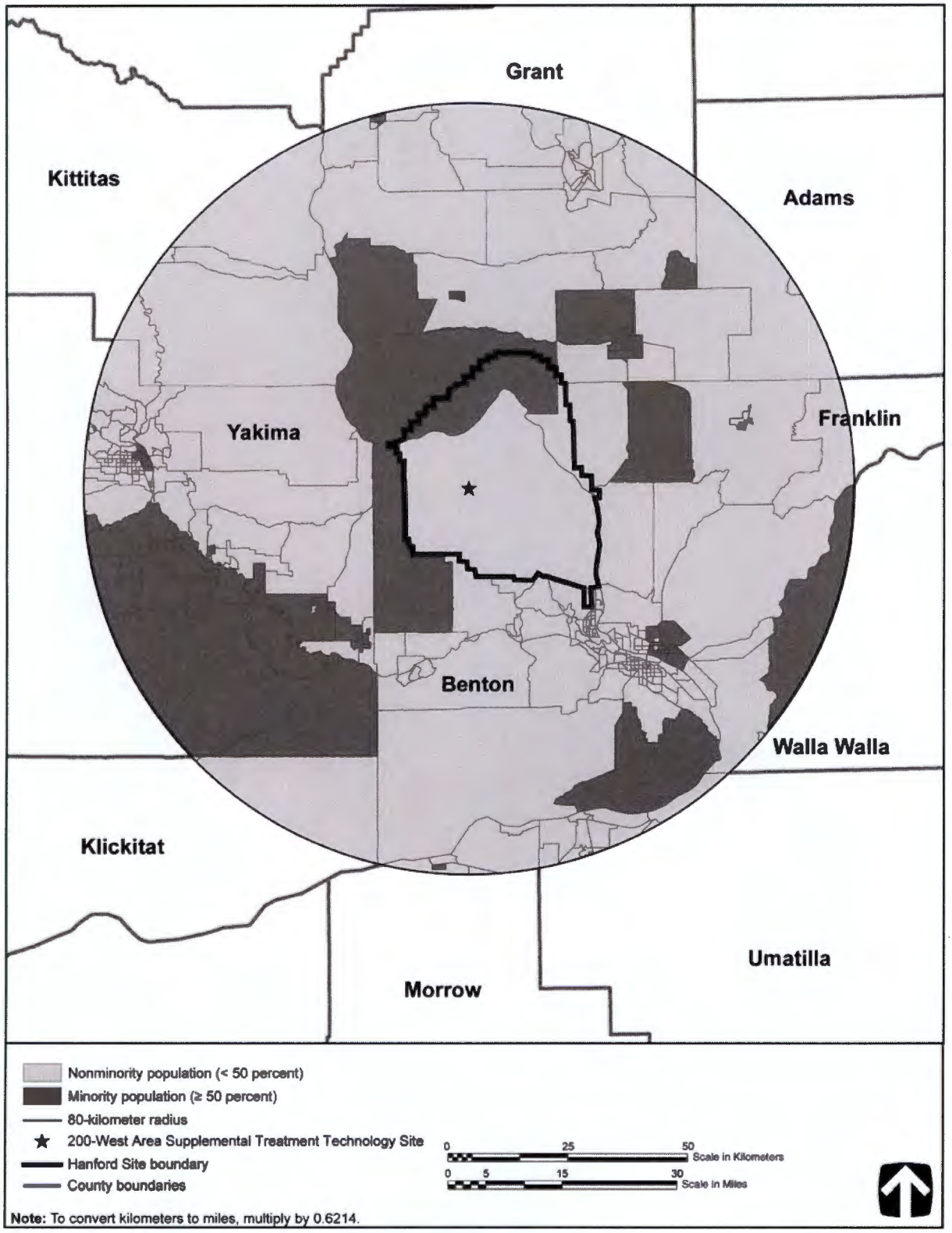

Figure J–1. Minority and Nonminority Populations Living in Potentially Affected Block Groups Surrounding the 200-West Area Supplemental Treatment Technology Site (2000)

Table J–2. Minority Populations Living in Potentially Affected Counties Surrounding the 200-West Area Supplemental Treatment Technology Site (2000)

County (State)	Total County Population[a]	Total Minority Population[a]	Potentially Affected Total Population	Potentially Affected Minority Population	Percentage of the Potentially Affected Population Total
Adams (Washington)	16,428	8,062	12,296	7,750	4.3
Benton (Washington)[b]	142,475	26,018	142,464	26,027	14.4
Franklin (Washington)	49,347	25,877	49,039	25,845	14.3
Grant (Washington)	74,698	25,815	55,421	22,775	12.6
Kittitas (Washington)	33,362	3,537	3,643	365	0.2
Klickitat (Washington)	19,161	2,832	264	78	0.0
Walla Walla (Washington)	55,180	11,678	4,213	769	0.4
Yakima (Washington)	222,581	96,848	203,306	91,164	50.4
Morrow (Oregon)	10,995	3,084	6,224	2,323	1.3
Umatilla (Oregon)	70,548	15,878	12,027	3,698	2.0
Total	**694,775**	**219,629**	**488,897**	**180,794**	**100.0**

[a] Census 2007d.

[b] Potentially affected populations may not equal total populations due to rounding.

Figures J–2 and J–3 show cumulative minority populations as a function of distance from STTS-West. Values along the vertical axis of these figures show minority populations living within a given distance from STTS-West. Moving outward from the facilities, the cumulative minority populations increase sharply near the outskirts of the population centers of Richland, Kennewick/Pasco, and Yakima. Approximately 18 percent of the potentially affected minority population lives within about 40 kilometers (25 miles) of the facility, and 55 percent resides within about 56 kilometers (35 miles). The potentially affected total minority population surrounding STTS-West is approximately 181,000 persons, accounting for approximately 37 percent of the total potentially affected population of approximately 489,000. Approximately 84 percent of the minority population surrounding STTS-West is Hispanic or Latino.

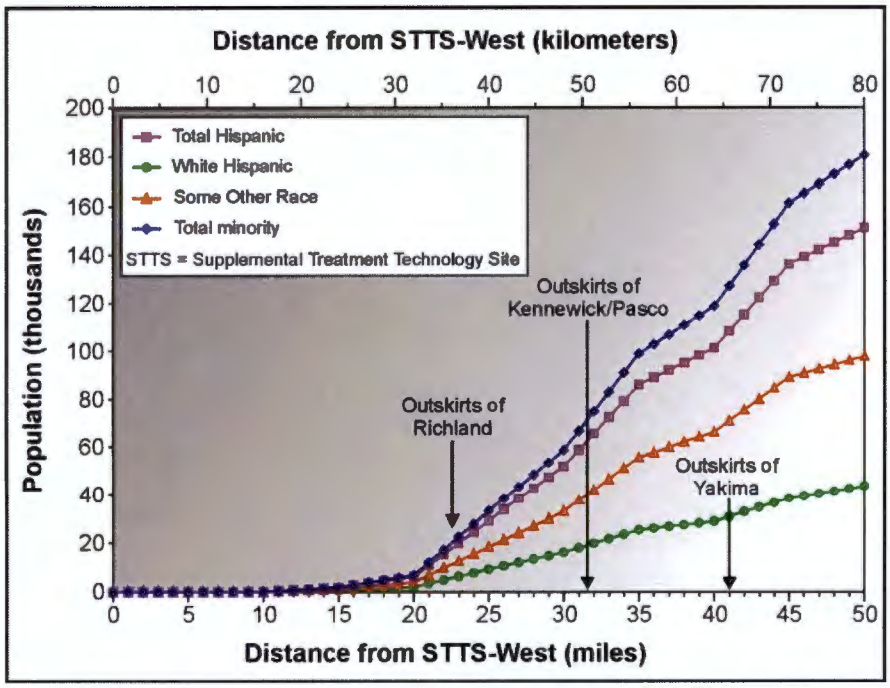

Figure J–2. Cumulative Larger-Scale Minority Populations as a Function of Distance from the 200-West Area Supplemental Treatment Technology Site

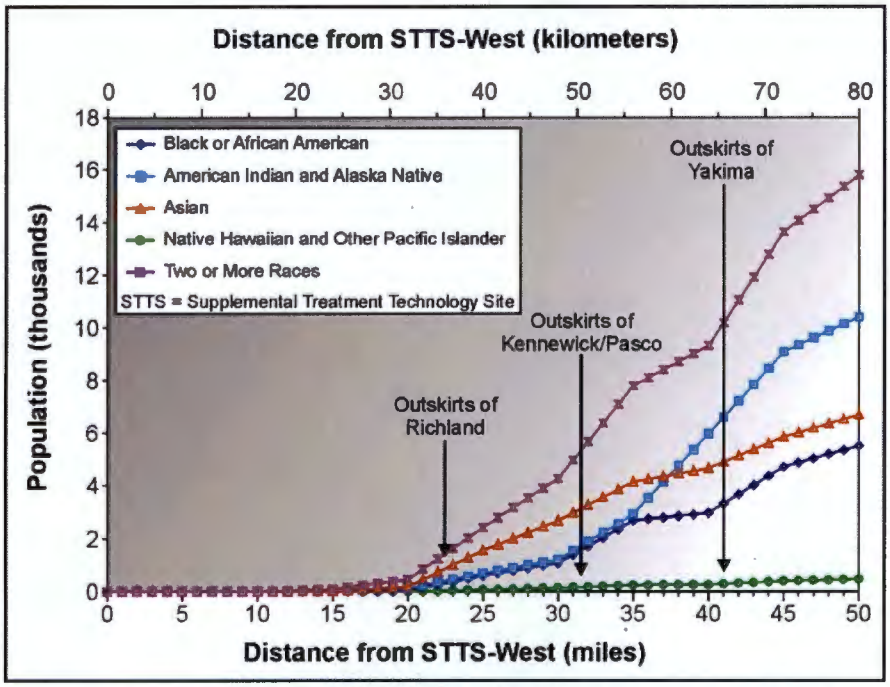

Figure J–3. Cumulative Smaller-Scale Minority Populations as a Function of Distance from the 200-West Area Supplemental Treatment Technology Site

Figure J–4 shows block groups surrounding STTS-West and low-income and non-low-income populations living in the potentially affected area. Of the 372 block groups surrounding STTS-West, an estimated 27 block groups contain low-income populations. As indicated in Table J–3, approximately one-half of the potentially affected low-income population lives in Yakima County, and over 90 percent of the potentially affected low-income population lives in the counties of Benton, Franklin, Grant, and Yakima. Low-income persons compose approximately 17 percent of the total population living in the potentially affected area.

Table J–3. Low-Income Populations Living in Potentially Affected Counties Surrounding the 200-West Area Supplemental Treatment Technology Site (2000)

County (State)	Total County Population[a]	Total Low-Income Population[a]	Potentially Affected Total Population	Potentially Affected Low-Income Population	Percentage of the Potentially Affected Low-Income Population Total
Adams (Washington)	16,217	2,951	12,222	2,403	3.0
Benton (Washington)	141,232	14,517	141,219	14,515	18.2
Franklin (Washington)	48,307	9,280	48,006	9,230	11.5
Grant (Washington)	73,591	12,809	54,826	9,888	12.4
Kittitas (Washington)	31,177	6,122	3,657	365	0.5
Klickitat (Washington)	18,983	3,236	251	55	0.1
Walla Walla (Washington)	50,245	7,567	4,208	334	0.4
Yakima (Washington)	218,966	43,070	199,747	40,444	50.6
Morrow (Oregon)	10,919	1,617	6,190	1,198	1.5
Umatilla (Oregon)	67,329	8,524	11,024	1,532	1.9
Total	**676,966**	**109,693**	**481,350**	**79,964**	**100.0**

[a] Census 2007e.

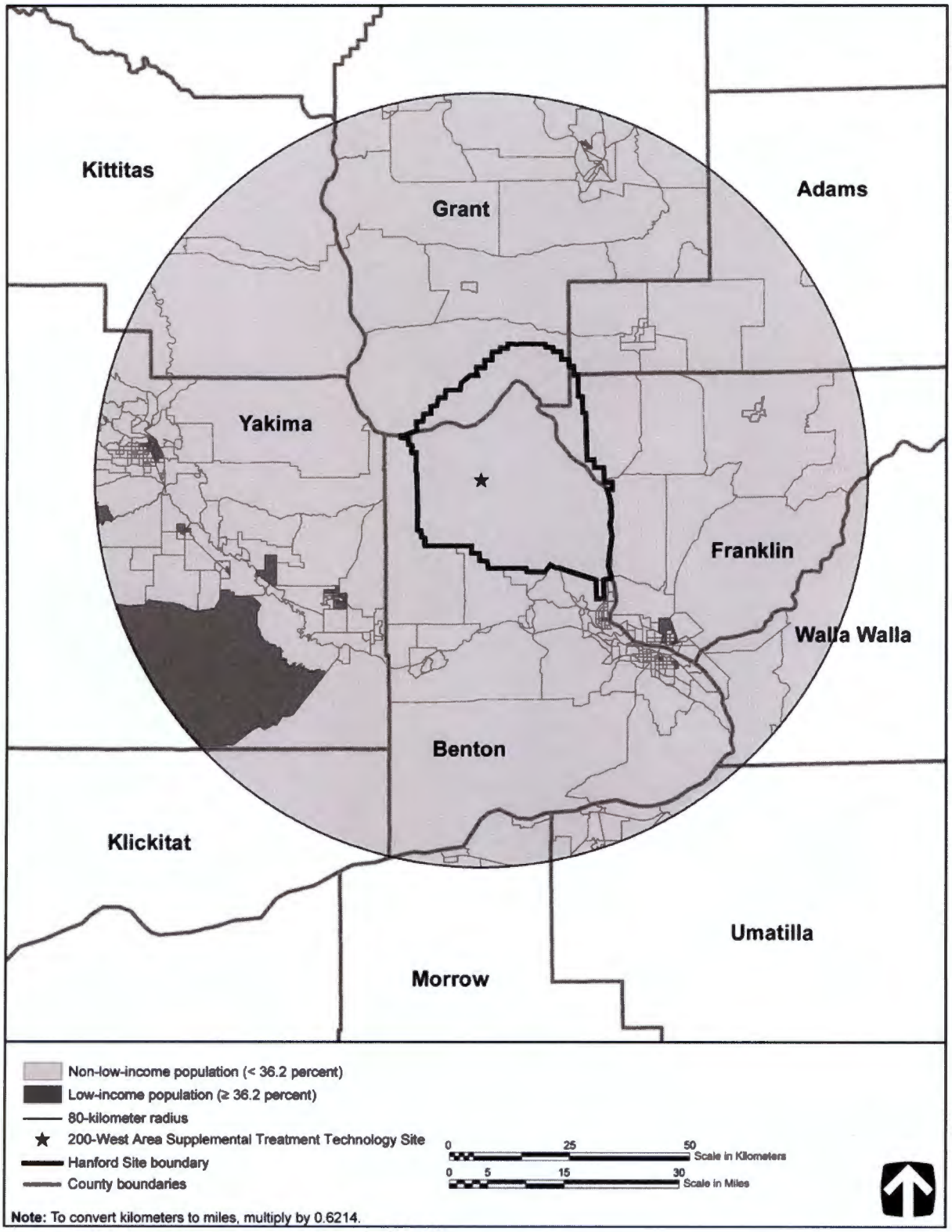

Figure J–4. Low-Income and Non-Low-Income Populations Living in Potentially Affected Block Groups Surrounding the 200-West Area Supplemental Treatment Technology Site (2000)

Figure J–5 shows cumulative low-income populations as a function of distance from STTS-West. Low-income populations surrounding STTS-West are concentrated in the Tri-Cities area and Yakima County.

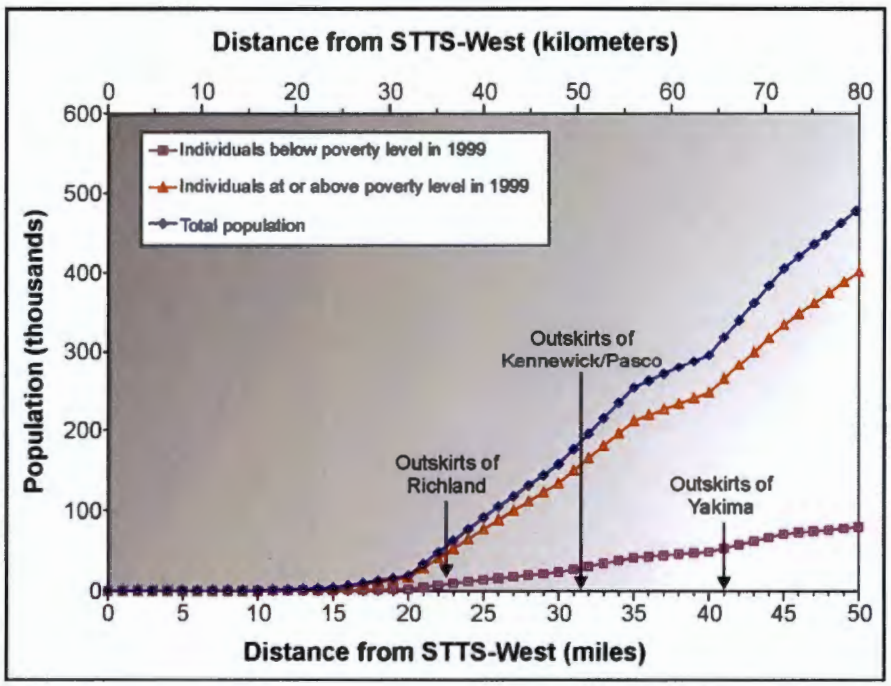

Figure J–5. Cumulative Low-Income Populations as a Function of Distance from the 200-West Area Supplemental Treatment Technology Site

J.5.2 Minority and Low-Income Populations Surrounding the Waste Treatment Plant

Figure J–6 shows minority and nonminority populations living in block groups surrounding the WTP. Of the 360 block groups that surround the WTP, an estimated 84 contain minority populations. Potentially affected counties include eight counties in Washington (Adams, Benton, Franklin, Grant, Kittitas, Klickitat, Walla Walla, and Yakima) and two counties in Oregon (Morrow and Umatilla).

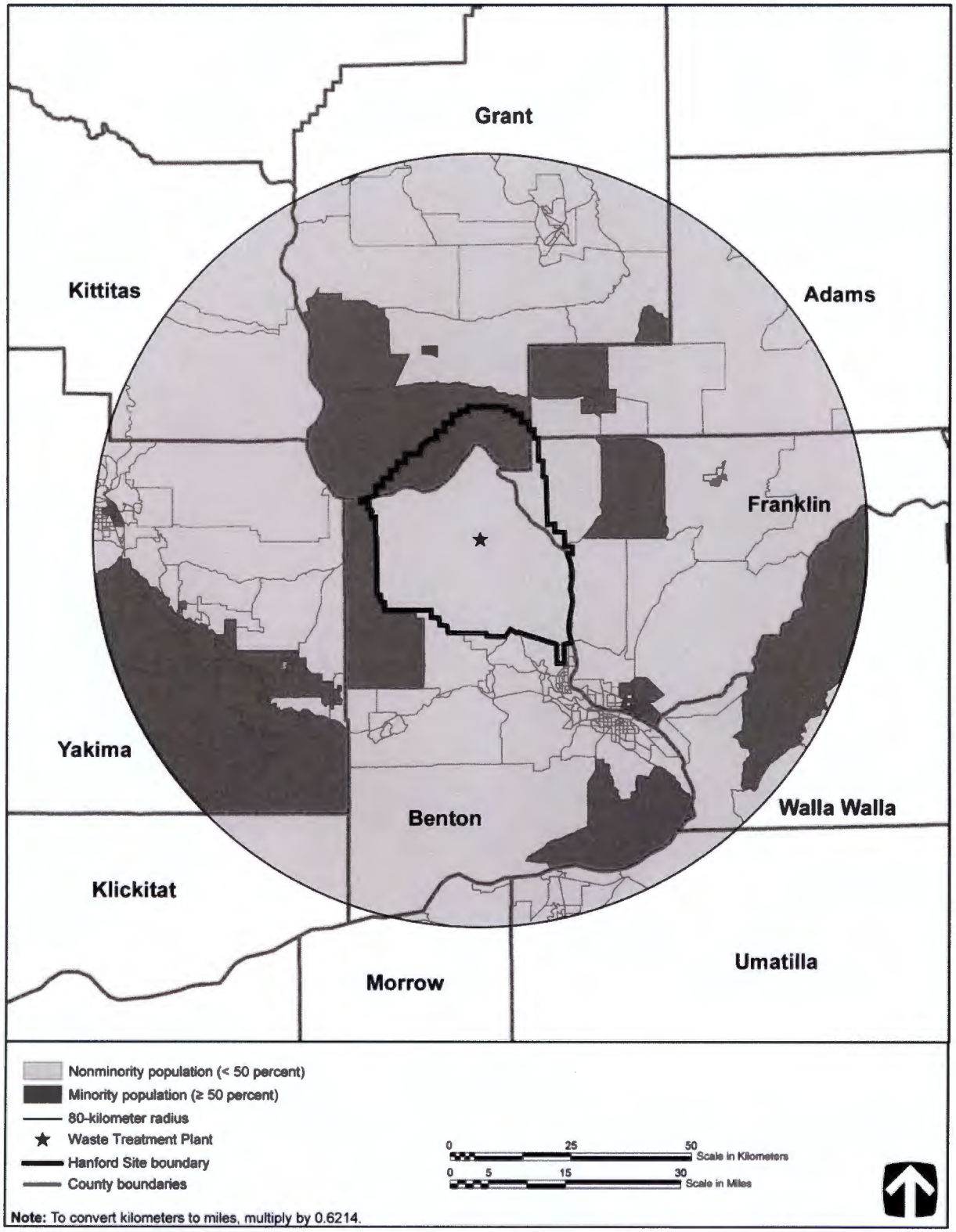

Figure J–6. Minority and Nonminority Populations Living in Potentially Affected Block Groups Surrounding the Waste Treatment Plant (2000)

As indicated in Table J–4, approximately one-half of the potentially affected minority population resides in Yakima County, and over 90 percent of the potentially affected minority population lives in four Washington counties: Benton, Franklin, Grant, and Yakima.

Table J–4. Minority Populations Living in Potentially Affected Counties Surrounding the Waste Treatment Plant (2000)

County (State)	Total County Population[a]	Total Minority Population[a]	Potentially Affected Total Population	Potentially Affected Minority Population	Percentage of the Potentially Affected Population Total
Adams (Washington)	16,428	8,062	12,574	7,791	4.5
Benton (Washington)	142,475	26,018	142,456	26,000	15.0
Franklin (Washington)	49,347	25,877	49,139	25,855	14.9
Grant (Washington)	74,698	25,815	53,849	21,314	12.3
Kittitas (Washington)	33,362	3,537	2,546	262	0.2
Klickitat (Washington)	19,161	2,832	162	48	0.0
Walla Walla (Washington)	55,180	11,678	5,068	1,087	0.6
Yakima (Washington)	222,581	96,848	159,157	83,793	48.4
Morrow (Oregon)	10,995	3,084	4,588	1,370	0.8
Umatilla (Oregon)	70,548	15,878	17,815	5,527	3.2
Total	**694,775**	**219,629**	**447,354**	**173,047**	**100.0**

[a] Census 2007d.

Figures J–7 and J–8 show cumulative minority populations as a function of distance from the WTP. Values along the vertical axis of this figure show minority populations living within a given distance from the WTP. Moving outward from the facilities, the cumulative minority populations increase sharply near the outskirts of the population centers of Richland, Kennewick/Pasco, and Yakima. Approximately 20 percent of the potentially affected minority population lives within about 39 kilometers (24 miles) of the facility, and 50 percent resides within about 53 kilometers (33 miles). The potentially affected total minority population surrounding the WTP is approximately 173,000 persons, accounting for approximately 39 percent of the total potentially affected population of approximately 447,000. Approximately 84 percent of the minority population surrounding the WTP is Hispanic or Latino.

Figure J–9 shows block groups surrounding the WTP as well as low-income and non-low-income populations living in the potentially affected area. Of the 360 block groups that surround WTP, an estimated 30 contain low-income populations.

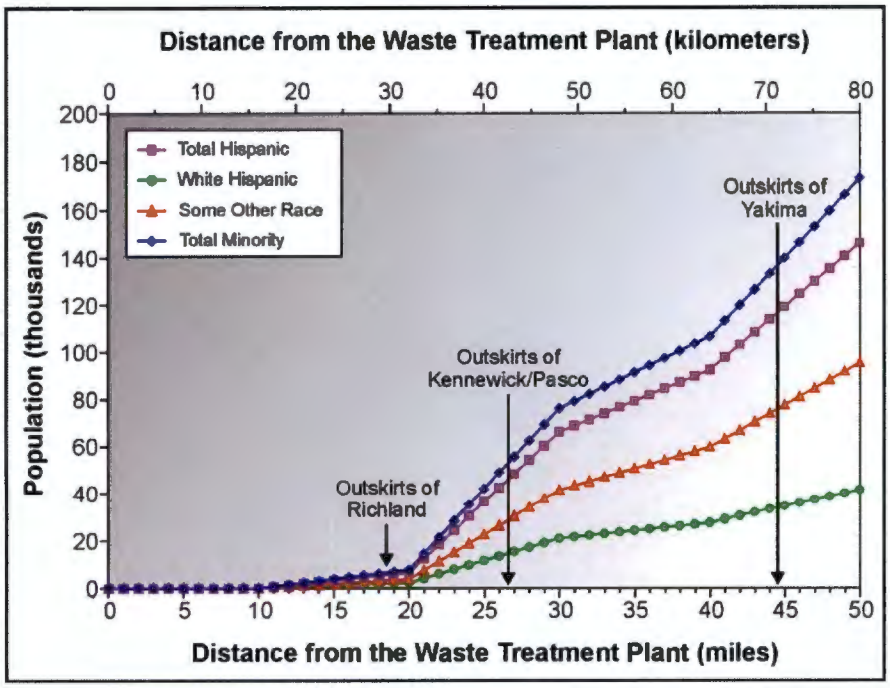

Figure J–7. Cumulative Larger-Scale Minority Populations as a Function of Distance from the Waste Treatment Plant

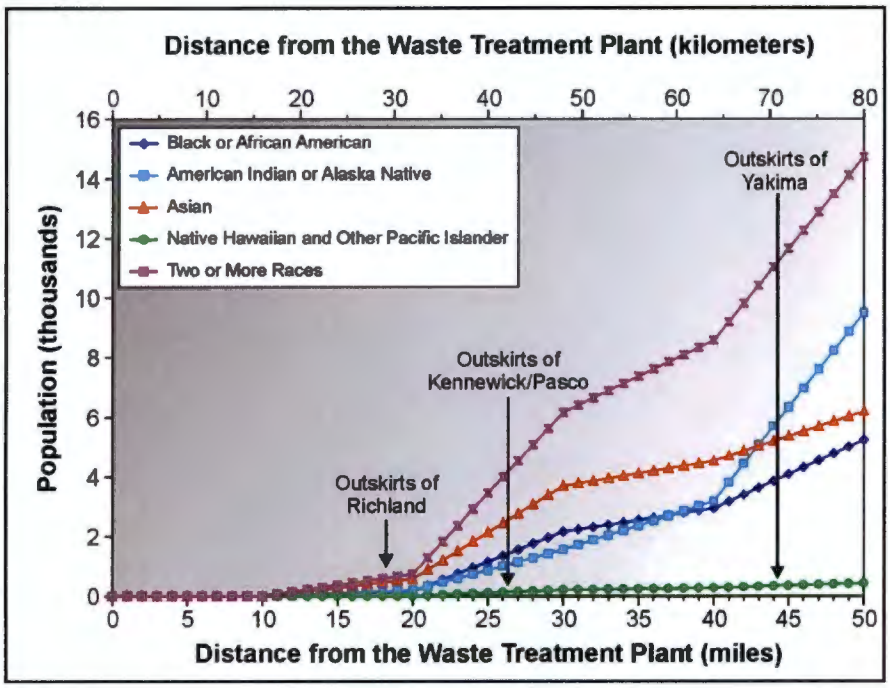

Figure J–8. Cumulative Smaller-Scale Minority Populations as a Function of Distance from the Waste Treatment Plant

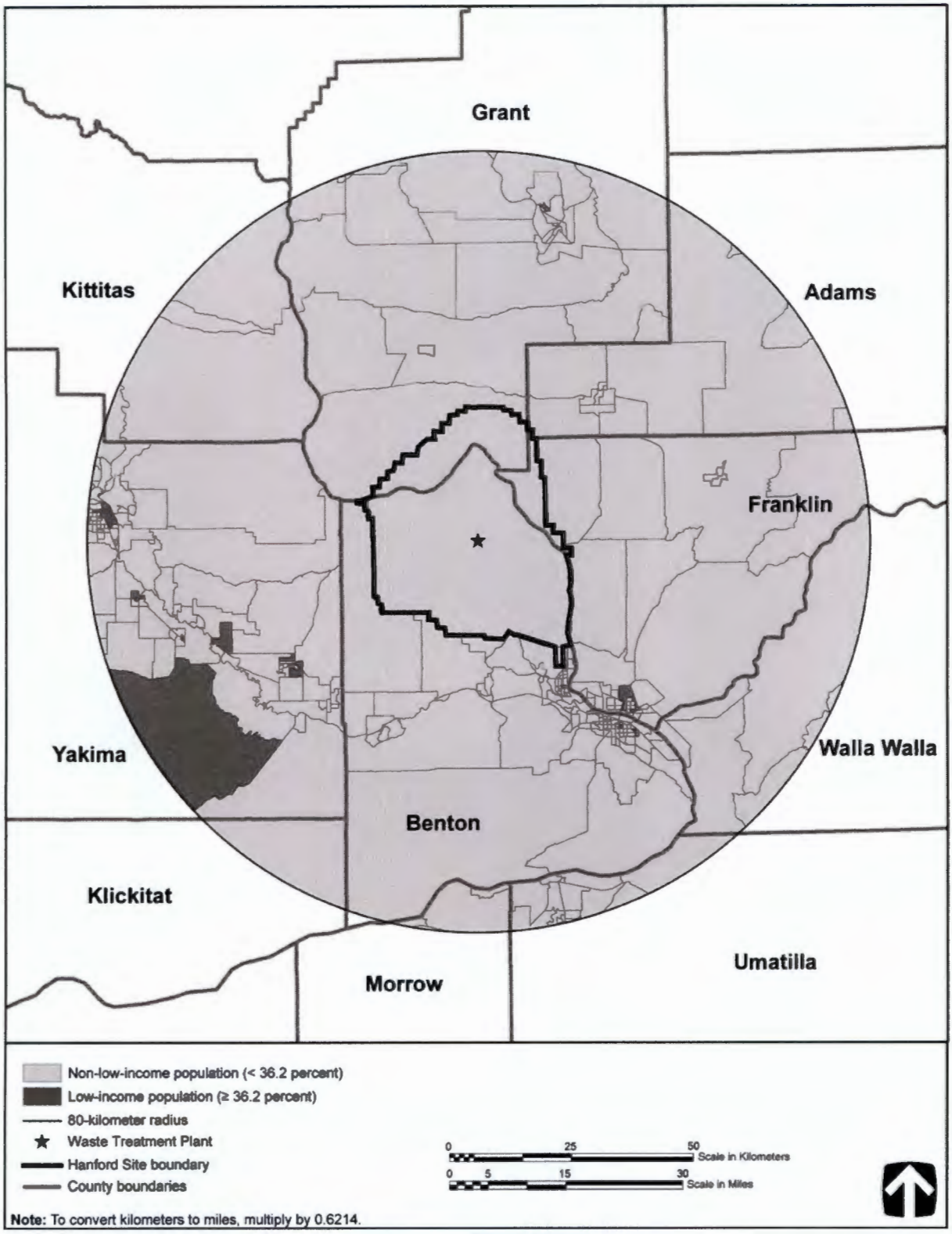

Figure J–9. Low-Income and Non-Low-Income Populations Living in Potentially Affected Block Groups Surrounding the Waste Treatment Plant (2000)

As indicated in Table J–5, approximately one-half of the potentially affected low-income population lives in Yakima County, and over 90 percent of the potentially affected low-income population lives in the counties of Benton, Franklin, Grant, and Yakima. Low-income persons compose approximately 17 percent of the total population living in the potentially affected area.

Table J–5. Low-Income Populations Living in Potentially Affected Counties Surrounding the Waste Treatment Plant (2000)

County (State)	Total County Population[a]	Total Low-Income Population[a]	Potentially Affected Total Population	Potentially Affected Low-Income Population	Percentage of the Potentially Affected Low-Income Population Total
Adams (Washington)	16,217	2,951	12,506	2,433	3.2
Benton (Washington)	141,232	14,517	141,217	14,513	18.8
Franklin (Washington)	48,307	9,280	48,104	9,245	12.0
Grant (Washington)	73,591	12,809	53,292	9,496	12.3
Kittitas (Washington)	31,177	6,122	2,559	251	0.3
Klickitat (Washington)	18,983	3,236	154	34	0.0
Walla Walla (Washington)	50,245	7,567	5,052	475	0.6
Yakima (Washington)	218,966	43,070	156,394	37,462	48.6
Morrow (Oregon)	10,919	1,617	4,559	832	1.1
Umatilla (Oregon)	67,329	8,524	16,746	2,305	3.0
Total	**676,966**	**109,693**	**440,583**	**77,046**	**100.0**

[a] Census 2007e.

Figure J–10 shows cumulative low-income populations as a function of distance from the WTP. Low-income populations surrounding the WTP are concentrated in the Tri-Cities area and Yakima County.

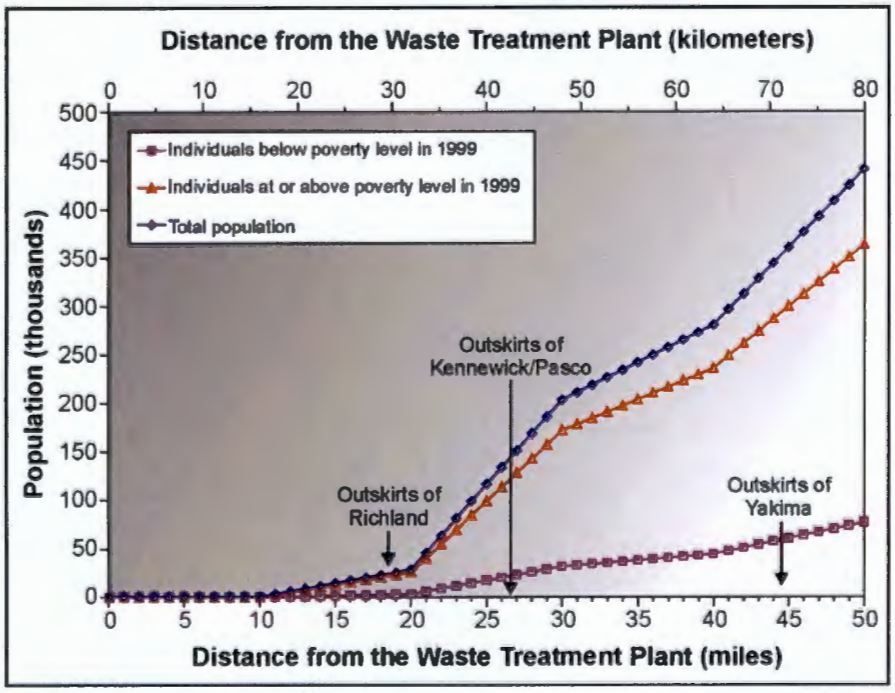

Figure J–10. Cumulative Low-Income Populations as a Function of Distance from the Waste Treatment Plant

J.5.3 Minority and Low-Income Populations Surrounding the 200-East Area Supplemental Treatment Technology Site

Figure J–11 shows minority and nonminority populations living in block groups surrounding STTS-East. Of the 364 block groups that surround STTS-East, an estimated 86 contain minority populations. STTS-East is located within approximately 600 meters (1,969 feet) of the WTP, and the populations surrounding STTS-East are nearly the same as those surrounding the WTP. Counties that would be potentially affected by activities at STTS-East include eight counties in Washington (Adams, Benton, Franklin, Grant, Kittitas, Klickitat, Walla Walla, and Yakima) and two counties in Oregon (Morrow and Umatilla).

As indicated in Table J–6, approximately one-half of the potentially affected minority population resides in Yakima County, and over 90 percent of the potentially affected minority population lives in four Washington counties: Benton, Franklin, Grant, and Yakima. Due to the close proximity of the WTP and STTS-East, data for minority populations surrounding STTS-East are nearly identical to those shown for WTP minority populations in Figures J–7 and J–8, respectively, in Section J.5.2.

Table J–6. Minority Populations Living in Potentially Affected Counties Surrounding the 200-East Area Supplemental Treatment Technology Site (2000)

County (State)	Total County Population[a]	Total Minority Population[a]	Potentially Affected Total Population	Potentially Affected Minority Population	Percentage of the Potentially Affected Population Total
Adams (Washington)	16,428	8,062	12,550	7,789	4.5
Benton (Washington)	142,475	26,018	142,442	26,001	15.0
Franklin (Washington)	49,347	25,877	49,137	25,855	14.9
Grant (Washington)	74,698	25,815	52,071	20,293	11.7
Kittitas (Washington)	33,362	3,537	2,510	260	0.1
Klickitat (Washington)	19,161	2,832	173	51	0.0
Walla Walla (Washington)	55,180	11,678	5,090	1,087	0.6
Yakima (Washington)	222,581	96,848	160,443	84,050	48.4
Morrow (Oregon)	10,995	3,084	5,373	1,808	1.0
Umatilla (Oregon)	70,548	15,878	21,777	6,635	3.8
Total	**694,775**	**219,629**	**451,556**	**173,829**	**100.0**

[a] Census 2007d.

Figure J–12 shows block groups surrounding STTS-East and low-income and non-low-income populations living in the potentially affected area. Of the 364 block groups that surround STTS-East, an estimated 32 contain low-income populations.

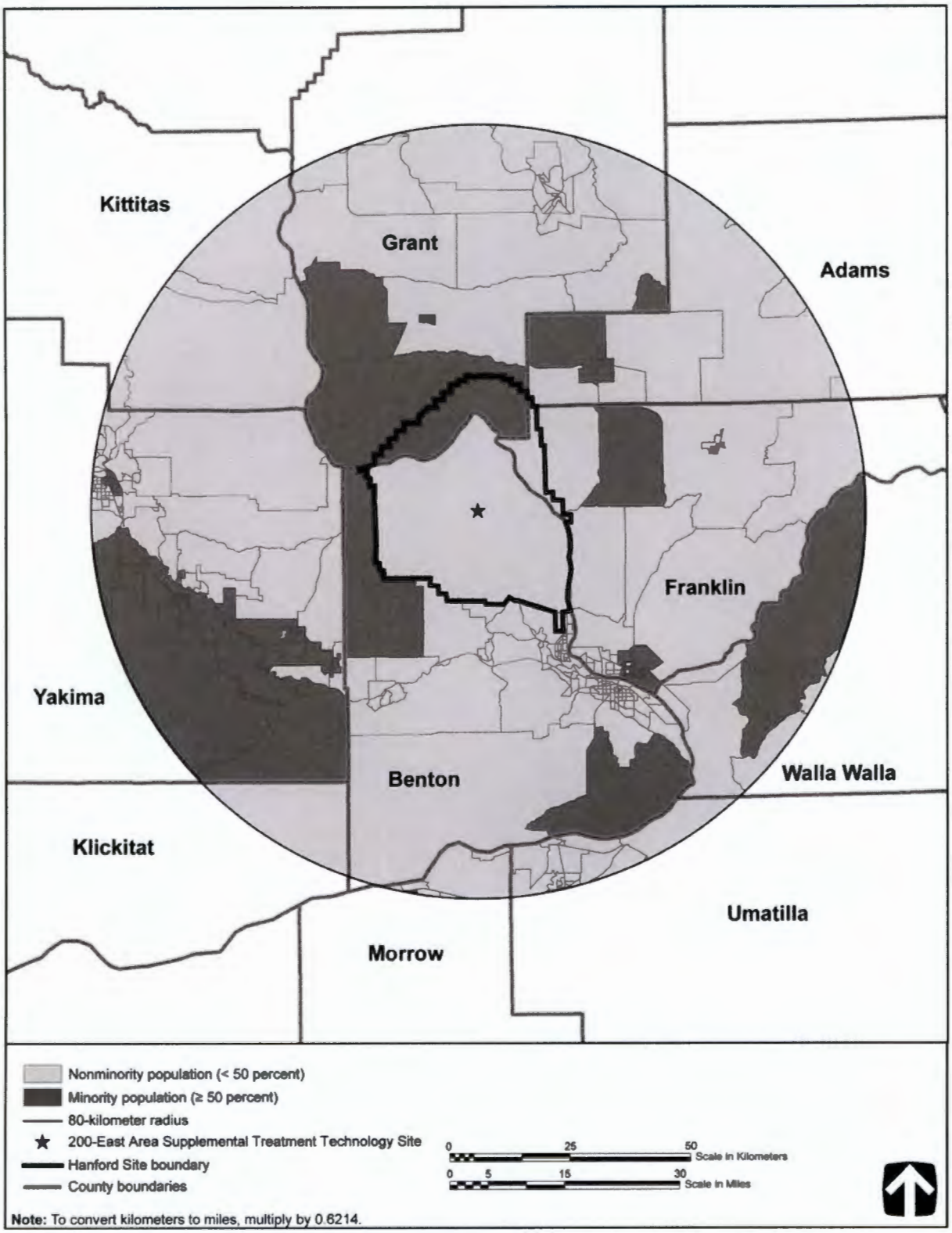

Figure J–11. Minority and Nonminority Populations Living in Potentially Affected Block Groups Surrounding the 200-East Area Supplemental Treatment Technology Site (2000)

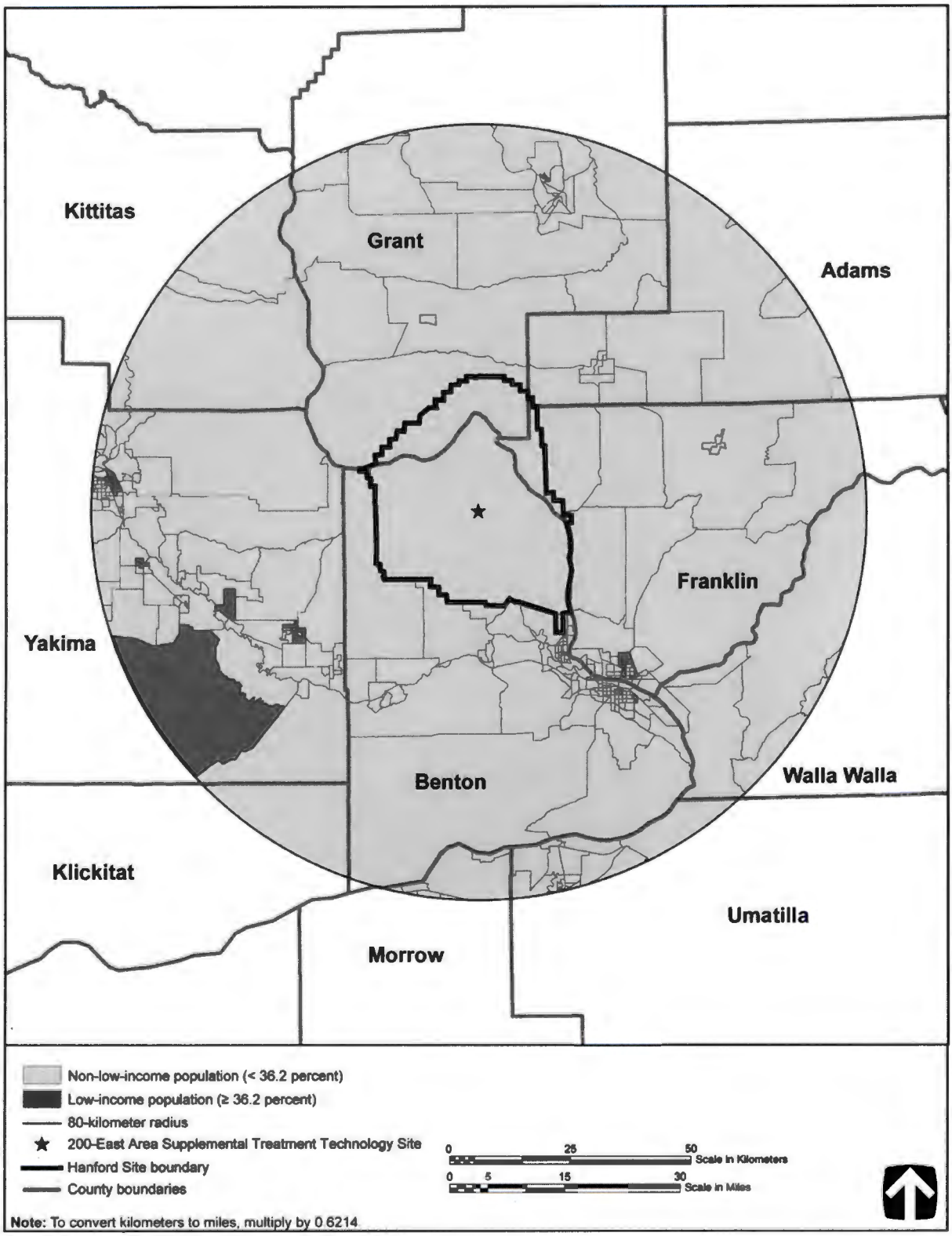

Figure J–12. Low-Income and Non-Low-Income Populations Living in Potentially Affected Block Groups Surrounding the 200-East Area Supplemental Treatment Technology Site (2000)

As indicated in Table J–7, approximately one-half of the potentially affected low-income population lives in Yakima County, and over 90 percent of the potentially affected low-income population lives in the counties of Benton, Franklin, Grant, and Yakima. Low-income persons compose approximately 17 percent of the total population living in the potentially affected area. Due to the close proximity of the WTP and STTS-East, data for the low-income population as a function of distance from STTS-East are nearly identical to those for the low-income population as a function of distance from the WTP in Figure J–10 in Section J.5.2. Low-income populations surrounding STTS-East are concentrated in the Tri-Cities area and Yakima County.

Table J–7. Low-Income Populations Living in Potentially Affected Counties Surrounding the 200-East Area Supplemental Treatment Technology Site (2000)

County (State)	Total County Population[a]	Total Minority Population[a]	Potentially Affected Total Population	Potentially Affected Minority Population	Percentage of the Potentially Affected Population Total
Adams (Washington)	16,217	2,951	12,485	2,429	3.1
Benton (Washington)	141,232	14,517	141,203	14,512	18.7
Franklin (Washington)	48,307	9,280	48,097	9,247	11.9
Grant (Washington)	73,591	12,809	51,502	9,141	11.8
Kittitas (Washington)	31,177	6,122	2,528	248	0.3
Klickitat (Washington)	18,983	3,236	164	37	0.0
Walla Walla (Washington)	50,245	7,567	5,078	476	0.6
Yakima (Washington)	218,966	43,070	157,596	37,585	48.5
Morrow (Oregon)	10,919	1,617	5,341	1,003	1.3
Umatilla (Oregon)	67,329	8,524	20,795	2,859	3.7
Total	**676,966**	**109,693**	**444,789**	**77,537**	**100.0**

[a] Census 2007e.

J.5.4 Minority and Low-Income Populations Surrounding the Fast Flux Test Facility

Figure J–13 shows minority and nonminority populations living in block groups surrounding FFTF, which is located in the 400 Area at Hanford. Of the 298 block groups that surround FFTF, an estimated 60 contain minority populations. Potentially affected counties include eight counties in Washington (Adams, Benton, Franklin, Grant, Kittitas, Klickitat, Walla Walla, and Yakima) and two counties in Oregon (Morrow and Umatilla).

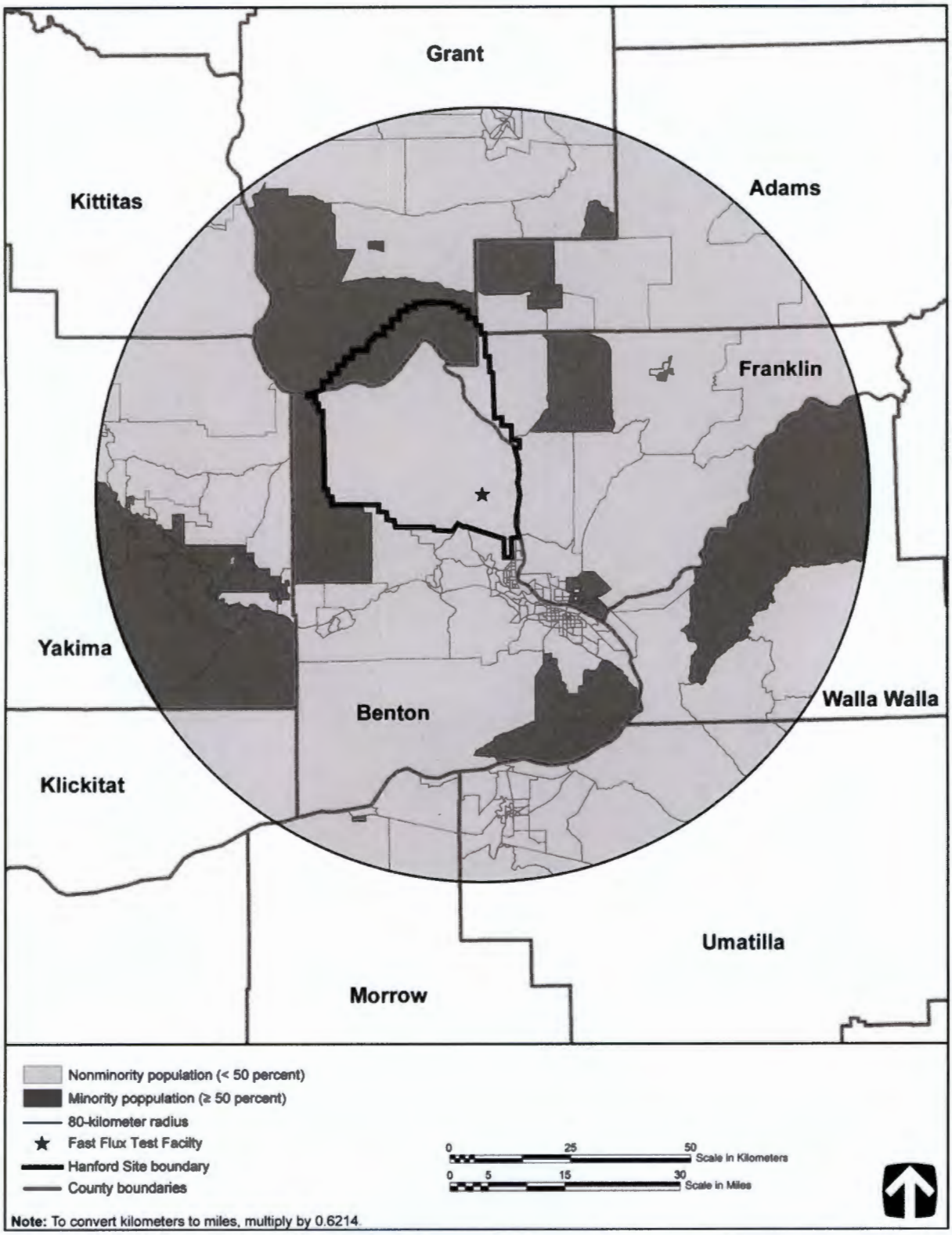

Figure J–13. Minority and Nonminority Populations Living in Potentially Affected Block Groups Surrounding the Fast Flux Test Facility (2000)

As indicated in Table J–8, approximately 33 percent of the potentially affected minority population resides in Yakima County, and over 90 percent of the potentially affected minority population lives in five counties: Benton, Franklin, Grant, and Yakima Counties in Washington and Umatilla County in Oregon.

Table J–8. Minority Populations Living in Potentially Affected Counties Surrounding the Fast Flux Test Facility (2000)

County (State)	Total County Population[a]	Total Minority Population[a]	Potentially Affected Total Population	Potentially Affected Minority Population	Percentage of the Potentially Affected Population Total
Adams (Washington)	16,428	8,062	12,579	7,793	5.9
Benton (Washington)	142,475	26,018	142,465	26,016	19.7
Franklin (Washington)	49,347	25,877	49,232	25,864	19.6
Grant (Washington)	74,698	25,815	39,353	16,172	12.3
Kittitas (Washington)	33,362	3,537	787	99	0.1
Klickitat (Washington)	19,161	2,832	215	65	0.0
Walla Walla (Washington)	55,180	11,678	6,984	1,570	1.2
Yakima (Washington)	222,581	96,848	66,206	42,819	32.5
Morrow (Oregon)	10,995	3,084	6,749	2,485	1.9
Umatilla (Oregon)	70,548	15,878	32,821	8,903	6.8
Total	**694,775**	**219,629**	**357,391**	**131,786**	**100.0**

[a] Census 2007d.

The total population of the potentially affected area surrounding FFTF is estimated to be approximately 357,000. The significant reduction in population compared to other areas at Hanford that are analyzed in this EIS can be attributed to Yakima City's location beyond the reach of the 80-kilometer (50-mile) radius of the potentially affected area. Figures J–14 and J–15 show cumulative minority populations as a function of distance from FFTF. Values along the vertical axis of this figure show minority populations living within a given distance from FFTF. Moving outward from the facilities, sharp increases in the cumulative minority populations can still be seen near the outskirts of the population centers of Richland and Kennewick/Pasco, Washington; however they occur roughly 16 kilometers (10 miles) closer than similar increases observed toward the outer rim of the potentially affected area surrounding the 200 Area facilities. An additional population spurt can be observed approximately 64 kilometers (40 miles) from FFTF, most likely attributed to the population center of Hermiston, Oregon. Additional increases in population are attributed to the outlying areas in Yakima County, Washington. Approximately 30 percent of the potentially affected minority population lives within about 32 kilometers (20 miles) of the facility, and 50 percent resides within about 47 kilometers (29 miles). The potentially affected total minority population surrounding FFTF is approximately 132,000 persons, accounting for approximately 37 percent of the total population. Approximately 86 percent of the minority population surrounding FFTF is Hispanic or Latino.

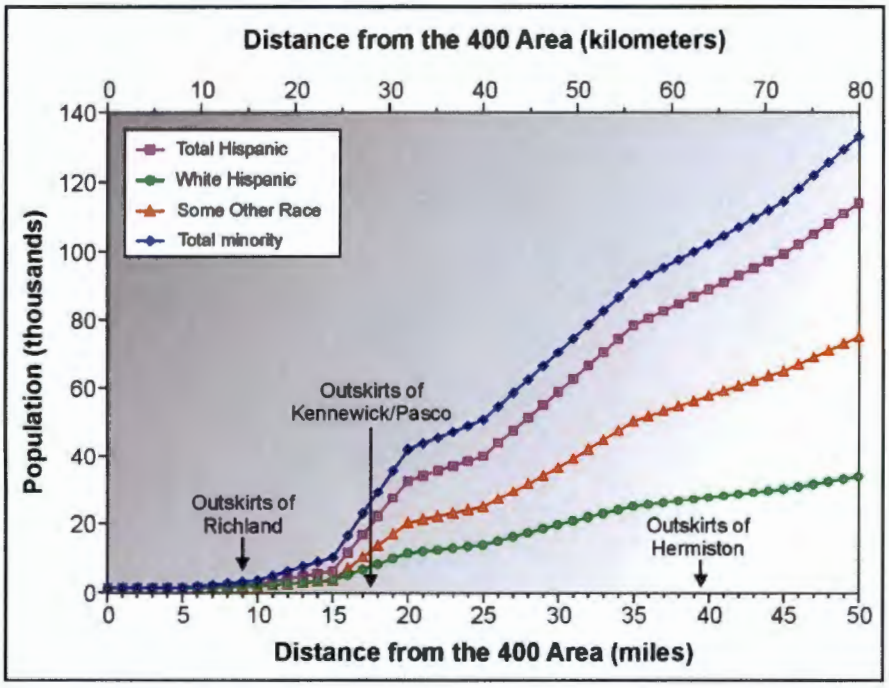

Figure J–14. Cumulative Larger-Scale Minority Populations as a Function of Distance from the Fast Flux Test Facility

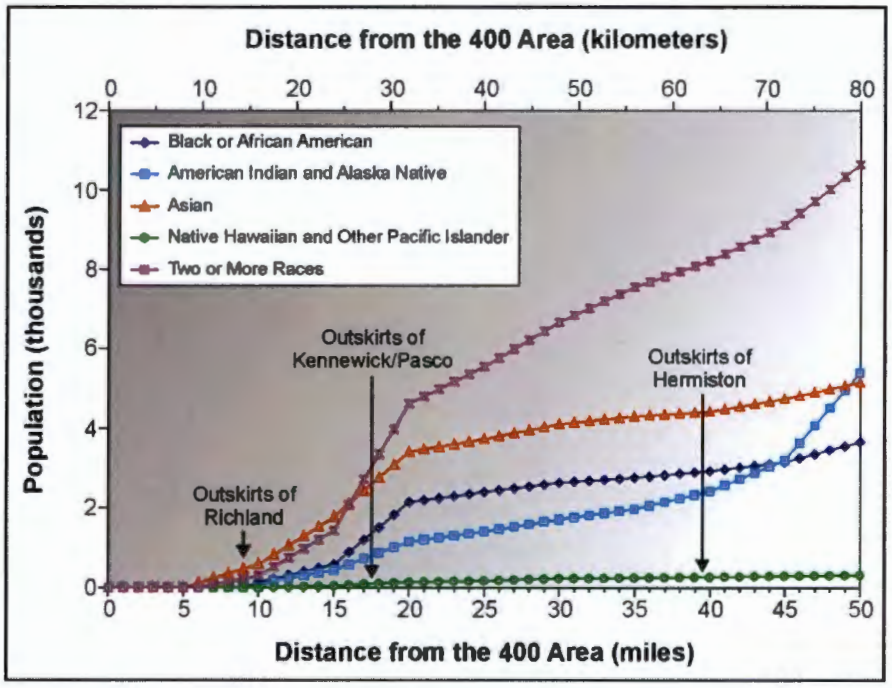

Figure J–15. Cumulative Smaller-Scale Minority Populations as a Function of Distance from the Fast Flux Test Facility

Figure J–16 shows block groups surrounding FFTF and low-income and non-low-income populations living in the potentially affected area. Of the 298 block groups that surround FFTF, an estimated 17 contain low-income populations.

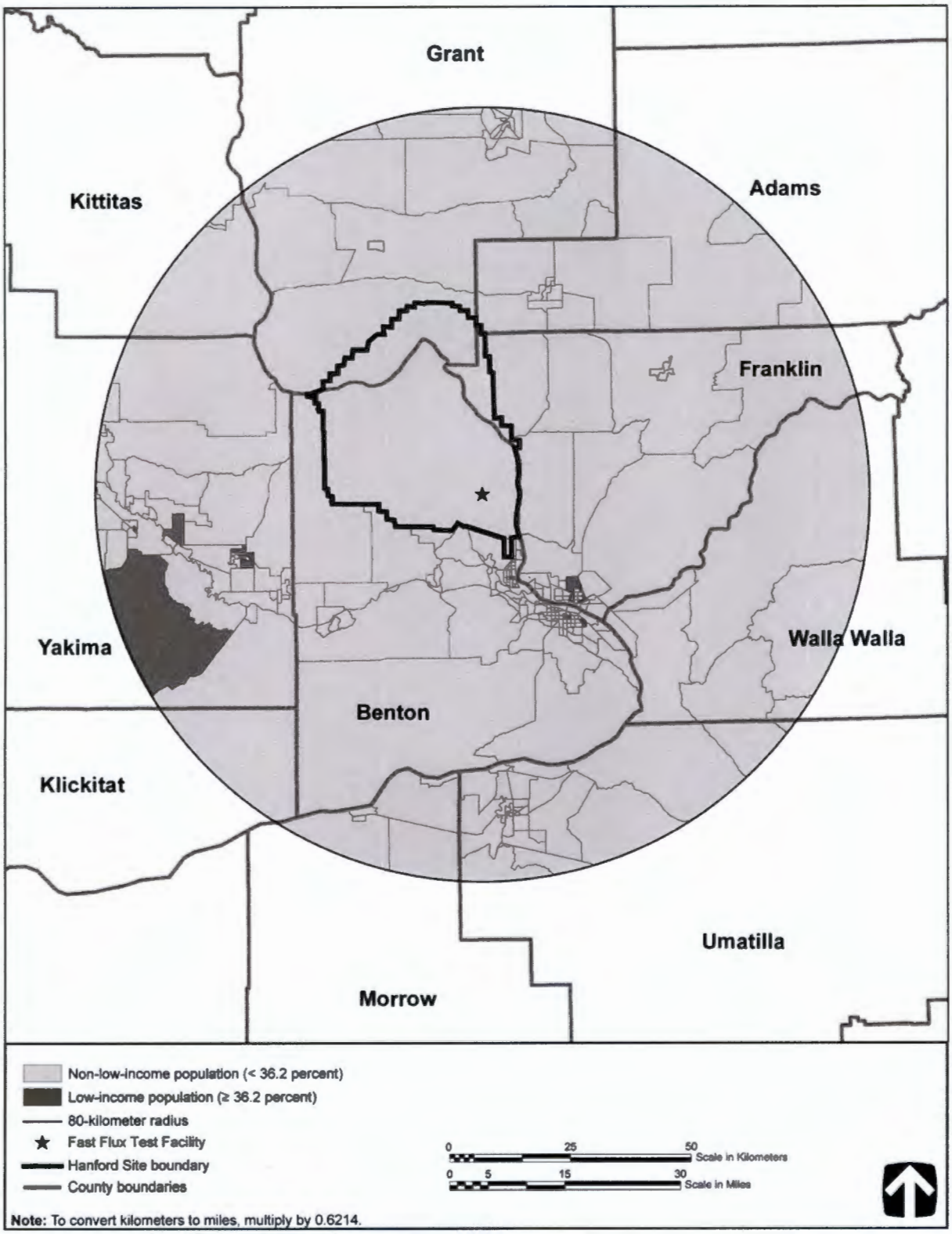

Figure J–16. Low-Income and Non-Low-Income Populations Living in Potentially Affected Block Groups Surrounding the Fast Flux Test Facility (2000)

As indicated in Table J–9, approximately 30 percent of the potentially affected low-income population lives in Yakima County, and over 90 percent of the potentially affected low-income population lives in five counties: Benton, Franklin, Grant, and Yakima Counties in Washington and Umatilla County in Oregon. Low-income persons compose approximately 16 percent of the total population living in the potentially affected area.

Table J–9. Low-Income Populations Living in Potentially Affected Counties Surrounding the Fast Flux Test Facility (2000)

County (State)	Total County Population[a]	Total Low-Income Population[a]	Potentially Affected Total Population	Potentially Affected Low-Income Population	Percentage of the Potentially Affected Low-Income Population Total
Adams (Washington)	16,217	2,951	12,508	2,431	4.4
Benton (Washington)[b]	141,232	14,517	141,219	14,521	26.3
Franklin (Washington)	48,307	9,280	48,183	9,256	16.8
Grant (Washington)	73,591	12,809	38,966	6,376	11.5
Kittitas (Washington)	31,177	6,122	799	67	0.1
Klickitat (Washington)	18,983	3,236	204	45	0.1
Walla Walla (Washington)	50,245	7,567	6,955	748	1.4
Yakima (Washington)	218,966	43,070	65,394	16,747	30.3
Morrow (Oregon)	10,919	1,617	6,718	1,242	2.2
Umatilla (Oregon)	67,329	8,524	30,940	3,801	6.9
Total	**676,966**	**109,693**	**351,886**	**55,234**	**100.0**

[a] Census 2007e.

[b] Potentially affected populations may not equal total populations due to rounding.

Figure J–17 shows cumulative low-income populations as a function of distance from FFTF. Low-income populations surrounding FFTF are concentrated in the Tri-Cities area and Yakima County in Washington and in Hermiston, Oregon.

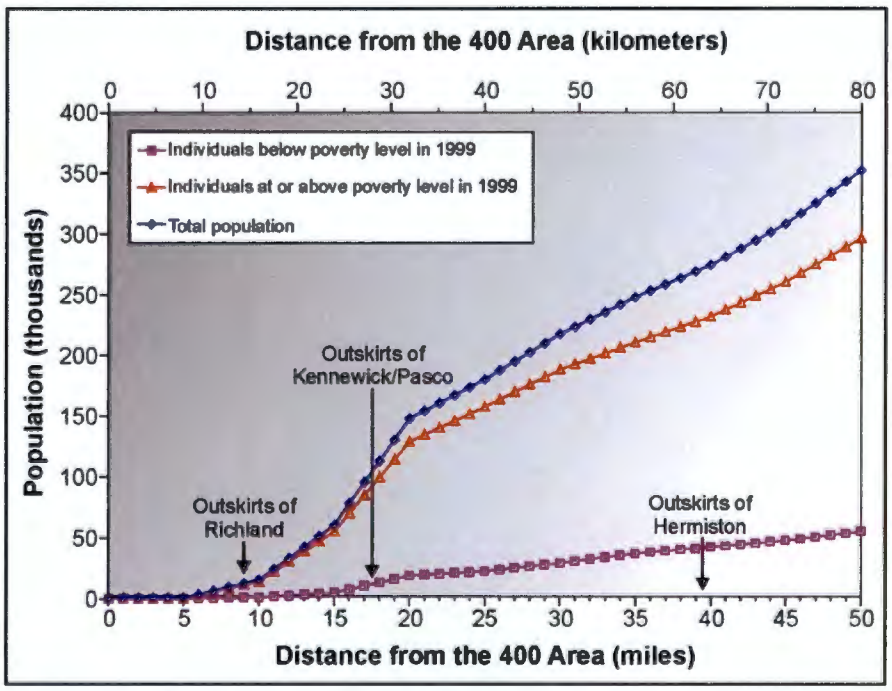

Figure J–17. Cumulative Low-Income Populations as a Function of Distance from the Fast Flux Test Facility

J.5.5 Minority and Low-Income Populations Surrounding Idaho National Laboratory

Figure J–18 shows minority and nonminority populations living in block groups surrounding INL. Of the 189 block groups that surround INL, an estimated 12 contain minority populations. Potentially affected counties include 14 counties in Idaho (Bannock, Bingham, Blaine, Bonneville, Butte, Caribou, Clark, Custer, Fremont, Jefferson, Lemhi, Madison, Minidoka, and Power). As indicated in Table J–10, approximately 66 percent of the potentially affected minority population resides in Bingham and Bonneville County, while another 30 percent of the potentially affected minority population lives in Bannock, Jefferson, and Madison Counties.

Table J–10. Minority Populations Living in Potentially Affected Counties Surrounding the Materials and Fuels Complex (2000)

County (Idaho)	Total County Population[a]	Total Minority Population[a]	Potentially Affected Total Population	Potentially Affected Minority Population	Percentage of the Potentially Affected Minority Population Total
Bannock	75,565	7,929	32,697	3,875	15.4
Bingham	41,735	8,911	40,557	8,724	34.7
Blaine	18,991	2,460	275	42	0.2
Bonneville	82,522	8,061	81,520	8,029	31.9
Butte	2,899	193	2,742	182	0.7
Caribou	7,304	375	0	0	0.0
Clark	1,022	369	625	233	0.9
Custer	4,342	242	160	8	0.0
Fremont	11,819	1,499	1,237	177	0.7
Jefferson	19,155	2,200	18,928	2,181	8.7
Lemhi	7,806	354	24	1	0.0
Madison	27,467	1,611	26,730	1,582	6.3
Minidoka	20,174	5,622	18	9	0.0
Power	7,538	1,946	449	132	0.5
Total	**328,339**	**41,772**	**205,962**	**25,175**	**100.0**

[a] Census 2007d.

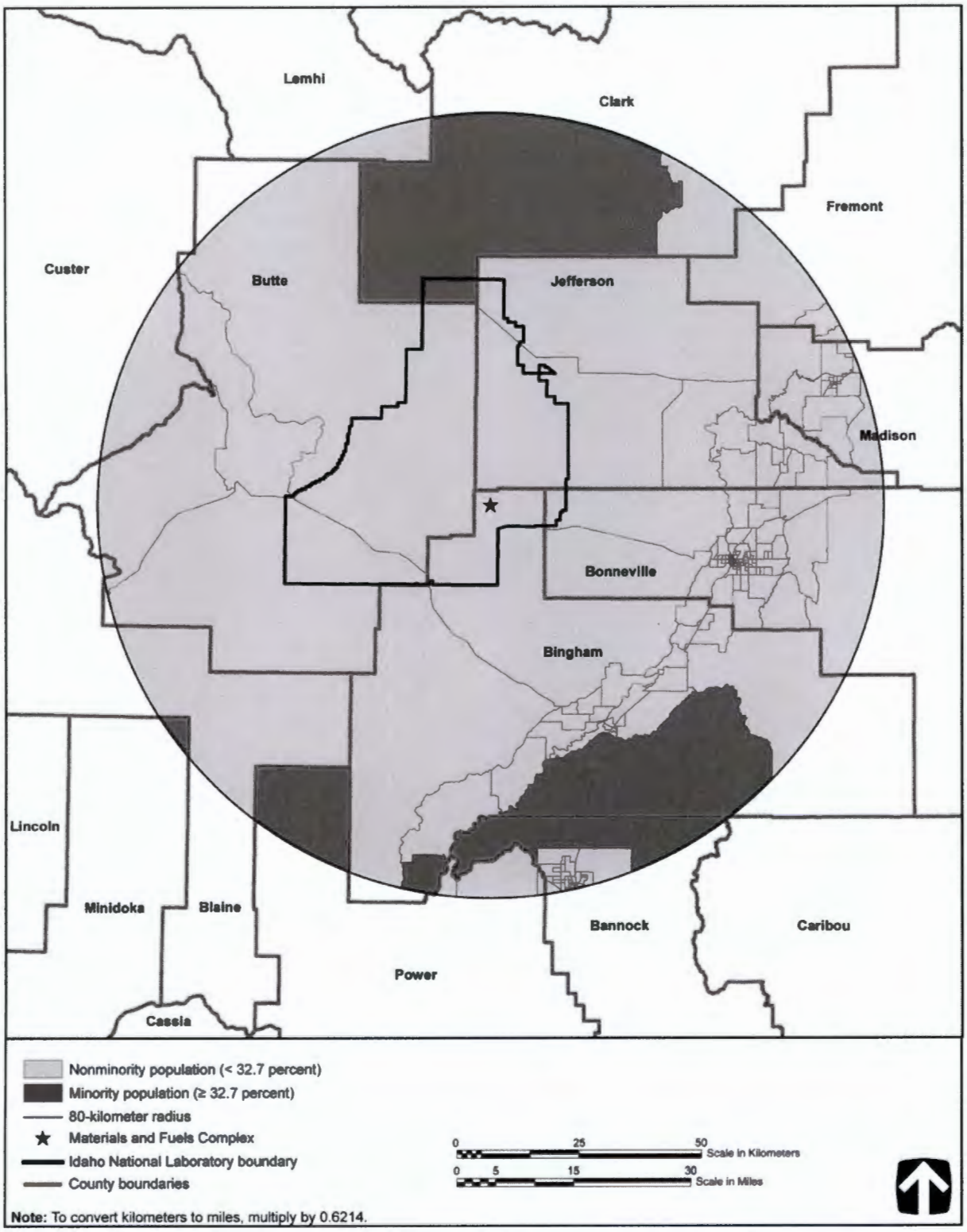

Figure J–18. Minority and Nonminority Populations Living in Potentially Affected Block Groups Surrounding the Materials and Fuels Complex (2000)

Figures J–19 and J–20 show cumulative minority populations as a function of distance from the MFC at INL. Values along the vertical axis of this figure show minority populations living within a given distance from the MFC. Moving outward from the MFC, the cumulative minority populations increase sharply near the outskirts of large population centers. Unlike the candidate facilities at Hanford, these large spikes do not occur until a distance of approximately 48 kilometers (30 miles), where Idaho Falls is located. The next significant jump in population occurs at approximately 72 kilometers (45 miles), near Pocatello. Approximately 10 percent of the potentially affected minority population lives within about 45 kilometers (28 miles) of the MFC, and 50 percent resides within about 56 kilometers (35 miles). The potentially affected total minority population surrounding the MFC is approximately 25,000 persons, accounting for approximately 12 percent of the total population. Approximately 65 percent of the minority population surrounding the MFC is Hispanic or Latino.

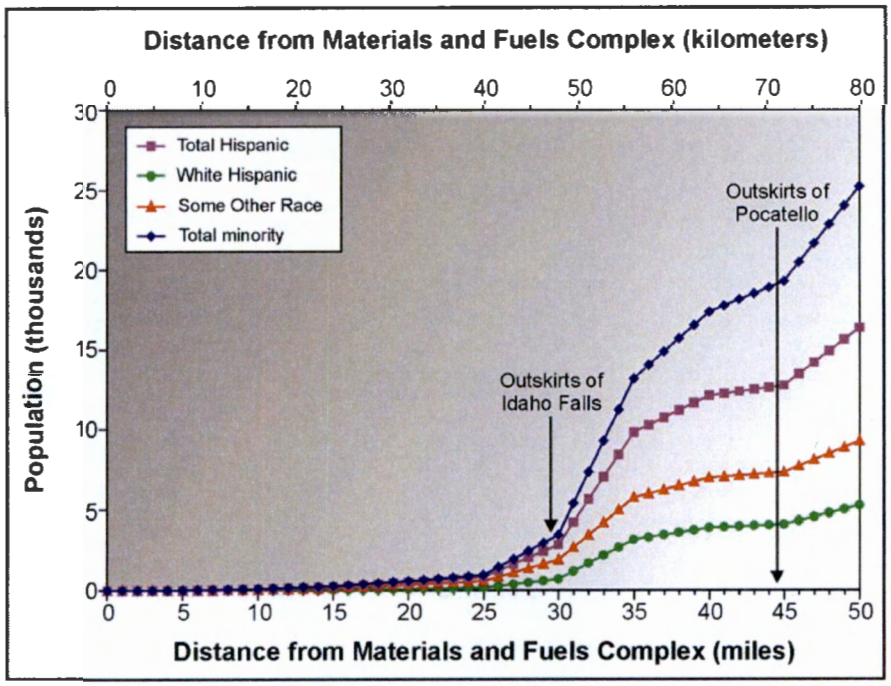

Figure J–19. Cumulative Larger-Scale Minority Populations as a Function of Distance from the Materials and Fuels Complex

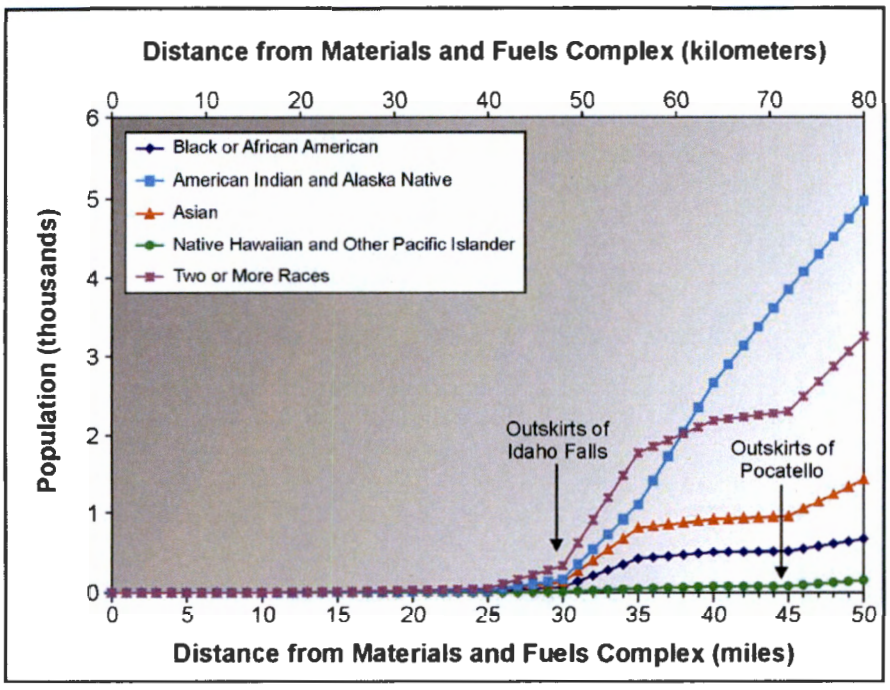

Figure J–20. Cumulative Smaller-Scale Minority Populations as a Function of Distance from the Materials and Fuels Complex

Figure J–21 shows the block groups surrounding INL and the low-income and non-low-income populations living in the potentially affected area. Of the 189 block groups that surround the MFC, it is estimated that 9 contain low-income populations. As indicated in Table J–11, approximately 60 percent of the potentially affected low-income population lives in Bonneville and Madison Counties. Another 30 percent of the potentially affected low-income population lives in Bannock and Bingham Counties. Low-income persons compose approximately 14 percent of the total population living in the potentially affected area. Figure J–22 shows cumulative low-income populations as a function of distance from the MFC. Low-income populations surrounding INL are concentrated in the Idaho Falls and Pocatello areas.

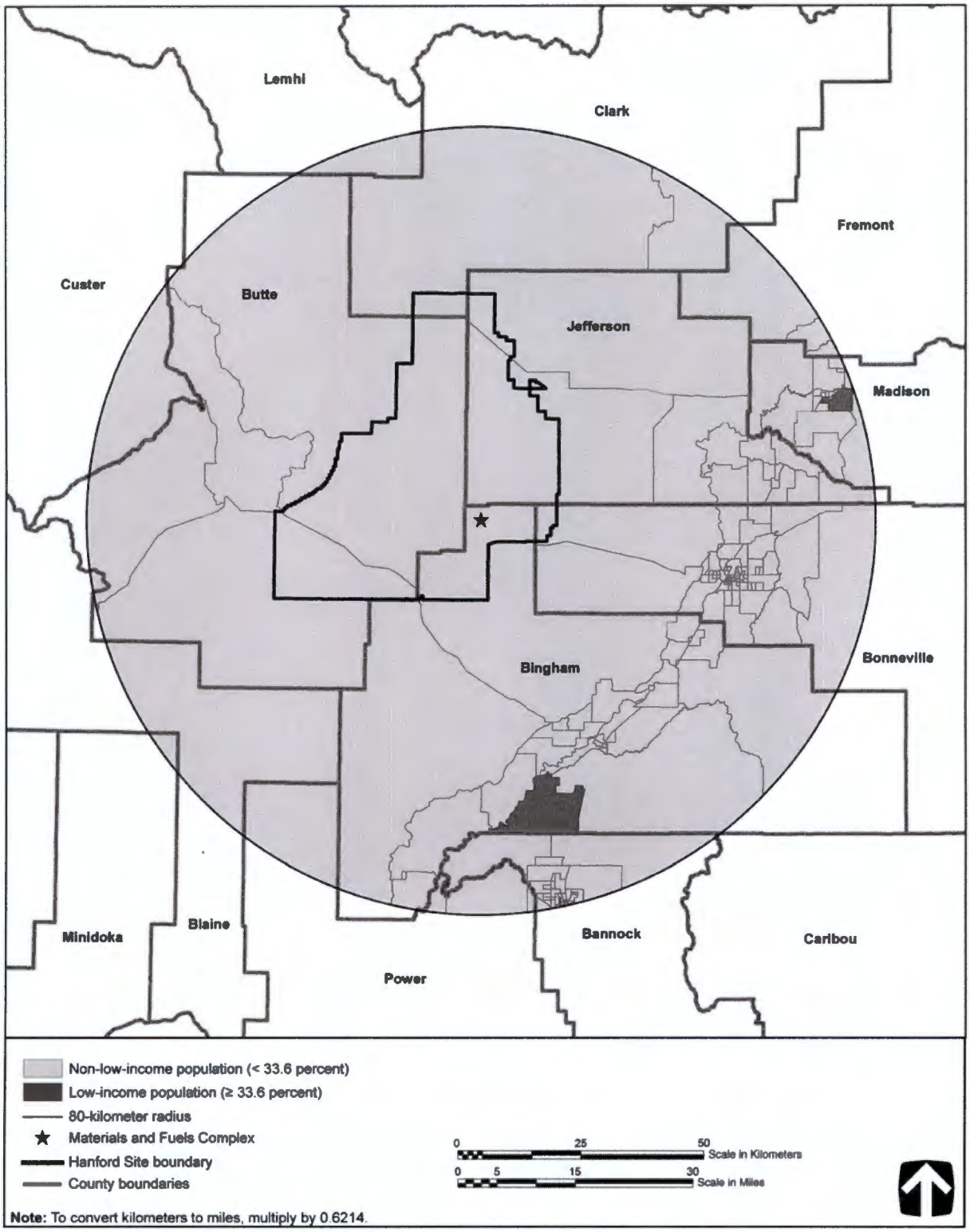

Figure J–21. Low-Income and Non-Low-Income Populations Living in Potentially Affected Block Groups Surrounding the Materials and Fuels Complex (2000)

Table J–11. Low-Income Populations Living in Potentially Affected Counties Surrounding the Materials and Fuels Complex (2000)

County (Idaho)	Total County Population[a]	Total Low-Income Population[a]	Potentially Affected Total Population	Potentially Affected Low-Income Population	Percentage of the Potentially Affected Low-Income Population Total
Bannock	73,414	10,181	32,435	3,719	13.5
Bingham	41,342	5,137	40,136	4,997	18.1
Blaine	18,868	1,469	274	24	0.1
Bonneville	81,532	8,260	80,521	8,178	29.6
Butte	2,869	522	2,707	498	1.8
Caribou	7,226	694	0	0	0.0
Clark	1,017	202	621	119	0.4
Custer	4,330	619	160	22	0.1
Fremont	11,530	1,633	1,218	106	0.4
Jefferson	19,090	1,984	18,867	1,946	7.0
Lemhi	7,736	1,185	24	5	0.0
Madison	26,051	7,948	25,297	7,922	28.7
Minidoka	19,992	2,960	20	4	0.0
Power	7,446	1,200	438	66	0.2
Total	**322,443**	**43,994**	**202,718**	**27,606**	**100.0**

[a] Census 2007e.

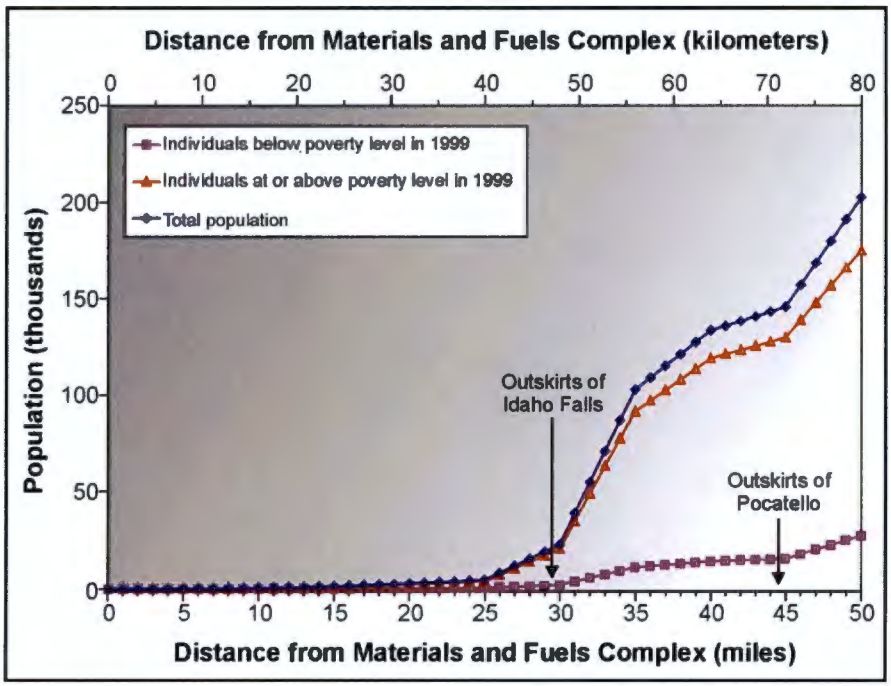

Figure J–22. Cumulative Low-Income Populations as a Function of Distance from the Materials and Fuels Complex

J.5.6 Impacts on Minority and Low-Income Populations

This environmental justice analysis is based on assessment of the impacts reported in Chapter 4 of this *TC & WM EIS*. Initially, all resource areas were examined to identify those with the potential for disproportionately high and adverse health or environmental impacts on minority and low-income populations. Access to Hanford is restricted, so the majority of impacts would be associated with onsite activities and would not affect populations residing off site; thus the potential for environmental justice concerns is small. Resource areas that could be impacted and that may affect populations residing off site include public health and safety due to normal operations and facility accidents, air quality, groundwater resources, and long-term human health. These areas were further analyzed because they do have the potential to pose environmental justice concerns.

J.5.6.1 Normal Operations and Facility Accidents

Radiological impacts of normal operations on minority, Hispanic, American Indian, and low-income populations were determined by applying the same methodology used to determine impacts of normal operations on the general public (total population). Concentrations of radiological air emissions originating from the appropriate facilities under each alternative were modeled using meteorological data and population distributions relative to the release sites to determine the impacts on each subset population. This approach is discussed in detail in Appendix K, Sections K.2.1.1.1, K.2.2.1.1, and K.2.3.1.1. Note that the exposure scenarios used to model the minority, Hispanic, American Indian, and low-income populations assume that these individuals would be exposed in the same manner as the general population, that is, by external exposure to the plume and deposited radioactive materials and by internal exposure from inhalation of contaminated air and deposited radioactive materials and ingestion of contaminated food, including homegrown produce and animal products from regional livestock.

For purposes of evaluating the potential for disproportionately high and adverse impacts caused by radiological emissions from normal operations, the average dose to an individual of the minority or low-income population is compared to the average dose to an individual of the remainder of the population. Table J–12 shows the population values used for this environmental justice analysis. The maximum annual dose (the maximum estimated dose in a single year of a particular alternative) and the project lifetime dose (the estimated dose received over the duration of a particular alternative) are used for this comparison. A maximum annual dose and a project lifetime dose were calculated for each subset of the population being evaluated (minority, Hispanic, American Indian, and low-income). The average dose to an individual of the population subset being evaluated is derived by dividing the population dose for the subset by the number of people in the subset.

$$D_{is} = \frac{D_{ps}}{n_s}$$

where:

D_{is} = average dose to an individual in the population subset s, millirem,
D_{ps} = population dose received by the population subset s, person-rem, and
n_s = number of people in the population subset s

Table J–12. Potentially Affected Populations[a]

Facility Site	Total Population[b]	Total Minority Population	Hispanic Population[c]	American Indian Population	Low-Income Population[d]
WTP	447,354	173,047	146,208	9,496	77,046
STTS-East	451,556	173,829	146,755	9,544	77,537
STTS-West	488,897	180,794	151,487	10,418	79,964
FFTF	357,391	131,786	112,899	5,383	55,234
INL	205,962	25,175	16,329	4,972	27,606

[a] Reflects populations living within an 80-kilometer (50-mile) radius of the indicated facility sites.

[b] Total population values used to compare with low-income populations are based on sample data. The values are 440,583; 444,789; 481,350; 351,886; and 202,718 for the WTP, STTS-East, STTS-West, FFTF, and INL, respectively.

[c] Includes all individuals, regardless of race, who identified themselves as Hispanic or Latino.

[d] Low-income population values are based on sample data.

Key: FFTF=Fast Flux Test Facility; INL=Idaho National Laboratory; STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

The result is then compared to the average dose to an individual who is not a member of the subset being evaluated. The average dose to a member of the remaining population is derived by dividing the population dose to the remainder of the population (population dose to the total population minus the population dose to the subset population) by the number of people in the remainder of the population (living within 80 kilometers [50 miles]) of the candidate facilities that are not in the population subset).

$$D_{ir} = \frac{D_{pr}}{n_r}$$

where:

D_{ir} = average dose to an individual in the remainder of the population (not a member of population subset s), millirem

D_{pr} = population dose received by the remainder of the population (the population that is not a member of subset s), and person-rem

n_r = number of people in the remainder of the population (total population minus population of subset s)

J.5.6.1.1 Tank Closure Alternatives

Table J–13 compares average individual doses to minority and nonminority populations under each Tank Closure alternative to examine the potential for disproportionately high and adverse impacts. There are no appreciable differences between the average dose to a minority individual and a nonminority individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on minority populations surrounding each facility site.

Table J–13. Tank Closure Alternatives – Total, Minority, and Nonminority Population and Average Individual Doses in Year of Maximum Impact

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Minority Population Dose (person-rem)	Minority Individual Average Dose (millirem)	Nonminority Population Dose (person-rem)	Nonminority Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	3.2	7.1×10^{-3}	1.1	6.4×10^{-3}	2.1	7.6×10^{-3}
STTS-West	3.1	6.3×10^{-3}	9.9×10^{-1}	5.5×10^{-3}	2.1	6.8×10^{-3}
Total	**6.3**	**1.3×10^{-2}**	**2.1**	**1.2×10^{-2}**	**4.2**	**1.4×10^{-2}**
Alternative 2A						
WTP	6.0×10^{1}	1.3×10^{-1}	2.1×10^{1}	1.2×10^{-1}	3.9×10^{1}	1.4×10^{-1}
STTS-East	5.3×10^{-7}	1.2×10^{-9}	1.8×10^{-7}	1.0×10^{-9}	3.5×10^{-7}	1.3×10^{-9}
STTS-West	0	0	0	0	0	0
Total	**6.0×10^{1}**	**1.3×10^{-1}**	**2.1×10^{1}**	**1.2×10^{-1}**	**3.9×10^{1}**	**1.4×10^{-1}**
Alternative 2B						
WTP	7.6×10^{1}	1.7×10^{-1}	2.6×10^{1}	1.5×10^{-1}	4.9×10^{1}	1.8×10^{-1}
STTS-East	1.7×10^{-1}	3.7×10^{-4}	5.6×10^{-2}	3.2×10^{-4}	1.1×10^{-1}	4.0×10^{-4}
STTS-West	1.6×10^{-1}	3.3×10^{-4}	5.1×10^{-2}	2.8×10^{-4}	1.1×10^{-1}	3.6×10^{-4}
Total	**7.6×10^{1}**	**1.7×10^{-1}**	**2.6×10^{1}**	**1.5×10^{-1}**	**5.0×10^{1}**	**1.8×10^{-1}**
Alternative 3A						
WTP	6.0×10^{1}	1.3×10^{-1}	2.1×10^{1}	1.2×10^{-1}	3.9×10^{1}	1.4×10^{-1}
STTS-East	4.2×10^{-1}	9.4×10^{-4}	1.5×10^{-1}	8.5×10^{-4}	2.8×10^{-1}	1.0×10^{-3}
STTS-West	4.5×10^{-1}	9.1×10^{-4}	1.4×10^{-1}	7.9×10^{-4}	3.0×10^{-1}	9.8×10^{-4}
Total	**6.1×10^{1}**	**1.4×10^{-1}**	**2.1×10^{1}**	**1.2×10^{-1}**	**4.0×10^{1}**	**1.5×10^{-1}**
Alternative 3B						
WTP	6.0×10^{1}	1.3×10^{-1}	2.1×10^{1}	1.2×10^{-1}	3.9×10^{1}	1.4×10^{-1}
STTS-East	6.2×10^{-5}	1.4×10^{-7}	2.1×10^{-5}	1.2×10^{-7}	4.1×10^{-5}	1.5×10^{-7}
STTS-West	1.8×10^{-3}	3.7×10^{-6}	5.8×10^{-4}	3.2×10^{-6}	1.2×10^{-3}	4.0×10^{-6}
Total	**6.0×10^{1}**	**1.3×10^{-1}**	**2.1×10^{1}**	**1.2×10^{-1}**	**3.9×10^{1}**	**1.4×10^{-1}**
Alternative 3C						
WTP	6.0×10^{1}	1.3×10^{-1}	2.1×10^{1}	1.2×10^{-1}	3.9×10^{1}	1.4×10^{-1}
STTS-East	4.2×10^{-1}	9.4×10^{-4}	1.5×10^{-1}	8.5×10^{-4}	2.8×10^{-1}	1.0×10^{-3}
STTS-West	4.5×10^{-1}	9.1×10^{-4}	1.4×10^{-1}	7.9×10^{-4}	3.0×10^{-1}	9.8×10^{-4}
Total	**6.1×10^{1}**	**1.4×10^{-1}**	**2.1×10^{1}**	**1.2×10^{-1}**	**4.0×10^{1}**	**1.5×10^{-1}**
Alternative 4						
WTP	6.0×10^{1}	1.3×10^{-1}	2.1×10^{1}	1.2×10^{-1}	3.9×10^{1}	1.4×10^{-1}
STTS-East	2.3×10^{-2}	5.2×10^{-5}	7.9×10^{-3}	4.6×10^{-5}	1.5×10^{-2}	5.6×10^{-5}
STTS-West	2.3×10^{-2}	4.8×10^{-5}	7.4×10^{-3}	4.1×10^{-5}	1.6×10^{-2}	5.2×10^{-5}
Total	**6.0×10^{1}**	**1.3×10^{-1}**	**2.1×10^{1}**	**1.2×10^{-1}**	**3.9×10^{1}**	**1.4×10^{-1}**
Alternative 5						
WTP	6.0×10^{1}	1.3×10^{-1}	2.1×10^{1}	1.2×10^{-1}	3.9×10^{1}	1.4×10^{-1}
STTS-East	3.0×10^{-5}	6.6×10^{-8}	1.0×10^{-5}	5.8×10^{-8}	2.0×10^{-5}	7.0×10^{-8}
STTS-West	5.6×10^{-1}	1.2×10^{-3}	1.8×10^{-1}	1.0×10^{-3}	3.8×10^{-1}	1.2×10^{-3}
Total	**6.1×10^{1}**	**1.4×10^{-1}**	**2.1×10^{1}**	**1.2×10^{-1}**	**4.0×10^{1}**	**1.5×10^{-1}**

Table I–36. Tank Closure Alternative 6A, Base Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Postclosure Care (CLO_POST)							
Radiological workers	N/A						
Nonradiological workers							3
On site	471,262	2151	2250	100	4,713	3	
Off site	N/A						
Removal of B Tank Farm (CLO_REMTB)							
Radiological workers	692,733	2065	2076	12	57,728	28	
Nonradiological workers							73
On site	1,098,495	2065	2076	12	91,541	45	
Off site	N/A						
Removal of T Tank Farm (CLO_REMTT)							
Radiological workers	692,733	2126	2137	12	57,728	28	
Nonradiological workers							73
On site	1,098,495	2126	2137	12	91,541	45	
Off site	N/A						
Removal of BY Tank Farm (CLO_REMTBY)							
Radiological workers	519,550	2111	2122	12	43,296	21	
Nonradiological workers							55
On site	823,871	2111	2122	12	68,656	34	
Off site	N/A						
Removal of BX Tank Farm (CLO_REMTBX)							
Radiological workers	519,550	2042	2053	12	43,296	21	
Nonradiological workers							55
On site	823,871	2042	2053	12	68,656	34	
Off site	N/A						
Removal of C Tank Farm (CLO_REMTC)							
Radiological workers	692,733	2088	2099	12	57,728	28	
Nonradiological workers							73
On site	1,098,495	2088	2099	12	91,541	45	
Off site	N/A						
Removal of A Tank Farm (CLO_REMTA)							
Radiological workers	259,775	2142	2153	12	21,648	11	
Nonradiological workers							28
On site	411,936	2142	2153	12	34,328	17	
Off site	N/A						
Removal of AX Tank Farm (CLO_REMTAX)							
Radiological workers	173,183	2142	2153	12	14,432	7	
Nonradiological workers							19
On site	274,624	2142	2153	12	22,885	12	
Off site	N/A						
Removal of S Tank Farm (CLO_REMTS)							
Radiological workers	519,550	2126	2137	12	43,296	21	
Nonradiological workers							55
On site	823,871	2126	2137	12	68,656	34	
Off site	N/A						

Table I–36. Tank Closure Alternative 6A, Base Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Removal of TY Tank Farm (CLO_REMTTY)							
Radiological workers	259,775	2111	2122	12	21,648	11	28
Nonradiological workers							
On site	411,936	2111	2122	12	34,328	17	
Off site	N/A						
Removal of TX Tank Farm (CLO_REMTTX)							
Radiological workers	779,325	2088	2099	12	64,944	32	82
Nonradiological workers							
On site	1,235,807	2088	2099	12	102,984	50	
Off site	N/A						
Removal of U Tank Farm (CLO_REMTU)							
Radiological workers	692,733	2065	2076	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2065	2076	12	91,541	45	
Off site	N/A						
Removal of SX Tank Farm (CLO_REMTSX)							
Radiological workers	649,437	2042	2053	12	54,120	27	69
Nonradiological workers							
On site	1,029,839	2042	2053	12	85,820	42	
Off site	N/A						
Removal of Deep Soil–B Tank Farm (CLO_REMSB)							
Radiological workers	73,371	2077	2084	8	9,171	5	11
Nonradiological workers							
On site	84,852	2077	2084	8	10,607	6	
Off site	N/A						
Removal of Deep Soil–T Tank Farm (CLO_REMST)							
Radiological workers	563,796	2138	2145	8	70,474	34	74
Nonradiological workers							
On site	652,024	2138	2145	8	81,503	40	
Off site	N/A						
Removal of Deep Soil–BX Tank Farm (CLO_REMSBX)							
Radiological workers	293,483	2054	2061	8	36,685	18	39
Nonradiological workers							
On site	339,410	2054	2061	8	42,426	21	
Off site	N/A						
Removal of Deep Soil–C Tank Farm (CLO_REMSC)							
Radiological workers	4,449	2100	2107	8	556	1	2
Nonradiological workers							
On site	5,145	2100	2107	8	643	1	
Off site	N/A						
Removal of Deep Soil–A Tank Farm (CLO_REMSA)							
Radiological workers	13,346	2154	2161	8	1,668	1	2
Nonradiological workers							
On site	15,434	2154	2161	8	1,929	1	
Off site	N/A						

Table I–36. Tank Closure Alternative 6A, Base Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Removal of Deep Soil–AX Tank Farm (CLO_REMSAX)							
Radiological workers	222,429	2154	2161	8	27,804	14	30
Nonradiological workers							
On site	257,237	2154	2161	8	32,155	16	
Off site	N/A						
Removal of Deep Soil–TX Tank Farm (CLO_REMSTX)							
Radiological workers	700,651	2100	2107	8	87,581	43	92
Nonradiological workers							
On site	810,297	2100	2107	8	101,287	49	
Off site	N/A						
Removal of Deep Soil–U Tank Farm (CLO_REMSU)							
Radiological workers	367,008	2077	2084	8	45,876	23	49
Nonradiological workers							
On site	424,441	2077	2084	8	53,055	26	
Off site	N/A						
Removal of Deep Soil–SX Tank Farm (CLO_REMSSX)							
Radiological workers	895,895	2054	2061	8	111,987	54	117
Nonradiological workers							
On site	1,036,093	2054	2061	8	129,152	63	
Off site	N/A						
Preprocessing Facility Construction (CLO_CONPPF)							
Radiological workers	N/A						2,389
Nonradiological workers							
On site	14,904,804	2039	2041	3	4,968,268	2,389	
Off site	5,035,407	2039	2041	3	1,678,469	807	
Preprocessing Facility Operations (CLO_OPSPPF)							
Radiological workers	13,087,360	2042	2162	121	108,160	52	54
Nonradiological workers							
On site	402,688	2042	2162	121	3,328	2	
Off site	N/A						
Preprocessing Facility Deactivation (CLO_DEAPPF)							
Radiological workers	108,160	2163	2163	1	108,160	52	54
Nonradiological workers							
On site	3,328	2163	2163	1	3,328	2	
Off site	N/A						
Total	**59,703,247**				**10,003,750**	**4,841**	**4,030**

[a] CLO_CONCS activities are conducted over six 4-year periods, totaling 24 years.
Period 1, 2038–2041; 2 facilities
Period 2, 2061–2064; 2 facilities
Period 3, 2084–2087; 2 facilities
Period 4, 2107–2110; 2 facilities
Period 5, 2122–2125; 2 facilities
Period 6, 2138–2141; 2 facilities

Table I–36. Tank Closure Alternative 6A, Base Case, Closure Rollup Workforce Estimate *(continued)*

[b] CLO_DEACS activities are conducted over seven 3-year periods, totaling 21 years.
Period 1, 2062–2064; 2 facilities
Period 2, 2085–2087; 2 facilities
Period 3, 2108–2110; 2 facilities
Period 4, 2123–2125; 2 facilities
Period 5, 2146–2148; 1 facility
Period 6, 2138–2140; 1 facility
Period 7, 2162–2164; 2 facilities

Formula: Hours per year = (total hours/12 containment structures)/3 years of deactivation per deactivation period.

Notes and Assumptions:

Total number of offsite full-time equivalents = 811.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

I.2.10 Tank Closure Alternative 6A: All Vitrification/No Separations; Clean Closure–Option Case

Table I–37. Tank Closure Alternative 6A, Option Case, Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Canister Storage Building (CON_CSB)							
Radiological workers	115,500	2006	2016	11	10,500	6	12
Nonradiological workers							
On site	135,929	2006	2016	11	12,357	6	
Off site	50,286	2006	2016	11	4,571	3	
Immobilized High-Level Radioactive Waste Shipping/Transfer Facility (CON_STF)							
Radiological Workers	N/A						380
Nonradiological workers							
Onsite construction	1,757,000	2011	2013	3	585,667	282	
Onsite exempt	610,000	2011	2013	3	203,333	98	
Offsite design	748,000	2011	2013	3	249,333	120	
Immobilized High-Level Radioactive Waste Interim Storage Modules (CON_ISM)							
Radiological Workers	N/A						309
Nonradiological workers							
Onsite construction	56,995,392	2014	2157	144	395,801	191	
Onsite exempt	35,200,000	2014	2157	144	244,444	118	
Offsite design	43,200,000	2014	2157	144	300,000	145	
Other Infrastructure Upgrades (CON_OIU)							
Radiological workers	782,094	2006	2034	29	26,969	13	45
Nonradiological workers							
On site	1,918,531	2006	2034	29	66,156	32	
Off site	743,125	2006	2034	29	25,625	13	
Tank Upgrades (CON_TU)							
Radiological workers	1,195,652	2006	2025	20	59,783	29	104
Nonradiological workers							
On site	3,112,174	2006	2025	20	155,609	75	
Off site	1,179,130	2006	2025	20	58,957	29	

Table I–37. Tank Closure Alternative 6A, Option Case, Construction Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Underground Transfer Lines (CON_UTL)							
Radiological workers	N/A						
Nonradiological workers							61
On site	126,005	2009	2009	1	126,005	61	
Off site	17,400	2009	2009	1	17,400	9	
Waste Treatment Plant (CON_WTP)							
Radiological workers	N/A						
Nonradiological workers							906
On site	22,612,500	2006	2017	12	1,884,375	906	
Off site	7,537,500	2006	2017	12	628,125	302	
Cesium and Strontium Capsule Processing Facility (CON_CSC)							
Radiological workers	N/A						
Nonradiological workers							190
On site	1,578,029	2158	2161	4	394,507	190	
Off site	465,683	2158	2161	4	116,421	56	
Tank Risers (CON_RIS)							
Radiological workers	188,760	2013	2016	4	47,190	23	
Nonradiological workers							54
On site	254,540	2013	2016	4	63,635	31	
Off site	N/A						
Double-Shell Tank Replacement (CON_DST)[a]							
Radiological workers	N/A						
Nonradiological workers							1,005
On site	37,590,000	2029	2114	18	2,088,333	1,005	
Off site	13,524,000	2029	2114	18	751,333	362	
Mobile Retrieval System (CON_MRS)							
Radiological workers	33,070,100	2013	2162	150	220,467	106	
Nonradiological workers							224
On site	36,507,695	2013	2162	150	243,385	118	
Off site	19,575,745	2013	2162	150	130,505	63	
Vacuum-Based Retrieval System (CON_VBR)							
Radiological workers	9,686,600	2013	2162	150	64,577	32	
Nonradiological workers							66
On site	10,344,950	2013	2162	150	68,966	34	
Off site	5,898,200	2013	2162	150	39,321	19	

Table I–37. Tank Closure Alternative 6A, Option Case, Construction Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Chemical Wash System (CON_CHW)							
Radiological workers	3,063,830	2013	2162	150	20,426	10	12
Nonradiological workers							
On site	607,453	2013	2162	150	4,050	2	
Off site	817,719	2013	2162	150	5,451	3	
High-Level Radioactive Waste Melter Interim Storage Facilities (CON_PAD)							
Radiological workers	N/A						1
Nonradiological workers							
On site	19,656	2017	2138	14	1,404	1	
Off site	N/A	Seven 2-year construction periods[b]					
Underground Transfer Line Replacements (CON_UTLU)							
Radiological workers	N/A						61
Nonradiological workers							
On site	126,005	2064	2064	1	126,005	61	
Off site	17,400	2064	2064	1	17,400	9	
Waste Treatment Plant Replacement (CON_WTPU)							
Radiological workers	N/A	Two 12-year construction periods[c]					678
Nonradiological workers							
On site	33,800,000	2067	2138	24	1,408,333	678	
Off site	11,300,000	2067	2138	24	470,833	227	
Immobilized High-Level Radioactive Waste Shipping/Transfer Facility Replacement (CON_STFU)							
Three 3-year construction periods[d]							
Radiological workers	N/A						380
Nonradiological workers							
Onsite construction	5,271,000	2076	2198	9	585,667	282	
Onsite exempt	1,830,000	2076	2198	9	203,333	98	
Offsite design	2,244,000	2076	2198	9	249,333	120	
Immobilized High-Level Radioactive Waste Interim Storage Module Replacement (CON_ISMU)							
Radiological workers	N/A						838
Nonradiological workers							
Onsite construction	129,130,185	2078	2197	120	1,076,085	518	
Onsite exempt	79,750,000	2078	2197	120	664,583	320	
Offsite design	97,875,000	2078	2197	120	815,625	393	
High-Level Radioactive Waste Debris Storage Facilities (CON_HLWST)							
Radiological workers	N/A						4
Nonradiological workers							
On site	577,280	2041	2110	70	8,247	4	
Off site	N/A						
Effluent Treatment Facility Replacement (CON_ETF)							
Radiological workers	N/A						329
Nonradiological workers							
On site	2,047,400	2023	2025	3	682,467	329	
Off site	703,895	2023	2025	3	234,632	113	

Table I–37. Tank Closure Alternative 6A, Option Case, Construction Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Effluent Treatment Facility Replacement (CON_ETFU)[e]							
Radiological workers	N/A						329
Nonradiological workers							
On site	8,189,600	2053	2145	12	682,467	329	
Off site	865,168	2053	2145	12	72,097	35	
242-A Evaporator Replacement (CON_EVA)							
Radiological workers	N/A						102
Nonradiological workers							
On site	635,400	2015	2017	3	211,800	102	
Off site	217,918	2015	2017	3	72,639	35	
242-A Evaporator Replacement (CON_EVAU)[f]							
Radiological workers	N/A						102
Nonradiological workers							
On site	3,177,000	2040	2142	15	211,800	102	
Off site	1,145,741	2040	2142	15	76,383	37	
Total	**730,132,170**				**17,184,712**	**8,285**	**6,192**

[a] CON_DST activities are conducted over three 6-year periods, totaling 18 years.
Period 1, 2029–2034
Period 2, 2069–2074
Period 3, 2109–2114

[b] CON_PAD activities are conducted over seven 2-year periods, totaling 14 years.
Period 1, 2017–2018
Period 2, 2037–2038
Period 3, 2057–2058
Period 4, 2077–2078
Period 5, 2097–2098
Period 6, 2117–2118
Period 7, 2137–2138

[c] CON_WTPU activities are conducted over two 12-year periods, totaling 24 years.
Period 1, 2067–2078
Period 2, 2127–2138

[d] CON_STFU activities are conducted over three 3-year periods, totaling 9 years.
Period 1, 2076–2078
Period 2, 2136–2138
Period 3, 2196–2198

[e] CON_EFTU activities are conducted over four 3-year periods, totaling 12 years.
Period 1, 2053–2055
Period 2, 2083–2085
Period 3, 2113–2115
Period 4, 2143–2145

[f] CON_EVAU activities are conducted over five 3-year periods, totaling 15 years.
Period 1, 2040–2042
Period 2, 2065–2067
Period 3, 2090–2092
Period 4, 2115–2117
Period 5, 2140–2142

Notes and Assumptions:
Total number of offsite full-time equivalents = 2,093.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–38. Tank Closure Alternative 6A, Option Case, Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Immobilized High-Level Radioactive Waste Interim Storage Facilities (OPS_ISF)							
Radiological workers	427,868,980	2018	2262	245	1,746,404	840	1,310
Nonradiological workers							
On site	239,316,000	2018	2262	245	976,800	470	
Off site	N/A						
Other Infrastructure Upgrades (OPS_OIU)							
Radiological workers	185,545	2006	2162	157	1,182	1	4
Nonradiological workers							
On site	680,333	2006	2162	157	4,333	3	
Off site	485,273	2006	2162	157	3,091	2	
Routine Operations (OPS_ROUT)							
Radiological workers	40,820,000	2006	2162	157	260,000	125	651
Nonradiological workers							
On site	171,601,000	2006	2162	157	1,093,000	526	
Off site	24,335,000	2006	2162	157	155,000	75	
Retrieval Operations (OPS_RET)							
Radiological workers	53,523	2006	2162	157	341	1	28
Nonradiological workers							
On site	8,724,205	2006	2162	157	55,568	27	
Off site	67,795	2006	2162	157	432	1	
Interim Stabilization/Double-Shell Tanks (OPS_IST)							
Radiological workers	5,762,614	2006	2162	157	36,705	18	44
Nonradiological workers							
On site	8,246,068	2006	2162	157	52,523	26	
Off site	9,106,000	2006	2162	157	58,000	28	
Waste Treatment Plant—Cesium and Strontium Capsules (OPS_WTP)							
Radiological workers	388,094,815	2018	2162	145	2,676,516	1,287	2,170
Nonradiological workers							
On site	266,176,439	2018	2162	145	1,835,700	883	
Off site	38,970	2018	2162	145	269	1	
Waste Treatment Plant (OPS_WTPCSC)							
Radiological workers	2,676,516	2163	2163	1	2,676,516	1,287	2,170
Nonradiological workers							
On site	1,835,700	2163	2163	1	1,835,700	883	
Off site	269	2163	2163	1	269	1	
Cesium and Strontium Capsule Processing Facility (OPS_CSC)							
Radiological workers	103,334	2162	2163	2	51,667	25	25
Nonradiological workers							
On site	N/A						
Off site	N/A						

Table I–38. Tank Closure Alternative 6A, Option Case, Operations Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Mobile Retrieval System (OPS_MRS)							
Radiological workers	21,108,220	2013	2162	150	140,721	68	130
Nonradiological workers							
On site	19,105,345	2013	2162	150	127,369	62	
Off site	N/A						
Vacuum-Based Retrieval System (OPS_VBR)							
Radiological workers	6,634,012	2013	2162	150	44,227	22	42
Nonradiological workers							
On site	6,004,537	2013	2162	150	40,030	20	
Off site	N/A						
Chemical Wash System (OPS_CHW)							
Radiological workers	13,871,116	2013	2162	150	92,474	45	86
Nonradiological workers							
On site	12,555,102	2013	2162	150	83,701	41	
Off site	N/A						
High-Level Radioactive Waste Melter Interim Storage Facilities (OPS_PAD)							
Radiological workers	N/A	2018	2262	245			
Nonradiological workers							
On site	N/A						
Off site	N/A						
High-Level Radioactive Waste Debris Storage Facilities (OPS_HLWST)							
Radiological workers	N/A	2042	2262	221			
Nonradiological workers							
On site	N/A						
Off site	N/A						
Effluent Treatment Facility Replacement (OPS_ETF)							
Radiological workers	24,884,160	2006	2166	161	154,560	75	94
Nonradiological workers							
On site	6,221,040	2006	2166	161	38,640	19	
Off site	N/A						
242-A Evaporator Replacement (OPS_EVA)							
Radiological workers	7,138,758	2018	2163	146	48,896	24	32
Nonradiological workers							
On site	2,183,211	2018	2163	146	14,954	8	
Off site	N/A						

Table I–38. Tank Closure Alternative 6A, Option Case, Operations Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Borrow Area C (OPS_CAREA)							
Radiological workers	N/A						
Nonradiological workers							
On site	14,482,800	2006	2167	162	89,400	43	43
Off site	N/A						
Total	**1,730,366,679**				**14,394,985**	**6,937**	**6,829**

Notes and Assumptions:
Total number of offsite full-time equivalents = 108.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007a, 2008.

Table I–39. Tank Closure Alternative 6A, Option Case, Deactivation Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Immobilized High-Level Radioactive Waste Interim Storage Facilities (DEA_ISF)							
Radiological workers	N/A						
Nonradiological workers							
On site	3,840	2078	2197	120	32	1	1
Off site	N/A						
Waste Treatment Plant (DEA_WTP)[a]							
Radiological workers	13,459,936	2079	2166	9	1,495,548	720	
Nonradiological workers							1,214
On site	9,231,553	2079	2166	9	1,025,728	494	
Off site	N/A						
Mobile Retrieval System (DEA_MRS)							
Radiological workers	2,775,115	2013	2162	150	18,501	9	
Nonradiological workers							9
On site	N/A						
Off site	N/A						
Vacuum-Based Retrieval System (DEA_VBR)							
Radiological workers	223,300	2013	2162	150	1,489	1	
Nonradiological workers							1
On site	N/A						
Off site	N/A						
Chemical Wash System (DEA_CHW)							
Radiological workers	185,472	2013	2162	150	1,236	1	
Nonradiological workers							1
On site	N/A						
Off site	N/A						

Table I–39. Tank Closure Alternative 6A, Option Case, Deactivation Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Cesium and Strontium Capsule Processing Facility (DEA_CSC)							
Radiological workers	23,920	2164	2164	1	23,920	12	12
Nonradiological workers							
On site	N/A						
Off site	N/A						
Effluent Treatment Facility Replacement (DEA_ETF)[b]							
Radiological workers	463,680	2026	2167	6	77,280	38	48
Nonradiological workers							
On site	115,920	2026	2167	6	19,320	10	
Off site	N/A						
242-A Evaporator Replacement (DEA_EVA)[c]							
Radiological workers	171,135	2018	2168	7	24,448	12	16
Nonradiological workers							
On site	52,337	2018	2168	7	7,477	4	
Off site	N/A						
Total	**26,706,208**				**2,694,979**	**1,302**	**1,302**

[a] DEA_WTP activities are conducted over three 3-year periods, totaling 9 years.
Period 1, 2079–2081
Period 2, 2139–2141
Period 3, 2164–2166

[b] DEA_ETF activities are conducted over six 1-year periods, totaling 6 years.
Period 1, 2026–2026
Period 2, 2056–2056
Period 3, 2086–2086
Period 4, 2116–2116
Period 5, 2146–2146
Period 6, 2167–2167

[c] DEA_EVA activities are conducted over seven 1-year periods, totaling 7 years.
Period 1, 2018–2018
Period 2, 2043–2043
Period 3, 2068–2068
Period 4, 2093–2093
Period 5, 2118–2118
Period 6, 2143–2143
Period 7, 2168–2168

Notes and Assumptions:
Total number of offsite full-time equivalents = 0.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–40. Tank Closure Alternative 6A, Option Case, Closure Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Containment Structure Construction (CLO_CONCS1)[a]							
Radiological workers	12,000	2038	2141	24	500	1	4
Nonradiological workers							
On site	120,000	2038	2141	24	5,000	3	
Off site	N/A						
Containment Structure Deactivation (CLO_DEACS1)[b]							
Radiological workers	12,000	2062	2164	21	571	1	4
Nonradiological workers							
On site	120,000	2062	2164	21	5,714	3	
Off site	N/A						
Decontamination and Decommissioning of 10 Selected Facilities (CLO_D&DTEN)							
Radiological workers	44,418	2018	2028	11	4,038	2	9
Nonradiological workers							
On site	146,679	2018	2028	11	13,334	7	
Off site	78,970	2018	2028	11	7,179	4	
Removal of B Tank Farm (CLO_REMTB)							
Radiological workers	692,733	2065	2076	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2065	2076	12	91,541	45	
Off site	N/A						
Removal of T Tank Farm (CLO_REMTT)							
Radiological workers	692,733	2126	2137	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2126	2137	12	91,541	45	
Off site	N/A						
Removal of BY Tank Farm (CLO_REMTBY)							
Radiological workers	519,550	2111	2122	12	43,296	21	55
Nonradiological workers							
On site	823,871	2111	2122	12	68,656	34	
Off site	N/A						
Removal of BX Tank Farm (CLO_REMTBX)							
Radiological workers	519,550	2042	2053	12	43,296	21	55
Nonradiological workers							
On site	823,871	2042	2053	12	68,656	34	
Off site	N/A						
Removal of C Tank Farm (CLO_REMTC)							
Radiological workers	692,733	2088	2099	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2088	2099	12	91,541	45	
Off site	N/A						
Removal of A Tank Farm (CLO_REMTA)							
Radiological workers	259,775	2142	2153	12	21,648	11	28
Nonradiological workers							
On site	411,936	2142	2153	12	34,328	17	
Off site	N/A						

Table I–40. Tank Closure Alternative 6A, Option Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Removal of AX Tank Farm (CLO_REMTAX)							
Radiological workers	173,183	2142	2153	12	14,432	7	19
Nonradiological workers							
On site	274,624	2142	2153	12	22,885	12	
Off site	N/A						
Removal of S Tank Farm (CLO_REMTS)							
Radiological workers	519,550	2126	2137	12	43,296	21	55
Nonradiological workers							
On site	823,871	2126	2137	12	68,656	34	
Off site	N/A						
Removal of TY Tank Farm (CLO_REMTTY)							
Radiological workers	259,775	2111	2122	12	21,648	11	28
Nonradiological workers							
On site	411,936	2111	2122	12	34,328	17	
Off site	N/A						
Removal of TX Tank Farm (CLO_REMTTX)							
Radiological workers	779,325	2088	2099	12	64,944	32	82
Nonradiological workers							
On site	1,235,807	2088	2099	12	102,984	50	
Off site	N/A						
Removal of U Tank Farm (CLO_REMTU)							
Radiological workers	692,733	2065	2076	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2065	2076	12	91,541	45	
Off site	N/A						
Removal of SX Tank Farm (CLO_REMTSX)							
Radiological workers	649,437	2042	2053	12	54,120	27	69
Nonradiological workers							
On site	1,029,839	2042	2053	12	85,820	42	
Off site	N/A						
Removal of Deep Soil–B Tank Farm (CLO_REMSB)							
Radiological workers	73,371	2077	2084	8	9,171	5	11
Nonradiological workers							
On site	84,852	2077	2084	8	10,607	6	
Off site	N/A						
Removal of Deep Soil–T Tank Farm (CLO_REMST)							
Radiological workers	563,796	2138	2145	8	70,474	34	74
Nonradiological workers							
On site	652,024	2138	2145	8	81,503	40	
Off site	N/A						

Table I–40. Tank Closure Alternative 6A, Option Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Removal of Deep Soil–BX Tank Farm (CLO_REMSBX)							
Radiological workers	293,483	2054	2061	8	36,685	18	39
Nonradiological workers							
On site	339,410	2054	2061	8	42,426	21	
Off site	N/A						
Removal of Deep Soil–C Tank Farm (CLO_REMSC)							
Radiological workers	4,449	2100	2107	8	556	1	2
Nonradiological workers							
On site	5,145	2100	2107	8	643	1	
Off site	N/A						
Removal of Deep Soil–A Tank Farm (CLO_REMSA)							
Radiological workers	13,346	2154	2161	8	1,668	1	2
Nonradiological workers							
On site	15,434	2154	2161	8	1,929	1	
Off site	N/A						
Removal of Deep Soil–AX Tank Farm (CLO_REMSAX)							
Radiological workers	222,429	2154	2161	8	27,804	14	30
Nonradiological workers							
On site	257,237	2154	2161	8	32,155	16	
Off site	N/A						
Removal of Deep Soil–TX Tank Farm (CLO_REMSTX)							
Radiological workers	700,651	2100	2107	8	87,581	43	92
Nonradiological workers							
On site	810,297	2100	2107	8	101,287	49	
Off site	N/A						
Removal of Deep Soil–U Tank Farm (CLO_REMSU)							
Radiological workers	367,008	2077	2084	8	45,876	23	49
Nonradiological workers							
On site	424,441	2077	2084	8	53,055	26	
Off site	N/A						
Removal of Deep Soil–SX Tank Farm (CLO_REMSSX)							
Radiological workers	895,895	2054	2061	8	111,987	54	117
Nonradiological workers							
On site	1,036,093	2054	2061	8	129,512	63	
Off site	N/A						
Clean Closure of B Area Cribs and Trenches (Ditches) (CLO_REMBC&T)							
Radiological workers	4,003,722	2054	2084	31	129,152	63	135
Nonradiological workers							
On site	4,630,266	2054	2084	31	149,363	72	
Off site	N/A						
Clean Closure of T Area Cribs and Trenches (Ditches) (CLO_REMTC&T)							
Radiological workers	4,003,722	2100	2145	46	87,037	42	91
Nonradiological workers							
On site	4,630,266	2100	2145	46	100,658	49	
Off site	N/A						

Table I–40. Tank Closure Alternative 6A, Option Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Containment Structure Construction–B and T Area Cribs and Trenches (Ditches) (CLO_CONCS2)[c]							
Radiological workers	4,000	2050	2099	8	500	1	4
Nonradiological workers							
On site	40,000	2050	2099	8	5,000	3	
Off site	N/A						
Decontamination and Decommissioning of the Structure over the Tank Farm after Soil Removal (CLO_DEACS2)[d]							
Radiological workers	4,000	2085	2148	6	667	1	5
Nonradiological workers							
On site	40,000	2085	2148	6	6,667	4	
Off site	N/A						
Preprocessing Facility Construction (CLO_CONPPF)							
Radiological workers	N/A						4,778
Nonradiological workers							
On site	29,809,609	2039	2041	3	9,936,536	4,778	
Off site	10,070,814	2039	2041	3	3,356,938	1,614	
Preprocessing Facility Operations (CLO_OPSPPF)							
Radiological workers	50,386,336	2042	2162	121	416,416	201	208
Nonradiological workers							
On site	1,550,349	2042	2162	121	12,813	7	
Off site	N/A						
Preprocessing Facility Deactivation (CLO_DEAPPF)							
Radiological workers	380,160	2163	2163	1	380,160	183	189
Nonradiological workers							
On site	11,697	2163	2163	1	11,697	6	
Off site	N/A						
Total	**133,539,179**				**16,864,930**	**8,144**	**6,526**

[a] CLO_CONCS1 activities are conducted over six 4-year periods, totaling 24 years.
Period 1, 2038–2041; 2 facilities
Period 2, 2061–2064; 2 facilities
Period 3, 2084–2087; 2 facilities
Period 4, 2107–2110; 2 facilities
Period 5, 2122–2125; 2 facilities
Period 6, 2138–2141; 2 facilities

[b] CLO_DEACS1 activities are conducted over seven 3-year periods, totaling 21 years.
Period 1, 2062–2064; 2 facilities
Period 2, 2085–2087; 2 facilities
Period 3, 2108–2110; 2 facilities
Period 4, 2123–2125; 2 facilities
Period 5, 2138–2140; 1 facility
Period 6, 2146–2148; 1 facility
Period 7, 2162–2164; 2 facilities

[c] CLO_CONCS2 activities are conducted over two 4-year periods, totaling 8 years.
Period 1, 2050–2053; 2 facilities
Period 2, 2096–2099; 2 facilities

[d] CLO_DEACS2 activities are conducted over two 3-year periods, totaling 6 years.
Period 1, 2085–2087; 2 facilities
Period 2, 2146–2148; 2 facilities

Table I–40. Tank Closure Alternative 6A, Option Case, Closure Rollup Workforce Estimate *(continued)*

Notes and Assumptions:
Total number of offsite full-time equivalents = 811.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007a, 2008.

I.2.11 Tank Closure Alternative 6B: All Vitrification with Separations; Clean Closure–Base Case

Table I–41. Tank Closure Alternative 6B, Base Case, Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Canister Storage Building (CON_CSB)							
Radiological workers	115,500	2006	2016	11	10,500	6	12
Nonradiological workers							
On site	135,929	2006	2016	11	12,357	6	
Off site	50,286	2006	2016	11	4,571	3	
Immobilized High-Level Radioactive Waste Shipping/Transfer Facility (CON_STF)							
Radiological workers	N/A						380
Nonradiological workers							
Onsite construction	1,757,000	2011	2013	3	585,667	282	
Onsite exempt	610,000	2011	2013	3	203,333	98	
Offsite design	748,000	2011	2013	3	249,333	120	
Immobilized High-Level Radioactive Waste Interim Storage Modules (CON_ISM)							
Radiological workers	N/A						232
Nonradiological workers							
Onsite construction	2,671,659	2014	2022	9	296,851	143	
Onsite exempt	1,650,000	2014	2022	9	183,333	89	
Offsite design	2,025,000	2014	2022	9	225,000	109	
Other Infrastructure Upgrades (CON_OIU)							
Radiological workers	782,094	2006	2034	29	26,969	13	45
Nonradiological workers							
On site	1,918,531	2006	2034	29	66,156	32	
Off site	743,125	2006	2034	29	25,625	13	
Tank Upgrades (CON_TU)							
Radiological workers	1,195,652	2006	2025	20	59,783	29	104
Nonradiological workers							
On site	3,112,174	2006	2025	20	155,609	75	
Off site	1,179,130	2006	2025	20	58,957	29	
Underground Transfer Lines (CON_UTL)							
Radiological workers	N/A						61
Nonradiological workers							
On site	126,005	2009	2009	1	126,005	61	
Off site	17,400	2009	2009	1	17,400	9	

Table I–41. Tank Closure Alternative 6B, Base Case, Construction Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Waste Treatment Plant (CON_WTP)							
Radiological workers	N/A						1,189
Nonradiological workers							
On site	29,672,500	2006	2017	12	2,472,708	1,189	
Off site	9,927,500	2006	2017	12	827,292	398	
Additional Low-Activity Waste Melters (CON_LAW)							
Radiological workers	N/A						340
Nonradiological workers							
On site	7,064,246	2008	2017	10	706,425	340	
Off site	2,386,570	2008	2017	10	238,657	115	
Cesium and Strontium Capsule Processing Facility (CON_CSC)							
Radiological workers	N/A						190
Nonradiological workers							
On site	1,578,029	2035	2038	4	394,507	190	
Off site	465,683	2035	2038	4	116,421	56	
Waste Receiver Facilities (CON_WRF)							
Radiological workers	N/A						454
Nonradiological workers							
On site	4,716,000	2013	2017	5	943,200	454	
Off site	1,696,000	2013	2017	5	339,200	164	
Tank Risers (CON_RIS)							
Radiological workers	188,760	2013	2016	4	47,190	23	54
Nonradiological workers							
On site	254,540	2013	2016	4	63,635	31	
Off site	N/A						
Mobile Retrieval System (CON_MRS)							
Radiological workers	21,731,780	2013	2043	31	701,025	338	711
Nonradiological workers							
On site	23,990,771	2013	2043	31	773,896	373	
Off site	12,864,061	2013	2043	31	414,970	200	
Vacuum-Based Retrieval System (CON_VBR)							
Radiological workers	11,196,200	2013	2043	31	361,168	174	360
Nonradiological workers							
On site	11,957,150	2013	2043	31	385,715	186	
Off site	6,817,400	2013	2043	31	219,916	106	
Chemical Wash System (CON_CHW)							
Radiological workers	2,378,750	2013	2043	31	76,734	37	45
Nonradiological workers							
On site	471,625	2013	2043	31	15,214	8	
Off site	634,875	2013	2043	31	20,480	10	

Table I–41. Tank Closure Alternative 6B, Base Case, Construction Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
High-Level Radioactive Waste Melter Interim Storage Facilities (CON_PAD)[a]							
Radiological workers	N/A						
Nonradiological workers							
On site	5,616	2015	2030	4	1,404	1	1
Off site	N/A						
Effluent Treatment Facility Replacement (CON_ETF)							
Radiological workers	N/A						
Nonradiological workers							
On site	2,047,400	2023	2025	3	682,467	329	329
Off site	703,895	2023	2025	3	234,632	113	
Effluent Treatment Facility Replacement (CON_ETFU)[b]							
Radiological workers	N/A						
Nonradiological workers							
On site	4,094,800	2053	2085	6	682,467	329	329
Off site	736,162	2053	2085	6	122,694	59	
242-A Evaporator Replacement (CON_EVA)							
Radiological workers	N/A						
Nonradiological workers							
On site	635,400	2015	2017	3	211,800	102	102
Off site	217,918	2015	2017	3	72,639	35	
Immobilized Low-Activity Waste Interim Storage Facility (CON_ILAWST)							
Radiological workers	N/A						
Nonradiological workers							
On site	602,600	2016	2043	28	21,521	11	11
Off site	N/A						
High-Level Radioactive Waste Debris Storage Facilities (CON_HLWST)							
Radiological workers	N/A						
Nonradiological workers							
On site	577,280	2021	2090	70	8,247	4	4
Off site	N/A						
Total	**178,450,996**				**13,463,671**	**6,492**	**4,953**

[a] CON_PAD Activities include two 2-year construction periods.
Period 1, 2015–2016
Period 2, 2029–2030

[b] CON_EFTU activities include two 3-year construction periods.
Period 1, 2053–2055
Period 2, 2083–2085

Notes and Assumptions:
Total number of offsite full-time equivalents = 1,539.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–42. Tank Closure Alternative 6B, Base Case, Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Immobilized High-Level Radioactive Waste Interim Storage Facilities (OPS_ISF)							
Radiological workers	7,779,436	2018	2066	49	158,764	77	120
Nonradiological workers							
On site	4,351,200	2018	2066	49	88,800	43	
Off site	N/A						
Other Infrastructure Upgrades (OPS_OIU)							
Radiological workers	44,909	2006	2043	38	1,182	1	4
Nonradiological workers							
On site	164,667	2006	2043	38	4,333	3	
Off site	117,455	2006	2043	38	3,091	2	
Routine Operations (OPS_ROUT)							
Radiological workers	9,880,000	2006	2043	38	260,000	125	651
Nonradiological workers							
On site	41,534,000	2006	2043	38	1,093,000	526	
Off site	5,890,000	2006	2043	38	155,000	75	
Interim Stabilization/Double-Shell Tanks (OPS_IST)							
Radiological workers	1,394,773	2006	2043	38	36,705	18	44
Nonradiological workers							
On site	1,995,864	2006	2043	38	52,523	26	
Off site	2,204,000	2006	2043	38	58,000	28	
Retrieval Operations (OPS_RET)							
Radiological workers	12,955	2006	2043	38	341	1	28
Nonradiological workers							
On site	2,111,591	2006	2043	38	55,568	27	
Off site	16,409	2006	2043	38	432	1	
Waste Treatment Plant (OPS_WTP)							
Radiological workers	62,753,000	2018	2043	26	2413,577	1,161	1,939
Nonradiological workers							
On site	42,074,000	2018	2043	26	1,618,231	778	
Off site	8,000	2018	2043	26	308	1	
Waste Treatment Plant—Cesium and Strontium Capsules (OPS_WTPCSC)							
Radiological workers	2,413,577	2040	2040	1	2,413,577	1,161	1,939
Nonradiological workers							
On site	1,618,231	2040	2040	1	1,168,231	778	
Off site	308	2040	2040	1	308	1	
Cesium and Strontium Capsule Processing Facility (OPS_CSC)							
Radiological workers	103,334	2039	2040	2	51,667	25	25
Nonradiological workers							
On site	N/A						
Off site	N/A						
Mobile Retrieval System (OPS_MRS)							
Radiological workers	13,871,116	2013	2043	31	447,455	216	411
Nonradiological workers							
On site	12,554,941	2013	2043	31	404,998	195	
Off site	N/A						

Table I–42. Tank Closure Alternative 6B, Base Case, Operations Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Vacuum-Based Retrieval System (OPS_VBR)							
Radiological workers	7,667,884	2013	2043	31	247,351	119	227
Nonradiological workers							
On site	6,940,309	2013	2043	31	223,881	108	
Off site	N/A						
Chemical Wash System (OPS_CHW)							
Radiological workers	10,769,500	2013	2043	31	347,403	168	320
Nonradiological workers							
On site	9,747,750	2013	2043	31	314,444	152	
Off site	N/A						
High-Level Radioactive Waste Melter Interim Storage Facilities (OPS_PAD)							
Radiological workers	N/A	2018	2199	182			0
Nonradiological workers							
On site	N/A						
Off site	N/A						
Effluent Treatment Facility Replacement (OPS_ETF)							
Radiological workers	14,683,200	2006	2100	95	154,560	75	94
Nonradiological workers							
On site	3,670,800	2006	2100	95	38,640	19	
Off site	N/A						
242-A Evaporator Replacement (OPS_EVA)							
Radiological workers	1,858,033	2006	2043	38	48,896	24	32
Nonradiological workers							
On site	568,233	2006	2043	38	14,954	8	
Off site	N/A						
Borrow Area C (OPS_CAREA)							
Radiological workers	N/A						43
Nonradiological workers							
On site	8,671,800	2006	2102	97	89,400	43	
Off site	N/A						
High-level Radioactive Waste Debris Storage Facility (OPS_ILAWST)							
Radiological workers	N/A	2018	2199	182			
Nonradiological workers							
On site	N/A						
Off site	N/A						
High-Level Radioactive Waste Debris Storage Facilities (OPS_HLWST)							
Radiological workers	N/A	2023	2199	177			
Nonradiological workers							
On site	N/A						
Off site	N/A						
Total	**277,471,275**				**12,415,618**	**5,985**	**5,877**

Notes and Assumptions:
Total number of offsite full-time equivalents = 108.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007a, 2008.

Table I–43. Tank Closure Alternative 6B, Base Case, Deactivation Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Immobilized High-Level Radioactive Waste Interim Storage Facilities (DEA_ISF)							
Radiological workers	N/A						
Nonradiological workers							1
On site	160	2067	2067	1	160	1	
Off site	N/A						
Waste Treatment Plant (DEA_WTP)							
Radiological workers	3,800,000	2044	2045	2	1,900,000	914	
Nonradiological workers							1,527
On site	2,550,000	2044	2045	2	1,275,000	613	
Off site	500	2044	2045	2	250	1	
Mobile Retrieval System (DEA_MRS)							
Radiological workers	1,823,647	2013	2043	31	58,827	29	
Nonradiological workers							29
On site	N/A						
Off site	N/A						
Vacuum-Based Retrieval System (DEA_VBR)							
Radiological workers	258,100	2013	2043	31	8,326	5	
Nonradiological workers							5
On site	N/A						
Off site	N/A						
Chemical Wash System (DEA_CHW)							
Radiological workers	144,000	2013	2043	31	4,645	3	
Nonradiological workers							3
On site	N/A						
Off site	N/A						
Cesium and Strontium Capsule Processing Facility (DEA_CSC)							
Radiological workers	23,920	2041	2041	1	23,920	12	
Nonradiological workers							12
On site	N/A						
Off site	N/A						
Effluent Treatment Facility Replacement (DEA_ETF)[a]							
Radiological workers	309,120	2026	2101	4	77,280	38	
Nonradiological workers							48
On site	77,280	2026	2101	4	19,320	10	
Off site	N/A						
242-A Evaporator (Original) (DEA_EVAO)							
Radiological workers	24,448	2018	2018	1	24,448	12	
Nonradiological workers							16
On site	7,477	2018	2018	1	7,477	4	
Off site	N/A						
242-A Evaporator Replacement (DEA_EVA)							
Radiological workers	24,448	2044	2044	1	24,448	12	
Nonradiological workers							16
On site	7,477	2044	2044	1	7,477	4	
Off site	N/A						
Total	**9,050,577**				**3,431,578**	**1,658**	**1,657**

Table I–43. Tank Closure Alternative 6B, Base Case, Deactivation Rollup Workforce Estimate *(continued)*

[a] DEA_ETF Activities include four 1-year periods.
Period 1, 2026–2026
Period 2, 2056–2056
Period 3, 2086–2086
Period 4, 2101–2101

Notes and Assumptions:
Total number of offsite full-time equivalents = 1.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–44. Tank Closure Alternative 6B, Base Case, Closure Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Containment Structure Construction (CLO_CONCS)							
Radiological workers	12,000	2019	2076	12	1,000	1	6
Nonradiological workers							
On site	120,000	2019	2076	12	10,000	5	
Off site	N/A	Three 4-year construction periods[a]					
Containment Structure Deactivation (CLO_DEACS)							
Radiological workers	12,000	2043	2099	15	800	1	5
Nonradiological workers							
On site	120,000	2043	2099	15	8,000	4	
Off site	N/A	Five 3-year deactivation periods[b]					
Decontamination and Decommissioning of 10 Selected Facilities (CLO_D&DTEN)							
Radiological workers	44,418	2018	2028	11	4,038	2	9
Nonradiological workers							
On site	146,679	2018	2028	11	13,334	7	
Off site	78,970	2018	2028	11	7,179	4	
Modified Resource Conservation and Recovery Act Subtitle C Barrier (CLO_RCRA)							
Radiological workers	429,000	2100	2101	2	214,500	104	414
Nonradiological workers							
On site	1,287,000	2100	2101	2	643,500	310	
Off site	N/A						
Postclosure Care (CLO_POST)							
Radiological workers	N/A						3
Nonradiological workers							
On site	471,262	2102	2201	100	4,713	3	
Off site	N/A						
Removal of B Tank Farm (CLO_REMTB)							
Radiological workers	692,733	2023	2034	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2023	2034	12	91,541	45	
Off site	N/A						

Table I–44. Tank Closure Alternative 6B, Base Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Removal of T Tank Farm (CLO_REMTT)							
Radiological workers	692,733	2077	2088	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2077	2088	12	91,541	45	
Off site	N/A						
Removal of BY Tank Farm (CLO_REMTBY)							
Radiological workers	519,550	2050	2061	12	43,296	21	55
Nonradiological workers							
On site	823,871	2050	2061	12	68,656	34	
Off site	N/A						
Removal of BX Tank Farm (CLO_REMTBX)							
Radiological workers	519,550	2023	2034	12	43,296	21	55
Nonradiological workers							
On site	823,871	2023	2034	12	68,656	34	
Off site	N/A						
Removal of C Tank Farm (CLO_REMTC)							
Radiological workers	692,733	2050	2061	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2050	2061	12	91,541	45	
Off site	N/A						
Removal of A Tank Farm (CLO_REMTA)							
Radiological workers	259,775	2077	2088	12	21,648	11	28
Nonradiological workers							
On site	411,936	2077	2088	12	34,328	17	
Off site	N/A						
Removal of AX Tank Farm (CLO_REMTAX)							
Radiological workers	173,183	2077	2088	12	14,432	7	19
Nonradiological workers							
On site	274,624	2077	2088	12	22,885	12	
Off site	N/A						
Removal of S Tank Farm (CLO_REMTS)							
Radiological workers	519,550	2077	2088	12	43,296	21	55
Nonradiological workers							
On site	823,871	2077	2088	12	68,656	34	
Off site	N/A						
Removal of TY Tank Farm (CLO_REMTTY)							
Radiological workers	259,775	2050	2061	12	21,648	11	28
Nonradiological workers							
On site	411,936	2050	2061	12	34,328	17	
Off site	N/A						
Removal of TX Tank Farm (CLO_REMTTX)							
Radiological workers	779,325	2050	2061	12	64,944	32	82
Nonradiological workers							
On site	1,235,807	2050	2061	12	102,984	50	
Off site	N/A						

Table I–44. Tank Closure Alternative 6B, Base Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Removal of U Tank Farm (CLO_REMTU)							
Radiological workers	692,733	2023	2034	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2023	2034	12	91,541	45	
Off site	N/A						
Removal of SX Tank Farm (CLO_REMTSX)							
Radiological workers	649,437	2023	2034	12	54,120	27	69
Nonradiological workers							
On site	1,029,839	2023	2034	12	85,820	42	
Off site	N/A						
Removal of Deep Soil–B Tank Farm (CLO_REMSB)							
Radiological workers	73,371	2035	2042	8	9,171	5	11
Nonradiological workers							
On site	84,852	2035	2042	8	10,607	6	
Off site	N/A						
Removal of Deep Soil–T Tank Farm (CLO_REMST)							
Radiological workers	563,796	2089	2096	8	70,474	34	74
Nonradiological workers							
On site	652,024	2089	2096	8	81,503	40	
Off site	N/A						
Removal of Deep Soil–BX Tank Farm (CLO_REMSBX)							
Radiological workers	293,483	2035	2042	8	36,685	18	39
Nonradiological workers							
On site	339,410	2035	2042	8	42,426	21	
Off site	N/A						
Removal of Deep Soil–C Tank Farm (CLO_REMSC)							
Radiological workers	4,449	2062	2069	8	556	1	2
Nonradiological workers							
On site	5,145	2062	2069	8	643	1	
Off site	N/A						
Removal of Deep Soil–A Tank Farm (CLO_REMSA)							
Radiological workers	13,346	2089	2096	8	1,668	1	2
Nonradiological workers							
On site	15,434	2089	2096	8	1,929	1	
Off site	N/A						
Removal of Deep Soil–AX Tank Farm (CLO_REMSAX)							
Radiological workers	222,429	2089	2096	8	27,804	14	30
Nonradiological workers							
On site	257,237	2089	2096	8	32,155	16	
Off site	N/A						
Removal of Deep Soil–TX Tank Farm (CLO_REMSTX)							
Radiological workers	700,651	2062	2069	8	87,581	43	92
Nonradiological workers							
On site	810,297	2062	2069	8	101,287	49	
Off site	N/A						

Table I–44. Tank Closure Alternative 6B, Base Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Removal of Deep Soil–U Tank Farm (CLO_REMSU)							
Radiological workers	367,008	2035	2042	8	45,876	23	49
Nonradiological workers							
On site	424,441	2035	2042	8	53,055	26	
Off site	N/A						
Removal of Deep Soil–SX Tank Farm (CLO_REMSSX)							
Radiological workers	895,895	2035	2042	8	111,987	54	117
Nonradiological workers							
On site	1,036,093	2035	2042	8	129,512	63	
Off site	N/A						
Preprocessing Facility Construction (CLO_CONPPF)							
Radiological workers	N/A						2,389
Nonradiological workers							
On site	14,904,804	2020	2022	3	4,968,268	2,389	
Off site	5,035,407	2020	2022	3	1,678,469	807	
Preprocessing Facility Operations (CLO_OPSPPF)							
Radiological workers	8,328,320	2023	2099	77	108,160	52	54
Nonradiological workers							
On site	256,256	2023	2099	77	3,328	2	
Off site	N/A						
Preprocessing Facility Deactivation (CLO_DEAPPF)							
Radiological workers	108,160	2100	2100	1	108,160	52	54
Nonradiological workers							
On site	3,328	2100	2100	1	3,328	2	
Off site	N/A						
Total	**54,797,775**				**10,011,765**	**4,844**	**4,033**

[a] CLO_CONCS activities include three 4-year periods.
Period 1, 2019–2022
Period 2, 2046–2049
Period 3, 2073–2076

[b] CLO_DEACS activities include five 3-year periods.
Period 1, 2043–2045
Period 2, 2062–2064
Period 3, 2070–2072
Period 4, 2089–2091
Period 5, 2097–2099

Notes and Assumptions:
Total number of offsite full-time equivalents = 811.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

I.2.12 Tank Closure Alternative 6B: All Vitrification with Separations; Clean Closure–Option Case

Table I–45. Tank Closure Alternative 6B, Option Case, Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Canister Storage Building (CON_CSB)							
Radiological workers	115,500	2006	2016	11	10,500	6	12
Nonradiological workers							
On site	135,929	2006	2016	11	12,357	6	
Off site	50,286	2006	2016	11	4,571	3	
Immobilized High-Level Radioactive Waste Shipping/Transfer Facility (CON_STF)							
Radiological workers	N/A						380
Nonradiological workers							
Onsite construction	1,757,000	2011	2013	3	585,667	282	
Onsite exempt	610,000	2011	2013	3	203,333	98	
Offsite design	748,000	2011	2013	3	249,333	120	
Immobilized High-Level Radioactive Waste Interim Storage Modules (CON_ISM)							
Radiological workers	N/A						232
Nonradiological workers							
Onsite construction	2,671,659	2014	2022	9	296,851	143	
Onsite exempt	1,650,000	2014	2022	9	183,333	89	
Offsite design	2,025,000	2014	2022	9	225,000	109	
Other Infrastructure Upgrades (CON_OIU)							
Radiological workers	782,094	2006	2034	29	26,969	13	45
Nonradiological workers							
On site	1,918,531	2006	2034	29	66,156	32	
Off site	743,125	2006	2034	29	25,625	13	
Tank Upgrades (CON_TU)							
Radiological workers	1,195,652	2006	2025	20	59,783	29	104
Nonradiological workers							
On site	3,112,174	2006	2025	20	155,609	75	
Off site	1,179,130	2006	2025	20	58,957	29	
Underground Transfer Lines (CON_UTL)							
Radiological workers	N/A						61
Nonradiological workers							
On site	126,005	2009	2009	1	126,005	61	
Off site	17,400	2009	2009	1	17,400	9	
Waste Treatment Plant (CON_WTP)							
Radiological workers	N/A						1,189
Nonradiological workers							
On site	29,672,500	2006	2017	12	2,472,708	1,189	
Off site	9,927,500	2006	2017	12	827,292	398	

Table I–45. Tank Closure Alternative 6B, Option Case, Construction Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Additional Low-Activity Waste Melters (CON_LAW)							
Radiological workers	N/A						340
Nonradiological workers							
On site	7,064,246	2008	2017	10	706,425	340	
Off site	2,386,570	2008	2017	10	238,657	115	
Cesium and Strontium Capsule Processing Facility (CON_CSC)							
Radiological workers	N/A						190
Nonradiological workers							
On site	1,578,029	2035	2038	4	394,507	190	
Off site	465,683	2035	2038	4	116,421	56	
Waste Receiver Facilities (CON_WRF)							
Radiological workers	N/A						454
Nonradiological workers							
On site	4,716,000	2013	2017	5	943,200	454	
Off site	1,696,000	2013	2017	5	339,200	164	
Tank Risers (CON_RIS)							
Radiological workers	188,760	2013	2016	4	47,190	23	54
Nonradiological workers							
On site	254,540	2013	2016	4	63,635	31	
Off site	N/A						
Mobile Retrieval System (CON_MRS)							
Radiological workers	21,731,780	2013	2043	31	701,025	338	711
Nonradiological workers							
On site	23,990,771	2013	2043	31	773,896	373	
Off site	12,864,061	2013	2043	31	414,970	200	
Vacuum-Based Retrieval System (CON_VBR)							
Radiological workers	11,196,200	2013	2043	31	361,168	174	360
Nonradiological workers							
On site	11,957,150	2013	2043	31	385,715	186	
Off site	6,817,400	2013	2043	31	219,916	106	
Chemical Wash System (CON_CHW)							
Radiological workers	2,378,750	2013	2043	31	76,734	37	45
Nonradiological workers							
On site	471,625	2013	2043	31	15,214	8	
Off site	634,875	2013	2043	31	20,480	10	
High-Level Radioactive Waste Melter Interim Storage Facilities (CON_PAD)[a]							
Radiological workers	N/A						1
Nonradiological workers							
On site	5,616	2015	2030	4	1,404	1	
Off site	N/A						

Table I–45. Tank Closure Alternative 6B, Option Case, Construction Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Effluent Treatment Facility Replacement (CON_ETF)							
Radiological workers	N/A						329
Nonradiological workers							
On site	2,047,400	2023	2025	3	682,467	329	
Off site	703,895	2023	2025	3	234,632	113	
Effluent Treatment Facility Replacement (CON_ETFU)[b]							
Radiological workers	N/A						329
Nonradiological workers							
On site	4,094,800	2053	2085	6	682,467	329	
Off site	736,162	2053	2085	6	122,694	59	
242-A Evaporator Replacement (CON_EVA)							
Radiological workers	N/A						102
Nonradiological workers							
On site	635,400	2015	2017	3	211,800	102	
Off site	217,918	2015	2017	3	72,639	35	
Immobilized Low-Activity Waste Interim Storage Facility (CON_ILAWST)							
Radiological workers	N/A						11
Nonradiological workers							
On site	602,600	2016	2043	28	21,521	11	
Off site	N/A						
High-Level Radioactive Waste Debris Storage Facilities (CON_HLWST)							
Radiological workers	N/A						4
Nonradiological workers							
On site	577,280	2021	2090	70	8,247	4	
Off site	N/A						
Total	**178,450,996**				**13,463,671**	**6,492**	**4,953**

[a] CON_PAD Activities include two 2-year construction periods.
Period 1, 2015–2016
Period 2, 2029–2030

[b] CON_PAD Activities include two 3-year construction periods.
Period 1, 2053–2055
Period 2, 2083–2085

Notes and Assumptions:
Total number of offsite full-time equivalents = 1,539.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–46. Tank Closure Alternative 6B, Option Case, Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Immobilized High-Level Radioactive Waste Interim Storage Facilities (OPS_ISF)							
Radiological workers	7,779,436	2018	2066	49	158,764	77	120
Nonradiological workers							
On site	4,351,200	2018	2066	49	88,800	43	
Off site	N/A						
Other Infrastructure Upgrades (OPS_OIU)							
Radiological workers	44,909	2006	2043	38	1,182	1	4
Nonradiological workers							
On site	164,667	2006	2043	38	4,333	3	
Off site	117,455	2006	2043	38	3,091	2	
Routine Operations (OPS_ROUT)							
Radiological workers	9,880,000	2006	2043	38	260,000	125	651
Nonradiological workers							
On site	41,534,000	2006	2043	38	1,093,000	526	
Off site	5,890,000	2006	2043	38	155,000	75	
Interim Stabilization/Double-Shell Tanks (OPS_IST)							
Radiological workers	1,394,773	2006	2043	38	36,705	18	44
Nonradiological workers							
On site	1,995,864	2006	2043	38	52,523	26	
Off site	2,204,000	2006	2043	38	58,000	28	
Retrieval Operations (OPS_RET)							
Radiological workers	12,955	2006	2043	38	341	1	28
Nonradiological workers							
On site	2,111,591	2006	2043	38	55,568	27	
Off site	16,409	2006	2043	38	432	1	
Waste Treatment Plant (OPS_WTP)							
Radiological workers	62,753,000	2018	2043	26	2,413,577	1,161	1,939
Nonradiological workers							
On site	42,074,000	2018	2043	26	1,618,231	778	
Off site	8,000	2018	2043	26	308	1	
Waste Treatment Plant—Cesium and Strontium Capsules (OPS_WTPCSC)							
Radiological workers	2,413,577	2040	2040	1	2,413,577	1,161	1,939
Nonradiological workers							
On site	1,618,231	2040	2040	1	1,168,231	778	
Off site	308	2040	2040	1	308	1	
Cesium and Strontium Capsule Processing Facility (OPS_CSC)							
Radiological workers	103,334	2039	2040	2	51,667	25	25
Nonradiological workers							
On site	N/A						
Off site	N/A						
Mobile Retrieval System (OPS_MRS)							
Radiological workers	13,871,116	2013	2043	31	447,455	216	411
Nonradiological workers							
On site	12,554,941	2013	2043	31	404,998	195	
Off site	N/A						

Table I–46. Tank Closure Alternative 6B, Option Case, Operations Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Vacuum-Based Retrieval System (OPS_VBR)							
Radiological workers	7,667,884	2013	2043	31	247,351	119	227
Nonradiological workers							
On site	6,940,309	2013	2043	31	223,881	108	
Off site	N/A						
Chemical Wash System (OPS_CHW)							
Radiological workers	10,769,500	2013	2043	31	347,403	168	320
Nonradiological workers							
On site	9,747,750	2013	2043	31	314,444	152	
Off site	N/A						
High-Level Radioactive Waste Melter Interim Storage Facilities (OPS_PAD)							
Radiological workers	N/A	2018	2199	182			0
Nonradiological workers							
On site	N/A						
Off site	N/A						
Effluent Treatment Facility Replacement (OPS_ETF)							
Radiological workers	14,683,200	2006	2100	95	154,560	75	94
Nonradiological workers							
On site	3,670,800	2006	2100	95	38,640	19	
Off site	N/A						
242-A Evaporator Replacement (OPS_EVA)							
Radiological workers	1,858,033	2006	2043	38	48,896	24	32
Nonradiological workers							
On site	568,233	2006	2043	38	14,954	8	
Off site	N/A						
Borrow Area C (OPS_CAREA)							
Radiological workers	N/A						43
Nonradiological workers							
On site	8,671,800	2006	2102	97	89,400	43	
Off site	N/A						
Immobilized Low-Activity Waste Interim Storage Facility (OPS_ILAWST)							
Radiological workers	N/A	2018	2199	182	N/A		
Nonradiological workers							
On site	N/A						
Off site	N/A						
High-Level Radioactive Waste Debris Storage Facilities (OPS_HLWST)							
Radiological workers	N/A	2023	2199	177	N/A		
Nonradiological workers							
On site	N/A						
Off site	N/A						
Total	**277,471,275**				**12,415,618**	**5,985**	**5,877**

Notes and Assumptions:

Total number of offsite full-time equivalents = 108.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–47. Tank Closure Alternative 6B, Option Case, Deactivation Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Immobilized High-Level Radioactive Waste Interim Storage Facilities (DEA_ISF)							
Radiological workers	N/A						
Nonradiological workers							1
On site	160	2067	2067	1	160	1	
Off site	N/A						
Waste Treatment Plant (DEA_WTP)							
Radiological workers	3,800,000	2044	2045	2	1,900,000	914	
Nonradiological workers							1,527
On site	2,550,000	2044	2045	2	1,275,000	613	
Off site	500	2044	2045	2	250	1	
Mobile Retrieval System (DEA_MRS)							
Radiological workers	1,823,647	2013	2043	31	58,827	29	
Nonradiological workers							29
On site	N/A						
Off site	N/A						
Vacuum-Based Retrieval System (DEA_VBR)							
Radiological workers	258,100	2013	2043	31	8,326	5	
Nonradiological workers							5
On site	N/A						
Off site	N/A						
Chemical Wash System (DEA_CHW)							
Radiological workers	144,000	2013	2043	31	4,645	3	
Nonradiological workers							3
On site	N/A						
Off site	N/A						
Cesium and Strontium Capsule Processing Facility (DEA_CSC)							
Radiological workers	23,920	2041	2041	1	23,920	12	
Nonradiological workers							12
On site	N/A						
Off site	N/A						
Effluent Treatment Facility Replacement (DEA_ETF)[a]							
Radiological workers	309,120	2026	2101	4	77,280	38	
Nonradiological workers							48
On site	77,280	2026	2101	4	19,320	10	
Off site	N/A						
242-A Evaporator (Original) (DEA_EVAO)							
Radiological workers	24,448	2018	2018	1	24,448	12	
Nonradiological workers							16
On site	7,477	2018	2018	1	7,477	4	
Off site	N/A						

Table I–47. Tank Closure Alternative 6B, Option Case, Deactivation Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
242-A Evaporator Replacement (DEA_EVA)							
Radiological workers	24,448	2044	2044	1	24,448	12	16
Nonradiological workers							
On site	7,477	2044	2044	1	7,477	4	
Off site	N/A						
Total	**9,050,577**				**3,431,578**	**1,658**	**1,657**

[a] DEA_ETF Activities include four 1-year periods.
Period 1, 2026–2026
Period 2, 2056–2056
Period 3, 2086–2086
Period 4, 2101–2101

Notes and Assumptions:
Total number of offsite full-time equivalents = 1.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–48. Tank Closure Alternative 6B, Option Case, Closure Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Containment Structure Construction (CLO_CONCS1) Three 4-year construction periods[a]							
Radiological workers	12,000	2019	2076	12	1,000	1	6
Nonradiological workers							
On site	120,000	2019	2076	12	10,000	5	
Off site	N/A						
Containment Structure Deactivation (CLO_DEACS1) Five 3-year deactivation periods[b]							
Radiological workers	12,000	2043	2099	15	800	1	5
Nonradiological workers							
On site	120,000	2043	2099	15	8,000	4	
Off site	N/A						
Decontamination and Decommissioning of 10 Selected Facilities (CLO_D&DTEN)							
Radiological workers	44,418	2018	2028	11	4,038	2	9
Nonradiological workers							
On site	146,679	2018	2028	11	13,334	7	
Off site	78,970	2018	2028	11	7,179	4	
Removal of B Tank Farm (CLO_REMTB)							
Radiological workers	692,733	2023	2034	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2023	2034	12	91,541	45	
Off site	N/A						

Table I–48. Tank Closure Alternative 6B, Option Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Removal of T Tank Farm (CLO_REMTT)							
Radiological workers	692,733	2077	2088	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2077	2088	12	91,541	45	
Off site	N/A						
Removal of BY Tank Farm (CLO_REMTBY)							
Radiological workers	519,550	2050	2061	12	43,296	21	55
Nonradiological workers							
On site	823,871	2050	2061	12	68,656	34	
Off site	N/A						
Removal of BX Tank Farm (CLO_REMTBX)							
Radiological workers	519,550	2023	2034	12	43,296	21	55
Nonradiological workers							
On site	823,871	2023	2034	12	68,656	34	
Off site	N/A						
Removal of C Tank Farm (CLO_REMTC)							
Radiological workers	692,733	2050	2061	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2050	2061	12	91,541	45	
Off site	N/A						
Removal of A Tank Farm (CLO_REMTA)							
Radiological workers	259,775	2077	2088	12	21,648	11	28
Nonradiological workers							
On site	411,936	2077	2088	12	34,328	17	
Off site	N/A						
Removal of AX Tank Farm (CLO_REMTAX)							
Radiological workers	173,183	2077	2088	12	14,432	7	19
Nonradiological workers							
On site	274,624	2077	2088	12	22,885	12	
Off site	N/A						
Removal of S Tank Farm (CLO_REMTS)							
Radiological workers	519,550	2077	2088	12	43,296	21	55
Nonradiological workers							
On site	823,871	2077	2088	12	68,656	34	
Off site	N/A						
Removal of TY Tank Farm (CLO_REMTTY)							
Radiological workers	259,775	2050	2061	12	21,648	11	28
Nonradiological workers							
On site	411,936	2050	2061	12	34,328	17	
Off site	N/A						
Removal of TX Tank Farm (CLO_REMTTX)							
Radiological workers	779,325	2050	2061	12	64,944	32	82
Nonradiological workers							
On site	1,235,807	2050	2061	12	102,984	50	
Off site	N/A						

Table I–48. Tank Closure Alternative 6B, Option Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Removal of U Tank Farm (CLO_REMTU)							
Radiological workers	692,733	2023	2034	12	57,728	28	73
Nonradiological workers							
On site	1,098,495	2023	2034	12	91,541	45	
Off site	N/A						
Removal of SX Tank Farm (CLO_REMTSX)							
Radiological workers	649,437	2023	2034	12	54,120	27	69
Nonradiological workers							
On site	1,029,839	2023	2034	12	85,820	42	
Off site	N/A						
Removal of Deep Soil–B Tank Farm (CLO_REMSB)							
Radiological workers	73,371	2035	2042	8	9,171	5	11
Nonradiological workers							
On site	84,852	2035	2042	8	10,607	6	
Off site	N/A						
Removal of Deep Soil–T Tank Farm (CLO_REMST)							
Radiological workers	563,796	2089	2096	8	70,474	34	74
Nonradiological workers							
On site	652,024	2089	2096	8	81,503	40	
Off site	N/A						
Removal of Deep Soil–BX Tank Farm (CLO_REMSBX)							
Radiological workers	293,483	2035	2042	8	36,685	18	39
Nonradiological workers							
On site	339,410	2035	2042	8	42,426	21	
Off site	N/A						
Removal of Deep Soil–C Tank Farm (CLO_REMSC)							
Radiological workers	4,449	2062	2069	8	556	1	2
Nonradiological workers							
On site	5,145	2062	2069	8	643	1	
Off site	N/A						
Removal of Deep Soil–A Tank Farm (CLO_REMSA)							
Radiological workers	13,346	2089	2096	8	1,668	1	2
Nonradiological workers							
On site	15,434	2089	2096	8	1,929	1	
Off site	N/A						
Removal of Deep Soil–AX Tank Farm (CLO_REMSAX)							
Radiological workers	222,429	2089	2096	8	27,804	14	30
Nonradiological workers							
On site	257,237	2089	2096	8	32,155	16	
Off site	N/A						

Table I–48. Tank Closure Alternative 6B, Option Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Removal of Deep Soil–TX Tank Farm (CLO_REMSTX)							
Radiological workers	700,651	2062	2069	8	87,581	43	92
Nonradiological workers							
On site	810,297	2062	2069	8	101,287	49	
Off site	N/A						
Removal of Deep Soil–U Tank Farm (CLO_REMSU)							
Radiological workers	367,008	2035	2042	8	45,876	23	49
Nonradiological workers							
On site	424,441	2035	2042	8	53,055	26	
Off site	N/A						
Removal of Deep Soil–SX Tank Farm (CLO_REMSSX)							
Radiological workers	895,895	2035	2042	8	111,987	54	117
Nonradiological workers							
On site	1,036,093	2035	2042	8	129,512	63	
Off site	N/A						
Clean Closure of B Area Cribs and Trenches (Ditches) (CLO_REMBC&T)							
Radiological workers	4,003,722	2035	2061	27	148,286	72	155
Nonradiological workers							
On site	4,630,266	2035	2061	27	171,491	83	
Off site	N/A						
Clean Closure of T Area Cribs and Trenches (Ditches) (CLO_REMTC&T)							
Radiological workers	4,003,722	2062	2096	35	114,392	55	119
Nonradiological workers							
On site	4,630,266	2062	2096	35	132,293	64	
Off site	N/A						
Containment Structure Construction–B and T Area Cribs and Trenches (Ditches) (CLO_CONCS2)[c]							
Radiological workers	4,000	2029	2059	8	500	1	4
Nonradiological workers							
On site	40,000	2029	2059	8	5,000	3	
Off site	N/A						
Containment Structure Deactivation–T Area Cribs and Trenches (Ditches) (CLO_DEACS2)[d]							
Radiological workers	4,000	2062	2099	6	667	1	5
Nonradiological workers							
On site	40,000	2062	2099	6	6,667	4	
Off site	N/A						
Preprocessing Facility Construction (CLO_CONPPF)							
Radiological workers	N/A						4,778
Nonradiological workers							
On site	29,809,069	2020	2022	3	9,936,536	4,778	
Off site	10,070,814	2020	2022	3	3,356,938	1,614	
Preprocessing Facility Operations (CLO_OPSPPF)							
Radiological workers	29,272,320	2023	2099	77	380,160	183	189
Nonradiological workers							
On site	900,687	2023	2099	77	11,697	6	
Off site	N/A						

Table I–48. Tank Closure Alternative 6B, Option Case, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Preprocessing Facility Deactivation (CLO_DEAPPF)							
Radiological workers	380,160	2100	2100	1	380,160	183	189
Nonradiological workers							
On site	11,697	2100	2100	1	11,697	6	
Off site	N/A						
Total	**111,775,501**				**16,935,824**	**8,176**	**6,558**

[a] CLO_CONCS1 activities include three 4-year periods.
Period 1, 2019–2022
Period 2, 2046–2049
Period 3, 2073–2076

[b] CLO_DEACS1 activities include five 3-year periods.
Period 1, 2043–2045
Period 2, 2062–2064
Period 3, 2070–2072
Period 4, 2089–2091
Period 5, 2097–2099

[c] CLO_CONCS2 activities include two 4-year periods.
Period 1, 2029–2032
Period 2, 2056–2059

[d] CLO_DEACS2 activities include two 3-year periods.
Period 1, 2062–2064
Period 2, 2097–2099

Notes and Assumptions:
Total number of offsite full-time equivalents = 1,618.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

I.2.13 Tank Closure Alternative 6C: All Vitrification with Separations; Landfill Closure

Table I–49. Tank Closure Alternative 6C Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Canister Storage Building (CON_CSB)							
Radiological workers	115,500	2006	2016	11	10,500	6	12
Nonradiological workers							
On site	135,929	2006	2016	11	12,357	6	
Off site	50,286	2006	2016	11	4,571	3	
Immobilized High-Level Radioactive Waste Shipping/Transfer Facility (CON_STF)							
Radiological workers	N/A						380
Nonradiological workers							
Onsite construction	1,757,000	2011	2013	3	585,667	282	
Onsite exempt	610,000	2011	2013	3	203,333	98	
Offsite design	748,000	2011	2013	3	249,333	120	

Table I–49. Tank Closure Alternative 6C Construction Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Immobilized High-Level Radioactive Waste Interim Storage Modules (CON_ISM)							
Radiological workers	N/A						232
Nonradiological workers							
Onsite construction	2,671,659	2014	2022	9	296,851	143	
Onsite exempt	1,650,000	2014	2022	9	183,333	89	
Offsite design	2,025,000	2014	2022	9	225,000	109	
Other Infrastructure Upgrades (CON_OIU)							
Radiological workers	782,094	2006	2034	29	26,969	13	45
Nonradiological workers							
On site	1,918,531	2006	2034	29	66,156	32	
Off site	743,125	2006	2034	29	25,625	13	
Tank Upgrades (CON_TU)							
Radiological workers	1,195,652	2006	2025	20	59,783	29	104
Nonradiological workers							
On site	3,112,174	2006	2025	20	155,609	75	
Off site	1,179,130	2006	2025	20	58,957	29	
Underground Transfer Lines (CON_UTL)							
Radiological workers	N/A						61
Nonradiological workers							
On site	126,005	2009	2009	1	126,005	61	
Off site	17,400	2009	2009	1	17,400	9	
Waste Treatment Plant (CON_WTP)							
Radiological workers	N/A						1,189
Nonradiological workers							
On site	29,672,500	2006	2017	12	2,472,708	1,189	
Off site	9,927,500	2006	2017	12	827,292	398	
Additional Low-Activity Waste Melters (CON_LAW)							
Radiological workers	N/A						340
Nonradiological workers							
On site	7,064,246	2008	2017	10	706,425	340	
Off site	2,386,570	2008	2017	10	238,657	115	
Cesium and Strontium Capsule Processing Facility (CON_CSC)							
Radiological workers	N/A						190
Nonradiological workers							
On site	1,578,029	2035	2038	4	394,507	190	
Off site	465,683	2035	2038	4	116,421	56	
Waste Receiver Facilities (CON_WRF)							
Radiological workers	N/A						454
Nonradiological workers							
On site	4,716,000	2013	2017	5	943,200	454	
Off site	1,696,000	2013	2017	5	339,200	164	

Table I–49. Tank Closure Alternative 6C Construction Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Tank Risers (CON_RIS)							
Radiological workers	172,920	2013	2016	4	43,230	21	50
Nonradiological workers							
On site	233,180	2013	2016	4	58,295	29	
Off site	N/A						
Modified Sluicing Retrieval System (CON_MS)							
Radiological workers	3,847,797	2013	2043	31	124,122	60	155
Nonradiological workers							
On site	6,076,615	2013	2043	31	196,020	95	
Off site	2,137,968	2013	2043	31	68,967	34	
Mobile Retrieval System (CON_MRS)							
Radiological workers	8,098,800	2013	2028	16	506,175	244	513
Nonradiological workers							
On site	8,940,660	2013	2028	16	558,791	269	
Off site	4,794,060	2013	2028	16	299,629	145	
Vacuum-Based Retrieval System (CON_VBR)							
Radiological workers	11,196,200	2029	2043	15	746,413	359	743
Nonradiological workers							
On site	11,957,150	2029	2043	15	797,143	384	
Off site	6,817,400	2029	2043	15	454,493	219	
High-Level Radioactive Waste Melter Interim Storage Facilities (CON_PAD)[a]							
Radiological workers	N/A						1
Nonradiological workers							
On site	5,616	2015	2030	4	1,404	1	
Off site	N/A						
Effluent Treatment Facility Replacement (CON_ETF)							
Radiological workers	N/A						329
Nonradiological workers							
On site	2,047,400	2023	2025	3	682,467	329	
Off site	703,895	2023	2025	3	234,632	113	
242-A Evaporator Replacement (CON_EVA)							
Radiological workers	N/A						102
Nonradiological workers							
On site	635,400	2015	2017	3	211,800	102	
Off site	217,918	2015	2017	3	72,639	35	
Immobilized Low-Activity Waste Interim Storage Facility (CON_ILAWST)							
Radiological workers	N/A						11
Nonradiological workers							
On site	602,600	2016	2043	28	21,521	11	
Off site	N/A						
Total	**144,829,591**				**13,423,601**	**6,473**	**4,911**

[a] CON_PAD activities include two 2-year periods.
Period 1, 2015–2016
Period 2, 2029–2030

Table I–49. Tank Closure Alternative 6C Construction Rollup Workforce Estimate *(continued)*

Notes and Assumptions:

Total number of offsite full-time equivalents = 1,562.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–50. Tank Closure Alternative 6C Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Immobilized High-Level Radioactive Waste Interim Storage Facilities (OPS_ISF)							
Radiological workers	7,779,436	2018	2066	49	158,764	77	120
Nonradiological workers							
On site	4,351,200	2018	2066	49	88,800	43	
Off site	N/A						
Other Infrastructure Upgrades (OPS_OIU)							
Radiological workers	44,909	2006	2043	38	1,182	1	4
Nonradiological workers							
On site	164,667	2006	2043	38	4,333	3	
Off site	117,455	2006	2043	38	3,091	2	
Routine Operations (OPS_ROUT)							
Radiological workers	9,880,000	2006	2043	38	260,000	125	651
Nonradiological workers							
On site	41,534,000	2006	2043	38	1,093,000	526	
Off site	5,890,000	2006	2043	38	155,000	75	
Retrieval Operations (OPS_RET)							
Radiological workers	12,955	2006	2043	38	341	1	28
Nonradiological workers							
On site	2,111,591	2006	2043	38	55,568	27	
Off site	16,409	2006	2043	38	432	1	
Interim Stabilization/Double-Shell Tanks (OPS_IST)							
Radiological workers	1,394,773	2006	2043	38	36,705	18	44
Nonradiological workers							
On site	1,995,864	2006	2043	38	52,523	26	
Off site	2,204,000	2006	2043	38	58,000	28	
Waste Treatment Plant (OPS_WTP)							
Radiological workers	62,753,000	2018	2043	26	2,413,577	1,161	1,939
Nonradiological workers							
On site	42,074,000	2018	2043	26	1,618,231	778	
Off site	8,000	2018	2043	26	308	1	
Waste Treatment Plant—Cesium and Strontium Capsules (OPS_WTPCSC)							
Radiological workers	2,413,577	2040	2040	1	2,413,577	1,161	1,939
Nonradiological workers							
On site	1,618,231	2040	2040	1	1,618,231	778	
Off site	308	2040	2040	1	308	1	

Table I–50. Tank Closure Alternative 6C Operations Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Cesium and Strontium Capsule Processing Facility (OPS_CSC)							
Radiological workers	103,334	2039	2040	2	51,667	25	25
Nonradiological workers							
On site	N/A						
Off site	N/A						
Modified Sluicing Retrieval System (OPS_MS)							
Radiological workers	5,778,109	2013	2043	31	186,391	90	149
Nonradiological workers							
On site	3,777,905	2013	2043	31	121,868	59	
Off site	N/A						
Mobile Retrieval System (OPS_MRS)							
Radiological workers	5,169,360	2013	2028	16	323,085	156	297
Nonradiological workers							
On site	4,678,860	2013	2028	16	292,429	141	
Off site	N/A						
Vacuum-Based Retrieval System (OPS_VBR)							
Radiological workers	7,667,884	2029	2043	15	511,192	246	469
Nonradiological workers							
On site	6,940,309	2029	2043	15	462,687	223	
Off site	N/A						
High-Level Radioactive Waste Melter Interim Storage Facilities (OPS_PAD)							
Radiological workers	N/A	2018	2145	128			
Nonradiological workers							
On site	N/A						
Off site							
Effluent Treatment Facility Replacement (OPS_ETF)							
Radiological workers	6,182,400	2006	2045	40	154,560	75	94
Nonradiological workers							
On site	1,545,600	2006	2045	40	38,640	19	
Off site	N/A						
242-A Evaporator Replacement (OPS_EVA)							
Radiological workers	1,858,033	2006	2043	38	48,896	24	32
Nonradiological workers							
On site	568,233	2006	2043	38	14,954	8	
Off site	N/A						
Borrow Area C (OPS_CAREA)							
Radiological workers	N/A						43
Nonradiological workers							
On site	4,201,800	2006	2052	47	89,400	43	
Off site	N/A						
Immobilized Low-Activity Waste Interim Storage Facility (OPS_ILAWST)							
Radiological workers	N/A	2018	2145	128	N/A		
Nonradiological workers							
On site	N/A						
Off site	N/A						
Total	**234,836,202**				**12,327,738**	**5,942**	**5,834**

Table I–50. Tank Closure Alternative 6C Operations Rollup Workforce Estimate *(continued)*

Notes and Assumptions:

Total number of offsite full-time equivalents = 108.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–51. Tank Closure Alternative 6C Deactivation Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Immobilized High-Level Radioactive Waste Interim Storage Facilities (DEA_ISF)							
Radiological workers	N/A						
Nonradiological workers							
On site	160	2067	2067	1	160	1	1
Off site	N/A						
Waste Treatment Plant (DEA_WTP)							
Radiological workers	3,800,000	2044	2045	2	1,900,000	914	
Nonradiological workers							1,527
On site	2,550,000	2044	2045	2	1,275,000	613	
Off site	500	2044	2045	2	250	1	
Modified Sluicing Retrieval System (DEA_MS)							
Radiological workers	291,082	2013	2043	31	9,390	5	
Nonradiological workers							5
On site	N/A						
Off site	N/A						
Mobile Retrieval System (DEA_MRS)							
Radiological workers	679,620	2013	2028	16	42,476	21	
Nonradiological workers							21
On site	N/A						
Off site	N/A						
Vacuum-Based Retrieval System (DEA_VBR)							
Radiological workers	258,100	2029	2043	15	17,207	9	
Nonradiological workers							9
On site	N/A						
Off site	N/A						
Cesium and Strontium Capsule Processing Facility (DEA_CSC)							
Radiological workers	23,920	2041	2041	1	23,920	12	
Nonradiological workers							12
On site	N/A						
Off site	N/A						
Effluent Treatment Facility (Original) (DEA_ETFO)							
Radiological workers	77,280	2026	2026	1	77,280	38	
Nonradiological workers							48
On site	19,320	2026	2026	1	19,320	10	
Off site	N/A						

Table I–51. Tank Closure Alternative 6C Deactivation Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Effluent Treatment Facility (DEA_ETF)							
Radiological workers	77,280	2046	2046	1	77,280	38	48
Nonradiological workers							
On site	19,320	2046	2046	1	19,320	10	
Off site	N/A						
242-A Evaporator (Original) (DEA_EVAO)							
Radiological workers	24,448	2018	2018	1	24,448	12	16
Nonradiological workers							
On site	7,477	2018	2018	1	7,477	4	
Off site	N/A						
242-A Evaporator Replacement (DEA_EVA)							
Radiological workers	24,448	2044	2044	1	24,448	12	16
Nonradiological workers							
On site	7,477	2044	2044	1	7,477	4	
Off site	N/A						
Total	**7,860,432**				**3,525,453**	**1,704**	**1,703**

Notes and Assumptions:

Total number of offsite full-time equivalents = 1.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

Table I–52. Tank Closure Alternative 6C Closure Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Tank-Filling Grout Facility Construction (CLO_CONGRO)							
Radiological workers	480	2032	2033	2	240	1	5
Nonradiological workers							
On site	13,360	2032	2033	2	6,680	4	
Off site	4,160	2032	2033	2	2,080	1	
Tank-Filling Grout Facility Operations (CLO_OPSGRO)							
Radiological workers	68,000	2034	2043	10	6,800	4	13
Nonradiological workers							
On site	185,280	2034	2043	10	18,528	9	
Off site	130,000	2034	2043	10	13,000	7	
Tank-Filling Grout Facility Deactivation (CLO_DEAGRO)							
Radiological workers	480	2044	2044	1	480	1	4
Nonradiological workers							
On site	4,320	2044	2044	1	4,320	3	
Off site	1,040	2044	2044	1	1,040	1	
Ancillary Equipment Grouting (CLO_ANCFIL)							
Radiological workers	337,943	2013	2037	25	13,518	7	7
Nonradiological workers							
On site	N/A						
Off site	N/A						

Table I–52. Tank Closure Alternative 6C Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Ancillary Equipment Removal (CLO_ANCREM)							
Radiological workers	166,452	2032	2037	6	27,742	14	14
Nonradiological workers							
On site	N/A						
Off site	N/A						
BX and SX Tank Farm Soil Removal (CLO_SOIL)							
Radiological workers	33,000	2032	2037	6	5,500	3	6
Nonradiological workers							
On site	30,000	2032	2037	6	5,000	3	
Off site	N/A						
Containment Structure Construction (CLO_CONCS)							
Radiological workers	2,000	2028	2031	4	500	1	4
Nonradiological workers							
On site	20,000	2028	2031	4	5,000	3	
Off site	N/A						
Containment Structure Deactivation (CLO_DEACS)							
Radiological workers	2,000	2038	2040	3	667	1	5
Nonradiological workers							
On site	20,000	2038	2040	3	6,667	4	
Off site	N/A						
Modified Resource Conservation and Recovery Act Subtitle C Barrier Construction (CLO_RCRA)							
Radiological workers	1,430,000	2039	2045	7	204,286	99	394
Nonradiological workers							
On site	4,290,000	2039	2045	7	612,857	295	
Off site	N/A						
Decontamination and Decommissioning of 10 Selected Facilities (CLO_D&DTEN)							
Radiological workers	44,418	2018	2028	11	4,038	2	9
Nonradiological workers							
On site	146,679	2018	2028	11	13,334	7	
Off site	78,970	2018	2028	11	7,179	4	
Postclosure Care (CLO_POST)							
Radiological workers	N/A						3
Nonradiological workers							
On site	471,262	2046	2145	100	4,713	3	
Off site	N/A						
Total	**7,479,844**				**964,168**	**477**	**464**

Notes and Assumptions:

Total number of offsite full-time equivalents = 13.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007a, 2008.

I.2.14 FFTF Decommissioning Alternative 1: No Action

Table I–53. FFTF Decommissioning Alternative 1 Deactivation Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Administrative Controls (DEA_ADM)							
Radiological workers	41,600	2008	2107	100	416	1	1
Nonradiological workers							
On site	N/A						
Off site	N/A						
Total	**41,600**				**416**	**1**	**1**

Notes and Assumptions:
Total number of offsite full-time equivalents = 0.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: FFTF=Fast Flux Test Facility; N/A=not applicable.
Source: Compiled from SAIC 2007b, 2008.

I.2.15 FFTF Decommissioning Alternative 2: Entombment

Table I–54. FFTF Decommissioning Alternative 2 Facility Disposition Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Above-Grade Structure and Equipment Removal (DEC_AGSR)							
Radiological workers	N/A						33
Nonradiological workers							
On site	546,000	2013	2020	8	68,250	33	
Off site	20,005	2013	2020	8	2,501	2	
Removal of Reactor Containment Building Below-Grade Vessels, Piping, Components (DEC_GB1)							
Radiological workers	7,680	2017	2017	1	7,680	4	6
Nonradiological workers							
On site	3,840	2017	2017	1	3,840	2	
Off site	N/A						
491 East and West Backfill with Grout (DEC_GB2)							
Radiological workers	N/A	2017	2017	1			
Nonradiological workers							
On site	N/A						
Off site	N/A						
Grout Facility Resource Calculation (DEC_OGFC)							
Radiological workers	N/A						11
Nonradiological workers							
On site	22,378	2016	2016	1	22,378	11	
Off site	N/A						
Grout Facility Resource Calculation–Operation (DEC_OGFO)							
Radiological workers	N/A						6
Nonradiological workers							
On site	10,560	2017	2017	1	10,560	6	
Off site	N/A						

Table I–54. FFTF Decommissioning Alternative 2 Facility Disposition Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Grout Facility Resource Calculation–Deactivation (DEC_OGFD)							
Radiological workers	N/A						
Nonradiological workers							
On site	7,214	2018	2018	1	7,214	4	4
Off site	N/A						
Nonhazardous Waste Transportation (DEC_WTR)							
Radiological workers	N/A						
Nonradiological workers							
On site	95	2013	2020	8	12	1	1
Off site	9	2013	2020	8	1	1	
Site Regrading (CLO_SRG)							
Radiological workers	N/A						
Nonradiological workers							
On site	45,228	2021	2021	1	45,228	22	22
Off site	4,523	2021	2021	1	4,523	3	
Site Revegetation (CLO_REV)							
Radiological workers	N/A						
Nonradiological workers							
On site	942	2021	2021	1	942	1	1
Off site	94	2021	2021	1	94	1	
Modified Resource Conservation and Recovery Act Subtitle C Barrier (CLO_RCRA)							
Radiological workers	N/A						
Nonradiological workers							
On site	55,715	2021	2021	1	55,715	27	27
Off site	5,571	2021	2021	1	5,571	3	
Institutional Controls (CLO_POST)							
Radiological workers	N/A						
Nonradiological workers							
On site	80,000	2022	2121	100	800	1	1
Off site	N/A						
Total	**809,855**				**235,309**	**122**	**112**

Notes and Assumptions:

Total number of offsite full-time equivalents = 10.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Source: Compiled from SAIC 2007b, 2008.

I.2.16 FFTF Decommissioning Alternative 3: Removal

Table I–55. FFTF Decommissioning Alternative 3 Facility Disposition Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Above-Grade Structure and Equipment Removal (DEC_AGSR)							
Radiological workers	N/A						33
Nonradiological workers							
On site	546,000	2013	2020	8	68,250	33	
Off site	20,005	2013	2020	8	2,501	2	
Removal of Reactor Containment Building Below-Grade Vessels, Piping, Components (DEC_RVRG)							
Radiological workers	130,881	2013	2014	2	65,440	32	48
Nonradiological workers							
On site	64,563	2013	2014	2	32,282	16	
Off site	N/A						
Grout Facility Resource Calculation (DEC_OGFC)							
Radiological workers	N/A						11
Nonradiological workers							
On site	22,378	2012	2012	1	22,378	11	
Off site	N/A						
Grout Facility Resource Calculation–Operation (DEC_OGFO)							
Radiological workers	N/A						3
Nonradiological workers							
On site	10,560	2013	2014	2	5,280	3	
Off site	N/A						
Grout Facility Resource Calculation–Deactivation (DEC_OGFD)							
Radiological workers	N/A						4
Nonradiological workers							
On site	7,214	2015	2015	1	7,214	4	
Off site	N/A						
Nonhazardous Waste Transportation (DEC_WTR)							
Radiological workers	N/A						1
Nonradiological workers							
On site	95	2013	2020	8	12	1	
Off site	9	2013	2020	8	1	1	
Site Regrading (CLO_SRG)							
Radiological workers	N/A						30
Nonradiological workers							
On site	61,620	2021	2021	1	61,620	30	
Off site	6,162	2021	2021	1	6,162	3	
Site Revegetation (CLO_REV)							
Radiological workers	N/A						1
Nonradiological workers							
On site	1,063	2021	2021	1	1,063	1	
Off site	106	2021	2021	1	106	1	

Table I–55. FFTF Decommissioning Alternative 3 Facility Disposition Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Institutional Controls (CLO_POST)							
Radiological workers	N/A						
Nonradiological workers							1
On site	80,000	2022	2121	100	800	1	
Off site	N/A						
Total	**950,656**				**273,109**	**139**	**132**

Notes and Assumptions:
Total number of offsite full-time equivalents = 8.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: FFTF=Fast Flux Test Facility; N/A=not applicable.
Source: Compiled from SAIC 2007b, 2008.

Table I–56. FFTF Decommissioning Alternatives 2 and 3 – Disposition of Remote-Handled Components Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Hanford Option							
Remote Treatment Project–Hanford 200-West Area (CON_HRTP)							
Radiological workers	N/A						
Nonradiological workers							53
On site	219,164	2015	2016	2	109,582	53	
Off site	124,370	2015	2016	2	62,185	30	
Remote Treatment Project–Hanford (OPS_HRTP)							
Radiological workers	83,200	2017	2017	1	83,200	40	
Nonradiological workers							40
On site	N/A						
Off site	5	2017	2017	1	5	1	
Remote Treatment Project–Hanford 200-West Area (DEA_HRTP)							
Radiological workers	41,600	2018	2018	1	41,600	20	
Nonradiological workers							20
On site	N/A						
Off site	N/A						
Total	**468,340**				**296,573**	**144**	**113**
Idaho Option							
Remote Treatment Project–Idaho National Laboratory Materials and Fuels Complex (CON_IRTP)							
Radiological workers	N/A						
Nonradiological workers							46
On site	189,358	2015	2016	2	94,679	46	
Off site	107,456	2015	2016	2	53,728	26	

Table I–56. FFTF Decommissioning Alternatives 2 and 3 – Disposition of Remote-Handled Components Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Remote Treatment Project–Idaho National Laboratory Materials and Fuels Complex (OPS_IRTP)							
Radiological workers	83,200	2017	2017	1	83,200	40	40
Nonradiological workers							
On site	N/A						
Off site	87	2017	2017	1	87	1	
Remote Treatment Project–Idaho National Laboratory Materials and Fuels Complex (DEA_IRTP)							
Radiological workers	41,632	2018	2018	1	41,632	21	21
Nonradiological workers							
On site	N/A						
Off site	N/A						
Total	**421,733**				**273,326**	**134**	**107**

Notes and Assumptions:

Total number of offsite full-time equivalents at Hanford= 31.

Total number of offsite full-time equivalents at INL = 27.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Source: Compiled from SAIC 2007b, 2008.

Table I–57. FFTF Decommissioning Alternatives 2 and 3 – Disposition of Bulk Sodium Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Hanford Reuse Option							
Hanford Sodium Reaction Facility (CON_HSRF)							
Radiological workers	N/A						44
Nonradiological workers							
On site	179,214	2015	2016	2	89,607	44	
Off site	86,994	2015	2016	2	43,497	21	
Hanford Sodium Reaction Facility (OPS_HSP)							
Radiological workers	10,400	2017	2017	1	10,400	5	5
Nonradiological workers							
On site	N/A						
Off site	N/A						
Hanford Sodium Reaction Facility (OPS_HSRF)							
Radiological workers	185,023	2017	2018	2	92,512	45	60
Nonradiological workers							
On site	61,796	2017	2018	2	30,898	15	
Off site	5,888	2017	2018	2	2,944	2	
Hanford Sodium Reaction Facility (DEA_HSRF)							
Radiological workers	11,027	2019	2019	1	11,027	6	17
Nonradiological workers							
On site	22,855	2019	2019	1	22,855	11	
Off site	16,444	2019	2019	1	16,444	8	
Total	**579,641**				**320,184**	**157**	**126**

Table I–57. FFTF Decommissioning Alternatives 2 and 3 – Disposition of Bulk Sodium Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Idaho Reuse Option							
Materials and Fuels Complex Sodium Processing Facility (CON_ISPF)							
Radiological workers	21,022	2014	2014	1	21,022	11	19
Nonradiological workers							
On site	15,648	2014	2014	1	15,648	8	
Off site	12,599	2014	2014	1	12,599	7	
Idaho National Laboratory Materials and Fuels Complex–Sodium Processing Facility and Fast Flux Test Facility Sodium Storage Facility (OPS_ISP)							
Radiological workers	10,400	2015	2015	1	10,400	5	5
Nonradiological workers							
On site	N/A						
Off site	N/A						
Sodium Processing Facility (OPS_ISPF)							
Radiological workers	168,978	2015	2016	2	84,489	41	50
Nonradiological workers							
On site	35,793	2015	2016	2	17,897	9	
Off site	N/A						
Fast Flux Test Facility Sodium Disposition–Idaho Option (DEA_ISPF)							
Radiological workers	828	2016	2016	1	828	1	2
Nonradiological workers							
On site	379	2016	2016	1	379	1	
Off site	N/A						
Total	**265,647**				**163,262**	**83**	**76**

Notes and Assumptions:

Total number of offsite full-time equivalents at Hanford= 31.

Total number of offsite full-time equivalents at INL = 7.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: FFTF=Fast Flux Test Facility; N/A=not applicable.

Source: Compiled from SAIC 2007b, 2008.

I.2.17 Waste Management Alternative 1: No Action

Table I–58. Waste Management Alternative 1 Operations/Deactivation Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Low-Level Radioactive Waste Burial Grounds (OPS_LLBG)							
Radiological workers	386,570	2007	2035	29	13,330	7	9
Nonradiological workers							
On site	113,769	2007	2035	29	3,923	2	
Off site	193,523	2007	2035	29	6,673	4	
Integrated Disposal Facility (DEA_IDF)							
Radiological workers	6,240	2009	2009	1	6,240	3	100
Nonradiological workers							
On site	200,120	2009	2009	1	200,120	97	
Off site	31,200	2009	2009	1	31,200	15	

Table I–58. Waste Management Alternative 1 Operations/Deactivation Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Postclosure Care (DEA_ADM)							
Radiological workers	N/A						1
Nonradiological workers							
On site	72,657	2036	2135	100	727	1	
Off site	N/A						
Total	**1,004,078**				**262,212**	**129**	**110**

Notes and Assumptions:
Total number of offsite full-time equivalents = 4.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

I.2.18 Waste Management Alternative 2: Disposal in IDF, 200-East Area Only

Table I–59. Waste Management Alternative 2 Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
A 2706T/TA/TB Facility (CON_TPLANT)							
Radiological workers	N/A						19
Nonradiological workers							
On site	78,468	2011	2012	2	39,234	19	
Off site	31,033	2011	2012	2	15,516	8	
Central Waste Complex (CON_WRAPCH)							
Radiological workers	N/A						213
Nonradiological workers							
On site	882,789	2011	2012	2	441,395	213	
Off site	133,191	2011	2012	2	66,595	33	
Waste Receiving and Processing Facility (CON_WRAPRH)							
Radiological workers	N/A						119
Nonradiological workers							
On site	1,482,600	2013	2018	6	247,100	119	
Off site	509,296	2013	2018	6	84,883	41	
Central Waste Complex (CON_CWCE)							
Radiological workers	N/A						71
Nonradiological workers							
On site	294,263	2011	2012	2	147,132	71	
Off site	104,571	2011	2012	2	52,286	26	
Total	**3,516,211**				**1,094,140**	**530**	**422**

Notes and Assumptions:
Total number of offsite full-time equivalents = 108.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

Table I–60. Waste Management Alternative 2 Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
T Plant Solid Waste Activities (OPS_TPLANT)							
Radiological workers	1,264,640	2013	2050	38	33,280	16	20
Nonradiological workers							
On site	316,160	2013	2050	38	8,320	4	
Off site	N/A						
Solid Waste Operations Complex Waste Receiving and Processing Facility (OPS_WRAPCH)							
Radiological workers	21,660,000	2013	2050	38	570,000	275	300
Nonradiological workers							
On site	1,976,000	2013	2050	38	52,000	25	
Off site	N/A						
Solid Waste Operations Complex Waste Receiving and Processing Facility (OPS_WRAPRH)							
Radiological workers	7,296,000	2019	2050	32	228,000	110	120
Nonradiological workers							
On site	665,600	2019	2050	32	20,800	10	
Off site	N/A						
Central Waste Complex (OPS_CWCE)							
Radiological workers	622,668	2013	2050	38	16,386	8	9
Nonradiological workers							
On site	69,198	2013	2050	38	1,821	1	
Off site	N/A						
Total	**33,870,266**				**930,607**	**449**	**449**

Notes and Assumptions:

Total number of offsite full-time equivalents = 0.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007c, 2008.

Table I–61. Waste Management Alternative 2 Deactivation Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
T Plant Solid Waste Activities (DEA_TPLANT)							
Radiological workers	22,187	2051	2051	1	22,187	11	14
Nonradiological workers							
On site	5,547	2051	2051	1	5,547	3	
Off site	N/A						
Solid Waste Operations Complex Waste Receiving and Processing Facility–Deactivation of the Contact-Handled Mixed Transuranic/Transuranic Waste Facility (DEA_WRAPCH)							
Radiological workers	285,000	2051	2051	1	285,000	138	151
Nonradiological workers							
On site	26,000	2051	2051	1	26,000	13	
Off site	N/A						
Solid Waste Operations Complex Waste Receiving and Processing Facility–Remote-Handled Mixed Transuranic/Transuranic Waste Facility Waste Expansion (DEA_WRAPRH)							
Radiological workers	114,000	2051	2051	1	114,000	55	60
Nonradiological workers							
On site	10,400	2051	2051	1	10,400	5	
Off site	N/A						

Table I–61. Waste Management Alternative 2 Deactivation Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Central Waste Complex (DEA_CWCE)							
Radiological workers	8,193	2051	2051	1	8,193	4	5
Nonradiological workers							
On site	911	2051	2051	1	911	1	
Off site	N/A						
Total	**472,237**				**472,237**	**230**	**230**

Notes and Assumptions:

Total number of offsite full-time equivalents = 0.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007c, 2008.

Table I–62. Waste Management Alternative 2, Disposal Group 1, Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Single Integrated Disposal Facility (CON_IDF)							
Radiological workers	N/A						160
Nonradiological workers							
On site	992,655	2006	2008	3	330,885	160	
Off site	N/A						
River Protection Project Disposal Facility (CON_RPPDF)							
Radiological workers	N/A						170
Nonradiological workers							
On site	1,056,703	2019	2021	3	352,234	170	
Off site	N/A						
Total	**2,049,357**				**683,119**	**330**	**330**

Notes and Assumptions:

Total number of offsite full-time equivalents = 0.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007c, 2008.

Table I–63. Waste Management Alternative 2, Disposal Group 1, Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Low-Level Radioactive Waste Burial Grounds (OPS_LLBG)							
Radiological workers	586,520	2007	2050	44	13,330	7	9
Nonradiological workers							
On site	172,615	2007	2050	44	3,923	2	
Off site	293,621	2007	2050	44	6,673	4	
Single Integrated Disposal Facility (OPS_IDF)							
Radiological workers	1,510,454	2009	2050	42	35,963	18	42
Nonradiological workers							
On site	2,091,398	2009	2050	42	49,795	24	
Off site	2,788,531	2009	2050	42	66,394	32	
River Protection Project Disposal Facility (OPS_RPPDF)							
Radiological workers	1,664,832	2022	2050	29	57,408	28	43
Nonradiological workers							
On site	897,562	2022	2050	29	30,950	15	
Off site	1,664,832	2022	2050	29	57,408	28	
Total	**11,670,365**				**321,845**	**158**	**94**

Notes and Assumptions:

Total number of offsite full-time equivalents = 64.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Source: Compiled from SAIC 2007c, 2008.

Table I–64. Waste Management Alternative 2, Disposal Group 1, Closure Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Modified Resource Conservation and Recovery Act Subtitle C Barrier (CLO_IDF)							
Radiological workers	N/A						619
Nonradiological workers							
On site	2,572,997	2051	2052	2	1,286,498	619	
Off site	257,300	2051	2052	2	128,650	62	
Postclosure Care (CLO_POSTIDF)							
Radiological workers	N/A						2
Nonradiological workers							
On site	390,770	2053	2152	100	3,908	2	
Off site	N/A						
Modified Resource Conservation and Recovery Act Subtitle C Barrier (CLO_RPPDF)							
Radiological workers	N/A						559
Nonradiological workers							
On site	2,321,501	2051	2052	2	1,160,750	559	
Off site	232,150	2051	2052	2	116,075	56	

Table I–64. Waste Management Alternative 2, Disposal Group 1, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Postclosure Care (CLO_POSTRPPDF)							
Radiological workers							
Nonradiological workers							
On site	352,575	2053	2152	100	3,526	2	2
Off site							
Total	**6,127,293**				**2,699,407**	**1,300**	**1,182**

Notes and Assumptions:
Total number of offsite full-time equivalents = 118.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

Table I–65. Waste Management Alternative 2, Disposal Group 2, Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Single Integrated Disposal Facility (CON_IDF)							
Radiological workers	N/A						
Nonradiological workers							
On site	700,596	2006	2008	3	233,532	113	113
Off site	N/A						
River Protection Project Disposal Facility (CON_RPPDF)							
Radiological workers	N/A						
Nonradiological workers							
On site	8,189,445	2019	2021	3	2,729,815	1,313	1,313
Off site	N/A						
Total	**8,890,041**				**2,963,347**	**1,426**	**1,426**

Notes and Assumptions:
Total number of offsite full-time equivalents = 0.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

Table I–66. Waste Management Alternative 2, Disposal Group 2, Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Low-Level Radioactive Waste Burial Grounds (OPS_LLBG)							
Radiological workers	586,520	2007	2050	44	13,330	7	
Nonradiological workers							9
On site	172,615	2007	2050	44	3,923	2	
Off site	293,621	2007	2050	44	6,673	4	

Table I–66. Waste Management Alternative 2, Disposal Group 2, Operations Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Single Integrated Disposal Facility (OPS_IDF)							
Radiological workers	1,169,210	2009	2100	92	12,709	7	16
Nonradiological workers							
On site	1,168,906	2009	2100	92	17,597	9	
Off site	2,158,541	2009	2100	92	23,462	12	
River Protection Project Disposal Facility (OPS_RPPDF)							
Radiological workers	35,148,048	2022	2100	79	444,912	214	330
Nonradiological workers							
On site	18,949,382	2022	2100	79	239,866	116	
Off site	35,148,048	2022	2100	79	444,912	214	
Total	**95,244,890**				**1,207,384**	**585**	**355**

Notes and Assumptions:

Total number of offsite full-time equivalents = 230.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Source: Compiled from SAIC 2007c, 2008.

Table I–67. Waste Management Alternative 2, Disposal Group 2, Closure Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Modified Resource Conservation and Recovery Act Subtitle C Barrier (CLO_IDF)							
Radiological workers	N/A						219
Nonradiological workers							
On site	909,255	2101	2102	2	454,627	219	
Off site	90,925	2101	2102	2	45,463	22	
Postclosure Care (CLO_POSTIDF)							
Radiological workers	N/A						1
Nonradiological workers							
On site	138,092	2103	2202	100	1,381	1	
Off site	N/A						
Modified Resource Conservation and Recovery Act Subtitle C Barrier (CLO_RPPDF)							
Radiological workers	N/A						4,325
Nonradiological workers							
On site	17,991,632	2101	2102	2	8,995,816	4,325	
Off site	1,799,163	2101	2102	2	899,582	433	

Table I–67. Waste Management Alternative 2, Disposal Group 2, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Postclosure Care (CLO_POSTRPPDF)							
Radiological workers	N/A						
Nonradiological workers							
On site	2,732,453	2103	2202	100	27,325	14	14
Off site	N/A						
Total	**23,661,521**				**10,424,193**	**5,014**	**4,559**

Notes and Assumptions:
Total number of offsite full-time equivalents = 455.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

Table I–68. Waste Management Alternative 2, Disposal Group 3, Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Single Integrated Disposal Facility (CON_IDF)							
Radiological workers	N/A						
Nonradiological workers							
On site	700,596	2006	2008	3	233,532	113	113
Off site	N/A						
River Protection Project Disposal Facility (CON_RPPDF)							
Radiological workers	N/A						
Nonradiological workers							
On site	8,189,445	2019	2021	3	2,729,815	1,313	1,313
Off site	N/A						
Total	**8,890,041**				**2,963,347**	**1,426**	**1,426**

Notes and Assumptions:
Total number of offsite full-time equivalents = 0.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

Table I–69. Waste Management Alternative 2, Disposal Group 3, Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Low-Level Radioactive Waste Burial Grounds (OPS_LLBG)							
Radiological workers	586,520	2007	2050	44	13,330	7	
Nonradiological workers							9
On site	172,615	2007	2050	44	3,923	2	
Off site	293,621	2007	2050	44	6,673	4	

Table I–69. Waste Management Alternative 2, Disposal Group 3, Operations Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Single Integrated Disposal Facility (OPS_IDF)							
Radiological workers	1,995,282	2009	2165	157	12,709	7	
Nonradiological workers							
On site	2,762,698	2009	2165	157	17,597	9	16
Off site	3,683,597	2009	2165	157	23,462	12	
River Protection Project Disposal Facility (OPS_RPPDF)							
Radiological workers	64,067,328	2022	2165	144	444,912	214	
Nonradiological workers							330
On site	34,540,646	2022	2165	144	239,866	116	
Off site	64,067,328	2022	2165	144	444,912	214	
Total	**171,583,114**				**1,194,054**	**585**	**355**

Notes and Assumptions:

Total number of offsite full-time equivalents = 230.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Source: Compiled from SAIC 2007c, 2008.

Table I–70. Waste Management Alternative 2, Disposal Group 3, Closure Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Modified Resource Conservation and Recovery Act Subtitle C Barrier (CLO_IDF)							
Radiological workers	N/A						
Nonradiological workers							219
On site	909,255	2166	2167	2	454,627	219	
Off site	90,925	2166	2167	2	45,463	22	
Postclosure Care (CLO_POSTIDF)							
Radiological workers	N/A						
Nonradiological workers							
On site	138,092	2168	2267	100	1,381	1	1
Off site	N/A						
Modified Resource Conservation and Recovery Act Subtitle C Barrier (CLO_RPPDF)							
Radiological workers	N/A						
Nonradiological workers							4,325
On site	17,991,632	2166	2167	2	8,995,816	4,325	
Off site	1,799,163	2166	2167	2	899,582	433	
Postclosure Care (CLO_POSTRPPDF)							
Radiological workers	N/A						
Nonradiological workers							14
On site	2,732,453	2168	2267	100	27,325	14	
Off site	N/A						
Total	**23,661,521**				**10,424,193**	**5,014**	**4,559**

Notes and Assumptions:

Total number of offsite full-time equivalents = 455.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007c, 2008.

I.2.19 Waste Management Alternative 3: Disposal in IDF, 200-East and 200-West Areas

Table I–71. Waste Management Alternative 3 Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
A 2706T/TA/TB Facility (CON_TPLANT)							
Radiological workers	N/A						19
Nonradiological workers							
On site	78,468	2011	2012	2	39,234	19	
Off site	31,033	2011	2012	2	15,516	8	
Central Waste Complex (CON_WRAPCH)							
Radiological workers	N/A						213
Nonradiological workers							
On site	882,789	2011	2012	2	441,395	213	
Off site	133,191	2011	2012	2	66,595	33	
Waste Receiving and Processing Facility (CON_WRAPRH)							
Radiological workers	N/A						119
Nonradiological workers							
On site	1,482,600	2013	2018	6	247,100	119	
Off site	509,296	2013	2018	6	84,883	41	
Central Waste Complex (CON_CWCE)							
Radiological workers	N/A						71
Nonradiological workers							
On site	294,263	2011	2012	2	147,132	71	
Off site	104,571	2011	2012	2	52,286	26	
Total	**3,516,211**				**1,094,140**	**530**	**422**

Notes and Assumptions:

Total number of offsite full-time equivalents = 108.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Key: N/A=not applicable.

Source: Compiled from SAIC 2007c, 2008.

Table I–72. Waste Management Alternative 3 Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
T Plant Solid Waste Activities (OPS_TPLANT)							
Radiological workers	1,264,640	2013	2050	38	33,280	16	20
Nonradiological workers							
On site	316,160	2013	2050	38	8,320	4	
Off site	N/A						
Solid Waste Operations Complex Waste Receiving and Processing Facility (OPS_WRAPCH)							
Radiological workers	21,660,000	2013	2050	38	570,000	275	300
Nonradiological workers							
On site	1,976,000	2013	2050	38	52,000	25	
Off site	N/A						

Table I–72. Waste Management Alternative 3 Operations Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Solid Waste Operations Complex Waste Receiving and Processing Facility (OPS_WRAPRH)							
Radiological workers	7,296,000	2019	2050	32	228,000	110	120
Nonradiological workers							
On site	665,600	2019	2050	32	20,800	10	
Off site	N/A						
Central Waste Complex (OPS_CWCE)							
Radiological workers	622,668	2013	2050	38	16,386	8	9
Nonradiological workers							
On site	69,198	2013	2050	38	1,821	1	
Off site	N/A						
Total	**33,870,266**				**930,607**	**449**	**449**

Notes and Assumptions:
Total number of offsite full-time equivalents = 0.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

Table I–73. Waste Management Alternative 3 Deactivation Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
T Plant Solid Waste Activities (DEA_TPLANT)							
Radiological workers	22,187	2051	2051	1	22,187	11	14
Nonradiological workers							
On site	5,547	2051	2051	1	5,547	3	
Off site	N/A						
Solid Waste Operations Complex Waste Receiving and Processing Facility–Deactivation of the Contact-Handled Mixed Transuranic/Transuranic Waste Facility (DEA_WRAPCH)							
Radiological workers	285,000	2051	2051	1	285,000	138	151
Nonradiological workers							
On site	26,000	2051	2051	1	26,000	13	
Off site	N/A						
Solid Waste Operations Complex Waste Receiving and Processing Facility–Remote-Handled Transuranic Waste Expansion (DEA_WRAPRH)							
Radiological workers	114,000	2051	2051	1	114,000	55	60
Nonradiological workers							
On site	10,400	2051	2051	1	10,400	5	
Off site	N/A						
Central Waste Complex (DEA_CWCE)							
Radiological workers	8,193	2051	2051	1	8,193	4	5
Nonradiological workers							
On site	911	2051	2051	1	911	1	
Off site	N/A						
Total	**472,237**				**472,237**	**230**	**230**

Notes and Assumptions:
Total number of offsite full-time equivalents = 0.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

Table I–74. Waste Management Alternative 3, Disposal Group 1, Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Two Integrated Disposal Facilities (One in 200-West Area and one in 200-East Area) (CON_IDFE)							
Radiological workers	N/A						240
Nonradiological workers							
On site	1,496,280	2006	2008	3	498,760	240	
Off site	N/A						
Two Integrated Disposal Facilities (One in 200-West Area and one in 200-East Area) (CON_IDFW)							
Radiological workers	N/A						179
Nonradiological workers							
On site	1,115,924	2006	2008	3	371,975	179	
Off site	N/A						
River Protection Project Disposal Facility (CON_RPPDF)							
Radiological workers	N/A						170
Nonradiological workers							
On site	1,056,703	2019	2021	3	352,234	170	
Off site	N/A						
Total	**3,668,908**				**1,222,969**	**589**	**589**

Notes and Assumptions:
Total number of offsite full-time equivalents = 0.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

Table I–75. Waste Management Alternative 3, Disposal Group 1, Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Low-Level Radioactive Waste Burial Grounds (OPS_LLBG)							
Radiological workers	586,520	2007	2050	44	13,330	7	9
Nonradiological workers							
On site	172,615	2007	2050	44	3,923	2	
Off site	293,621	2007	2050	44	6,673	4	
Integrated Disposal Facility–200-East Area (OPS_IDFE)							
Radiological workers	1,385,530	2009	2050	42	32,989	16	38
Nonradiological workers							
On site	1,918,426	2009	2050	42	45,677	22	
Off site	2,557,901	2009	2050	42	60,902	30	
Integrated Disposal Facility–200-West Area (OPS_IDFW)							
Radiological workers	113,568	2009	2050	42	2,704	2	4
Nonradiological workers							
On site	157,248	2009	2050	42	3,744	2	
Off site	209,664	2009	2050	42	4,992	3	

Table I–75. Waste Management Alternative 3, Disposal Group 1, Operations Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
River Protection Project Disposal Facility (OPS_RPPDF)							
Radiological workers	1,664,832	2022	2050	29	57,408	28	43
Nonradiological workers							
On site	897,562	2022	2050	29	30,950	15	
Off site	1,664,832	2022	2050	29	57,408	28	
Total	**11,622,317**				**320,701**	**159**	**94**

Notes and Assumptions:

Total number of offsite full-time equivalents = 65.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Source: Compiled from SAIC 2007c, 2008.

Table I–76. Waste Management Alternative 3, Disposal Group 1, Closure Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Integrated Disposal Facility–200-East Area (CLO_IDFE)							
Radiological workers	N/A						568
Nonradiological workers							
On site	2,360,193	2051	2052	2	1,180,096	568	
Off site	236,019	2051	2052	2	118,010	57	
Integrated Disposal Facility–200-West Area (CLO_IDFW)							
Radiological workers	N/A						47
Nonradiological workers							
On site	193,458	2051	2052	2	96,729	47	
Off site	19,346	2051	2052	2	9,673	5	
Postclosure Care–Integrated Disposal Facility 200-East Area (CLO_POSTIDFE)							
Radiological workers	N/A						2
Nonradiological workers							
On site	365,740	2053	2152	100	3,657	2	
Off site	N/A						
Postclosure Care–Integrated Disposal Facility 200-West Area (CLO_POSTIDFW)							
Radiological workers	N/A						1
Nonradiological workers							
On site	29,979	2053	2152	100	300	1	
Off site	N/A						
Modified Resource Conservation and Recovery Act Subtitle C Barrier (CLO_RPPDF)							
Radiological workers	N/A						559
Nonradiological workers							
On site	2,321,501	2051	2052	2	1,160,750	559	
Off site	232,150	2051	2052	2	116,075	56	

Table I–76. Waste Management Alternative 3, Disposal Group 1, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Postclosure Care–River Protection Project Disposal Facility (CLO_POSTRPPDF)							
Radiological workers	N/A						
Nonradiological workers							
On site	352,575	2053	2152	100	3,526	2	2
Off site	N/A						
Total	**6,110,960**				**2,688,817**	**1,297**	**1,179**

Notes and Assumptions:
Total number of offsite full-time equivalents = 118.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

Table I–77. Waste Management Alternative 3, Disposal Group 2, Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Two Integrated Disposal Facilities (One in 200-West Area and one in 200-East Area) (CON_IDFE)							
Radiological workers	N/A						
Nonradiological workers							
On site	1,211,013	2006	2008	3	403,671	195	195
Off site	N/A						
Two Integrated Disposal Facilities (One in 200-West Area and one in 200-East Area) (CON_IDFW)							
Radiological workers	N/A						
Nonradiological workers							
On site	1,115,924	2006	2008	3	371,975	179	179
Off site	N/A						
River Protection Project Disposal Facility (CON_RPPDF)							
Radiological workers	N/A						
Nonradiological workers							
On site	8,189,445	2019	2021	3	2,729,815	1,313	1,313
Off site	N/A						
Total	**10,516,383**				**3,505,461**	**1,687**	**1,687**

Notes and Assumptions:
Total number of offsite full-time equivalents = 0.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

Table I–78. Waste Management Alternative 3, Disposal Group 2, Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Low-Level Radioactive Waste Burial Grounds (OPS_LLBG)							
Radiological workers	586,520	2007	2050	44	13,330	7	9
Nonradiological workers							
On site	172,615	2007	2050	44	3,923	2	
Off site	293,621	2007	2050	44	6,673	4	
Integrated Disposal Facility–200-East Area (OPS_IDFE)							
Radiological workers	945,318	2009	2100	92	10,275	5	12
Nonradiological workers							
On site	1,308,902	2009	2100	92	14,227	7	
Off site	1,745,203	2009	2100	92	18,970	10	
Integrated Disposal Facility–200-West Area (OPS_IDFW)							
Radiological workers	113,568	2009	2050	42	2,704	2	4
Nonradiological workers							
On site	157,248	2009	2050	42	3,744	2	
Off site	209,664	2009	2050	42	4,992	3	
River Protection Project Disposal Facility (OPS_RPPDF)							
Radiological workers	35,148,048	2022	2100	79	444,912	214	330
Nonradiological workers							
On site	18,949,382	2022	2100	79	239,866	116	
Off site	35,148,048	2022	2100	79	444,912	214	
Total	**94,778,138**				**1,208,528**	**586**	**355**

Notes and Assumptions:

Total number of offsite full-time equivalents = 231.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Source: Compiled from SAIC 2007c, 2008.

Table I–79. Waste Management Alternative 3, Disposal Group 2, Closure Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Integrated Disposal Facility–200-East Area (CLO_IDFE)							
Radiological workers	N/A						177
Nonradiological workers							
On site	735,142	2101	2102	2	367,571	177	
Off site	73,514	2101	2102	2	36,757	18	
Integrated Disposal Facility–200-West Area (CLO_IDFW)							
Radiological workers	N/A						47
Nonradiological workers							
On site	193,458	2051	2052	2	96,729	47	
Off site	19,346	2051	2052	2	9,673	5	
Postclosure Care–Integrated Disposal Facility 200-East Area (CLO_POSTIDFE)							
Radiological workers	N/A						
Nonradiological workers							
On site	113,919	2103	2202	100	1,139	1	1
Off site	N/A						

Table I–79. Waste Management Alternative 3, Disposal Group 2, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Postclosure Care–Integrated Disposal Facility 200-West Area (CLO_POSTIDFW)							
Radiological workers	N/A						1
Nonradiological workers							
On site	29,979	2053	2152	100	300	1	
Off site	N/A						
Modified Resource Conservation and Recovery Act Subtitle C Barrier (CLO_RPPDF)							
Radiological workers	N/A						4,325
Nonradiological workers							
On site	17,991,632	2101	2102	2	8,995,816	4,325	
Off site	1,799,163	2101	2102	2	899,582	433	
Postclosure Care–River Protection Project Disposal Facility (CLO_POSTRPPDF)							
Radiological workers	N/A						14
Nonradiological workers							
On site	2,732,453	2103	2202	100	27,325	14	
Off site	N/A						
Total	**23,688,607**				**10,434,892**	**5,021**	**4,565**

Notes and Assumptions:
Total number of offsite full-time equivalents = 456.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

Table I–80. Waste Management Alternative 3, Disposal Group 3, Construction Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Two Integrated Disposal Facilities (One in 200-West Area and one in 200-East Area) (CON_IDFE)							
Radiological workers	N/A						195
Nonradiological workers							
On site	1,211,013	2006	2008	3	403,671	195	
Off site	N/A						
Two Integrated Disposal Facilities (One in 200-West Area and one in 200-East Area) (CON_IDFW)							
Radiological workers	N/A						179
Nonradiological workers							
On site	1,115,924	2006	2008	3	371,975	179	
Off site	N/A						
River Protection Project Disposal Facility (CON_RPPDF)							
Radiological workers	N/A						1,313
Nonradiological workers							
On site	8,189,445	2019	2021	3	2,729,815	1,313	
Off site	N/A						
Total	**10,516,383**				**3,505,461**	**1,687**	**1,687**

Notes and Assumptions:
Total number of offsite full-time equivalents = 0.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

Table I–81. Waste Management Alternative 3, Disposal Group 3, Operations Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Low-Level Radioactive Waste Burial Grounds (OPS_LLBG)							
Radiological workers	586,520	2007	2050	44	13,330	7	9
Nonradiological workers							
On site	172,615	2007	2050	44	3,923	2	
Off site	293,621	2007	2050	44	6,673	4	
Integrated Disposal Facility–200-East Area (OPS_IDFE)							
Radiological workers	1,613,206	2009	2165	157	10,275	5	12
Nonradiological workers							
On site	2,233,670	2009	2165	157	14,227	7	
Off site	2,978,227	2009	2165	157	18,970	10	
Integrated Disposal Facility–200-West Area (OPS_IDFW)							
Radiological workers	113,568	2009	2050	42	2,704	2	4
Nonradiological workers							
On site	157,248	2009	2050	42	3,744	2	
Off site	209,664	2009	2050	42	4,992	3	
River Protection Project Disposal Facility (OPS_RPPDF)							
Radiological workers	64,067,328	2022	2165	144	444,912	214	330
Nonradiological workers							
On site	34,540,646	2022	2165	144	239,866	116	
Off site	64,067,328	2022	2165	144	444,912	214	
Total	**171,033,642**				**1,208,528**	**586**	**355**

Notes and Assumptions:

Total number of offsite full-time equivalents = 231.

Hours worked per year = 2,080.

One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.

Source: Compiled from SAIC 2007c, 2008.

Table I–82. Waste Management Alternative 3, Disposal Group 3, Closure Rollup Workforce Estimate

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Integrated Disposal Facility–200-East Area (CLO_IDFE)							
Radiological workers	N/A						177
Nonradiological workers							
On site	735,142	2166	2167	2	367,571	177	
Off site	73,514	2166	2167	2	36,757	18	
Integrated Disposal Facility–200-West Area (CLO_IDFW)							
Radiological workers	N/A						47
Nonradiological workers							
On site	193,458	2051	2052	2	96,729	47	
Off site	19,346	2051	2052	2	9,673	5	
Postclosure Care–Integrated Disposal Facility 200-East Area (CLO_POSTIDFE)							
Radiological workers	N/A						
Nonradiological workers							
On site	113,919	2168	2267	100	1,139	1	1
Off site	N/A						

Table I–82. Waste Management Alternative 3, Disposal Group 3, Closure Rollup Workforce Estimate *(continued)*

Activity	Total Hours	Duration			Hours per Year	Full-Time Equivalents per Year	Onsite Full-Time Equivalents
		Start	Finish	Years			
Postclosure Care–Integrated Disposal Facility 200-West Area (CLO_POSTIDFW)							
Radiological workers	N/A						1
Nonradiological workers							
On site	29,979	2053	2152	100	300	1	
Off site	N/A						
Modified Resource Conservation Recovery Act Subtitle C Barrier (CLO_RPPDF)							
Radiological workers	N/A						4,325
Nonradiological workers							
On site	17,991,632	2166	2167	2	8,995,816	4,325	
Off site	1,799,163	2166	2167	2	899,582	433	
Postclosure Care–River Protection Project Disposal Facility (CLO_POSTRPPDF)							
Radiological workers	N/A						14
Nonradiological workers							
On site	2,732,453	2168	2267	100	27,325	14	
Off site	N/A						
Total	**23,688,607**				**10,434,892**	**5,021**	**4,565**

Notes and Assumptions:
Total number of offsite full-time equivalents = 456.
Hours worked per year = 2,080.
One full-time equivalent was assumed for activities estimated to require less than 2,080 hours per year.
Key: N/A=not applicable.
Source: Compiled from SAIC 2007c, 2008.

I.3 REFERENCES

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Table J–13. Tank Closure Alternatives – Total, Minority, and Nonminority Population and Average Individual Doses in Year of Maximum Impact *(continued)*

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Minority Population Dose (person-rem)	Minority Individual Average Dose (millirem)	Nonminority Population Dose (person-rem)	Nonminority Individual Average Dose (millirem)
Alternative 6A, Base Case						
WTP	6.0×10^{1}	1.3×10^{-1}	2.1×10^{1}	1.2×10^{-1}	3.9×10^{1}	1.4×10^{-1}
STTS-East	9.7×10^{-2}	2.2×10^{-4}	3.3×10^{-2}	1.9×10^{-4}	6.4×10^{-2}	2.3×10^{-4}
STTS-West	7.6×10^{-2}	1.6×10^{-4}	2.4×10^{-2}	1.3×10^{-4}	5.2×10^{-2}	1.7×10^{-4}
Total	$\mathbf{6.0\times10^{1}}$	$\mathbf{1.3\times10^{-1}}$	$\mathbf{2.1\times10^{1}}$	$\mathbf{1.2\times10^{-1}}$	$\mathbf{3.9\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$
Alternative 6A, Option Case						
WTP	6.0×10^{1}	1.3×10^{-1}	2.1×10^{1}	1.2×10^{-1}	3.9×10^{1}	1.4×10^{-1}
STTS-East	1.6×10^{-1}	3.6×10^{-4}	5.6×10^{-2}	3.2×10^{-4}	1.1×10^{-1}	3.9×10^{-4}
STTS-West	1.4×10^{-1}	2.9×10^{-4}	4.6×10^{-2}	2.5×10^{-4}	9.7×10^{-2}	3.2×10^{-4}
Total	$\mathbf{6.0\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$	$\mathbf{2.1\times10^{1}}$	$\mathbf{1.2\times10^{-1}}$	$\mathbf{4.0\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$
Alternative 6B, Base Case						
WTP	7.4×10^{1}	1.6×10^{-1}	2.6×10^{1}	1.5×10^{-1}	4.8×10^{1}	1.8×10^{-1}
STTS-East	1.3	2.9×10^{-3}	4.5×10^{-1}	2.6×10^{-3}	8.8×10^{-1}	3.2×10^{-3}
STTS-West	1.1	2.3×10^{-3}	3.6×10^{-1}	2.0×10^{-3}	7.7×10^{-1}	2.5×10^{-3}
Total	$\mathbf{7.6\times10^{1}}$	$\mathbf{1.7\times10^{-1}}$	$\mathbf{2.6\times10^{1}}$	$\mathbf{1.5\times10^{-1}}$	$\mathbf{5.0\times10^{1}}$	$\mathbf{1.8\times10^{-1}}$
Alternative 6B, Option Case						
WTP	7.4×10^{1}	1.7×10^{-1}	2.6×10^{1}	1.5×10^{-1}	4.8×10^{1}	1.8×10^{-1}
STTS-East	2.2	4.8×10^{-3}	7.4×10^{-1}	4.2×10^{-3}	1.4	5.2×10^{-3}
STTS-West	1.8	3.7×10^{-3}	5.7×10^{-1}	3.2×10^{-3}	1.2	4.0×10^{-3}
Total	$\mathbf{7.8\times10^{1}}$	$\mathbf{1.7\times10^{-1}}$	$\mathbf{2.7\times10^{1}}$	$\mathbf{1.6\times10^{-1}}$	$\mathbf{5.1\times10^{1}}$	$\mathbf{1.9\times10^{-1}}$
Alternative 6C						
WTP	7.4×10^{1}	1.6×10^{-1}	2.6×10^{1}	1.5×10^{-1}	4.8×10^{1}	1.8×10^{-1}
STTS-East	1.7×10^{-1}	3.7×10^{-4}	5.6×10^{-2}	3.2×10^{-4}	1.1×10^{-1}	4.0×10^{-4}
STTS-West	1.6×10^{-1}	3.3×10^{-4}	5.1×10^{-2}	2.8×10^{-4}	1.1×10^{-1}	3.6×10^{-4}
Total	$\mathbf{7.4\times10^{1}}$	$\mathbf{1.7\times10^{-1}}$	$\mathbf{2.6\times10^{1}}$	$\mathbf{1.5\times10^{-1}}$	$\mathbf{4.8\times10^{1}}$	$\mathbf{1.8\times10^{-1}}$

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–14 compares average individual doses to American Indian and non–American Indian populations under each Tank Closure alternative to examine the potential for disproportionately high and adverse impacts. There are no appreciable differences between the average dose to an American Indian individual and a non–American Indian individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on American Indian populations surrounding each facility site.

Table J–14. Tank Closure Alternatives – Total, American Indian, and Non–American Indian Population and Average Individual Doses in Year of Maximum Impact

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	American Indian Population Dose (person-rem)	American Indian Individual Average Dose (millirem)	Non–American Indian Population Dose (person-rem)	Non–American Indian Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	3.2	7.1×10^{-3}	3.9×10^{-2}	4.0×10^{-3}	3.2	7.2×10^{-3}
STTS-West	3.1	6.3×10^{-3}	3.9×10^{-2}	3.8×10^{-3}	3.1	6.4×10^{-3}
Total	**6.3**	**1.3×10^{-2}**	**7.8×10^{-2}**	**7.8×10^{-3}**	**6.2**	**1.4×10^{-2}**
Alternative 2A						
WTP	6.0×10^{1}	1.3×10^{-1}	7.8×10^{-1}	8.2×10^{-2}	5.9×10^{1}	1.4×10^{-1}
STTS-East	5.3×10^{-7}	1.2×10^{-9}	6.2×10^{-9}	6.5×10^{-10}	5.2×10^{-7}	1.2×10^{-9}
STTS-West	0	0	0	0	0	0
Total	**6.0×10^{1}**	**1.3×10^{-1}**	**7.8×10^{-1}**	**8.2×10^{-2}**	**5.9×10^{1}**	**1.4×10^{-1}**
Alternative 2B						
WTP	7.6×10^{1}	1.7×10^{-1}	9.8×10^{-1}	1.0×10^{-1}	7.5×10^{1}	1.7×10^{-1}
STTS-East	1.7×10^{-1}	3.7×10^{-4}	1.9×10^{-3}	2.0×10^{-4}	1.7×10^{-1}	3.7×10^{-4}
STTS-West	1.6×10^{-1}	3.3×10^{-4}	2.0×10^{-3}	1.9×10^{-4}	1.6×10^{-1}	3.3×10^{-4}
Total	**7.6×10^{1}**	**1.7×10^{-1}**	**9.8×10^{-1}**	**1.0×10^{-1}**	**7.5×10^{1}**	**1.7×10^{-1}**
Alternative 3A						
WTP	6.0×10^{1}	1.3×10^{-1}	7.8×10^{-1}	8.2×10^{-2}	5.9×10^{1}	1.4×10^{-1}
STTS-East	4.2×10^{-1}	9.4×10^{-4}	4.9×10^{-3}	5.2×10^{-4}	4.2×10^{-1}	9.5×10^{-4}
STTS-West	4.5×10^{-1}	9.1×10^{-4}	5.5×10^{-3}	5.3×10^{-4}	4.4×10^{-1}	9.2×10^{-4}
Total	**6.1×10^{1}**	**1.4×10^{-1}**	**7.9×10^{-1}**	**8.3×10^{-2}**	**6.0×10^{1}**	**1.4×10^{-1}**
Alternative 3B						
WTP	6.0×10^{1}	1.3×10^{-1}	7.8×10^{-1}	8.2×10^{-2}	5.9×10^{1}	1.4×10^{-1}
STTS-East	6.2×10^{-5}	1.4×10^{-7}	7.1×10^{-7}	7.5×10^{-8}	6.1×10^{-5}	1.4×10^{-7}
STTS-West	1.8×10^{-3}	3.7×10^{-6}	2.2×10^{-5}	2.2×10^{-6}	1.8×10^{-3}	3.8×10^{-6}
Total	**6.0×10^{1}**	**1.3×10^{-1}**	**7.8×10^{-1}**	**8.2×10^{-2}**	**5.9×10^{1}**	**1.4×10^{-1}**
Alternative 3C						
WTP	6.0×10^{1}	1.3×10^{-1}	7.8×10^{-1}	8.2×10^{-2}	5.9×10^{1}	1.4×10^{-1}
STTS-East	4.2×10^{-1}	9.4×10^{-4}	4.9×10^{-3}	5.2×10^{-4}	4.2×10^{-1}	9.5×10^{-4}
STTS-West	4.5×10^{-1}	9.1×10^{-4}	5.5×10^{-3}	5.3×10^{-4}	4.4×10^{-1}	9.2×10^{-4}
Total	**6.1×10^{1}**	**1.4×10^{-1}**	**7.9×10^{-1}**	**8.3×10^{-2}**	**6.0×10^{1}**	**1.4×10^{-1}**
Alternative 4						
WTP	6.0×10^{1}	1.3×10^{-1}	7.8×10^{-1}	8.2×10^{-2}	5.9×10^{1}	1.4×10^{-1}
STTS-East	2.3×10^{-2}	5.2×10^{-5}	2.7×10^{-4}	2.8×10^{-5}	2.3×10^{-2}	5.2×10^{-5}
STTS-West	2.3×10^{-2}	4.8×10^{-5}	2.9×10^{-4}	2.8×10^{-5}	2.3×10^{-2}	4.8×10^{-5}
Total	**6.0×10^{1}**	**1.3×10^{-1}**	**7.8×10^{-1}**	**8.2×10^{-2}**	**5.9×10^{1}**	**1.4×10^{-1}**
Alternative 5						
WTP	6.0×10^{1}	1.3×10^{-1}	7.8×10^{-1}	8.2×10^{-2}	6.0×10^{1}	1.4×10^{-1}
STTS-East	3.0×10^{-5}	6.6×10^{-8}	3.4×10^{-7}	3.6×10^{-8}	2.9×10^{-5}	6.6×10^{-8}
STTS-West	5.6×10^{-1}	1.2×10^{-3}	7.0×10^{-3}	6.7×10^{-4}	5.6×10^{-1}	1.2×10^{-3}
Total	**6.1×10^{1}**	**1.4×10^{-1}**	**7.9×10^{-1}**	**8.3×10^{-2}**	**6.0×10^{1}**	**1.4×10^{-1}**

Table J–14. Tank Closure Alternatives – Total, American Indian, and Non–American Indian Population and Average Individual Doses in Year of Maximum Impact *(continued)*

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	American Indian Population Dose (person-rem)	American Indian Individual Average Dose (millirem)	Non–American Indian Population Dose (person-rem)	Non–American Indian Individual Average Dose (millirem)
Alternative 6A, Base Case						
WTP	6.0×10^{1}	1.3×10^{-1}	7.8×10^{-1}	8.2×10^{-2}	5.9×10^{1}	1.4×10^{-1}
STTS-East	9.7×10^{-2}	2.2×10^{-4}	1.1×10^{-3}	1.2×10^{-4}	9.6×10^{-2}	2.2×10^{-4}
STTS-West	7.6×10^{-2}	1.6×10^{-4}	9.3×10^{-4}	9.0×10^{-5}	7.5×10^{-2}	1.6×10^{-4}
Total	$\mathbf{6.0\times10^{1}}$	$\mathbf{1.3\times10^{-1}}$	$\mathbf{7.8\times10^{-1}}$	$\mathbf{8.2\times10^{-2}}$	$\mathbf{6.0\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$
Alternative 6A, Option Case						
WTP	6.0×10^{1}	1.3×10^{-1}	7.8×10^{-1}	8.2×10^{-2}	5.9×10^{1}	1.4×10^{-1}
STTS-East	1.6×10^{-1}	3.6×10^{-4}	1.9×10^{-3}	2.0×10^{-4}	1.6×10^{-1}	3.7×10^{-4}
STTS-West	1.4×10^{-1}	2.9×10^{-4}	1.8×10^{-3}	1.7×10^{-4}	1.4×10^{-1}	2.9×10^{-4}
Total	$\mathbf{6.0\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$	$\mathbf{7.8\times10^{-1}}$	$\mathbf{8.2\times10^{-2}}$	$\mathbf{6.0\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$
Alternative 6B, Base Case						
WTP	7.4×10^{1}	1.6×10^{-1}	9.5×10^{-1}	1.0×10^{-1}	7.3×10^{1}	1.7×10^{-1}
STTS-East	1.3	2.9×10^{-3}	1.5×10^{-2}	1.6×10^{-3}	1.3	3.0×10^{-3}
STTS-West	1.1	2.3×10^{-3}	1.4×10^{-2}	1.3×10^{-3}	1.1	2.3×10^{-3}
Total	$\mathbf{7.6\times10^{1}}$	$\mathbf{1.7\times10^{-1}}$	$\mathbf{9.8\times10^{-1}}$	$\mathbf{1.0\times10^{-1}}$	$\mathbf{7.5\times10^{1}}$	$\mathbf{1.7\times10^{-1}}$
Alternative 6B, Option Case						
WTP	7.4×10^{1}	1.7×10^{-1}	9.5×10^{-1}	1.0×10^{-1}	7.3×10^{1}	1.7×10^{-1}
STTS-East	2.2	4.8×10^{-3}	2.5×10^{-2}	2.6×10^{-3}	2.2	4.9×10^{-3}
STTS-West	1.8	3.7×10^{-3}	2.2×10^{-2}	2.1×10^{-3}	1.8	3.7×10^{-3}
Total	$\mathbf{7.8\times10^{1}}$	$\mathbf{1.7\times10^{-1}}$	**1.0**	$\mathbf{1.0\times10^{-1}}$	$\mathbf{7.7\times10^{1}}$	$\mathbf{1.8\times10^{-1}}$
Alternative 6C						
WTP	7.4×10^{1}	1.6×10^{-1}	9.5×10^{-1}	1.0×10^{-1}	7.3×10^{1}	1.7×10^{-1}
STTS-East	1.7×10^{-1}	3.7×10^{-4}	1.9×10^{-3}	2.0×10^{-4}	1.7×10^{-1}	3.7×10^{-4}
STTS-West	1.6×10^{-1}	3.3×10^{-4}	2.0×10^{-3}	1.9×10^{-4}	1.6×10^{-1}	3.3×10^{-4}
Total	$\mathbf{7.4\times10^{1}}$	$\mathbf{1.7\times10^{-1}}$	$\mathbf{9.5\times10^{-1}}$	$\mathbf{1.0\times10^{-1}}$	$\mathbf{7.3\times10^{1}}$	$\mathbf{1.7\times10^{-1}}$

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–15 compares average individual doses to Hispanic and non-Hispanic populations under each Tank Closure alternative to examine the potential for disproportionately high and adverse impacts. There are no appreciable differences between the average dose to a Hispanic individual and a non-Hispanic individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on Hispanic populations surrounding each facility site.

Table J–15. Tank Closure Alternatives – Total, Hispanic, and Non-Hispanic Population and Average Individual Doses in Year of Maximum Impact

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Hispanic Population Dose[a] (person-rem)	Hispanic Individual Average Dose[a] (millirem)	Non-Hispanic Population Dose (person-rem)	Non-Hispanic Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	3.2	7.1×10^{-3}	9.2×10^{-1}	6.3×10^{-3}	2.3	7.5×10^{-3}
STTS-West	3.1	6.3×10^{-3}	8.1×10^{-1}	5.4×10^{-3}	2.3	6.7×10^{-3}
Total	**6.3**	**1.3×10^{-2}**	**1.7**	**1.2×10^{-2}**	**4.6**	**1.4×10^{-2}**
Alternative 2A						
WTP	6.0×10^{1}	1.3×10^{-1}	1.7×10^{1}	1.2×10^{-1}	4.3×10^{1}	1.4×10^{-1}
STTS-East	5.3×10^{-7}	1.2×10^{-9}	1.5×10^{-7}	1.0×10^{-9}	3.8×10^{-7}	1.2×10^{-9}
STTS-West	0	0	0	0	0	0
Total	**6.0×10^{1}**	**1.3×10^{-1}**	**1.7×10^{1}**	**1.2×10^{-1}**	**4.3×10^{1}**	**1.4×10^{-1}**
Alternative 2B						
WTP	7.6×10^{1}	1.7×10^{-1}	2.2×10^{1}	1.5×10^{-1}	5.4×10^{1}	1.8×10^{-1}
STTS-East	1.7×10^{-1}	3.7×10^{-4}	4.7×10^{-2}	3.2×10^{-4}	1.2×10^{-1}	3.9×10^{-4}
STTS-West	1.6×10^{-1}	3.3×10^{-4}	4.2×10^{-2}	2.7×10^{-4}	1.2×10^{-1}	3.5×10^{-4}
Total	**7.6×10^{1}**	**1.7×10^{-1}**	**2.2×10^{1}**	**1.5×10^{-1}**	**5.4×10^{1}**	**1.8×10^{-1}**
Alternative 3A						
WTP	6.0×10^{1}	1.3×10^{-1}	1.7×10^{1}	1.2×10^{-1}	4.3×10^{1}	1.4×10^{-1}
STTS-East	4.2×10^{-1}	9.4×10^{-4}	1.2×10^{-1}	8.5×10^{-4}	3.0×10^{-1}	9.9×10^{-4}
STTS-West	4.5×10^{-1}	9.1×10^{-4}	1.2×10^{-1}	7.8×10^{-4}	3.3×10^{-1}	9.7×10^{-4}
Total	**6.1×10^{1}**	**1.4×10^{-1}**	**1.8×10^{1}**	**1.2×10^{-1}**	**4.3×10^{1}**	**1.4×10^{-1}**
Alternative 3B						
WTP	6.0×10^{1}	1.3×10^{-1}	1.7×10^{1}	1.2×10^{-1}	4.3×10^{1}	1.4×10^{-1}
STTS-East	6.2×10^{-5}	1.4×10^{-7}	1.7×10^{-5}	1.2×10^{-7}	4.4×10^{-5}	1.4×10^{-7}
STTS-West	1.8×10^{-3}	3.7×10^{-6}	4.8×10^{-4}	3.2×10^{-6}	1.3×10^{-3}	4.0×10^{-6}
Total	**6.0×10^{1}**	**1.3×10^{-1}**	**1.7×10^{1}**	**1.2×10^{-1}**	**4.3×10^{1}**	**1.4×10^{-1}**
Alternative 3C						
WTP	6.0×10^{1}	1.3×10^{-1}	1.7×10^{1}	1.2×10^{-1}	4.3×10^{1}	1.4×10^{-1}
STTS-East	4.2×10^{-1}	9.4×10^{-4}	1.2×10^{-1}	8.5×10^{-4}	3.0×10^{-1}	9.9×10^{-4}
STTS-West	4.5×10^{-1}	9.1×10^{-4}	1.2×10^{-1}	7.8×10^{-4}	3.3×10^{-1}	9.7×10^{-4}
Total	**6.1×10^{1}**	**1.4×10^{-1}**	**1.8×10^{1}**	**1.2×10^{-1}**	**4.3×10^{1}**	**1.4×10^{-1}**
Alternative 4						
WTP	6.0×10^{1}	1.3×10^{-1}	1.7×10^{1}	1.2×10^{-1}	4.3×10^{1}	1.4×10^{-1}
STTS-East	2.3×10^{-2}	5.2×10^{-5}	6.6×10^{-3}	4.5×10^{-5}	1.7×10^{-2}	5.5×10^{-5}
STTS-West	2.3×10^{-2}	4.8×10^{-5}	6.2×10^{-3}	4.1×10^{-5}	1.7×10^{-2}	5.1×10^{-5}
Total	**6.0×10^{1}**	**1.3×10^{-1}**	**1.7×10^{1}**	**1.2×10^{-1}**	**4.3×10^{1}**	**1.4×10^{-1}**
Alternative 5						
WTP	6.0×10^{1}	1.3×10^{-1}	1.8×10^{1}	1.2×10^{-1}	4.3×10^{1}	1.4×10^{-1}
STTS-East	3.0×10^{-5}	6.6×10^{-8}	8.4×10^{-6}	5.7×10^{-8}	2.1×10^{-5}	7.0×10^{-8}
STTS-West	5.6×10^{-1}	1.2×10^{-3}	1.5×10^{-1}	9.9×10^{-4}	4.1×10^{-1}	1.2×10^{-3}
Total	**6.1×10^{1}**	**1.4×10^{-1}**	**1.8×10^{1}**	**1.2×10^{-1}**	**4.3×10^{1}**	**1.4×10^{-1}**
Alternative 6A, Base Case						
WTP	6.0×10^{1}	1.3×10^{-1}	1.7×10^{1}	1.2×10^{-1}	4.3×10^{1}	1.4×10^{-1}
STTS-East	9.7×10^{-2}	2.2×10^{-4}	2.8×10^{-2}	1.9×10^{-4}	7.0×10^{-2}	2.3×10^{-4}
STTS-West	7.6×10^{-2}	1.6×10^{-4}	2.0×10^{-2}	1.3×10^{-4}	5.6×10^{-2}	1.7×10^{-4}
Total	**6.0×10^{1}**	**1.3×10^{-1}**	**1.8×10^{1}**	**1.2×10^{-1}**	**4.3×10^{1}**	**1.4×10^{-1}**

Table J–15. Tank Closure Alternatives – Total, Hispanic, and Non-Hispanic Population and Average Individual Doses in Year of Maximum Impact *(continued)*

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Hispanic Population Dose[a] (person-rem)	Hispanic Individual Average Dose[a] (millirem)	Non-Hispanic Population Dose (person-rem)	Non-Hispanic Individual Average Dose (millirem)
Alternative 6A, Option Case						
WTP	6.0×10^{1}	1.3×10^{-1}	1.7×10^{1}	1.2×10^{-1}	4.3×10^{1}	1.4×10^{-1}
STTS-East	1.6×10^{-1}	3.6×10^{-4}	4.6×10^{-2}	3.2×10^{-4}	1.2×10^{-1}	3.9×10^{-4}
STTS-West	1.4×10^{-1}	2.9×10^{-4}	3.8×10^{-2}	2.5×10^{-4}	1.1×10^{-1}	3.1×10^{-4}
Total	**6.0×10^{1}**	**1.4×10^{-1}**	**1.8×10^{1}**	**1.2×10^{-1}**	**4.3×10^{1}**	**1.4×10^{-1}**
Alternative 6B, Base Case						
WTP	7.4×10^{1}	1.6×10^{-1}	2.1×10^{1}	1.5×10^{-1}	5.2×10^{1}	1.7×10^{-1}
STTS-East	1.3	2.9×10^{-3}	3.7×10^{-1}	2.6×10^{-3}	9.6×10^{-1}	3.1×10^{-3}
STTS-West	1.1	2.3×10^{-3}	3.0×10^{-1}	2.0×10^{-3}	8.3×10^{-1}	2.5×10^{-3}
Total	**7.6×10^{1}**	**1.7×10^{-1}**	**2.2×10^{1}**	**1.5×10^{-1}**	**5.4×10^{1}**	**1.8×10^{-1}**
Alternative 6B, Option Case						
WTP	7.4×10^{1}	1.7×10^{-1}	2.1×10^{1}	1.5×10^{-1}	5.2×10^{1}	1.7×10^{-1}
STTS-East	2.2	4.8×10^{-3}	6.1×10^{-1}	4.2×10^{-3}	1.6	5.1×10^{-3}
STTS-West	1.8	3.7×10^{-3}	4.7×10^{-1}	3.1×10^{-3}	1.3	3.9×10^{-3}
Total	**7.8×10^{1}**	**1.7×10^{-1}**	**2.3×10^{1}**	**1.5×10^{-1}**	**5.5×10^{1}**	**1.8×10^{-1}**
Alternative 6C						
WTP	7.4×10^{1}	1.6×10^{-1}	2.1×10^{1}	1.5×10^{-1}	5.2×10^{1}	1.7×10^{-1}
STTS-East	1.7×10^{-1}	3.7×10^{-4}	4.7×10^{-2}	3.2×10^{-4}	1.2×10^{-1}	3.9×10^{-4}
STTS-West	1.6×10^{-1}	3.3×10^{-4}	4.2×10^{-2}	2.7×10^{-4}	1.2×10^{-1}	3.5×10^{-4}
Total	**7.4×10^{1}**	**1.7×10^{-1}**	**2.2×10^{1}**	**1.5×10^{-1}**	**5.3×10^{1}**	**1.7×10^{-1}**

[a] Includes all individuals, regardless of race, who identified themselves as Hispanic or Latino.

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–16 compares average individual doses to low-income and non-low-income populations under each Tank Closure alternative to examine the potential for disproportionately high and adverse impacts. There are no appreciable differences between the average dose to a low-income individual and a non-low-income individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on low-income populations surrounding each facility site.

Table J–16. Tank Closure Alternatives – Total, Low-Income, and Non-Low-Income Population and Average Individual Doses in Year of Maximum Impact

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Low-Income Population Dose (person-rem)	Low-Income Individual Average Dose (millirem)	Non-Low-Income Population Dose (person-rem)	Non-Low-Income Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	3.2	7.1×10^{-3}	4.8×10^{-1}	6.2×10^{-3}	2.7	7.3×10^{-3}
STTS-West	3.1	6.3×10^{-3}	4.2×10^{-1}	5.3×10^{-3}	2.7	6.5×10^{-3}
Total	**6.3**	**1.3×10^{-2}**	**9.0×10^{-1}**	**1.1×10^{-2}**	**5.4**	**1.4×10^{-2}**
Alternative 2A						
WTP	6.0×10^{1}	1.3×10^{-1}	9.3	1.2×10^{-1}	5.1×10^{1}	1.4×10^{-1}
STTS-East	5.3×10^{-7}	1.2×10^{-9}	7.9×10^{-8}	1.0×10^{-9}	4.5×10^{-7}	1.2×10^{-9}
STTS-West	0	0	0	0	0	0
Total	**6.0×10^{1}**	**1.3×10^{-1}**	**9.3**	**1.2×10^{-1}**	**5.1×10^{1}**	**1.4×10^{-1}**

Table J–16. Tank Closure Alternatives – Total, Low-Income, and Non-Low-Income Population and Average Individual Doses in Year of Maximum Impact *(continued)*

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Low-Income Population Dose (person-rem)	Low-Income Individual Average Dose (millirem)	Non-Low-Income Population Dose (person-rem)	Non-Low-Income Individual Average Dose (millirem)
Alternative 2B						
WTP	7.6×10^{1}	1.7×10^{-1}	1.2×10^{1}	1.5×10^{-1}	6.4×10^{1}	1.7×10^{-1}
STTS-East	1.7×10^{-1}	3.7×10^{-4}	2.5×10^{-2}	3.2×10^{-4}	1.4×10^{-1}	3.8×10^{-4}
STTS-West	1.6×10^{-1}	3.3×10^{-4}	2.2×10^{-2}	2.7×10^{-4}	1.4×10^{-1}	3.4×10^{-4}
Total	$\mathbf{7.6\times10^{1}}$	$\mathbf{1.7\times10^{-1}}$	$\mathbf{1.2\times10^{1}}$	$\mathbf{1.5\times10^{-1}}$	$\mathbf{6.4\times10^{1}}$	$\mathbf{1.7\times10^{-1}}$
Alternative 3A						
WTP	6.0×10^{1}	1.3×10^{-1}	9.3	1.2×10^{-1}	5.1×10^{1}	1.4×10^{-1}
STTS-East	4.2×10^{-1}	9.4×10^{-4}	6.2×10^{-2}	8.0×10^{-4}	3.6×10^{-1}	9.7×10^{-4}
STTS-West	4.5×10^{-1}	9.1×10^{-4}	6.0×10^{-2}	7.4×10^{-4}	3.9×10^{-1}	9.4×10^{-4}
Total	$\mathbf{6.1\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$	**9.4**	$\mathbf{1.2\times10^{-1}}$	$\mathbf{5.2\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$
Alternative 3B						
WTP	6.0×10^{1}	1.3×10^{-1}	9.3	1.2×10^{-1}	5.1×10^{1}	1.4×10^{-1}
STTS-East	6.2×10^{-5}	1.4×10^{-7}	9.1×10^{-6}	1.2×10^{-7}	5.3×10^{-5}	1.4×10^{-7}
STTS-West	1.8×10^{-3}	3.7×10^{-6}	2.5×10^{-4}	3.1×10^{-6}	1.6×10^{-3}	3.9×10^{-6}
Total	$\mathbf{6.0\times10^{1}}$	$\mathbf{1.3\times10^{-1}}$	**9.3**	$\mathbf{1.2\times10^{-1}}$	$\mathbf{5.1\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$
Alternative 3C						
WTP	6.0×10^{1}	1.3×10^{-1}	9.3	1.2×10^{-1}	5.1×10^{1}	1.4×10^{-1}
STTS-East	4.2×10^{-1}	9.4×10^{-4}	6.2×10^{-2}	8.0×10^{-4}	3.6×10^{-1}	9.7×10^{-4}
STTS-West	4.5×10^{-1}	9.1×10^{-4}	6.0×10^{-2}	7.4×10^{-4}	3.9×10^{-1}	9.4×10^{-4}
Total	$\mathbf{6.1\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$	**9.4**	$\mathbf{1.2\times10^{-1}}$	$\mathbf{5.2\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$
Alternative 4						
WTP	6.0×10^{1}	1.3×10^{-1}	9.3	1.2×10^{-1}	5.1×10^{1}	1.4×10^{-1}
STTS-East	2.3×10^{-2}	5.2×10^{-5}	3.5×10^{-3}	4.5×10^{-5}	2.0×10^{-2}	5.3×10^{-5}
STTS-West	2.3×10^{-2}	4.8×10^{-5}	3.1×10^{-3}	3.9×10^{-5}	2.0×10^{-2}	4.9×10^{-5}
Total	$\mathbf{6.0\times10^{1}}$	$\mathbf{1.3\times10^{-1}}$	**9.3**	$\mathbf{1.2\times10^{-1}}$	$\mathbf{5.1\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$
Alternative 5						
WTP	6.0×10^{1}	1.3×10^{-1}	9.3	1.2×10^{-1}	5.1×10^{1}	1.4×10^{-1}
STTS-East	3.0×10^{-5}	6.6×10^{-8}	4.4×10^{-6}	5.6×10^{-8}	2.5×10^{-5}	6.8×10^{-8}
STTS-West	5.6×10^{-1}	1.2×10^{-3}	7.5×10^{-2}	9.4×10^{-4}	4.9×10^{-1}	1.2×10^{-3}
Total	$\mathbf{6.1\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$	**9.4**	$\mathbf{1.2\times10^{-1}}$	$\mathbf{5.2\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$
Alternative 6A, Base Case						
WTP	6.0×10^{1}	1.3×10^{-1}	9.3	1.2×10^{-1}	5.1×10^{1}	1.4×10^{-1}
STTS-East	9.7×10^{-2}	2.2×10^{-4}	1.4×10^{-2}	1.9×10^{-4}	8.3×10^{-2}	2.2×10^{-4}
STTS-West	7.6×10^{-2}	1.6×10^{-4}	1.0×10^{-2}	1.3×10^{-4}	6.6×10^{-2}	1.6×10^{-4}
Total	$\mathbf{6.0\times10^{1}}$	$\mathbf{1.3\times10^{-1}}$	**9.3**	$\mathbf{1.2\times10^{-1}}$	$\mathbf{5.1\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$
Alternative 6A, Option Case						
WTP	6.0×10^{1}	1.3×10^{-1}	9.3	1.2×10^{-1}	5.1×10^{1}	1.4×10^{-1}
STTS-East	1.6×10^{-1}	3.6×10^{-4}	2.4×10^{-2}	3.1×10^{-4}	1.4×10^{-1}	3.7×10^{-4}
STTS-West	1.4×10^{-1}	2.9×10^{-4}	1.9×10^{-2}	2.4×10^{-4}	1.2×10^{-1}	3.0×10^{-4}
Total	$\mathbf{6.0\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$	**9.3**	$\mathbf{1.2\times10^{-1}}$	$\mathbf{5.1\times10^{1}}$	$\mathbf{1.4\times10^{-1}}$

Table J–16. Tank Closure Alternatives – Total, Low-Income, and Non-Low-Income Population and Average Individual Doses in Year of Maximum Impact *(continued)*

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Low-Income Population Dose (person-rem)	Low-Income Individual Average Dose (millirem)	Non-Low-Income Population Dose (person-rem)	Non-Low-Income Individual Average Dose (millirem)
Alternative 6B, Base Case						
WTP	7.4×10^{1}	1.6×10^{-1}	1.1×10^{1}	1.5×10^{-1}	6.2×10^{1}	1.7×10^{-1}
STTS-East	1.3	2.9×10^{-3}	2.0×10^{-1}	2.5×10^{-3}	1.1	3.0×10^{-3}
STTS-West	1.1	2.3×10^{-3}	1.5×10^{-1}	1.9×10^{-3}	9.7×10^{-1}	2.4×10^{-3}
Total	**7.6×1^{1}**	**1.7×10^{-1}**	**1.2×10^{1}**	**1.5×10^{-1}**	**6.5×10^{1}**	**1.7×10^{-1}**
Alternative 6B, Option Case						
WTP	7.4×10^{1}	1.7×10^{-1}	1.1×10^{1}	1.5×10^{-1}	6.3×10^{1}	1.7×10^{-1}
STTS-East	2.2	4.8×10^{-3}	3.2×10^{-1}	4.2×10^{-3}	1.9	5.0×10^{-3}
STTS-West	1.8	3.7×10^{-3}	2.4×10^{-1}	3.0×10^{-3}	1.6	3.8×10^{-3}
Total	**7.8×10^{1}**	**1.7×10^{-1}**	**1.2×10^{1}**	**1.5×10^{-1}**	**6.6×10^{1}**	**1.8×10^{-1}**
Alternative 6C						
WTP	7.4×10^{1}	1.6×10^{-1}	1.1×10^{1}	1.5×10^{-1}	6.2×10^{1}	1.7×10^{-3}
STTS-East	1.7×10^{-1}	3.7×10^{-4}	2.5×10^{-2}	3.2×10^{-4}	1.4×10^{-1}	3.8×10^{-4}
STTS-West	1.6×10^{-1}	3.3×10^{-4}	2.2×10^{-2}	2.7×10^{-4}	1.4×10^{-1}	3.4×10^{-4}
Total	**7.4×10^{1}**	**1.7×10^{-1}**	**1.1×10^{1}**	**1.5×10^{-1}**	**6.3×10^{1}**	**1.7×10^{-1}**

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–17 compares the average individual doses to minority and nonminority populations under each Tank Closure alternative over the lifetime of the project to examine the potential for disproportionately high and adverse impacts. There are no appreciable differences between the average dose to a minority individual and a nonminority individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on minority populations surrounding each facility site.

Table J–17. Tank Closure Alternatives – Total, Minority, and Nonminority Population and Average Individual Doses Over the Life of the Project

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Minority Population Dose (person-rem)	Minority Individual Average Dose (millirem)	Nonminority Population Dose (person-rem)	Nonminority Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	3.1×10^{2}	6.8×10^{-1}	1.1×10^{2}	6.1×10^{-1}	2.0×10^{2}	7.2×10^{-1}
STTS-West	2.9×10^{2}	6.0×10^{-1}	9.4×10^{1}	5.2×10^{-1}	2.0×10^{2}	6.5×10^{-1}
Total	**6.0×10^{2}**	**1.3**	**2.0×10^{2}**	**1.1**	**4.0×10^{2}**	**1.4**
Alternative 2A						
WTP	4.5×10^{2}	1.0	1.5×10^{2}	8.9×10^{-1}	2.9×10^{2}	1.1
STTS-East	3.2×10^{2}	7.1×10^{-1}	1.1×10^{2}	6.4×10^{-1}	2.1×10^{2}	7.5×10^{-1}
STTS-West	3.1×10^{2}	6.3×10^{-1}	9.8×10^{1}	5.4×10^{-1}	2.1×10^{2}	6.8×10^{-1}
Total	**1.1×10^{3}**	**2.3**	**3.6×10^{2}**	**2.1**	**7.1×10^{2}**	**2.5**
Alternative 2B						
WTP	4.5×10^{2}	1.0	1.6×10^{2}	9.0×10^{-1}	3.0×10^{2}	1.1
STTS-East	6.0	1.3×10^{-2}	2.0	1.2×10^{-2}	4.0	1.4×10^{-2}
STTS-West	5.7	1.2×10^{-2}	1.8	1.0×10^{-2}	3.9	1.3×10^{-2}
Total	**4.6×10^{2}**	**1.0**	**1.6×10^{2}**	**9.2×10^{-1}**	**3.0×10^{2}**	**1.1**

Table J–17. Tank Closure Alternatives – Total, Minority, and Nonminority Population and Average Individual Doses Over the Life of the Project *(continued)*

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Minority Population Dose (person-rem)	Minority Individual Average Dose (millirem)	Nonminority Population Dose (person-rem)	Nonminority Individual Average Dose (millirem)
Alternative 3A						
WTP	3.6×10^{2}	8.1×10^{-1}	1.3×10^{2}	7.3×10^{-1}	2.4×10^{2}	8.7×10^{-1}
STTS-East	1.0×10^{2}	2.2×10^{-1}	3.5×10^{1}	2.0×10^{-1}	6.6×10^{1}	2.4×10^{-1}
STTS-West	1.0×10^{2}	2.1×10^{-1}	3.3×10^{1}	1.8×10^{-1}	7.1×10^{1}	2.3×10^{-1}
Total	**5.7×10^{2}**	**1.2**	**1.9×10^{2}**	**1.1**	**3.7×10^{2}**	**1.3**
Alternative 3B						
WTP	3.6×10^{2}	8.1×10^{-1}	1.3×10^{2}	7.3×10^{-1}	2.4×10^{2}	8.7×10^{-1}
STTS-East	7.2	1.6×10^{-2}	2.4	1.4×10^{-2}	4.8	1.7×10^{-2}
STTS-West	5.6	1.1×10^{-2}	1.8	9.8×10^{-3}	3.8	1.2×10^{-2}
Total	**3.8×10^{2}**	**8.4×10^{-1}**	**1.3×10^{2}**	**7.5×10^{-1}**	**2.5×10^{2}**	**9.0×10^{-1}**
Alternative 3C						
WTP	3.6×10^{2}	8.1×10^{-1}	1.3×10^{2}	7.3×10^{-1}	2.4×10^{2}	8.7×10^{-1}
STTS-East	1.0×10^{2}	2.2×10^{-1}	3.5×10^{1}	2.0×10^{-1}	6.6×10^{1}	2.4×10^{-1}
STTS-West	1.0×10^{2}	2.1×10^{-1}	3.3×10^{1}	1.8×10^{-1}	7.1×10^{1}	2.3×10^{-1}
Total	**5.7×10^{2}**	**1.2**	**1.9×10^{2}**	**1.1**	**3.7×10^{2}**	**1.3**
Alternative 4						
WTP	3.7×10^{2}	8.2×10^{-1}	1.3×10^{2}	7.3×10^{-1}	2.4×10^{2}	8.7×10^{-1}
STTS-East	1.2×10^{1}	2.6×10^{-2}	4.8	2.7×10^{-2}	6.8	2.5×10^{-2}
STTS-West	1.1×10^{2}	2.3×10^{-1}	3.4×10^{1}	1.9×10^{-1}	7.6×10^{1}	2.5×10^{-1}
Total	**4.9×10^{2}**	**1.1**	**1.7×10^{2}**	**9.5×10^{-1}**	**3.2×10^{2}**	**1.1**
Alternative 5						
WTP	3.6×10^{2}	7.9×10^{-1}	1.2×10^{2}	7.1×10^{-1}	2.3×10^{2}	8.5×10^{-1}
STTS-East	6.0	1.3×10^{-2}	2.0	1.2×10^{-2}	4.0	1.4×10^{-2}
STTS-West	9.5×10^{1}	2.0×10^{-1}	3.0×10^{1}	1.7×10^{-1}	6.5×10^{1}	2.1×10^{-1}
Total	**4.6×10^{2}**	**1.0**	**1.6×10^{2}**	**8.9×10^{-1}**	**3.0×10^{2}**	**1.1**
Alternative 6A, Base Case						
WTP	4.6×10^{2}	1.0	1.6×10^{2}	9.3×10^{-1}	3.0×10^{2}	1.1
STTS-East	9.3×10^{1}	2.1×10^{-1}	5.2×10^{1}	3.0×10^{-1}	4.2×10^{1}	1.5×10^{-1}
STTS-West	1.8	3.7×10^{-3}	3.9×10^{-1}	2.2×10^{-3}	1.4	4.6×10^{-3}
Total	**5.6×10^{2}**	**1.2**	**2.1×10^{2}**	**1.2**	**3.5×10^{2}**	**1.3**
Alternative 6A, Option Case						
WTP	4.6×10^{2}	1.0	1.6×10^{2}	9.3×10^{-1}	3.0×10^{2}	1.1
STTS-East	1.5×10^{2}	3.3×10^{-1}	8.8×10^{1}	5.1×10^{-1}	6.2×10^{1}	2.2×10^{-1}
STTS-West	1.5×10^{2}	3.1×10^{-1}	1.3×10^{1}	6.9×10^{-2}	1.4×10^{2}	4.5×10^{-1}
Total	**7.6×10^{2}**	**1.7**	**2.6×10^{2}**	**1.5**	**5.0×10^{2}**	**1.8**
Alternative 6B, Base Case						
WTP	4.5×10^{2}	1.0	1.5×10^{2}	8.9×10^{-1}	2.9×10^{2}	1.1
STTS-East	7.5×10^{1}	1.7×10^{-1}	4.5×10^{1}	2.6×10^{-1}	3.0×10^{1}	1.1×10^{-1}
STTS-West	7.5×10^{1}	1.5×10^{-1}	5.2	2.9×10^{-2}	7.0×10^{1}	2.3×10^{-1}
Total	**6.0×10^{2}**	**1.3**	**2.1×10^{2}**	**1.2**	**3.9×10^{2}**	**1.4**
Alternative 6B, Option Case						
WTP	4.5×10^{2}	1.0	1.6×10^{2}	9.0×10^{-1}	2.9×10^{2}	1.1
STTS-East	1.3×10^{2}	2.9×10^{-1}	8.2×10^{1}	4.7×10^{-1}	5.0×10^{1}	1.8×10^{-1}
STTS-West	1.3×10^{2}	2.7×10^{-1}	6.5	3.6×10^{-2}	1.2×10^{2}	4.0×10^{-1}
Total	**7.1×10^{2}**	**1.6**	**2.4×10^{2}**	**1.4**	**4.7×10^{2}**	**1.6**
Alternative 6C						
WTP	4.5×10^{2}	1.0	1.5×10^{2}	8.9×10^{-1}	2.9×10^{2}	1.1
STTS-East	6.0	1.3×10^{-2}	2.0	1.2×10^{-2}	4.0	1.4×10^{-2}
STTS-West	5.70	1.2×10^{-2}	1.8	1.0×10^{-2}	3.9	1.3×10^{-2}
Total	**4.6×10^{2}**	**1.0**	**1.6×10^{2}**	**9.2×10^{-1}**	**3.0×10^{2}**	**1.1**

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–18 compares the average individual doses to American Indian and non–American Indian populations under each Tank Closure alternative over the lifetime of the project, to examine the potential for disproportionately high and adverse impacts. There are no appreciable differences between the average dose to an American Indian individual and a non–American Indian individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on American Indian populations surrounding each facility site.

Table J–18. Tank Closure Alternatives – Total, American Indian, and Non–American Indian Population and Average Individual Doses Over the Life of the Project

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	American Indian Population Dose (person-rem)	American Indian Individual Average Dose (millirem)	Non–American Indian Population Dose (person-rem)	Non–American Indian Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	3.1×10^{2}	6.8×10^{-1}	3.7	3.9×10^{-1}	3.0×10^{2}	6.9×10^{-1}
STTS-West	2.9×10^{2}	6.0×10^{-1}	3.8	3.6×10^{-1}	2.9×10^{2}	6.1×10^{-1}
Total	**6.0×10^{2}**	**1.3**	**7.5**	**7.5×10^{-1}**	**5.9×10^{2}**	**1.3**
Alternative 2A						
WTP	4.5×10^{2}	1.0	5.7	6.0×10^{-1}	4.4×10^{2}	1.0
STTS-East	3.2×10^{2}	7.1×10^{-1}	3.8	4.0×10^{-1}	3.2×10^{2}	7.2×10^{-1}
STTS-West	3.1×10^{2}	6.3×10^{-1}	3.9	3.8×10^{-1}	3.0×10^{2}	6.3×10^{-1}
Total	**1.1×10^{3}**	**2.3**	**1.3×10^{1}**	**1.4**	**1.1×10^{3}**	**2.4**
Alternative 2B						
WTP	4.5×10^{2}	1.0	5.8	6.1×10^{-1}	4.5×10^{2}	1.0
STTS-East	6.0	1.3×10^{-2}	6.6×10^{-2}	7.0×10^{-3}	5.9	1.3×10^{-2}
STTS-West	5.7	1.2×10^{-2}	7.0×10^{-2}	6.7×10^{-3}	5.7	1.2×10^{-2}
Total	**4.6×10^{2}**	**1.0**	**5.9**	**6.2×10^{-1}**	**4.6×10^{2}**	**1.0**
Alternative 3A						
WTP	3.6×10^{2}	8.1×10^{-1}	4.6	4.9×10^{-1}	3.6×10^{2}	8.2×10^{-1}
STTS-East	1.0×10^{2}	2.2×10^{-1}	1.2	1.2×10^{-1}	1.0×10^{2}	2.3×10^{-1}
STTS-West	1.0×10^{2}	2.1×10^{-1}	1.3	1.2×10^{-1}	1.0×10^{2}	2.1×10^{-1}
Total	**5.7×10^{2}**	**1.2**	**7.1**	**7.3×10^{-1}**	**5.6×10^{2}**	**1.3**
Alternative 3B						
WTP	3.6×10^{2}	8.1×10^{-1}	4.6	4.9×10^{-1}	3.6×10^{2}	8.2×10^{-1}
STTS-East	7.2	1.6×10^{-2}	8.1×10^{-2}	8.5×10^{-3}	7.1	1.6×10^{-2}
STTS-West	5.6	1.1×10^{-2}	6.8×10^{-2}	6.5×10^{-3}	5.5	1.2×10^{-2}
Total	**3.8×10^{2}**	**8.4×10^{-1}**	**4.8**	**5.0×10^{-1}**	**3.7×10^{2}**	**8.5×10^{-1}**
Alternative 3C						
WTP	3.6×10^{2}	8.1×10^{-1}	4.6	4.9×10^{-1}	3.6×10^{2}	8.2×10^{-1}
STTS-East	1.0×10^{2}	2.2×10^{-1}	1.2	1.2×10^{-1}	1.0×10^{2}	2.3×10^{-1}
STTS-West	1.0×10^{2}	2.1×10^{-1}	1.3	1.2×10^{-1}	1.0×10^{2}	2.1×10^{-1}
Total	**5.7×10^{2}**	**1.2**	**7.1**	**7.3×10^{-1}**	**5.6×10^{2}**	**1.3**
Alternative 4						
WTP	3.7×10^{2}	8.2×10^{-1}	4.7	4.9×10^{-1}	3.6×10^{2}	8.2×10^{-1}
STTS-East	1.2×10^{1}	2.6×10^{-2}	1.6×10^{-1}	1.7×10^{-2}	1.1×10^{1}	2.6×10^{-2}
STTS-West	1.1×10^{2}	2.3×10^{-1}	1.3	1.3×10^{-1}	1.1×10^{2}	2.3×10^{-1}
Total	**4.9×10^{2}**	**1.1**	**6.2**	**6.4×10^{-1}**	**4.8×10^{2}**	**1.1**

Table J–18. Tank Closure Alternatives – Total, American Indian, and Non–American Indian Population and Average Individual Doses Over the Life of the Project *(continued)*

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	American Indian Population Dose (person-rem)	American Indian Individual Average Dose (millirem)	Non–American Indian Population Dose (person-rem)	Non–American Indian Individual Average Dose (millirem)
Alternative 5						
WTP	3.6×10^{2}	7.9×10^{-1}	4.5	4.8×10^{-1}	3.5×10^{2}	8.0×10^{-1}
STTS-East	6.0	1.3×10^{-2}	6.8×10^{-2}	7.1×10^{-3}	6.0	1.3×10^{-2}
STTS-West	9.5×10^{1}	2.0×10^{-1}	1.2	1.1×10^{-1}	9.4×10^{1}	2.0×10^{-1}
Total	$\mathbf{4.6\times10^{2}}$	**1.0**	**5.8**	$\mathbf{6.0\times10^{-1}}$	$\mathbf{4.5\times10^{2}}$	**1.0**
Alternative 6A, Base Case						
WTP	4.6×10^{2}	1.0	5.9	6.2×10^{-1}	4.6×10^{2}	1.0
STTS-East	9.3×10^{1}	2.1×10^{-1}	1.7	1.8×10^{-1}	9.2×10^{1}	2.1×10^{-1}
STTS-West	1.8	3.7×10^{-3}	1.5×10^{-2}	1.5×10^{-3}	1.8	3.7×10^{-3}
Total	$\mathbf{5.6\times10^{2}}$	**1.2**	**7.7**	$\mathbf{8.1\times10^{-1}}$	$\mathbf{5.5\times10^{2}}$	**1.3**
Alternative 6A, Option Case						
WTP	4.6×10^{2}	1.0	5.9	6.2×10^{-1}	4.6×10^{2}	1.0
STTS-East	1.5×10^{2}	3.3×10^{-1}	3.0	3.2×10^{-1}	1.5×10^{2}	3.3×10^{-1}
STTS-West	1.5×10^{2}	3.1×10^{-1}	4.9×10^{-1}	4.7×10^{-2}	1.5×10^{2}	3.1×10^{-1}
Total	$\mathbf{7.6\times10^{2}}$	**1.7**	**9.4**	$\mathbf{9.9\times10^{-1}}$	$\mathbf{7.5\times10^{2}}$	**1.7**
Alternative 6B, Base Case						
WTP	4.5×10^{2}	1.0	5.7	6.0×10^{-1}	4.4×10^{2}	1.0
STTS-East	7.5×10^{1}	1.7×10^{-1}	1.5	1.6×10^{-1}	7.3×10^{1}	1.7×10^{-1}
STTS-West	7.5×10^{1}	1.5×10^{-1}	2.0×10^{-1}	1.9×10^{-2}	7.5×10^{1}	1.6×10^{-1}
Total	$\mathbf{6.0\times10^{2}}$	**1.3**	**7.5**	$\mathbf{7.8\times10^{-1}}$	$\mathbf{5.9\times10^{2}}$	**1.3**
Alternative 6B, Option Case						
WTP	4.5×10^{2}	1.0	5.7	6.0×10^{-1}	4.4×10^{2}	1.0
STTS-East	1.3×10^{2}	2.9×10^{-1}	2.8	2.9×10^{-1}	1.3×10^{2}	2.9×10^{-1}
STTS-West	1.3×10^{2}	2.7×10^{-1}	2.6×10^{-1}	2.5×10^{-2}	1.3×10^{2}	2.7×10^{-1}
Total	$\mathbf{7.1\times10^{2}}$	**1.6**	**8.8**	$\mathbf{9.2\times10^{-1}}$	$\mathbf{7.0\times10^{2}}$	**1.6**
Alternative 6C						
WTP	4.5×10^{2}	1.0	5.7	6.0×10^{-1}	4.4×10^{2}	1.0
STT-East	6.0	1.3×10^{-2}	6.6×10^{-2}	7.0×10^{-3}	5.9	1.3×10^{-2}
STTS-West	5.7	1.2×10^{-2}	7.0×10^{-2}	6.7×10^{-3}	5.7	1.2×10^{-2}
Total	$\mathbf{4.6\times10^{2}}$	**1.0**	**5.9**	$\mathbf{6.2\times10^{-1}}$	$\mathbf{4.5\times10^{2}}$	**1.0**

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–19 compares the average individual doses to Hispanic and non-Hispanic populations under each Tank Closure alternative over the lifetime of the project to examine the potential for disproportionately high and adverse impacts. There are no appreciable differences between the average dose to a Hispanic individual and a non-Hispanic individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on Hispanic populations surrounding each facility site.

Table J–19. Tank Closure Alternatives – Total, Hispanic, and Non-Hispanic Population and Average Individual Doses Over the Life of the Project

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Hispanic Population Dose[a] (person-rem)	Hispanic Individual Average Dose[a] (millirem)	Non-Hispanic Population Dose (person-rem)	Non-Hispanic Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	3.1×10^{2}	6.8×10^{-1}	8.8×10^{1}	6.0×10^{-1}	2.2×10^{2}	7.2×10^{-1}
STTS-West	2.9×10^{2}	6.0×10^{-1}	7.8×10^{1}	5.1×10^{-1}	2.2×10^{2}	6.4×10^{-1}
Total	**6.0×10^{2}**	**1.3**	**1.7×10^{2}**	**1.1**	**4.4×10^{2}**	**1.4**
Alternative 2A						
WTP	4.5×10^{2}	1.0	1.3×10^{2}	8.9×10^{-1}	3.2×10^{2}	1.1
STTS-East	3.2×10^{2}	7.1×10^{-1}	9.1×10^{1}	6.2×10^{-1}	2.3×10^{2}	7.5×10^{-1}
STTS-West	3.1×10^{2}	6.3×10^{-1}	8.1×10^{1}	5.3×10^{-1}	2.3×10^{2}	6.7×10^{-1}
Total	**1.1×10^{3}**	**2.3**	**3.0×10^{2}**	**2.0**	**7.7×10^{2}**	**2.5**
Alternative 2B						
WTP	4.5×10^{2}	1.0	1.3×10^{2}	9.0×10^{-1}	3.2×10^{2}	1.1
STTS-East	6.0	1.3×10^{-2}	1.7	1.1×10^{-2}	4.3	1.4×10^{-2}
STTS-West	5.7	1.2×10^{-2}	1.5	9.8×10^{-3}	4.3	1.3×10^{-2}
Total	**4.6×10^{2}**	**1.0**	**1.3×10^{2}**	**9.2×10^{-1}**	**3.3×10^{2}**	**1.1**
Alternative 3A						
WTP	3.6×10^{2}	8.1×10^{-1}	1.1×10^{2}	7.2×10^{-1}	2.6×10^{2}	8.5×10^{-1}
STTS-East	1.0×10^{2}	2.2×10^{-1}	3.0×10^{1}	2.0×10^{-1}	7.2×10^{1}	2.4×10^{-1}
STTS-West	1.0×10^{2}	2.1×10^{-1}	2.8×10^{1}	1.8×10^{-1}	7.6×10^{1}	2.3×10^{-1}
Total	**5.7×10^{2}**	**1.2**	**1.6×10^{2}**	**1.1**	**4.1×10^{2}**	**1.3**
Alternative 3B						
WTP	3.6×10^{2}	8.1×10^{-1}	1.1×10^{2}	7.2×10^{-1}	2.6×10^{2}	8.5×10^{-1}
STTS-East	7.2	1.6×10^{-2}	2.0	1.4×10^{-2}	5.2	1.7×10^{-2}
STTS-West	5.6	1.1×10^{-2}	1.5	9.6×10^{-3}	4.2	1.2×10^{-2}
Total	**3.8×10^{2}**	**8.4×10^{-1}**	**1.1×10^{2}**	**7.5×10^{-1}**	**2.7×10^{2}**	**8.8×10^{-1}**
Alternative 3C						
WTP	3.6×10^{2}	8.1×10^{-1}	1.1×10^{2}	7.2×10^{-1}	2.6×10^{2}	8.5×10^{-1}
STTS-East	1.0×10^{2}	2.2×10^{-1}	3.0×10^{1}	2.0×10^{-1}	7.2×10^{1}	2.4×10^{-1}
STTS-West	1.0×10^{2}	2.1×10^{-1}	2.8×10^{1}	1.8×10^{-1}	7.6×10^{1}	2.3×10^{-1}
Total	**5.7×10^{2}**	**1.2**	**1.6×10^{2}**	**1.1**	**4.1×10^{2}**	**1.3**
Alternative 4						
WTP	3.7×10^{2}	8.2×10^{-1}	1.1×10^{2}	7.3×10^{-1}	2.6×10^{2}	8.6×10^{-1}
STTS-East	1.2×10^{1}	2.6×10^{-2}	4.0	2.7×10^{-2}	7.7	2.5×10^{-2}
STTS-West	1.1×10^{2}	2.3×10^{-1}	2.9×10^{1}	1.9×10^{-1}	8.2×10^{1}	2.4×10^{-1}
Total	**4.9×10^{2}**	**1.1**	**1.4×10^{2}**	**9.5×10^{-1}**	**3.5×10^{2}**	**1.1**

Table J–19. Tank Closure Alternatives – Total, Hispanic, and Non-Hispanic Population and Average Individual Doses Over the Life of the Project *(continued)*

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Hispanic Population Dose[a] (person-rem)	Hispanic Individual Average Dose[a] (millirem)	Non-Hispanic Population Dose (person-rem)	Non-Hispanic Individual Average Dose (millirem)
Alternative 5						
WTP	3.6×10^{2}	7.9×10^{-1}	1.0×10^{2}	7.1×10^{-1}	2.5×10^{2}	8.4×10^{-1}
STTS-East	6.0	1.3×10^{-2}	1.7	1.1×10^{-2}	4.3	1.4×10^{-2}
STTS-West	9.5×10^{1}	2.0×10^{-1}	2.5×10^{1}	1.7×10^{-1}	7.0×10^{1}	2.1×10^{-1}
Total	**4.6×10^{2}**	**1.0**	**1.3×10^{2}**	**8.9×10^{-1}**	**3.3×10^{2}**	**1.1**
Alternative 6A, Base Case						
WTP	4.6×10^{2}	1.0	1.3×10^{2}	9.2×10^{-1}	3.3×10^{2}	1.1
STTS-East	9.3×10^{1}	2.1×10^{-1}	4.3×10^{1}	2.9×10^{-1}	5.1×10^{1}	1.7×10^{-1}
STTS-West	1.8	3.7×10^{-3}	3.3×10^{-1}	2.1×10^{-3}	1.5	4.4×10^{-3}
Total	**5.6×10^{2}**	**1.2**	**1.8×10^{2}**	**1.2**	**3.8×10^{2}**	**1.3**
Alternative 6A, Option Case						
WTP	4.6×10^{2}	1.0	1.3×10^{2}	9.2×10^{-1}	3.3×10^{2}	1.1
STTS-East	1.5×10^{2}	3.3×10^{-1}	7.3×10^{1}	5.0×10^{-1}	7.7×10^{1}	2.5×10^{-1}
STTS-West	1.5×10^{2}	3.1×10^{-1}	1.0×10^{1}	6.8×10^{-2}	1.4×10^{2}	4.1×10^{-1}
Total	**7.6×10^{2}**	**1.7**	**2.2×10^{2}**	**1.5**	**5.4×10^{2}**	**1.8**
Alternative 6B, Base Case						
WTP	4.5×10^{2}	1.0	1.3×10^{2}	8.9×10^{-1}	3.2×10^{2}	1.1
STTS-East	7.5×10^{1}	1.7×10^{-1}	3.8×10^{1}	2.6×10^{-1}	3.7×10^{1}	1.2×10^{-1}
STTS-West	7.5×10^{1}	1.5×10^{-1}	4.3	2.8×10^{-2}	7.1×10^{1}	2.1×10^{-1}
Total	**6.0×10^{2}**	**1.3**	**1.7×10^{2}**	**1.2**	**4.2×10^{2}**	**1.4**
Alternative 6B, Option Case						
WTP	4.5×10^{2}	1.0	1.3×10^{2}	8.9×10^{-1}	3.2×10^{2}	1.1
STTS-East	1.3×10^{2}	2.9×10^{-1}	6.8×10^{1}	4.6×10^{-1}	6.4×10^{1}	2.1×10^{-1}
STTS-West	1.3×10^{2}	2.7×10^{-1}	5.4	3.6×10^{-2}	1.3×10^{2}	3.7×10^{-1}
Total	**7.1×10^{2}**	**1.6**	**2.0×10^{2}**	**1.4**	**5.1×10^{2}**	**1.6**
Alternative 6C						
WTP	4.5×10^{2}	1	1.3×10^{2}	8.9×10^{-1}	3.2×10^{2}	1.1
STTS-East	6.0	1.3×10^{-2}	1.70	1.1×10^{-2}	4.3	1.4×10^{-2}
STTS-West	5.7	1.2×10^{-2}	1.50	9.8×10^{-3}	4.3	1.3×10^{-2}
Total	**4.6×10^{2}**	**1.0**	**1.3×10^{2}**	**9.1×10^{-1}**	**3.3×10^{2}**	**1.1**

[a] Includes all individuals, regardless of race, who identified themselves as Hispanic or Latino.

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–20 compares average individual doses to low-income and non-low-income populations under each Tank Closure alternative over the lifetime of the project to examine the potential for disproportionately high and adverse impacts. There are no appreciable differences between the average dose to a low-income individual and a non-low-income individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on low-income populations surrounding each facility site.

Table J–20. Tank Closure Alternatives – Total, Low-Income, and Non-Low-Income Population and Average Individual Doses Over the Life of the Project

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Low-Income Population Dose (person-rem)	Low-Income Individual Average Dose (millirem)	Non-Low-Income Population Dose (person-rem)	Non-Low-Income Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	3.1×10^{2}	6.8×10^{-1}	4.6×10^{1}	5.9×10^{-1}	2.6×10^{2}	7.0×10^{-1}
STTS-West	2.9×10^{2}	6.0×10^{-1}	4.0×10^{1}	5.0×10^{-1}	2.5×10^{2}	6.2×10^{-1}
Total	**6.0×10^{2}**	**1.3**	**8.6×10^{1}**	**1.1**	**5.2×10^{2}**	**1.3**
Alternative 2A						
WTP	4.5×10^{2}	1.0	6.7×10^{1}	8.8×10^{-1}	3.8×10^{2}	1.0
STTS-East	3.2×10^{2}	7.1×10^{-1}	4.8×10^{1}	6.2×10^{-1}	2.7×10^{2}	7.3×10^{-1}
STTS-West	3.1×10^{2}	6.3×10^{-1}	4.2×10^{1}	5.2×10^{-1}	2.7×10^{2}	6.5×10^{-1}
Total	**1.1×10^{3}**	**2.3**	**1.6×10^{2}**	**2.0**	**9.2×10^{2}**	**2.4**
Alternative 2B						
WTP	4.5×10^{2}	1.0	6.8×10^{1}	8.8×10^{-1}	3.8×10^{2}	1.0
STTS-East	6.0	1.3×10^{-2}	8.8×10^{-1}	1.1×10^{-2}	5.1	1.4×10^{-2}
STTS-West	5.7	1.2×10^{-2}	7.8×10^{-1}	9.8×10^{-3}	5.0	1.2×10^{-2}
Total	**4.6×10^{2}**	**1.0**	**7.0×10^{1}**	**9.1×10^{-1}**	**3.9×10^{2}**	**1.1**
Alternative 3A						
WTP	3.6×10^{2}	8.1×10^{-1}	5.5×10^{1}	7.1×10^{-1}	3.1×10^{2}	8.3×10^{-1}
STTS-East	1.0×10^{2}	2.2×10^{-1}	1.5×10^{1}	1.9×10^{-1}	8.7×10^{1}	2.3×10^{-1}
STTS-West	1.0×10^{2}	2.1×10^{-1}	1.4×10^{1}	1.7×10^{-1}	9.0×10^{1}	2.2×10^{-1}
Total	**5.7×10^{2}**	**1.2**	**8.4×10^{1}**	**1.1**	**4.8×10^{2}**	**1.3**
Alternative 3B						
WTP	3.6×10^{2}	8.1×10^{-1}	5.5×10^{1}	7.1×10^{-1}	3.1×10^{2}	8.3×10^{-1}
STTS-East	7.2	1.6×10^{-2}	1.1	1.4×10^{-2}	6.1	1.6×10^{-2}
STTS-West	5.6	1.1×10^{-2}	7.6×10^{-1}	9.6×10^{-3}	4.8	1.2×10^{-2}
Total	**3.8×10^{2}**	**8.4×10^{-1}**	**5.7×10^{1}**	**7.4×10^{-1}**	**3.2×10^{2}**	**8.6×10^{-1}**
Alternative 3C						
WTP	3.6×10^{2}	8.1×10^{-1}	5.5×10^{1}	7.1×10^{-1}	3.1×10^{2}	8.3×10^{-1}
STTS-East	1.0×10^{2}	2.2×10^{-1}	1.5×10^{1}	1.9×10^{-1}	8.7×10^{1}	2.3×10^{-1}
STTS-West	1.0×10^{2}	2.1×10^{-1}	1.4×10^{1}	1.7×10^{-1}	9.0×10^{1}	2.2×10^{-1}
Total	**5.7×10^{2}**	**1.2**	**8.4×10^{1}**	**1.1**	**4.8×10^{2}**	**1.3**
Alternative 4						
WTP	3.7×10^{2}	8.2×10^{-1}	5.5×10^{1}	7.2×10^{-1}	3.1×10^{2}	8.4×10^{-1}
STTS-East	1.2×10^{1}	2.6×10^{-2}	2.1	2.7×10^{-2}	9.5	2.5×10^{-2}
STTS-West	1.1×10^{2}	2.3×10^{-1}	1.4×10^{1}	1.8×10^{-1}	9.6×10^{1}	2.3×10^{-1}
Total	**4.9×10^{2}**	**1.1**	**7.2×10^{1}**	**9.2×10^{-1}**	**4.2×10^{2}**	**1.1**
Alternative 5						
WTP	3.6×10^{2}	7.9×10^{-1}	5.4×10^{1}	7.0×10^{-1}	3.0×10^{2}	8.1×10^{-1}
STTS-East	6.0	1.3×10^{-2}	8.9×10^{-1}	1.2×10^{-2}	5.1	1.4×10^{-2}
STTS-West	9.5×10^{1}	2.0×10^{-1}	1.3×10^{1}	1.6×10^{-1}	8.3×10^{1}	2.0×10^{-1}
Total	**4.6×10^{2}**	**1.0**	**6.7×10^{1}**	**8.7×10^{-1}**	**3.9×10^{2}**	**1.0**
Alternative 6A, Base Case						
WTP	4.6×10^{2}	1.0	7.0×10^{1}	9.1×10^{-1}	3.9×10^{2}	1.1
STTS-East	9.3×10^{1}	2.1×10^{-1}	2.2×10^{1}	2.9×10^{-1}	7.1×10^{1}	1.9×10^{-1}
STTS-West	1.8	3.7×10^{-3}	1.7×10^{-1}	2.1×10^{-3}	1.6	4.0×10^{-3}
Total	**5.6×10^{2}**	**1.2**	**9.3×10^{1}**	**1.2**	**4.7×10^{2}**	**1.3**

Table J–20. Tank Closure Alternatives – Total, Low-Income, and Non-Low-Income Population and Individual Average Doses *(continued)*

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Low-Income Population Dose (person-rem)	Low-Income Individual Average Dose (millirem)	Non-Low-Income Population Dose (person-rem)	Non-Low-Income Individual Average Dose (millirem)
Alternative 6A, Option Case						
WTP	4.6×10^{2}	1.0	7.0×10^{1}	9.1×10^{-1}	3.9×10^{2}	1.1
STTS-East	1.5×10^{2}	3.3×10^{-1}	3.9×10^{1}	5.0×10^{-1}	1.1×10^{2}	3.0×10^{-1}
STTS-West	1.5×10^{2}	3.1×10^{-1}	5.4	6.7×10^{-2}	1.4×10^{2}	3.5×10^{-1}
Total	**7.6×10^{2}**	**1.7**	**1.1×10^{2}**	**1.5**	**6.5×10^{2}**	**1.7**
Alternative 6B, Base Case						
WTP	4.5×10^{2}	1.0	6.8×10^{1}	8.8×10^{-1}	3.8×10^{2}	1.0
STTS-East	7.5×10^{1}	1.7×10^{-1}	2.0×10^{1}	2.5×10^{-1}	5.5×10^{1}	1.5×10^{-1}
STTS-West	7.5×10^{1}	1.5×10^{-1}	2.2	2.8×10^{-2}	7.3×10^{1}	1.8×10^{-1}
Total	**6.0×10^{2}**	**1.3**	**8.9×10^{1}**	**1.2**	**5.1×10^{2}**	**1.4**
Alternative 6B, Option Case						
WTP	4.5×10^{2}	1.0	6.8×10^{1}	8.8×10^{-1}	3.8×10^{2}	1.0
STTS-East	1.3×10^{2}	2.9×10^{-1}	3.6×10^{1}	4.6×10^{-1}	9.6×10^{1}	2.6×10^{-1}
STTS-West	1.3×10^{2}	2.7×10^{-1}	2.8	3.5×10^{-2}	1.3×10^{2}	3.1×10^{-1}
Total	**7.1×10^{2}**	**1.6**	**1.1×10^{2}**	**1.4**	**6.0×10^{2}**	**1.6**
Alternative 6C						
WTP	4.5×10^{2}	1.0	6.8×10^{1}	8.8×10^{-1}	3.8×10^{2}	1.0
STTS-East	6.0	1.3×10^{-2}	8.8×10^{-1}	1.1×10^{-2}	5.1	1.4×10^{-2}
STTS-West	5.7	1.2×10^{-2}	7.9×10^{-1}	9.8×10^{-3}	5.0	1.2×10^{-2}
Total	**4.6×10^{2}**	**1.0**	**6.9×10^{1}**	**9.0×10^{-1}**	**3.9×10^{2}**	**1.1**

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

As discussed in Appendix K, Section K.2.1.1.1.1, normal operations would result in impacts on a maximally exposed individual (MEI) directly east of the 200 Areas in most cases and east-southeast along the Ringold section of the Columbia River and across the river from the Hanford 300 Area in a few cases. To explore potential American Indian environmental justice concerns associated with normal operations, impacts on a hypothetical individual residing at the boundary of the Yakama Reservation were evaluated. Table J–21 presents the maximum annual dose and cancer fatality risk to an MEI located there.

The results of this analysis show that the probability for an individual at this location to develop an LCF from radioactive releases during normal operations would essentially be zero. In addition, the maximum annual dose to an MEI residing at the reservation boundary would be approximately one order of magnitude less than the maximum annual dose to an MEI at the Hanford boundary.

Table J–21. Tank Closure Alternatives – Maximum Annual Dose and Risk to the Maximally Exposed Individual Located at the Boundary of the Yakama Reservation

Alternative	WTP	STTS-East	STTS-West	Total	Risk[a]
	Dose (millirem)				
1	0	3.6×10^{-3}	4.2×10^{-3}	7.9×10^{-3}	5×10^{-9}
2A	1.3×10^{-1}	5.5×10^{-10}	0	1.3×10^{-1}	8×10^{-8}
2B	1.6×10^{-1}	2.8×10^{-4}	3.2×10^{-4}	1.6×10^{-1}	1×10^{-7}
3A	1.3×10^{-1}	1.0×10^{-3}	1.1×10^{-3}	1.3×10^{-1}	8×10^{-8}
3B	1.3×10^{-1}	9.5×10^{-8}	3.0×10^{-6}	1.3×10^{-1}	8×10^{-8}
3C	1.3×10^{-1}	1.0×10^{-3}	1.1×10^{-3}	1.3×10^{-1}	8×10^{-8}
4	1.3×10^{-1}	3.1×10^{-5}	3.6×10^{-5}	1.3×10^{-1}	8×10^{-8}
5	1.3×10^{-1}	4.6×10^{-8}	1.4×10^{-3}	1.3×10^{-1}	8×10^{-8}
6A Base	1.3×10^{-1}	1.4×10^{-4}	1.4×10^{-4}	1.3×10^{-1}	8×10^{-8}
6A Option	1.3×10^{-1}	2.2×10^{-4}	2.3×10^{-4}	1.3×10^{-1}	8×10^{-8}
6B Base	1.5×10^{-1}	2.1×10^{-3}	2.1×10^{-3}	1.6×10^{-1}	9×10^{-8}
6B Option	1.5×10^{-1}	3.1×10^{-3}	3.0×10^{-3}	1.6×10^{-1}	1×10^{-7}
6C	1.5×10^{-1}	2.8×10^{-4}	3.2×10^{-4}	1.5×10^{-1}	9×10^{-8}

[a] Cancer risk is the probability of developing a latent cancer fatality, which is estimated by multiplying the dose by the risk factor of 0.0006 latent cancer fatalities per rem (DOE 2003).

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–22 presents the dose and cancer fatality risk over the lifetime of the project to an MEI located at the boundary of the Yakama Reservation.

Table J–22. Tank Closure Alternatives – Dose and Risk to the Maximally Exposed Individual Located at the Boundary of the Yakama Reservation Over the Life of the Project

Alternative	Duration of Exposure (years)	WTP	STTS-East	STTS-West	Total	Risk[a]
		Dose (millirem)				
1	102	0	3.4×10^{-1}	3.9×10^{-1}	7.3×10^{-1}	4×10^{-7}
2A	188	8.4×10^{-1}	3.6×10^{-1}	4.2×10^{-1}	1.6	1×10^{-6}
2B	40	7.4×10^{-1}	8.1×10^{-3}	9.5×10^{-3}	7.6×10^{-1}	5×10^{-7}
3A	37	6.5×10^{-1}	2.3×10^{-1}	2.6×10^{-1}	1.1	7×10^{-7}
3B	37	6.5×10^{-1}	1.1×10^{-2}	1.1×10^{-2}	6.8×10^{-1}	4×10^{-7}
3C	37	6.5×10^{-1}	2.3×10^{-1}	2.6×10^{-1}	1.1	7×10^{-7}
4	40	6.6×10^{-1}	1.8×10^{-2}	2.7×10^{-1}	9.5×10^{-1}	6×10^{-7}
5	31	6.6×10^{-1}	9.3×10^{-3}	2.4×10^{-1}	9.1×10^{-1}	5×10^{-7}
6A Base	163	7.6×10^{-1}	1.2×10^{-1}	2.7×10^{-3}	8.8×10^{-1}	5×10^{-7}
6A Option	163	8.7×10^{-1}	2.2×10^{-1}	2.5×10^{-1}	1.3	8×10^{-7}
6B Base	95	8.4×10^{-1}	1.2×10^{-1}	1.4×10^{-1}	1.1	7×10^{-7}
6B Option	95	8.4×10^{-1}	1.8×10^{-1}	2.1×10^{-1}	1.2	7×10^{-7}
6C	40	7.3×10^{-1}	8.1×10^{-3}	9.5×10^{-3}	7.5×10^{-1}	4×10^{-7}

[a] Cancer risk is the probability of developing a latent cancer fatality, which is estimated by multiplying the dose by the risk factor of 0.0006 latent cancer fatalities per rem (DOE 2003).

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

The results of this analysis show that the probability for an individual at this location to develop an LCF from radioactive releases during normal operations would essentially be zero. In addition, the dose to an MEI residing at the reservation boundary over the life of the project would be approximately one order of magnitude less than the dose to an MEI at the Hanford boundary over the life of the project.

In addition, a scenario was analyzed for an individual living at or near the Hanford boundary who subsists predominantly on the consumption of homegrown produce, animal products from a family farm, and foodstuffs harvested from the wild (e.g., fruits, vegetables, fish, and game) to determine a maximum potential dose. For this scenario, the hypothetical individual was assumed to live at the same location as

the MEI analyzed for the general public and could represent a member of a minority group who lives a subsistence lifestyle. This individual was assumed to get all of his or her food from the sources listed above. It was further conservatively assumed that all food came from an environment that was radiologically contaminated from air deposition. Irrigation water for crops and livestock and drinking water was assumed to come from radiologically contaminated surface waters. In contrast, the general population MEI was assumed to consume only a portion of his or her diet from regional food contaminated by radiological emissions. Table J–23 presents comparative data on the food consumption rates for the subsistence consumer and the general population MEI.

Table J–23. Comparative Food Consumption Rates for Subsistence Consumer and the General Population Maximally Exposed Individual

Ingestion Exposure Pathway	General Population MEI[a] (kilograms per year except as noted)	Subsistence Consumer (kilograms per year except as noted)	Reference
Leafy vegetable	65	65	Beyeler et al. 1999; DOE and Ecology 1996
Other vegetable	120	120	DOE 1995; DOE and Ecology 1996
Fruit	120	120	DOE 1995; DOE and Ecology 1996
Grain	90	90	Beyeler et al. 1999
Meat/game	27.8	125	DOE 1995; DOE and Ecology 1996
Eggs	19	19	Beyeler et al. 1999
Fish	0	62	EPA 1997
Dairy	110 liters	219 liters	DOE 1995; DOE and Ecology 1996
Surface water	0	730 liters	DOE 1995

[a] From Appendix K of this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington.*

Note: To convert kilograms to pounds, multiply by 2.2046; liters to gallons, by 0.26417.

Key: MEI=maximally exposed individual.

For the purposes of analysis and comparison, the dose to this subsistence consumer was analyzed for radiological airborne releases under Alternative 2B, which resulted in the highest MEI dose of 1.7 millirem in the year of maximum impact. This dose would only be applicable to the one year in which cesium and strontium capsules are processed. The dose to this individual exposed to the same releases under Alternative 2B for the whole year would be 3.1 millirem. Both of these doses are well below the National Emission Standards for Hazardous Air Pollutants limit of 10 millirem per year (40 CFR 61.90–61.97). Considering that both the MEI and this individual would also be receiving a dose in excess of 300 millirem per year from natural background radiation, there would be no appreciable differences between these two doses. The alternatives analyzed in this EIS would therefore not pose a disproportionately high and adverse impact on an individual with a subsistence diet.

Appendix K, Section K.3.4 discusses the radiological and chemical consequences of facility accidents under each Tank Closure alternative. Examination of the risks under each alternative shows that there would be essentially no LCFs per year for the offsite population, including minority and low-income populations, from radiological emissions. Hazardous chemical impacts are not expected to affect offsite populations. Therefore, these alternatives would not pose disproportionately high and adverse impacts on the minority and low-income populations.

J.5.6.1.2 FFTF Decommissioning Alternatives

Table J–24 compares average individual doses to minority and nonminority populations under each FFTF Decommissioning alternative to examine the potential for disproportionately high and adverse impacts. The Idaho Option under Alternatives 2 and 3 would result in the average dose to a minority individual slightly exceeding the average dose to a nonminority individual. However, the values show that there are no appreciable differences between average doses. Therefore, these alternatives would not pose disproportionately high and adverse impacts on minority populations surrounding each facility site.

Table J–24. FFTF Decommissioning Alternatives – Total, Minority, and Nonminority Population and Average Individual Doses in Year of Maximum Impact

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Minority Population Dose (person-rem)	Minority Individual Average Dose (millirem)	Nonminority Population Dose (person-rem)	Nonminority Individual Average Dose (millirem)
Alternative 1						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2 Hanford Site						
FFTF	3.3×10^{-3}	9.2×10^{-6}	9.9×10^{-4}	7.5×10^{-6}	2.3×10^{-3}	1.0×10^{-5}
200-West Area	9.0×10^{-5}	1.8×10^{-7}	2.9×10^{-5}	1.6×10^{-7}	6.1×10^{-5}	2.0×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{3.4\times10^{-3}}$	$\mathbf{9.4\times10^{-6}}$	$\mathbf{1.0\times10^{-3}}$	$\mathbf{7.6\times10^{-6}}$	$\mathbf{2.4\times10^{-3}}$	$\mathbf{1.0\times10^{-5}}$
Alternative 2 Idaho National Laboratory						
FFTF	1.0×10^{-6}	2.8×10^{-9}	3.0×10^{-7}	2.3×10^{-9}	7.0×10^{-7}	3.1×10^{-9}
200-West Area	0	0	0	0	0	0
INL	2.2×10^{-4}	1.1×10^{-6}	2.8×10^{-5}	1.1×10^{-6}	1.9×10^{-4}	1.0×10^{-6}
Total	$\mathbf{2.2\times10^{-4}}$	$\mathbf{1.1\times10^{-6}}$	$\mathbf{2.9\times10^{-5}}$	$\mathbf{1.1\times10^{-6}}$	$\mathbf{1.9\times10^{-4}}$	$\mathbf{1.0\times10^{-6}}$
Alternative 3 Hanford Site						
FFTF	3.3×10^{-3}	9.2×10^{-6}	9.9×10^{-4}	7.5×10^{-6}	2.3×10^{-3}	1.0×10^{-5}
200-West Area	9.0×10^{-5}	1.8×10^{-7}	2.9×10^{-5}	1.6×10^{-7}	6.1×10^{-5}	2.0×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{3.4\times10^{-3}}$	$\mathbf{9.4\times10^{-6}}$	$\mathbf{1.0\times10^{-3}}$	$\mathbf{7.6\times10^{-6}}$	$\mathbf{2.4\times10^{-3}}$	$\mathbf{1.0\times10^{-5}}$
Alternative 3 Idaho National Laboratory						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	2.2×10^{-4}	1.1×10^{-6}	2.8×10^{-5}	1.1×10^{-6}	1.9×10^{-4}	1.0×10^{-6}
Total	$\mathbf{2.2\times10^{-4}}$	$\mathbf{1.1\times10^{-6}}$	$\mathbf{2.8\times10^{-5}}$	$\mathbf{1.1\times10^{-6}}$	$\mathbf{1.9\times10^{-4}}$	$\mathbf{1.0\times10^{-6}}$

Key: FFTF=Fast Flux Test Facility; INL=Idaho National Laboratory.

Table J–25 compares average individual doses to American Indian and non–American Indian populations under each FFTF Decommissioning alternative to examine the potential for disproportionately high and adverse impacts. There are no appreciable differences between the average dose to an American Indian individual and a non–American Indian individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on American Indian populations surrounding each facility site.

Table J–25. FFTF Decommissioning Alternatives – Total, American Indian, and Non–American Indian Population and Average Individual Doses in Year of Maximum Impact

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	American Indian Population Dose (person-rem)	American Indian Individual Average Dose (millirem)	Non–American Indian Population Dose (person-rem)	Non–American Indian Individual Average Dose (millirem)
Alternative 1						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2 Hanford Site						
FFTF	3.3×10^{-3}	9.2×10^{-6}	2.9×10^{-5}	5.4×10^{-6}	3.3×10^{-3}	9.3×10^{-6}
200-West Area	9.0×10^{-5}	1.8×10^{-7}	1.1×10^{-6}	1.1×10^{-7}	8.9×10^{-5}	1.9×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{3.4\times10^{-3}}$	$\mathbf{9.4\times10^{-6}}$	$\mathbf{3.0\times10^{-5}}$	$\mathbf{5.5\times10^{-6}}$	$\mathbf{3.4\times10^{-3}}$	$\mathbf{9.5\times10^{-6}}$
Alternative 2 Idaho National Laboratory						
FFTF	1.0×10^{-6}	2.8×10^{-9}	8.8×10^{-9}	1.6×10^{-9}	9.9×10^{-7}	2.8×10^{-9}
200-West Area	0	0	0	0	0	0
INL	2.2×10^{-4}	1.1×10^{-6}	5.0×10^{-6}	1.0×10^{-6}	2.1×10^{-4}	1.1×10^{-6}
Total	$\mathbf{2.2\times10^{-4}}$	$\mathbf{1.1\times10^{-6}}$	$\mathbf{5.0\times10^{-6}}$	$\mathbf{1.0\times10^{-6}}$	$\mathbf{2.1\times10^{-4}}$	$\mathbf{1.1\times10^{-6}}$
Alternative 3 Hanford Site						
FFTF	3.3×10^{-3}	9.2×10^{-6}	2.9×10^{-5}	5.4×10^{-6}	3.3×10^{-3}	9.3×10^{-6}
200-West Area	9.0×10^{-5}	1.8×10^{-7}	1.1×10^{-6}	1.1×10^{-7}	8.9×10^{-5}	1.9×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{3.4\times10^{-3}}$	$\mathbf{9.4\times10^{-6}}$	$\mathbf{3.0\times10^{-5}}$	$\mathbf{5.5\times10^{-6}}$	$\mathbf{3.4\times10^{-3}}$	$\mathbf{9.5\times10^{-6}}$
Alternative 3 Idaho National Laboratory						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	2.2×10^{-4}	1.1×10^{-6}	5.0×10^{-6}	1.0×10^{-6}	2.1×10^{-4}	1.1×10^{-6}
Total	$\mathbf{2.2\times10^{-4}}$	$\mathbf{1.1\times10^{-6}}$	$\mathbf{5.0\times10^{-6}}$	$\mathbf{1.0\times10^{-6}}$	$\mathbf{2.1\times10^{-4}}$	$\mathbf{1.1\times10^{-6}}$

Key: FFTF=Fast Flux Test Facility; INL=Idaho National Laboratory.

Table J–26 compares average individual doses to Hispanic and non-Hispanic populations under each FFTF Decommissioning alternative to examine the potential for disproportionately high and adverse impacts. The Idaho Option under Alternatives 2 and 3 would result in the average dose to a Hispanic individual slightly exceeding the average dose to a non-Hispanic individual. However, the values show that there are no appreciable differences between average doses. Therefore, these alternatives would not pose disproportionately high and adverse impacts on Hispanic or Latino populations surrounding each facility site.

Table J–26. FFTF Decommissioning Alternatives – Total, Hispanic, and Non-Hispanic Population and Average Individual Doses in Year of Maximum Impact

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Hispanic Population Dose[a] (person-rem)	Hispanic Individual Average Dose[a] (millirem)	Non-Hispanic Population Dose (person-rem)	Non-Hispanic Individual Average Dose (millirem)
Alternative 1						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2 Hanford Site						
FFTF	3.3×10^{-3}	9.2×10^{-6}	8.0×10^{-4}	7.1×10^{-6}	2.5×10^{-3}	1.0×10^{-5}
200-West Area	9.0×10^{-5}	1.8×10^{-7}	2.4×10^{-5}	1.6×10^{-7}	6.6×10^{-5}	2.0×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{3.4\times10^{-3}}$	$\mathbf{9.4\times10^{-6}}$	$\mathbf{8.2\times10^{-4}}$	$\mathbf{7.2\times10^{-6}}$	$\mathbf{2.6\times10^{-3}}$	$\mathbf{1.0\times10^{-5}}$
Alternative 2 Idaho National Laboratory						
FFTF	1.0×10^{-6}	2.8×10^{-9}	2.4×10^{-7}	2.1×10^{-9}	7.6×10^{-7}	3.1×10^{-9}
200-West Area	0	0	0	0	0	0
INL	2.2×10^{-4}	1.0×10^{-6}	2.0×10^{-5}	1.2×10^{-6}	2.0×10^{-4}	1.0×10^{-6}
Total	$\mathbf{2.2\times10^{-4}}$	$\mathbf{1.0\times10^{-6}}$	$\mathbf{2.0\times10^{-5}}$	$\mathbf{1.2\times10^{-6}}$	$\mathbf{2.0\times10^{-4}}$	$\mathbf{1.0\times10^{-6}}$
Alternative 3 Hanford Site						
FFTF	3.3×10^{-3}	9.2×10^{-6}	8.0×10^{-4}	7.1×10^{-6}	2.5×10^{-3}	1.0×10^{-5}
200-West Area	9.0×10^{-5}	1.8×10^{-7}	2.4×10^{-5}	1.6×10^{-7}	6.6×10^{-5}	2.0×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{3.4\times10^{-3}}$	$\mathbf{9.4\times10^{-6}}$	$\mathbf{8.2\times10^{-4}}$	$\mathbf{7.2\times10^{-6}}$	$\mathbf{2.6\times10^{-3}}$	$\mathbf{1.0\times10^{-5}}$
Alternative 3 Idaho National Laboratory						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	2.2×10^{-4}	1.1×10^{-6}	2.0×10^{-5}	1.2×10^{-6}	2.0×10^{-4}	1.0×10^{-6}
Total	$\mathbf{2.2\times10^{-4}}$	$\mathbf{1.1\times10^{-6}}$	$\mathbf{2.0\times10^{-5}}$	$\mathbf{1.2\times10^{-6}}$	$\mathbf{2.0\times10^{-4}}$	$\mathbf{1.0\times10^{-6}}$

[a] Includes all individuals, regardless of race, who identified themselves as Hispanic or Latino.

Key: FFTF=Fast Flux Test Facility; INL=Idaho National Laboratory.

Table J–27 compares average individual doses to low-income and non-low-income populations under each FFTF Decommissioning alternative to examine the potential for disproportionately high and adverse impacts. There are no appreciable differences between the average dose to a low-income individual and a non-low-income individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on low-income populations surrounding each facility site.

Table J–27. FFTF Decommissioning Alternatives – Total, Low-Income, and Non-Low-Income Population and Average Individual Doses in Year of Maximum Impact

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Low-Income Population Dose (person-rem)	Low-Income Individual Average Dose (millirem)	Non-Low-Income Population Dose (person-rem)	Non-Low-Income Individual Average Dose (millirem)
Alternative 1						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2 Hanford Site						
FFTF	3.3×10^{-3}	9.2×10^{-6}	4.3×10^{-4}	7.7×10^{-6}	2.9×10^{-3}	9.5×10^{-6}
200-West Area	9.0×10^{-5}	1.8×10^{-7}	1.2×10^{-5}	1.5×10^{-7}	7.8×10^{-5}	1.9×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{3.4\times10^{-3}}$	$\mathbf{9.4\times10^{-6}}$	$\mathbf{4.4\times10^{-4}}$	$\mathbf{7.9\times10^{-6}}$	$\mathbf{3.0\times10^{-3}}$	$\mathbf{9.7\times10^{-6}}$
Alternative 2 Idaho National Laboratory						
FFTF	1.0×10^{-6}	2.8×10^{-9}	1.3×10^{-7}	2.4×10^{-9}	8.7×10^{-7}	2.9×10^{-9}
200-West Area	0	0	0	0	0	0
INL	2.2×10^{-4}	1.1×10^{-6}	2.9×10^{-5}	1.0×10^{-6}	1.9×10^{-4}	1.1×10^{-6}
Total	$\mathbf{2.2\times10^{-4}}$	$\mathbf{1.1\times10^{-6}}$	$\mathbf{2.9\times10^{-5}}$	$\mathbf{1.0\times10^{-6}}$	$\mathbf{1.9\times10^{-4}}$	$\mathbf{1.1\times10^{-6}}$
Alternative 3 Hanford Site						
FFTF	3.3×10^{-3}	9.2×10^{-6}	4.3×10^{-4}	7.7×10^{-6}	2.9×10^{-3}	9.5×10^{-6}
200-West Area	9.0×10^{-5}	1.8×10^{-7}	1.2×10^{-5}	1.5×10^{-7}	7.8×10^{-5}	1.9×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{3.4\times10^{-3}}$	$\mathbf{9.4\times10^{-6}}$	$\mathbf{4.4\times10^{-4}}$	$\mathbf{7.9\times10^{-6}}$	$\mathbf{3.0\times10^{-3}}$	$\mathbf{9.7\times10^{-6}}$
Alternative 3 Idaho National Laboratory						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	2.2×10^{-4}	1.1×10^{-6}	2.9×10^{-5}	1.6×10^{-6}	1.9×10^{-4}	1.1×10^{-6}
Total	$\mathbf{2.2\times10^{-4}}$	$\mathbf{1.1\times10^{-6}}$	$\mathbf{2.9\times10^{-5}}$	$\mathbf{1.6\times10^{-6}}$	$\mathbf{1.9\times10^{-4}}$	$\mathbf{1.1\times10^{-6}}$

Key: FFTF=Fast Flux Test Facility; INL=Idaho National Laboratory.

Table J–28 compares average individual doses to minority and nonminority populations under each FFTF Decommissioning alternative over the lifetime of the project to examine the potential for disproportionately high and adverse impacts. The Idaho Option under Alternatives 2 and 3 would result in the average dose to a minority individual slightly exceeding the average dose to a nonminority individual. However, the values show that there are no appreciable differences between average doses. Therefore, these alternatives would not pose disproportionately high and adverse impacts on minority populations surrounding each facility site.

Table J–28. FFTF Decommissioning Alternatives – Total, Minority, and Nonminority Population and Average Individual Doses Over the Life of the Project

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Minority Population Dose (person-rem)	Minority Individual Average Dose (millirem)	Nonminority Population Dose person-rem)	Nonminority Individual Average Dose (millirem)
Alternative 1						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2 Hanford Site						
FFTF	7.2×10^{-3}	2.0×10^{-5}	2.2×10^{-3}	1.6×10^{-5}	5.0×10^{-3}	2.2×10^{-5}
200-West Area	1.4×10^{-4}	2.9×10^{-7}	4.3×10^{-5}	2.4×10^{-7}	9.7×10^{-5}	3.1×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{7.3\times10^{-3}}$	$\mathbf{2.0\times10^{-5}}$	$\mathbf{2.2\times10^{-3}}$	$\mathbf{1.7\times10^{-5}}$	$\mathbf{5.1\times10^{-3}}$	$\mathbf{2.3\times10^{-5}}$
Alternative 2 Idaho National Laboratory						
FFTF	1.0×10^{-6}	2.8×10^{-9}	3.0×10^{-7}	2.3×10^{-9}	7.0×10^{-7}	3.1×10^{-9}
200-Area West	0	0	0	0	0	0
INL	4.3×10^{-4}	2.1×10^{-6}	5.8×10^{-5}	2.3×10^{-6}	3.7×10^{-4}	2.1×10^{-6}
Total	$\mathbf{4.3\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$	$\mathbf{5.9\times10^{-5}}$	$\mathbf{2.3\times10^{-6}}$	$\mathbf{3.7\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$
Alternative 3 Hanford Site						
FFTF	7.2×10^{-3}	2.0×10^{-5}	2.2×10^{-3}	1.6×10^{-5}	5.0×10^{-3}	2.2×10^{-5}
200-West Area	1.4×10^{-4}	2.9×10^{-7}	4.3×10^{-5}	2.4×10^{-7}	9.7×10^{-5}	3.1×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{7.3\times10^{-3}}$	$\mathbf{2.0\times10^{-5}}$	$\mathbf{2.2\times10^{-3}}$	$\mathbf{1.7\times10^{-5}}$	$\mathbf{5.1\times10^{-3}}$	$\mathbf{2.3\times10^{-5}}$
Alternative 3 Idaho National Laboratory						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	4.3×10^{-4}	2.1×10^{-6}	5.8×10^{-5}	2.3×10^{-6}	3.7×10^{-4}	2.1×10^{-6}
Total	$\mathbf{4.3\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$	$\mathbf{5.8\times10^{-5}}$	$\mathbf{2.3\times10^{-6}}$	$\mathbf{3.7\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$

Key: FFTF=Fast Flux Test Facility; INL=Idaho National Laboratory.

Table J–29 compares average individual doses to American Indian and non–American Indian populations under each FFTF Decommissioning alternative over the lifetime of the project to examine the potential for disproportionately high and adverse impacts. There are no appreciable differences between the average dose to an American Indian individual and a non–American Indian individual. Therefore, these alternatives would not pose disproportionately high and adverse impacts on American Indian populations surrounding each facility site.

Table J–29. FFTF Decommissioning Alternatives – Total, American Indian, and Non–American Indian Population and Average Individual Doses Over the Life of the Project

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	American Indian Population Dose (person-rem)	American Indian Individual Average Dose (millirem)	Non–American Indian Population Dose (person-rem)	Non–American Indian Individual Average Dose (millirem)
Alternative 1						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2 Hanford Site						
FFTF	7.2×10^{-3}	2.0×10^{-5}	6.4×10^{-5}	1.2×10^{-5}	7.1×10^{-3}	2.0×10^{-5}
200-West Area	1.4×10^{-4}	2.9×10^{-7}	1.7×10^{-6}	1.6×10^{-7}	1.4×10^{-4}	2.9×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{7.3\times10^{-3}}$	$\mathbf{2.0\times10^{-5}}$	$\mathbf{6.5\times10^{-5}}$	$\mathbf{1.2\times10^{-5}}$	$\mathbf{7.3\times10^{-3}}$	$\mathbf{2.1\times10^{-5}}$
Alternative 2 Idaho National Laboratory						
FFTF	1.0×10^{-6}	2.8×10^{-9}	8.8×10^{-9}	1.6×10^{-9}	9.9×10^{-7}	2.8×10^{-9}
200-West Area	0	0	0	0	0	0
INL	4.3×10^{-4}	2.1×10^{-6}	1.0×10^{-5}	2.1×10^{-6}	4.2×10^{-4}	2.1×10^{-6}
Total	$\mathbf{4.3\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$	$\mathbf{1.0\times10^{-5}}$	$\mathbf{2.1\times10^{-6}}$	$\mathbf{4.2\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$
Alternative 3 Hanford Site						
FFTF	7.2×10^{-3}	2.0×10^{-5}	6.3×10^{-5}	1.2×10^{-5}	7.1×10^{-3}	2.0×10^{-5}
200-West Area	1.4×10^{-4}	2.9×10^{-7}	1.7×10^{-6}	1.6×10^{-7}	1.4×10^{-4}	2.9×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{7.3\times10^{-3}}$	$\mathbf{2.0\times10^{-5}}$	$\mathbf{6.5\times10^{-5}}$	$\mathbf{1.2\times10^{-5}}$	$\mathbf{7.3\times10^{-3}}$	$\mathbf{2.1\times10^{-5}}$
Alternative 3 Idaho National Laboratory						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	4.3×10^{-4}	2.1×10^{-6}	1.0×10^{-5}	2.1×10^{-6}	4.2×10^{-4}	2.1×10^{-6}
Total	$\mathbf{4.3\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$	$\mathbf{1.0\times10^{-5}}$	$\mathbf{2.1\times10^{-6}}$	$\mathbf{4.2\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$

Key: FFTF=Fast Flux Test Facility; INL=Idaho National Laboratory.

Table J–30 compares average individual doses to Hispanic and non-Hispanic populations under each FFTF Decommissioning alternative over the lifetime of the project to examine the potential for disproportionately high and adverse impacts. The Idaho Option under Alternatives 2 and 3 would result in the average dose to a Hispanic individual slightly exceeding the average dose to a non-Hispanic individual. However, the values show that there are no appreciable differences between average doses. Therefore, these alternatives would not pose disproportionately high and adverse impacts on Hispanic or Latino populations surrounding each facility site.

Table J–30. FFTF Decommissioning Alternatives – Total, Hispanic, and Non-Hispanic Population and Average Individual Doses Over the Life of the Project

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Hispanic Population Dose[a] (person-rem)	Hispanic Individual Average Dose[a] (millirem)	Non-Hispanic Population Dose (person-rem)	Non-Hispanic Individual Average Dose (millirem)
Alternative 1						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2 Hanford Site						
FFTF	7.2×10^{-3}	2.0×10^{-5}	1.8×10^{-3}	1.6×10^{-5}	5.4×10^{-3}	2.2×10^{-5}
200-West Area	1.4×10^{-4}	2.9×10^{-7}	3.6×10^{-5}	2.4×10^{-7}	1.0×10^{-4}	3.1×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{7.3\times10^{-3}}$	$\mathbf{2.0\times10^{-5}}$	$\mathbf{1.8\times10^{-3}}$	$\mathbf{1.6\times10^{-5}}$	$\mathbf{5.6\times10^{-3}}$	$\mathbf{2.3\times10^{-5}}$
Alternative 2 Idaho National Laboratory						
FFTF	1.0×10^{-6}	2.8×10^{-9}	2.4×10^{-7}	2.1×10^{-9}	7.6×10^{-7}	3.1×10^{-9}
200-West Area	0	0	0	0	0	0
INL	4.3×10^{-4}	2.1×10^{-6}	4.1×10^{-5}	2.5×10^{-6}	3.9×10^{-4}	2.1×10^{-6}
Total	$\mathbf{4.3\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$	$\mathbf{4.1\times10^{-5}}$	$\mathbf{2.5\times10^{-6}}$	$\mathbf{3.9\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$
Alternative 3 Hanford Site						
FFTF	7.2×10^{-3}	2.0×10^{-5}	1.8×10^{-3}	1.6×10^{-5}	5.4×10^{-3}	2.2×10^{-5}
200-West Area	1.4×10^{-4}	2.9×10^{-7}	3.6×10^{-5}	2.4×10^{-7}	1.0×10^{-4}	3.1×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{7.3\times10^{-3}}$	$\mathbf{2.0\times10^{-5}}$	$\mathbf{1.8\times10^{-3}}$	$\mathbf{1.6\times10^{-5}}$	$\mathbf{5.6\times10^{-3}}$	$\mathbf{2.3\times10^{-5}}$
Alternative 3 Idaho National Laboratory						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	4.3×10^{-4}	2.1×10^{-6}	4.1×10^{-5}	2.5×10^{-6}	3.9×10^{-4}	2.1×10^{-6}
Total	$\mathbf{4.3\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$	$\mathbf{4.1\times10^{-5}}$	$\mathbf{2.5\times10^{-6}}$	$\mathbf{3.9\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$

[a] Includes all individuals, regardless of race, who identified themselves as Hispanic or Latino.

Key: FFTF=Fast Flux Test Facility; INL=Idaho National Laboratory.

Table J–31 compares average individual doses to low-income and non-low-income populations under each FFTF Decommissioning alternative over the lifetime of the project to examine the potential for disproportionately high and adverse impacts. The Idaho Option under Alternatives 2 and 3 would result in the average dose to a low-income individual slightly exceeding the average dose to a non-low-income individual. However, the values show that there are no appreciable differences between average doses. Therefore, these alternatives would not pose disproportionately high and adverse impacts on low-income populations surrounding each facility site.

Table J–31. FFTF Decommissioning Alternatives – Total, Low-Income, and Non-Low-Income Population and Average Individual Doses Over the Life of the Project

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Low-Income Population Dose (person-rem)	Low-Income Individual Average Dose (millirem)	Non-Low-Income Population Dose (person-rem)	Non-Low-Income Individual Average Dose (millirem)
Alternative 1						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2 Hanford Site						
FFTF	7.2×10^{-3}	2.0×10^{-5}	9.4×10^{-4}	1.7×10^{-5}	6.3×10^{-3}	2.1×10^{-5}
200-West Area	1.4×10^{-4}	2.9×10^{-7}	1.8×10^{-5}	2.3×10^{-7}	1.2×10^{-4}	3.0×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{7.3\times10^{-3}}$	$\mathbf{2.0\times10^{-5}}$	$\mathbf{9.6\times10^{-4}}$	$\mathbf{1.7\times10^{-5}}$	$\mathbf{6.4\times10^{-3}}$	$\mathbf{2.1\times10^{-5}}$
Alternative 2 Idaho National Laboratory						
FFTF	1.0×10^{-6}	2.8×10^{-9}	1.3×10^{-7}	2.4×10^{-9}	8.7×10^{-7}	2.9×10^{-9}
200-West Area	0	0	0	0	0	0
INL	4.3×10^{-4}	2.1×10^{-6}	5.9×10^{-5}	2.2×10^{-6}	3.7×10^{-4}	2.1×10^{-6}
Total	$\mathbf{4.3\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$	$\mathbf{6.0\times10^{-5}}$	$\mathbf{2.2\times10^{-6}}$	$\mathbf{3.7\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$
Alternative 3 Hanford Site						
FFTF	7.2×10^{-3}	2.0×10^{-5}	9.3×10^{-4}	1.7×10^{-5}	6.3×10^{-3}	2.1×10^{-5}
200-West Area	1.4×10^{-4}	2.9×10^{-7}	1.8×10^{-5}	2.3×10^{-7}	1.2×10^{-4}	3.0×10^{-7}
INL	0	0	0	0	0	0
Total	$\mathbf{7.3\times10^{-3}}$	$\mathbf{2.0\times10^{-5}}$	$\mathbf{9.6\times10^{-4}}$	$\mathbf{1.7\times10^{-5}}$	$\mathbf{6.4\times10^{-3}}$	$\mathbf{2.1\times10^{-5}}$
Alternative 3 Idaho National Laboratory						
FFTF	0	0	0	0	0	0
200-West Area	0	0	0	0	0	0
INL	4.3×10^{-4}	2.1×10^{-6}	5.9×10^{-5}	2.1×10^{-6}	3.7×10^{-4}	2.1×10^{-6}
Total	$\mathbf{4.3\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$	$\mathbf{5.9\times10^{-5}}$	$\mathbf{2.1\times10^{-6}}$	$\mathbf{3.7\times10^{-4}}$	$\mathbf{2.1\times10^{-6}}$

Key: FFTF=Fast Flux Test Facility; INL=Idaho National Laboratory.

Table J–32 presents the maximum annual dose and cancer fatality risk to an MEI located at the appropriate reservation boundary. The results of this analysis show that the probability of such an individual to develop an LCF from radioactive releases during normal operations would essentially be zero. In addition, the maximum annual dose to an MEI residing at a reservation boundary would be approximately one order of magnitude less than the maximum annual dose to an MEI at each respective site boundary under all FFTF Decommissioning alternatives.

Appendix K, Section K.2.2.1.1 discusses the approach used to model the FFTF Decommissioning alternatives. The same MEIs modeled under the Tank Closure alternatives are used for emissions from the 200 Area. An offsite MEI was identified for emissions from the 400 Area. This MEI is located to the southeast, across the river from the 300 Area. Similar to the Tank Closure alternatives, an MEI at the boundary of the Yakama Reservation is analyzed to explore potential environmental justice concerns surrounding Hanford. Some FFTF Decommissioning alternatives include options to process materials at the INL MFC. An offsite MEI from this location is identified to be south-southeast of the MFC. To explore potential American Indian environmental justice concerns associated with normal operations under these alternatives, impacts to a hypothetical individual residing at the boundary of the Fort Hall Reservation were evaluated.

Table J–32. FFTF Decommissioning Alternatives – Maximum Annual Dose and Risk to a Maximally Exposed Individual Located at the Appropriate Reservation Boundary

	Yakama Reservation				Fort Hall Reservation	
	FFTF	STTS-West	Hanford Site Total	Risk[a]	INL	Risk[a]
Alternative	Dose (millirem)					
1	0	0	0	0	0	0
2 Hanford Site	3.0×10^{-6}	1.6×10^{-7}	3.1×10^{-6}	1.9×10^{-12}	0	0
2 INL	7.9×10^{-10}	0	7.9×10^{-10}	4.7×10^{-16}	2.9×10^{-6}	2.0×10^{-12}
3 Hanford Site	3.0×10^{-6}	1.6×10^{-7}	3.1×10^{-6}	1.9×10^{-12}	0	0
3 INL	0	0	0	0	2.9×10^{-6}	2.0×10^{-12}

[a] Cancer risk is the probability of developing a latent cancer fatality, which is estimated by multiplying the dose by the risk factor of 0.0006 latent cancer fatalities per rem (DOE 2003).

Key: FFTF=Fast Flux Test Facility; INL=Idaho National Laboratory; STTS-West=200-West Area Supplemental Treatment Technology Site.

Table J–33 presents the dose and cancer fatality risk over the lifetime of the project to an MEI located at the appropriate reservation boundary. The results of this analysis show that the probability of such an individual to develop an LCF from radioactive releases during normal operations would essentially be zero. In addition, the dose to an MEI residing at a reservation boundary over the life of the project would be approximately one order of magnitude less than the dose to an MEI at each respective site boundary over the life of the project.

Table J–33. FFTF Decommissioning Alternatives – Dose and Risk to a Maximally Exposed Individual Located at the Appropriate Reservation Boundary Over the Life of the Project

Alternative	Duration of Exposure (years)	Yakama Reservation				Fort Hall Reservation	
		FFTF	STTS-West	Hanford Total	Risk[a]	INL	Risk[a]
		Dose (millirem)					
1	0[b]	0	0	0	0	0	0
2 Hanford Site	3	6.6×10^{-6}	2.4×10^{-7}	6.8×10^{-6}	4.1×10^{-12}	0	0
2 INL	4	7.9×10^{-10}	0	7.9×10^{-10}	4.7×10^{-16}	5.9×10^{-6}	3.5×10^{-12}
3 Hanford Site	3	6.6×10^{-6}	2.4×10^{-7}	6.8×10^{-6}	4.1×10^{-12}	0	0
3 INL	4	0	0	0	0	5.9×10^{-6}	3.5×10^{-12}

[a] Cancer risk is the probability of developing a latent cancer fatality, which is estimated by multiplying the dose by the risk factor of 0.0006 latent cancer fatalities per rem (DOE 2003).

[b] There would be no incremental radiological air releases above current facility operations reported as part of the baseline in the affected environment section of this *TC & WM EIS*.

Key: FFTF=Fast Flux Test Facility; INL=Idaho National Laboratory; STTS-West=200-West Area Supplemental Treatment Technology Site.

Appendix K, Section K.3.5 discusses the radiological and chemical consequences of facility accidents under each FFTF Decommissioning alternative. Examination of the risks under each alternative shows that there would be essentially no LCFs per year for the offsite population, including minority and low-income populations, due to radiological emissions. The most severe chemical impacts would be the result of a Hanford sodium storage tank failure scenario, which could result in a hazardous plume slightly exceeding the site boundary to the east of the 400 Area; however it is not be expected to reach the far side of the Columbia River. The potentially affected area is located in Franklin County, Washington, census tract 206.01, block group 2. This block group has not been identified to contain minority or low-income populations. Therefore, these alternatives would not pose disproportionately high and adverse impacts on minority or low-income populations.

J.5.6.1.3 Waste Management Alternatives

Table J–34 compares average individual doses to minority and nonminority populations under each Waste Management alternative to examine the potential for disproportionately high and adverse impacts. These impacts would be the same regardless of disposal group. There are no appreciable differences between the average dose to a minority individual and a nonminority individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on minority populations surrounding each facility site.

Table J–34. Waste Management Alternatives – Total, Minority, and Nonminority Population and Average Individual Doses in Year of Maximum Impact

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Minority Population Dose (person-rem)	Minority Individual Average Dose (millirem)	Nonminority Population Dose (person-rem)	Nonminority Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	1.8×10^{-5}	3.7×10^{-8}	5.6×10^{-6}	3.1×10^{-8}	1.2×10^{-5}	4.0×10^{-8}
Total	$\mathbf{1.8\times10^{-5}}$	$\mathbf{3.7\times10^{-8}}$	$\mathbf{5.6\times10^{-6}}$	$\mathbf{3.1\times10^{-8}}$	$\mathbf{1.2\times10^{-5}}$	$\mathbf{4.0\times10^{-8}}$
Alternative 3						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	1.8×10^{-5}	3.7×10^{-8}	5.6×10^{-6}	3.1×10^{-8}	1.2×10^{-5}	4.0×10^{-8}
Total	$\mathbf{1.8\times10^{-5}}$	$\mathbf{3.7\times10^{-8}}$	$\mathbf{5.6\times10^{-6}}$	$\mathbf{3.1\times10^{-8}}$	$\mathbf{1.2\times10^{-5}}$	$\mathbf{4.0\times10^{-8}}$

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–35 compares average individual doses to American Indian and non–American Indian populations under each Waste Management alternative to examine the potential for disproportionately high and adverse impacts. These impacts would be the same regardless of disposal group. There are no appreciable differences between the average dose to an American Indian individual and a non–American Indian individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on American Indian populations surrounding each facility site.

Table J–35. Waste Management Alternatives – Total, American Indian, and Non–American Indian Population and Average Individual Doses in Year of Maximum Impact

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	American Indian Population Dose (person-rem)	American Indian Individual Average Dose (millirem)	Non-American Indian Population Dose (person-rem)	Non-American Indian Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	1.8×10^{-5}	3.7×10^{-8}	2.2×10^{-7}	2.1×10^{-8}	1.8×10^{-5}	3.7×10^{-8}
Total	$\mathbf{1.8\times10^{-5}}$	$\mathbf{3.7\times10^{-8}}$	$\mathbf{2.2\times10^{-7}}$	$\mathbf{2.1\times10^{-8}}$	$\mathbf{1.8\times10^{-5}}$	$\mathbf{3.7\times10^{-8}}$
Alternative 3						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	1.8×10^{-5}	3.7×10^{-8}	2.2×10^{-7}	2.1×10^{-8}	1.8×10^{-5}	3.7×10^{-8}
Total	$\mathbf{1.8\times10^{-5}}$	$\mathbf{3.7\times10^{-8}}$	$\mathbf{2.2\times10^{-7}}$	$\mathbf{2.1\times10^{-8}}$	$\mathbf{1.8\times10^{-5}}$	$\mathbf{3.7\times10^{-8}}$

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–36 compares average individual doses to Hispanic and non-Hispanic populations under each Waste Management alternative to examine the potential for disproportionately high and adverse impacts. These impacts would be the same regardless of disposal group. There are no appreciable differences between the average dose to a Hispanic individual and a non-Hispanic individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on Hispanic or Latino populations surrounding each facility site.

Table J–36. Waste Management Alternatives – Total, Hispanic, and Non-Hispanic Population and Average Individual Doses in Year of Maximum Impact

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Hispanic Population Dose[a] (person-rem)	Hispanic Individual Average Dose[a] (millirem)	Non-Hispanic Population Dose (person-rem)	Non-Hispanic Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	1.8×10^{-5}	3.7×10^{-8}	4.6×10^{-6}	3.1×10^{-8}	1.3×10^{-5}	4.0×10^{-8}
Total	$\mathbf{1.8\times10^{-5}}$	$\mathbf{3.7\times10^{-8}}$	$\mathbf{4.6\times10^{-6}}$	$\mathbf{3.1\times10^{-8}}$	$\mathbf{1.3\times10^{-5}}$	$\mathbf{4.0\times10^{-8}}$
Alternative 3						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	1.8×10^{-5}	3.7×1^{-8}	4.6×10^{-6}	3.1×10^{-8}	1.3×10^{-5}	4.0×10^{-8}
Total	$\mathbf{1.8\times10^{-5}}$	$\mathbf{3.7\times1^{-8}}$	$\mathbf{4.6\times10^{-6}}$	$\mathbf{3.1\times10^{-8}}$	$\mathbf{1.3\times10^{-5}}$	$\mathbf{4.0\times10^{-8}}$

[a] Includes all individuals, regardless of race, who identified themselves as Hispanic or Latino.

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–37 compares average individual doses to low-income and non-low-income populations under each Waste Management alternative to examine the potential for disproportionately high and adverse impacts. These impacts would be the same regardless of disposal group. There are no appreciable differences between the average dose to a low-income individual and a non-low-income individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on low-income populations surrounding each facility site.

Table J–37. Waste Management Alternatives – Total, Low-Income, and Non-Low-Income Population and Average Individual Doses in Year of Maximum Impact

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Low-Income Population Dose (person-rem)	Low-Income Individual Average Dose (millirem)	Non-Low-Income Population Dose (person-rem)	Non-Low-Income Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0.	0	0
STTS-West	1.8×10^{-5}	3.7×10^{-8}	2.3×10^{-6}	2.9×10^{-8}	1.6×10^{-5}	3.8×10^{-8}
Total	$\mathbf{1.8\times10^{-5}}$	$\mathbf{3.7\times10^{-8}}$	$\mathbf{2.3\times10^{-6}}$	$\mathbf{2.9\times10^{-8}}$	$\mathbf{1.6\times10^{-5}}$	$\mathbf{3.8\times10^{-8}}$
Alternative 3						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	1.8×10^{-5}	3.7×10^{-8}	2.3×10^{-6}	2.9×10^{-8}	1.6×10^{-5}	3.8×10^{-8}
Total	$\mathbf{1.8\times10^{-5}}$	$\mathbf{3.7\times10^{-8}}$	$\mathbf{2.3\times10^{-6}}$	$\mathbf{2.9\times10^{-8}}$	$\mathbf{1.6\times10^{-5}}$	$\mathbf{3.8\times10^{-8}}$

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–38 compares the average individual doses to minority and nonminority populations under each Waste Management alternative over the lifetime of the project to examine the potential for disproportionately high and adverse impacts. These impacts would be the same regardless of disposal group. There are no appreciable differences between the average dose to a minority individual and a nonminority individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on minority populations surrounding each facility site.

Table J–38. Waste Management Alternatives – Total, Minority, and Nonminority Population and Average Individual Doses Over the Life of the Project

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Minority Population Dose (person-rem)	Minority Individual Average Dose (millirem)	Nonminority Population Dose (person-rem)	Nonminority Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	6.7×10^{-4}	1.4×10^{-6}	2.1×10^{-4}	1.2×10^{-6}	4.6×10^{-4}	1.5×10^{-6}
Total	$\mathbf{6.7\times10^{-4}}$	$\mathbf{1.4\times10^{-6}}$	$\mathbf{2.1\times10^{-4}}$	$\mathbf{1.2\times10^{-6}}$	$\mathbf{4.6\times10^{-4}}$	$\mathbf{1.5\times10^{-6}}$
Alternative 3						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	6.7×10^{-4}	1.4×10^{-6}	2.1×10^{-4}	1.2×10^{-6}	4.6×10^{-4}	1.5×10^{-6}
Total	$\mathbf{6.7\times10^{-4}}$	$\mathbf{1.4\times10^{-6}}$	$\mathbf{2.1\times10^{-4}}$	$\mathbf{1.2\times10^{-6}}$	$\mathbf{4.6\times10^{-4}}$	$\mathbf{1.5\times10^{-6}}$

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–39 compares the average individual doses to American Indian and non–American Indian populations under each Waste Management alternative over the lifetime of the project to examine the potential for disproportionately high and adverse impacts. These impacts would be the same regardless of disposal group. There are no appreciable differences between the average dose to an American Indian individual and a non–American Indian individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on American Indian populations surrounding each facility site.

Table J–39. Waste Management Alternatives – Total, American Indian, and Non–American Indian Population and Average Individual Doses Over the Life of the Project

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	American Indian Population Dose (person-rem)	American Indian Individual Average Dose (millirem)	Non–American Indian Population Dose (person-rem)	Non–American Indian Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	6.7×10^{-4}	1.4×10^{-6}	8.3×10^{-6}	8.0×10^{-7}	6.6×10^{-4}	1.4×10^{-6}
Total	**6.7×10^{-4}**	**1.4×10^{-6}**	**8.3×10^{-6}**	**8.0×10^{-7}**	**6.6×10^{-4}**	**1.4×10^{-6}**
Alternative 3						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0.	0	0
STTS-West	6.7×10^{-4}	1.4×10^{-6}	8.3×10^{-6}	8.0×10^{-7}	6.6×10^{-4}	1.4×10^{-6}
Total	**6.7×10^{-4}**	**1.4×10^{-6}**	**8.3×10^{-6}**	**8.0×10^{-7}**	**6.6×10^{-4}**	**1.4×10^{-6}**

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–40 compares the average individual doses to Hispanic and non-Hispanic populations under each Waste Management alternative over the lifetime of the project to examine the potential for disproportionately high and adverse impacts. These impacts would be the same regardless of the disposal groups. There are no appreciable differences between the average dose to a Hispanic individual and a non-Hispanic individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on American Indian populations surrounding each facility site.

Table J–40. Waste Management Alternatives – Total, Hispanic, and Non-Hispanic Population and Average Individual Doses Over the Life of the Project

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Hispanic Population Dose[a] (person-rem)	Hispanic Individual Average Dose[a] (millirem)	Non-Hispanic Population Dose (person-rem)	Non-Hispanic Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	6.7×10^{-4}	1.4×10^{-6}	1.8×10^{-4}	1.2×10^{-6}	4.9×10^{-4}	1.5×10^{-6}
Total	$\mathbf{6.7\times10^{-4}}$	$\mathbf{1.4\times10^{-6}}$	$\mathbf{1.8\times10^{-4}}$	$\mathbf{1.2\times10^{-6}}$	$\mathbf{4.9\times10^{-4}}$	$\mathbf{1.5\times10^{-6}}$
Alternative 3						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	6.7×10^{-4}	1.4×10^{-6}	1.8×10^{-4}	1.2×10^{-6}	4.9×10^{-4}	1.5×10^{-6}
Total	$\mathbf{6.7\times10^{-4}}$	$\mathbf{1.4\times10^{-6}}$	$\mathbf{1.8\times10^{-4}}$	$\mathbf{1.2\times10^{-6}}$	$\mathbf{4.9\times10^{-4}}$	$\mathbf{1.5\times10^{-6}}$

[a] Includes all individuals, regardless of race, who identified themselves as Hispanic or Latino.

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–41 compares the average individual doses to low-income and non-low-income populations under each Waste Management alternative over the lifetime of the project to examine the potential for disproportionately high and adverse impacts. These impacts would be the same regardless of disposal group. There are no appreciable differences between the average dose to a low-income individual and a non-low-income individual under any of the alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on low-income populations surrounding each facility site.

Table J–41. Waste Management Alternatives – Total, Low-Income, and Non-Low-Income Population and Average Individual Doses Over the Life of the Project

Facility Site	Total Population Dose (person-rem)	Individual Average Dose (millirem)	Low-Income Population Dose (person-rem)	Low-Income Individual Average Dose (millirem)	Non-Low-Income Population Dose (person-rem)	Non-Low-Income Individual Average Dose (millirem)
Alternative 1						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	0	0	0	0	0	0
Total	**0**	**0**	**0**	**0**	**0**	**0**
Alternative 2						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	6.7×10^{-4}	1.4×10^{-6}	8.9×10^{-5}	1.1×10^{-6}	5.8×10^{-4}	1.4×10^{-6}
Total	$\mathbf{6.7\times10^{-4}}$	$\mathbf{1.4\times10^{-6}}$	$\mathbf{8.9\times10^{-5}}$	$\mathbf{1.1\times10^{-6}}$	$\mathbf{5.8\times10^{-4}}$	$\mathbf{1.4\times10^{-6}}$
Alternative 3						
WTP	0	0	0	0	0	0
STTS-East	0	0	0	0	0	0
STTS-West	6.7×10^{-4}	1.4×10^{-6}	8.9×10^{-5}	1.1×10^{-6}	5.8×10^{-4}	1.4×10^{-6}
Total	$\mathbf{6.7\times10^{-4}}$	$\mathbf{1.4\times10^{-6}}$	$\mathbf{8.9\times10^{-5}}$	$\mathbf{1.1\times10^{-6}}$	$\mathbf{5.8\times10^{-4}}$	$\mathbf{1.4\times10^{-6}}$

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–42 presents the maximum annual dose and cancer fatality risk to an MEI located at the boundary of the Yakama Reservation. The results of this analysis show that the probability of an individual at this location to develop an LCF from radioactive releases during normal operations would essentially be zero. In addition, the maximum annual dose to a MEI residing at the reservation boundary would be approximately one order of magnitude less than the maximum annual dose to an MEI at the Hanford boundary under all Waste Management alternatives.

Table J–42. Waste Management Alternatives – Maximum Annual Dose and Risk to the Maximally Exposed Individual at the Boundary of the Yakama Reservation

Alternative	WTP	STTS-East	STTS-West	Total	Risk[a]
	Dose (millirem)				
1	0	0	0	0	0
2	0	0	2.1×10^{-8}	2.1×10^{-8}	1×10^{-14}
3	0	0	2.1×10^{-8}	2.1×10^{-8}	1×10^{-14}

[a] Cancer risk is the probability of developing a latent cancer fatality, which is estimated by multiplying the dose by the risk factor of 0.0006 latent cancer fatalities per rem (DOE 2003).

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table J–43 presents the dose and cancer fatality risk over the lifetime of the project to an MEI located at the boundary of the Yakama Reservation. The results of this analysis show that the probability of an individual at this location to develop an LCF from radioactive releases during normal operations would essentially be zero. In addition, the dose to an MEI residing at the reservation boundary over the life of the project would be approximately one order of magnitude less than the dose to an MEI at the Hanford boundary over the life of the project under all Waste Management alternatives.

Table J–43. Waste Management Alternatives – Dose and Risk to the Maximally Exposed Individual Located at the Boundary of the Yakama Reservation Over the Life of the Project

Alternative	Duration of Exposure (years)	WTP	STTS-East	STTS-West	Total	Risk[a]
		Dose (millirem)				
1	0[b]	0	0	0	0	0
2	39	0	0	8.1×10^{-7}	8.1×10^{-7}	5×10^{-13}
3	39	0	0	8.1×10^{-7}	8.1×10^{-7}	5×10^{-13}

[a] Cancer risk is the probability of developing a latent cancer fatality, which is estimated by multiplying the dose by the risk factor of 0.0006 latent cancer fatalities per rem (DOE 2003).

[b] There would be no incremental radiological air releases above current facility operations reported as part of the baseline in the affected environment section of this *TC & WM EIS*.

Key: STTS-East=200-East Area Supplemental Treatment Technology Site; STTS-West=200-West Area Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Appendix K, Section K.3.6 discusses the radiological and chemical consequences of facility accidents under each Waste Management alternative. Examination of the risks under each alternative shows that there would be essentially no LCFs per year for the offsite population, including minority and low-income populations due to radiological emissions. Potential risks from hazardous chemical impacts from reasonably foreseeable accidents would be encompassed by those discussed in Section J.5.6.2.2 under the FFTF Decommissioning alternatives. Therefore, these alternatives would not pose disproportionately high and adverse impacts on minority or low-income populations.

J.5.6.2 Air Quality

Air quality impacts were not analyzed separately for each subset population because the results would be similar to those for radiological impacts (see Section J.5.6.2); because there were no disproportionately high and adverse health or environmental impacts on minority, American Indian, Hispanic, or low-income populations due to radiological air releases during normal operations, the same would be true for nonradioactive air emissions.

J.5.6.3 Groundwater Resources: Long-Term Human Health Impacts

Appendix Q, Section Q.3 evaluated groundwater impacts and associated potential long-term human health effects for each Tank Closure, FFTF Decommissioning, and Waste Management alternative. Receptors analyzed with a potential for environmental justice concerns include a resident farmer, an American Indian resident farmer, and an American Indian hunter-gatherer. The hypothetical resident farmer and American Indian resident farmer were both assumed to use only groundwater for drinking water ingestion and crop irrigation. While only a portion of the food consumed by the resident farmer was assumed to come from crops and animal products exposed to contaminated groundwater, all of the food consumed by the American Indian resident farmer was assumed to be exposed to contaminated groundwater. The American Indian hunter-gatherer was assumed to have a subsistence consumption pattern that differs from that of the American Indian resident farmer. The American Indian hunter-gatherer does not cultivate crops but gathers food from indigenous plants, harvests fish from the Columbia River, and is exposed to a combination of surface water and groundwater. Given these assumptions, the two American Indian receptors would be most at risk from contaminated groundwater. These receptors were used to develop exposure scenarios at several on- and offsite locations identified in Appendix O, Section O.1.2.2 and Appendix Q, Section Q.2.2.

J.5.6.3.1 Tank Closure Alternatives

Results of the analysis of groundwater contamination under the Tank Closure alternatives for the American Indian receptors are presented in Appendix Q, Tables Q–20 through Q–208. Long-term human health impacts of Tank Closure actions would be greatest under Tank Closure Alternative 1. Radiological releases under this alternative would result in the doses at the A and B Barriers and the Core Zone Boundary exceeding regulatory limits for the resident farmer, American Indian resident farmer, and the American Indian hunter-gatherer; the dose at the S Barrier would exceed regulatory limits for the American Indian resident farmer and American Indian hunter-gatherer; at the T Barrier, for the American Indian hunter-gatherer. None of the hypothetical receptors at the Columbia River nearshore or surface-water locations would be exposed to a dose in excess of regulatory limits. Nonradiological releases under this alternative would result in exceedance of the Hazard Index for chromium and nitrate at all onsite locations analyzed for the resident farmer, American Indian resident farmer, and American Indian hunter-gatherer. The analysis determined that the greatest impact of any alternative on long-term human health would result in radiological doses in excess of regulatory limits and chemical exposures with a Hazard Index greater than 1 for receptors located on site at the A, B, S, T, or U Barriers, the Core Zone Boundary, or the Columbia River nearshore. There are no such onsite receptors currently at Hanford. The onsite exposure scenarios do not currently exist and have never existed during Hanford operations. Therefore, the estimated high health risks for past years are hypothetical risks only; no persons were ever exposed at these levels. While it is possible for these receptor scenarios to develop in the future, none are expected within a reasonably foreseeable timeframe because the Core Zone is designated for Industrial-Exclusive land use, the Columbia River nearshore location is designated for Preservation (Hanford Reach National Monument), and the area between them is designated for Conservation (Mining) (DOE 1999). It is unlikely, therefore that any of the Tank Closure alternatives would pose a disproportionately high and adverse long-term human health risk to the American Indian population at offsite locations. The greatest risk would be to the American Indian resident farmer at the

Core Zone Boundary. During the year of peak dose, this receptor would receive a radiological dose of 3.4 rem. During the year of peak Hazard Index, this receptor would be exposed to chemicals resulting in a Hazard Index greater than 1. The adverse impacts would also be applicable to the non–American Indian receptors at the same locations, but to a lesser extent.

J.5.6.3.2 FFTF Decommissioning Alternatives

Results of the analysis of groundwater contamination under the FFTF Decommissioning alternatives for the American Indian receptors are presented in Appendix Q, Tables Q–213 through Q–218. Long-term human health impacts of FFTF decommissioning actions would be greatest under FFTF Decommissioning Alternative 1. Under this alternative, none of the hypothetical receptors at any of the assessment boundaries would receive a radiological dose in excess of regulatory limits or a chemical exposure with a Hazard Index greater than 1. The greatest risk would be to the American Indian resident farmer at the FFTF boundary. During the year of peak dose, this receptor would receive a radiological dose of 3.8 millirem, compared to the regulatory limit of 100 millirem from all sources. During the year of peak Hazard Index, this receptor would be exposed to chemicals resulting in a Hazard Index less than 1. Therefore, none of the FFTF Decommissioning alternatives would pose a disproportionately high and adverse long-term human health risk to the American Indian population at offsite locations.

J.5.6.3.3 Waste Management Alternatives

Results of the analysis of groundwater contamination under the Waste Management alternatives for the American Indian receptors are presented in Appendix Q, Tables Q–220 through Q–358. Long-term human health impacts of waste management actions would be greatest under Waste Management Alternative 2, Disposal Group 1, Subgroup 1-D. Radiological releases under this alternative would result in the doses at the 200-East Area Integrated Disposal Facility (IDF-East) Barrier and the Core Zone Boundary exceeding regulatory limits for the resident farmer and the American Indian resident farmer. None of the hypothetical receptors at the River Protection Project Disposal Facility Barrier, the Columbia River nearshore, or the Columbia River surface-water location would be exposed to a dose in excess of regulatory limits. Nonradiological releases under this alternative would result in exceedance of the Hazard Index for chromium at the IDF-East Barrier, Core Zone Boundary, and Columbia River nearshore for the resident farmer and the American Indian resident farmer. The analysis determined that the greatest impact of any alternative on long-term human health would result in radiological doses in excess of regulatory limits and chemical exposures with a Hazard Index greater than 1 for receptors located on site at the IDF-East Barrier, the Core Zone Boundary, or the Columbia River nearshore. There are no such onsite receptors currently at Hanford. The onsite exposure scenarios do not currently exist and have never existed during Hanford operations. Therefore, the estimated high health risks for past years are hypothetical risks only; no persons were ever exposed at these levels. While it is possible for these receptor scenarios to develop in the future, none are expected within a reasonably foreseeable timeframe because the Core Zone is designated for Industrial-Exclusive land use, the Columbia River nearshore location is designated for Preservation (Hanford Reach National Monument), and the area between them is designated for Conservation (Mining) (DOE 1999). It is unlikely, therefore, that any of the Waste Management alternatives would pose a disproportionately high and adverse long-term human health risk to the American Indian population. The greatest risk would be to the American Indian resident farmer at the IDF-East boundary. During the year of peak dose, this receptor would receive a radiological dose of 281 millirem. During the year of peak Hazard Index, this receptor would be exposed to chemicals resulting in a Hazard Index greater than 1. The adverse impacts would also be applicable to non-American Indian receptors at the same locations, but to a lesser extent.

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APPENDIX K
HUMAN HEALTH RISK ANALYSIS

This appendix presents the methodologies and assumptions used for estimating potential impacts on, and risks to, individuals and the general public from exposure to releases of radioactive and hazardous chemical materials during normal operations and as a result of hypothetical accidents. It also presents the methodology that was used to assess industrial safety. This information is intended to support the public and occupational health and safety assessments described in Chapter 4 of this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*. Section K.1 presents background information on the nature and hazards of radiation and chemicals. Section K.2 presents the methodology used in the assessment of normal radiological impacts, followed by the results of the radiological impact analyses. Section K.3 presents the assumptions and methodologies used in the assessment of facility accidents, followed by presentation of the impacts of accidental radioactive material and hazardous chemical releases. Section K.4 discusses the method used for assessment of industrial safety.

K.1 BACKGROUND

K.1.1 Radiation

Radiation exposure and its consequences are topics of interest to the general public. For this reason, this *Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington (TC & WM EIS)* provides the reader with information regarding the consequences of exposure to radiation, provides the reader with information about the nature of radiation, and explains the basic concepts used to evaluate radiation health effects.

K.1.1.1 What Is Radiation?

Radiation is energy and/or mass transferred in the form of particles or waves. Globally, human beings are exposed constantly to radiation from cosmic sources (outer space); terrestrial sources, such as the Earth's rocks and soils; and radionuclides naturally present in the body. This radiation contributes to the natural background radiation that always surrounds us. Manmade sources of radiation also exist, including medical and dental x-rays, household smoke detectors, and materials released from nuclear and coal-fired power plants.

All matter in the universe is composed of atoms. Radiation comes from the activity of tiny particles within an atom. An atom consists of a positively charged nucleus (central part of an atom) with a number of negatively charged electron particles in various orbits around the nucleus. There are two types of particles in the nucleus: neutrons, which are electrically neutral, and protons, which are positively charged. Atoms with different numbers of protons are known as "elements." There are more than 100 natural and manmade elements. An element has equal numbers of electrons and protons. When atoms of an element differ in their number of neutrons, they are called "isotopes" of that element. All elements have three or more isotopes, some or all of which could be unstable (i.e., change over time).

Unstable isotopes undergo spontaneous change, known as "radioactive disintegration" or "radioactive decay." The process of continuously undergoing spontaneous disintegration is called "radioactivity." The "radioactivity" of a material decreases with time. The time it takes a material to lose half of its original radioactivity is its half-life. An isotope's half-life is a measure of its decay rate. For example, an isotope with a half-life of 8 days will lose one-half of its radioactivity in that amount of time. In 8 more days, one-half of the remaining radioactivity will be lost, and so on. Each radioactive element has a characteristic half-life. The half-lives of various radioactive elements may vary from millionths of a second to millions of years.

As unstable isotopes change into more-stable forms, they emit energy and/or particles (mass). A particle may be either an alpha particle (a helium nucleus), a beta particle (an electron), or a neutron, with various levels of kinetic energy. Sometimes these particles are emitted in conjunction with gamma rays. The particles and gamma rays are referred to as "ionizing radiation." Ionizing radiation means that the particles and gamma rays can ionize, or electrically charge, an atom by stripping off one or more of its electrons. Even though gamma rays do not carry an electric charge, they can ionize atoms by ejecting electrons as they pass through an element. Thus, they cause ionization indirectly. Ionizing radiation can change the chemical composition of many things, including living tissue (organs), which can affect the way they function.

When a radioactive isotope of an element emits a particle, it changes to an entirely different element or isotope, one that may or may not be radioactive. Eventually, a stable element is formed. This transformation, which may take several steps, is known as a "decay chain." For example, radium, a member of the radioactive decay chain of uranium, has a half-life of 1,622 years. It emits an alpha particle and becomes radon, a radioactive gas with a half-life of only 3.8 days. Radon decays first to polonium, then through a series of further decay steps to bismuth, and ultimately to a stable isotope of lead. The characteristics of various forms of ionizing radiation are briefly described below.

Alpha (α) particles—Alpha particles are the heaviest type of ionizing radiation. They can travel only a few centimeters in air. Alpha particles lose their energy almost as soon as they collide with anything. They can be stopped easily by a sheet of paper or by the skin's surface.

Beta (β) particles—Beta particles are much (7,300 times) lighter than alpha particles. They can travel a longer distance than alpha particles in the air. A high-energy beta particle can travel a few meters in the air. Beta particles can pass through a sheet of paper, but may be stopped by a thin sheet of aluminum foil or glass.

Gamma (γ) rays—Gamma rays (and x-rays), unlike alpha or beta particles, are waves of pure energy. Gamma rays travel at the speed of light. Gamma radiation is very penetrating and requires a large mass, such as a thick wall of concrete, lead, or steel, to stop it.

Neutrons (n)—Neutrons are particles that contribute to radiation exposure both directly and indirectly. The most prolific source of neutrons is a nuclear reactor. Indirect radiation exposure occurs when gamma rays and alpha particles are emitted following neutron capture in matter. A neutron has about one-quarter the weight of an alpha particle. It will travel in the air until it is absorbed by another element.

K.1.1.1.1 Measurement Units for Radiation

During the early days of radiological experimentation, there was no precise measurement unit for radiation. Therefore, a variety of units were used to determine the amount, type, and intensity of radiation. Just as heat can be measured in terms of its intensity or effects using units of calories or degrees, amounts of radiation or its effects can be measured in units of curies, radiation absorbed dose (rad), or dose equivalent (roentgen equivalent man, or rem). The following paragraphs describe the basis for these units.

Curie—The curie, named after the scientists Marie and Pierre Curie, describes the "intensity" or activity of a sample of radioactive material. The rate of decay of 1 gram of radium was the basis of this unit of measure. Because the measured decay rate kept changing slightly as measurement techniques became more accurate, the curie was subsequently defined as exactly 37 billion disintegrations (decays) per second.

Rad—The rad is used to measure the physical absorption of radiation. The total energy absorbed per unit quantity of tissue is referred to as "absorbed dose" (or simply dose). As sunlight heats pavement by giving up an amount of energy to it, radiation similarly gives up energy to objects in its path. One rad is equal to the amount of radiation that leads to the deposition of 0.01 joule of energy per kilogram of absorbing material.

Rem—A rem is used to measure dose equivalent. The dose equivalent in rem equals the absorbed dose in rads in tissue multiplied by the appropriate quality factor (the biological effectiveness of a given type of radiation) and possibly other modifying factors. The rem is used in measuring the effects of radiation on the body similar to the way degrees Celsius or Fahrenheit (°C or °F) are used in measuring the effects of sunlight heating pavement. Thus, 1 rem from one type of radiation is presumed to have the same biological effects as 1 rem from any other kind of radiation. This allows comparison of the biological effects of radionuclides that emit different types of radiation. One thousandth of a rem is called a "millirem."

Person-rem—A person-rem used to measure collective radiation dose, i.e., the sum of the individual doses received by a population or group from exposure to a specified source of radiation.

Equivalent Radiation Units in the International System of Units

Traditional Unit	International System Unit
1 curie	3.7×10^{10} becquerel (Bq)
1 rad	0.01 gray (Gy)
1 rem	0.01 sieverts (Sv)

The units of measure for radiation in the International System of Units are becquerels (used to measure source intensity [activity]), grays (used to measure absorbed dose), and sieverts (used to measure dose equivalent).

An individual may be exposed to ionizing radiation externally (from a radioactive source outside the body) or internally (from ingesting or inhaling radioactive material). The external dose is different from the internal dose because an external dose is delivered only during the actual time of exposure to the external radiation source, while an internal dose continues to be delivered as long as the radioactive source is in the body. The dose from internal exposure is typically calculated over 50 years following the initial exposure. Both radioactive decay and elimination of the radionuclide by ordinary metabolic processes decrease the dose rate with the passage of time.

Doses projected from normal operations and from accidents are reported in terms of total effective dose equivalent, the sum of the effective dose equivalent due to penetrating radiation from sources external to the body and the committed effective dose equivalent from internal deposition of radionuclides. The committed effective dose equivalent is an estimate of the radiation dose to a person resulting from inhalation or ingestion of radioactive material that takes into account the radiation sensitivities of different organs and the time (up to 50 years) a particular substance stays in the body (further discussed in Section K.1.1.1.3).

K.1.1.1.2 Sources of Radiation

The average American receives a total dose of approximately 365 millirem per year from all sources of radiation, both natural and manmade; approximately 300 millirem per year of this total are from natural sources (NCRP 1987). The sources of radiation can be divided into six different categories: (1) cosmic radiation, (2) terrestrial radiation, (3) internal radiation, (4) consumer products, (5) medical diagnosis and therapy, and (6) other sources. These categories are discussed in the following paragraphs.

Cosmic radiation—Cosmic radiation is ionizing radiation resulting from energetic charged particles from space continuously hitting the Earth's atmosphere. These particles, and the secondary particles and photons they create, constitute cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with the altitude above sea

level. The average dose to a person in the United States from this source is approximately 30 millirem per year.

External terrestrial radiation—External terrestrial radiation is the radiation emitted from the radioactive materials in the Earth's rocks and soils. The average individual dose from external terrestrial radiation is approximately 30 millirem per year.

Internal radiation—Internal radiation results from inhalation or ingestion of natural radioactive material. Natural radionuclides in the body include isotopes of uranium, thorium, radium, radon, polonium, bismuth, potassium, rubidium, and carbon. The major contributors to the annual dose equivalent for internal radioactivity are the short-lived decay products of radon, which contribute approximately 200 millirem per year. The average individual dose from other internal radionuclides is approximately 40 millirem per year.

Consumer products—Consumer products also contain sources of ionizing radiation. In some products, such as smoke detectors and airport x-ray machines, the radiation source is essential to the product's operation. In other products, such as televisions and tobacco, the radiation occurs as the products function. The average dose from consumer products is approximately 10 millirem per year.

Medical diagnosis and therapy—Radiation is an important diagnostic medical tool and cancer treatment. Diagnostic x-rays result in an average dose of 39 millirem per year. Nuclear medical procedures result in an average dose of 14 millirem per year.[1]

Other sources—There are a few additional sources of radiation that contribute minor doses to individuals in the United States. The dose from nuclear fuel cycle facilities (e.g., uranium mines, mills, and fuel processing plants) and nuclear power plants has been estimated to be less than 1 millirem per year. Radioactive fallout from atmospheric atomic bomb tests, emissions from certain mineral extraction facilities, and transportation of radioactive materials contribute less than 1 millirem per year to the average dose to an individual. Air travel contributes approximately 1 millirem per year to the average dose.

K.1.1.1.3 Exposure Pathways

As stated earlier, an individual may be exposed to ionizing radiation both externally and internally. The different routes that could lead to radiation exposure are called "exposure pathways." Each type of exposure and its associated exposure pathways are discussed separately in the following paragraphs.

External exposure—External exposure results from exposure to radiation outside the body via any of several different pathways, including exposure to a cloud of radiation passing over the receptor (an exposed individual), standing on ground that is contaminated with radioactivity, and swimming or boating in contaminated water. If the receptor departs from the source of radiation exposure, the dose rate will decrease. It was assumed that external exposure occurs uniformly during the year. The appropriate dose measure for external pathways is called the "effective dose equivalent."

Internal exposure—Internal exposure results from a radiation source entering the human body through either inhalation of contaminated air or ingestion of contaminated food or water. In contrast to external exposure, once a radiation source enters the body, it remains there for a period of time that varies depending on its biological half-life (the time required for a radioactive material taken in by a living organism to be reduced to half the initial quantity by a combination of biological elimination

[1] Exposures from nuclear diagnostic and medical procedures vary over a wide range depending on the procedure. The reported values are average annual doses in the U.S. population (NCRP 1987).

processes and radioactive decay). The absorbed dose to each organ of the body is calculated for a period of 50 years following the intake. The calculated absorbed dose is called the "committed dose equivalent." Various organs have different susceptibilities to harm from radiation. The quantity that takes these different susceptibilities into account is called the "committed effective dose equivalent"; it provides a broad indicator of the risk to the health of an individual from radiation. The committed effective dose equivalent is a weighted sum of the committed dose equivalent in each major organ or tissue. The concept of committed effective dose equivalent applies only to internal pathways.

K.1.1.1.4 Radiation Protection Guides

Various organizations have issued radiation protection guides. The responsibilities of the main radiation safety organizations, particularly those that affect policies in the United States, are summarized below.

International Commission on Radiological Protection (ICRP)—The ICRP is responsible for providing guidance in matters of radiation safety. The operating policy of this organization is to prepare recommendations that address basic principles of radiation protection, leaving to the various national protection committees the responsibility to prepare detailed technical regulations, recommendations, or codes of practice best suited to the needs of their countries.

National Council on Radiation Protection and Measurements—In the United States, this council is the national organization responsible for adapting and providing detailed technical guidelines to implement ICRP recommendations. The council consists of technical experts who are specialists in radiation protection and scientists who are experts in disciplines that form the basis for radiation protection.

National Research Council/National Academy of Sciences—The National Research Council, which functions under the auspices of the National Academy of Sciences, integrates the broad science and technology community with the Academy's mission to further knowledge and advise the Federal Government. The National Research Council's Committee on the Biological Effects of Ionizing Radiation (BEIR Committee) prepares reports to advise the Federal Government on the health consequences of radiation exposure.

U.S. Environmental Protection Agency (EPA)—EPA has published a series of documents, *Radiation Protection Guidance to Federal Agencies*. This guidance is used as a regulatory benchmark by a number of Federal agencies, including the U.S. Department of Energy (DOE), in the realm of limiting public and occupational workforce exposures to the greatest extent possible.

U.S. Nuclear Regulatory Commission (NRC)—NRC regulates source materials, special nuclear materials, and byproduct materials used by commercial entities, such as nuclear power plants, either directly or through state agreements. NRC has promulgated "Standards for Protection Against Radiation" in Title 10 of the *Code of Federal Regulations* (CFR), Part 20 (10 CFR 20), which apply to commercial uses of the materials listed above.

U.S. Department of Energy (DOE)—DOE establishes requirements for radiological protection at DOE sites in regulations and orders. Requirements for worker protection are included in 10 CFR 835. Radiological protection of the public and environment are addressed in DOE Order 5400.5.

K.1.1.2 Limits of Radiation Exposure

Limits of exposure to members of the public and radiation workers are derived from ICRP recommendations. EPA uses National Council on Radiation Protection and Measurements and ICRP recommendations to set specific annual exposure limits (usually less than those specified by the ICRP) in its radiation protection guidance to federal agencies documents. Each regulatory organization then

establishes its own set of radiation standards. The various exposure limits set by DOE and EPA for radiation workers and members of the public are given in Table K–1.

Table K–1. Exposure Limits for Members of the Public and Radiation Workers

Guidance Criteria (Organization)	Public Exposure Limits at the Site Boundary	Worker Exposure Limits
10 CFR 835 (DOE)	–	5,000 millirem per year[a]
10 CFR 835.1002 (DOE)	–	1,000 millirem per year[b]
DOE Order 5400.5 (DOE)[c]	10 millirem per year (all air pathways) 4 millirem per year (drinking-water pathways) 100 millirem per year (all pathways)	–
40 CFR 61.90–61.97 (EPA)	10 millirem per year (all air pathways)	–
40 CFR 141 (EPA)	4 millirem per year (drinking-water pathways)	–

[a] Although this measurement is a limit (or level) that is enforced by DOE, worker doses must be managed in accordance with as low as is reasonably achievable principles. Refer to footnote b.

[b] This measurement is a control level. It was established by DOE to assist in achieving its goal to maintain radiological doses as low as is reasonably achievable. DOE recommends that facilities adopt a more-limiting 500 millirem per year Administrative Control Level (DOE Standard 1098-99). Reasonable attempts have to be made by the site to maintain individual worker doses below these levels.

[c] Derived from or consistent with 40 CFR 61.90–61.97; 40 CFR 141; and 10 CFR 20.

Key: CFR=*Code of Federal Regulations*; DOE=U.S. Department of Energy; EPA=U.S. Environmental Protection Agency.

K.1.1.3 Health Effects due to Exposure to Radiation

To provide the background for discussions of impacts, this section explains the basic concepts used in the evaluation of radiation effects. Radiation can cause a variety of damaging health effects in people. The most significant effects are induced cancer fatalities, called "latent cancer fatalities" (LCFs) because the onset of cancer may take many years to develop after the radiation dose is received. In this *TC & WM EIS*, LCFs are used to measure the estimated risk due to radiation exposure.

The National Research Council's BEIR Committee has prepared a series of reports to advise the Federal Government on the health consequences of radiation exposure. Based on its 1990 report, *Health Effects of Exposure to Low Levels of Ionizing Radiation, BEIR V* (National Research Council 1990), the former Committee on Interagency Radiation Research and Policy Coordination recommended cancer risk factors of 0.0005 per rem for the public and 0.0004 per rem for working-age populations (CIRRPC 1992). In 2002, the Interagency Steering Committee on Radiation Standards (ISCORS) recommended that Federal agencies use conversion factors of 0.0006 fatal cancers per rem for mortality and 0.0008 cancers per rem for morbidity when making qualitative or semiquantitative estimates of risk from radiation exposure to members of the general public. No separate values were recommended for workers. The DOE Office of Environmental and Policy Guidance subsequently recommended that DOE personnel and contractors use the risk factors recommended by ISCORS, stating that, for most purposes, the value for the general population (0.0006 fatal cancers per rem) could be used for both workers and members of the public in National Environmental Policy Act (NEPA) analyses (DOE 2003).

Recent publications by both the BEIR Committee and the ICRP support the continued use of the ISCORS-recommended risk values. *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2* (National Research Council 2006) reported fatal cancer risk factors of 0.00048 per rem for males and 0.00066 per rem for females in a population with an age distribution similar to that of the entire U.S. population (average value of 0.00057 per rem for a population with equal numbers of males and females). ICRP Publication 103 (Valentin 2007) recommends nominal cancer risk coefficients of 0.00041 and 0.00055 per rem for adults and the general population, respectively, and estimates the risk from heritable effects to be about 3 to 4 percent of the nominal fatal cancer risk (see Table K–2).

Table K–2. Nominal Health Risk Estimators Associated with Exposure to Ionizing Radiation[a]

Exposed Population	Cancer[b]	Genetic Effects	Total
Worker (Adult)[c]	0.00041	0.00001	0.00042
Whole	0.00055	0.00002	0.00057

[a] Risk per rem (individual dose) or person-rem (population dose). For individual doses equal to or greater than 20 rem, the health risk estimators are multiplied by 2.

[b] Risk of all cancers, adjusted for lethality and quality-of-life impacts.

[c] Ages 18–64 years.

Source: Valentin 2007, Table A.4.4.

Accordingly, a risk factor of 0.0006 LCFs per rem was used in this *TC & WM EIS* to estimate risk due to radiation doses from normal operations and accidents. For high individual doses (greater than or equal to 20 rem), the health risk factor was multiplied by 2. In addition, nuclide-specific risk coefficients were developed using techniques accounting for gender, age, and exposure pathway (Eckerman et al. 1999). These coefficients, documented in the Health Effects Assessment Summary Tables database, were adopted for use in evaluation of impacts occurring in the long-term period following stabilization or closure of the high-level radioactive waste (HLW) tanks.

Using the risk factors discussed above, a calculated dose can be used to provide an estimate of the risk of an LCF. For example, if each member of a population of 100,000 people were exposed to a one-time dose of 100 millirem (0.1 rem), the collective dose would be 10,000 person-rem (100,000 persons times 0.1 rem). Using the risk factor of 0.0006 LCFs per person-rem, this collective dose is expected to cause 6 additional LCFs in this population (10,000 person-rem times 0.0006 LCFs per person-rem).

Sometimes, calculations of the number of LCFs do not yield whole numbers, and may yield a number less than 1. For example, if each individual of a population of 100,000 people were to receive an annual dose of 1 millirem (0.001 rem), the collective dose would be 100 person-rem, and the corresponding risk of an LCF would be 0.06 (100,000 persons times 0.001 rem times 0.0006 LCFs per person-rem). A fractional result should be interpreted as a statistical estimate. That is, 0.06 is the average number of LCFs expected if many groups of 100,000 people were to experience the same radiation exposure situation. For most groups, no LCFs would occur; in a few groups, 1 LCF would occur; in a very small number of groups, 2 or more LCFs would occur. The average number of LCFs over all of the groups would be 0.06 (just like the average of 0, 0, 0, and 1 is 1 divided by 4, or 0.25). In the preceding example, the most likely outcome for any single group would be 0 LCFs. In this *TC & WM EIS*, LCFs calculated for a population are presented as both the rounded whole number, representing the most likely outcome for that population, and the calculated statistical estimate of risk, presented in parentheses.

The numerical estimates of LCFs presented in this environmental impact statement (EIS) were obtained using a linear extrapolation from the nominal risk estimated for lifetime total cancer mortality that results from a dose of 0.1 gray (10 rad). Other methods of extrapolation to the low-dose region could yield higher or lower numerical estimates of LCFs. Studies of human populations exposed to low doses are inadequate to demonstrate the actual level of risk. There is scientific uncertainty about cancer risk in the low-dose region below the range of epidemiologic observation. However, comprehensive review of available biological and biophysical data supports a "linear-no-threshold" risk model—in which the risk of cancer proceeds in a linear fashion at lower doses without a threshold—and that the smallest dose has the potential to cause a small increase in risk to humans (National Research Council 2006).

K.1.2 Chemicals

The reprocessing of nuclear fuels, the manufacture of nuclear materials, and the processing of fuel cycle waste entail the use of chemicals. Some of the more-hazardous chemicals could pose risks to human health, even to the point of being fatal, if they are accidentally released to the environment or if they come

into contact with workers in an occupational setting. The risks from exposure are of two general types: toxic, noncarcinogenic (non-cancer-causing) effects and cancer-inducing effects. In addition, the presence of some chemicals may pose a physical hazard to humans, such as chemical burns to the skin or internal organs, explosions or thermal hazards, displacement of oxygen, or runaway chemical reactions that cause high-energy release events.

K.1.2.1 What is a Toxic or Hazardous Chemical?

Nearly every chemical that exists can be detrimental to human health under specific exposure conditions. A large number, both carcinogenic (cancer-causing) and noncarcinogenic, are specifically addressed in Occupational Safety and Health Administration (OSHA) regulations. The exposure limit or guideline for any given substance depends on the basic toxic or hazardous properties of the material, its physical properties (solid, liquid, gas, or vapor), the circumstances of exposure (inhalation, consumption of water or food, or contact with soil or contaminated surfaces), and whether the exposure occurs at a low rate during normal operations or at a high rate as a result of an accident. Occupational exposure limitations and other controls for specific toxic or hazardous chemicals are provided in various sections of the "Occupational Safety and Health Standards" (29 CFR 1910). Acute exposure concentration guidelines for more than 3,000 chemicals have been developed by DOE and others for use in hazards analyses and emergency planning and response (DOE 2008).

K.1.2.2 Usage of Chemicals

Chemical usage can be categorized by either process chemicals or chemicals that support and maintain waste management operations. Process chemicals are those required in the direct processing of wastes. The specific chemicals used depend upon the specific processes chosen. The waste being processed, with its various chemical constituents, also falls into the category of process chemicals. Nonprocess chemicals that support and maintain waste management operations are typically cleaning fluids and lubricants.

K.1.2.3 Exposure Pathways

To cause toxic effects on human biological systems, chemicals must make contact with or be introduced into the body. There are three general means of entry into the body: inhalation, ingestion, and dermal (skin) contact. The effects through a particular pathway will depend essentially on the properties of the toxic chemical, its concentration in one or more environmental media (air, water, and soil), and human behavior. Exposure may be dominated by contact with chemicals in a single medium or may reflect concurrent contacts with multiple media.

K.1.2.4 Chemical Exposure Limits and Criteria

Exposure to chemicals in occupational settings is limited to levels within applicable OSHA Permissible Exposure Limits (29 CFR 1910) or the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (ACGIH 2002). Exposures are typically maintained below the levels specified in these references by either engineered controls or the use of protective equipment.

The flammable and explosive hazards associated with chemicals are typically controlled through standards promulgated by OSHA (29 CFR 1910.106). These standards address the storage, labeling, and information required to be provided to the worker.

For accidental airborne releases of hazardous chemicals into the environment, DOE has specified criteria to be used as indicators of human health impacts resulting from acute exposures (DOE Guide 151.1–2). For each specific hazardous chemical of concern, criteria are drawn from one of the following systems (listed in order of preference): the Acute Exposure Guideline Levels (AEGLs) promulgated by EPA; the Emergency Response Planning Guidelines (ERPGs), published by the American Industrial Hygiene

Association; and the Temporary Emergency Exposure Limits (TEELs), developed by DOE. The system of AEGLs includes values for five exposure periods, ranging from 10 minutes to 8 hours. However, the ERPG and TEEL systems provide values only for exposures of 1 hour. To allow the systems to be used together, DOE has specified that the 1-hour (60-minute) AEGL values are to be used. For the chemicals addressed by each system, three exposure levels (i.e., thresholds), expressed in terms of airborne concentrations, have been developed. Although the specific definitions vary slightly between the systems, the levels of human health impact associated with exposure for 1 hour to each airborne concentration level can be paraphrased as follows: exposures of up to 1 hour at or below level 1 may result in mild, transient, adverse health effects; exposures of up to one hour above level 1 and up to level 2 should not result in irreversible or other serious health effects or symptoms that could impair a person's ability to take protective actions; exposures of up to 1 hour above level 2 and up to level 3 should not result in an experience or development of life-threatening health effects; and exposures of up to 1 hour above level 3 could result in life-threatening health effects or death. DOE has specified that level 2 is the threshold above which unacceptable human health effects may be experienced. At concentrations above level 2, action should be taken to avoid, reduce, or mitigate human exposure. Level 3 has been identified as the threshold above which severe human health effects are expected.

K.1.2.5 Health Effects of Hazardous Chemical Exposure

Various chemicals invoke different types of damage to human biological systems. The harm may even vary according to the sensitivity of each individual person exposed. Hazardous chemical releases from routine operations generally are expected to result in concentrations below levels that would cause acute toxic health effects. Acute toxic health effects generally result from short-term exposure to relatively high concentrations of the toxic contaminant, such as those resulting from accidental releases. Long-term exposure to lower concentrations can produce adverse chronic health effects, both carcinogenic and noncarcinogenic. Excess incidences of cancer are the endpoint of carcinogenic effects. However, a spectrum of chemical-specific noncancer health effects (e.g., headaches, skin irritation, neurotoxicity, immunotoxicity, reproductive and genetic toxicity, liver/kidney toxicity, and developmental toxicity) could be observed due to exposure to noncarcinogenic compounds.

K.1.2.6 Hazardous Chemical Impact Assessment

Illness, injury, and death resulting from industrial accidents in occupational settings (i.e., routine operations) are assessed in the "Industrial Safety" sections of Chapter 4 (see Sections 4.1.15, 4.2.15, 4.3.15, and 4.4.13) and summarized in Chapter 2 (see Sections 2.8.1.15, 2.8.15, and 2.8.3.15. These industrial safety impacts are included in the general industry incidence rates. The remainder of this discussion pertains to the assessment of impacts on populations other than direct facility workers. The results of these assessments for each alternative may be found in Chapter 4, Sections 4.1.11, 4.2.11, and 4.3.11, "Public and Occupational Health and Safety—Facility Accidents." Additional information is also provided in Appendix G, "Air Quality Analysis," and Appendix P, "Ecological Resources and Risk Analysis."

The exposure assessment for accidents estimated how chemicals could travel to a receptor, how these chemicals could come into contact with a receptor's body, and whether the chemicals present in the environmental medium were likely to be of sufficient concentration to cause significant adverse effects. The exposure assessment assumes inhalation to be the only pathway and air the only medium. This simplification was based principally on the volatility of the chemicals released. Normal human behavior also was considered (i.e., an individual was assumed to perform activities under normal conditions). To maximize the impact of the exposure, the analysis also assumed that the released chemicals would remain in the air with no or negligible partitioning to other media (i.e., water and ground). Thus, no dermal contact or ingestion is considered in this assessment.

To determine long-term impacts (see Appendix Q), noncancer health effects were estimated by comparing the annual concentrations of contaminants to the reference concentrations published in the *Integrated Risk Information System* (EPA 2008). The potential toxic effects on an individual from exposure to a toxic chemical were evaluated by dividing the estimated inhalation concentration of that chemical by its reference concentration value to obtain a noncancer Hazard Quotient (EPA 1989). For exposure to multiple compounds, Hazard Quotients were calculated for each toxic chemical and then summed to generate a Hazard Index as shown in the following equation

$$HI = \sum_i \frac{CA_i}{RfC_i}$$

where:

HI	=	Hazard Index
CA_i	=	concentration of the chemical i in the air, micrograms per cubic meter
RfC_i	=	reference concentration for chemical i, micrograms per cubic meter

The Hazard Index is the estimate of the total noncancer toxicity impact. According to the EPA risk assessment guidelines, if the Hazard Index value is less than or equal to 1, the exposure is unlikely to produce adverse toxic effects. However, if it exceeds 1, adverse toxic effects may result from exposure to the considered chemicals.

The risks from exposure to carcinogenic chemicals were evaluated using chemical-specific unit risk factors, which are estimates of the maximum lifetime probability of an individual developing cancer from exposure to the chemical and the chemical concentration in the air. The unit risk factors for carcinogenic chemicals were taken from EPA's *Integrated Risk Information System* database. Therefore, for carcinogenic chemicals, the risk was estimated by the following equation (EPA 1989):

$$\text{Risk} = 1 - e^{(-CA \times URF)}$$

where :

e	=	~2.718
CA	=	contaminant concentration in the air, micrograms per cubic meter
URF	=	unit risk factor for inhalation specific to the contaminant obtained from the Integrated Risk Information System, cancers per micrograms per cubic meter

As the value in the parentheses is generally small (less than 0.01), the equation is simplified to:

$$\text{Risk} = CA \times URF$$

CA	=	contaminant concentration in the air, micrograms per cubic meter
URF	=	unit risk factor for inhalation specific to the contaminant obtained from the Integrated Risk Information System, cancers per micrograms per cubic meter

K.2 NORMAL OPERATIONS

This section describes the methodology used to evaluate the impacts of radiological emissions from tank closure, Fast Flux Test Facility (FFTF) decommissioning, and waste management activities on the public and workers. Dose assessments were performed for members of the general public near Hanford Site (and Idaho National Laboratory [INL] for selected FFTF decommissioning options) to estimate the incremental doses and related risks that would be associated with the alternatives addressed in this *TC & WM EIS*. Incremental doses for members of the public were calculated using the Hanford

Environmental Radiation Dosimetry Software System (Generation II) (GENII) computer code (Napier et al. 1988) for the following receptors:

- *Population*—The general public living within 80 kilometers (50 miles) of the facilities.
- *Maximally exposed individual (MEI)*—The MEI is a hypothetical individual member of the public located at the position near the site boundary that would yield the highest impacts during normal operations.
- *Onsite MEI*—The onsite MEI is a member of the public who works at Hanford but is not associated with DOE facilities or operations. The Columbia Generating Station and the Laser Interferometer Gravitational-Wave Observatory were the two worksites considered. This receptor would only be exposed during a normal work shift.

Impacts were also evaluated for two classes of workers: (1) radiation workers, involved workers who might be exposed to radiation while performing activities associated with the alternatives; and (2) noninvolved workers, onsite workers who may be incidentally exposed as a result of the actions taken to implement a project, but who are not directly involved in the project. Radiological impacts were determined for both radiation workers and noninvolved workers.

K.2.1 Tank Closure Alternatives

K.2.1.1 Impacts on the Public During Normal Operations

This section describes the methodology used to evaluate the impacts of radiological emissions from waste treatment and tank closure activities on the population near Hanford. Later sections of this appendix address any differences in the methodology as it was applied to radiological impacts analysis for FFTF decommissioning and waste management.

K.2.1.1.1 Approach

Under normal operations, radiological releases would occur during activities associated with tank farm operations, including waste retrieval, pretreatment, and treatment and tank farm closure. Small amounts of radioactivity from normal operations may be released in liquid effluents. The liquid effluents would be routed to the Treated Effluent Disposal Facility or the Liquid Effluent Retention Facility/Effluent Treatment Facility, which are existing, state-permitted facilities. Effluents are sampled prior to release and treated, as necessary, using best available technologies to ensure they meet state discharge limits. Based on a previous environmental assessment (DOE 1992), discharges from these facilities were determined to be of no significant impact and therefore are not expected to make a distinguishable difference in the calculated doses to members of the public.

For purposes of evaluating the impacts of radiological air emissions, the activities and facilities associated with each Tank Closure alternative are treated as originating from one of three locations: the Waste Treatment Plant (WTP), the 200-East Area, or the 200-West Area. Releases modeled as originating from the WTP included those from the vitrification and pretreatment facilities. All other activities and facilities in the 200-East Area were modeled as if they were located at the 200-East Area Supplemental Treatment Technology Site (STTS-East) in the southeast corner of the 200-East Area (see Figure K–1). This location has been identified for supplemental technologies (e.g., bulk vitrification, cast stone, or steam reforming) if they are deployed in the 200-East Area. This location was selected because the emissions of the supplemental technologies would be substantially higher for most radionuclides than those associated with other project-related, 200-East Area activities, such as normal tank farm operations or waste retrieval. Similarly, emissions from the 200-West Area were modeled as if they arose from the 200-West Area STTS (STTS-West) in the southeast corner of the 200-West Area (see Figure K–1), the site for

deployment of supplemental technologies in the 200-West Area. Although tank farms are located at a number of positions within the 200-East and 200-West Areas (all tank farms are within 2.6 kilometers [1.6 miles] of STTS-East and -West), the simplifying assumption that radiological emissions other than those from the WTP would come from these STTSs added a level of conservatism to the analysis because the STTSs would be located closer to the principal receptors in the predominant downwind direction, the population centers of Richland, Pasco, and Kennewick, and closer to the MEI, located eastward.

The activities associated with each of these emission source locations are summarized as follows:

WTP:

- HLW vitrification
- Low-activity waste (LAW) vitrification
- Cesium and strontium de-encapsulation and processing
- Waste pretreatment
- Sulfate removal

STTS-East:

- Tank farm operations
- Tank waste retrieval
- Tank farm facilities deactivation
- Bulk vitrification
- Cast stone
- Steam reforming
- Remote-handled transuranic (TRU) waste treatment
- Contact-handled TRU waste treatment
- Tank removal
- Soil removal

STTS-West:

- Tank farm operations
- Tank waste retrieval
- Tank farm facilities deactivation
- Bulk vitrification
- Cast stone
- Steam reforming
- Contact-handled TRU waste treatment
- Tank removal
- Soil removal

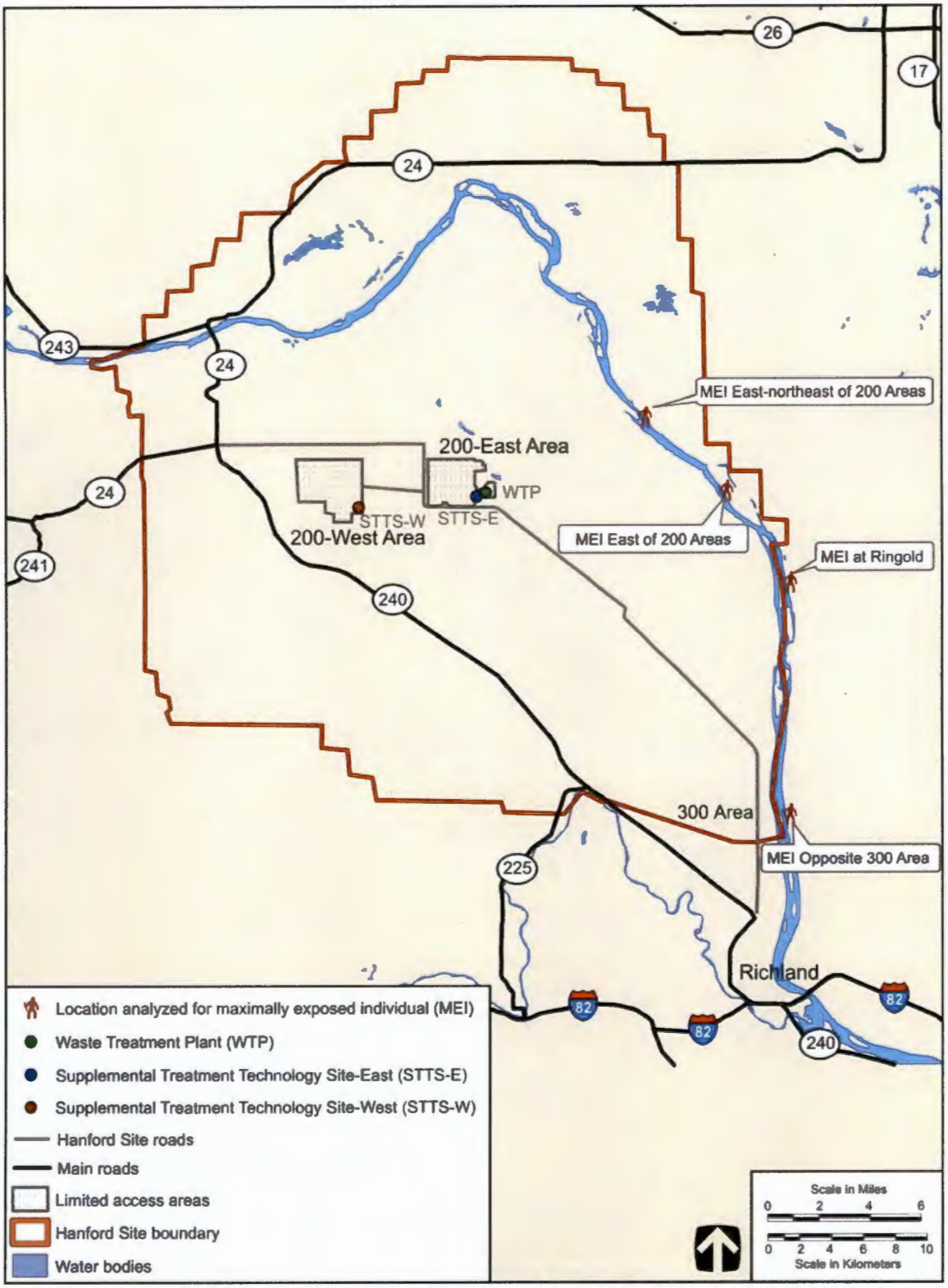

Figure K–1. Locations Assumed to Be Sources of Radiological Air Emissions and Possible Locations of the Maximally Exposed Individual

K.2.1.1.1.1 Exposure Scenarios

The analysis of radioactive releases from normal operations evaluated the impacts on three public receptors: the general population living within 80 kilometers (50 miles) of the release locations, a hypothetical MEI, and an onsite MEI. The general population, the MEI, and the onsite MEI would receive external as well as internal doses from radioactive releases.

The population living within 80 kilometers (50 miles) of the release locations would be exposed to atmospheric releases of radioactive materials that are carried by the wind. Therefore, the meteorological conditions at Hanford and the population distribution around the site would affect the dose received by the population. Details of the population distribution and the meteorological conditions are presented in Section K.2.1.1.3, "Input Parameters." Members of the general population would receive an external exposure to radiation from the radioactive plume as it passes and from materials that are deposited on the ground. They would also receive an internal dose from the inhalation and ingestion of radionuclides. Members of the population would receive an internal dose through inhalation of contaminated air as the plume passes and inhalation of resuspended materials that are deposited on the ground. They were also assumed to receive an internal dose by consuming produce grown in a family garden and animal products from regional livestock contaminated by deposition and uptake of radioactive materials. The assumed respiration rate and the amount of contaminated food consumed are discussed in Section K.2.1.1.3.

For the purpose of analyzing the impacts of radiological releases to the air from normal operations, the MEI was assumed to be an individual who lives near the Hanford boundary in the location that results in the maximum impact. The GENII computer code (Napier et al. 1988), which was used to project the impacts of radiological releases from normal operations, was also used to evaluate possible locations of the MEI. Using the joint frequency distribution of meteorological data for the Hanford 200 Areas, the assumed emission source locations (the WTP, STTS-East, and STTS-West), and the release inventories, MEI analyses were performed for multiple locations on the bank of the Columbia River opposite Hanford (see Figure K–1). These analyses showed that the MEI would be located at one of the following locations: (1) a point about 11 kilometers (6.8 miles) east-northeast of the WTP, (2) a point about 13.1 kilometers (8.1 miles) east of the WTP, or (3) a point along the Ringold section of the Columbia River about 18.2 kilometers (11.3 miles) east-southeast of the WTP. A point across the river from the Hanford 300 Area, about 22 kilometers (13.7 miles) southeast of the WTP, was also considered but never yielded the maximum result. As the relative emissions from the three source locations change, the location of the MEI would also change. Generally, the more the emissions are dominated by elevated releases from the WTP (modeled as coming from the 61-meter-[200-foot-] high stack), the more likely the MEI would be to the east or east-southeast. Although it is expected that the supplemental treatment technologies would have elevated releases (e.g., from stack emissions), no detailed design information for the associated facilities was available to use in the analysis. Therefore, it was assumed that the emissions from the supplemental treatment facilities at STTS-East and -West would be at ground level. Emissions modeled as arising from ground-level sources would not disperse as much as those from elevated release points. As reduced dispersal would mean more-concentrated plumes, this assumption resulted in a conservative analysis that overestimated the dose impact.

The MEI would be exposed in the same manner as the general population, that is, by external exposure to the plume and deposited radioactive materials and by internal exposure from inhalation of radioactive materials and ingestion of contaminated food. The MEI was assumed to consume a larger quantity of produce grown in a family garden.

The onsite MEI, a member of the public whose workday is spent at the Columbia Generating Station or Laser Interferometer Gravitational-Wave Observatory at Hanford, would receive an external dose from the plume and material deposited on the ground and an internal dose from inhalation of the plume and resuspended radioactive materials deposited on the ground.

K.2.1.1.2 Modeling

The radiological impacts of releases during normal operations of the facilities used to retrieve and treat tank waste and to deactivate and close tank farm facilities were calculated using Version 1.485 of the GENII computer code (Napier et al. 1988). Site-specific input data were used, including location, meteorology, population, and source terms. This section briefly describes GENII and outlines the approach used for estimating impacts of normal operations.

K.2.1.1.2.1 Description of the GENII Code

The GENII computer code, developed by Pacific Northwest National Laboratory, is an integrated system of models (referred to as "modules") that analyzes environmental contamination resulting from acute or chronic releases to, or initial contamination in, air, water, or soil. The GENII computer code calculates radiation doses to individuals and populations. Its assumptions, technical approach, method, and quality assurance are well documented. The code has gone through an extensive quality assurance and quality control process, which included comparing results from model computations with those from manual calculations and performing internal and external peer reviews (Napier et al. 1988).

The GENII code consists of several modules for various applications, as described in the code manual (Napier et al. 1988). For this *TC & WM EIS*, only the ENVIN, ENV, and DOSE modules were used. The output of one module is stored in a file that can be used by the next module in the system. The functions of the three modules used in this EIS are discussed below.

ENVIN

The ENVIN module of the GENII code controls the reading of input files and organizes input for optimal use in the environmental transport and exposure module, ENV. The ENVIN module interprets the basic input, reads the basic GENII data libraries and other optional input files, and organizes the input into sequential segments based on radionuclide decay chains.

A standardized file that contains scenario, control, and inventory parameters is used as input to ENVIN. Radionuclide inventories can be entered as functions of releases to air or water, concentrations in basic environmental media (air, soil, or water), or concentrations in foods. If certain atmospheric dispersion options have been selected, this module generates tables of atmospheric dispersion parameters that are used in later calculations. The ENVIN module prepares the data transfer files that are used as input by the ENV module; ENVIN generates the first portion of the calculation documentation, the run input parameters report.

ENV

The ENV module calculates the environmental transfer, uptake, and human exposure to radionuclides that result from the chosen scenario for the user-specified source term. The module reads the input files from ENVIN and then, for each radionuclide chain, sequentially performs the preliminary calculations to establish the conditions at the start of the exposure scenario. Environmental concentrations of radionuclides at the start are established by assuming decay of pre-existing sources, considering biotic transport of existing subsurface contamination, and defining soil contamination from continuing atmospheric or irrigation depositions. For each year of postulated exposure, the module then estimates the concentrations of each radionuclide in the chain in air, surface soil, deep soil, groundwater, and surface water. Human exposure and intake of each radionuclide are calculated for (1) pathways of external exposure from finite or infinite atmospheric plumes; (2) external exposure from contaminated soil, sediments, and water; (3) external exposure from special geometries (e.g., a shoreline exposure); (4) internal exposure from inhalation; and (5) internal exposure from consumption of terrestrial foods, aquatic foods, drinking water, and animal products, and inadvertent intake of soil. The intermediate

information on annual media concentrations and intake rates is written to data transfer files. Although these may be accessed directly, they are usually used as input to the DOSE module of GENII.

DOSE

The DOSE module reads the intake and exposure rates defined by the ENV module and converts the data to radiation dose.

K.2.1.1.3 Input Parameters

Site-specific and scenario-dependent data are used as input to the GENII computer code. The following paragraphs describe the development of data that were used in the analyses of doses to the general public and the MEI near Hanford.

K.2.1.1.3.1 Meteorological Data

The GENII computer code uses a data set of the joint frequency distribution of windspeed, direction, and Pasquill atmospheric stability class as input to modeling the atmospheric transport of radioactive emissions. Tables K–3 and K–4 present the joint frequency distribution data for the Hanford 200 Areas for the 61-meter (200-foot) and 9-meter (30-foot) heights, respectively. These data represent the 10-year averages of data collected from 1997 through 2006 at the 200 Area Hanford Meteorological Station (Burk 2007). Wind rose representations of these data are included in Chapter 3, Section 3.2.4.1.

In the current *TC & WM EIS* analysis, the meteorological data from the 61-meter (200-foot) height were used in evaluating the impacts of releases from the WTP. This height is consistent with the current WTP design in which most emissions would be from a 61-meter (200-foot) height. The 9-meter (30-foot) height joint frequency data were used as input to model the transport of releases from STTS-East and -West.

Table K–3. Joint Frequency Distribution for the Hanford Site 200 Areas at a 61-Meter Height

Average Windspeed (meters per second)	Pasquill Atmospheric Stability Class	Percentage of Time Wind Blows from the Indicated Direction															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0.78	A	0.11	0.12	0.14	0.12	0.12	0.1	0.08	0.07	0.07	0.04	0.05	0.04	0.04	0.06	0.07	0.08
	B	0.05	0.06	0.07	0.06	0.06	0.04	0.04	0.04	0.02	0.03	0.03	0.03	0.04	0.03	0.04	0.06
	C	0.05	0.06	0.06	0.04	0.04	0.05	0.05	0.03	0.03	0.03	0.01	0.02	0.02	0.02	0.03	0.05
	D	0.41	0.41	0.39	0.33	0.33	0.25	0.38	0.3	0.19	0.18	0.17	0.17	0.2	0.24	0.32	0.41
	E	0.21	0.18	0.17	0.18	0.2	0.2	0.33	0.23	0.18	0.15	0.16	0.15	0.18	0.22	0.23	0.25
	F	0.17	0.15	0.12	0.14	0.13	0.13	0.18	0.17	0.12	0.13	0.15	0.15	0.2	0.15	0.19	0.18
	G	0.05	0.06	0.05	0.06	0.06	0.05	0.08	0.08	0.08	0.07	0.06	0.06	0.09	0.11	0.1	0.08
2.5	A	0.58	0.64	0.5	0.47	0.62	0.4	0.5	0.46	0.27	0.24	0.24	0.16	0.18	0.24	0.48	0.77
	B	0.17	0.17	0.14	0.12	0.13	0.11	0.16	0.1	0.08	0.09	0.08	0.07	0.07	0.11	0.21	0.26
	C	0.14	0.12	0.1	0.09	0.08	0.09	0.12	0.08	0.06	0.05	0.06	0.04	0.04	0.07	0.14	0.19
	D	0.64	0.47	0.41	0.37	0.43	0.37	0.49	0.39	0.23	0.2	0.24	0.27	0.34	0.57	1.09	1
	E	0.32	0.27	0.19	0.2	0.26	0.26	0.37	0.33	0.19	0.17	0.27	0.34	0.57	0.81	0.91	0.55
	F	0.26	0.15	0.14	0.1	0.15	0.15	0.31	0.3	0.21	0.2	0.26	0.41	0.66	0.82	0.86	0.57
	G	0.07	0.05	0.05	0.05	0.05	0.06	0.07	0.12	0.08	0.1	0.17	0.22	0.33	0.33	0.29	0.16
4.5	A	0.29	0.3	0.2	0.1	0.14	0.09	0.08	0.07	0.09	0.18	0.28	0.3	0.14	0.26	0.74	0.44
	B	0.08	0.09	0.03	0.01	0.02	0.02	0.01	0.02	0.03	0.05	0.08	0.09	0.06	0.12	0.27	0.1
	C	0.07	0.04	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.03	0.05	0.06	0.04	0.09	0.21	0.08
	D	0.18	0.13	0.08	0.06	0.12	0.09	0.08	0.11	0.1	0.16	0.28	0.32	0.35	0.82	1.34	0.35
	E	0.14	0.1	0.11	0.09	0.15	0.13	0.09	0.2	0.1	0.16	0.31	0.53	1.06	1.85	1.5	0.35
	F	0.09	0.05	0.03	0.03	0.04	0.05	0.06	0.21	0.1	0.07	0.19	0.47	1.02	1.63	1.41	0.39
	G	0.02	0	0	0	0.01	0	0.01	0.05	0.03	0.03	0.07	0.17	0.38	0.47	0.47	0.15
7.0	A	0.08	0.14	0.08	0.02	0.02	0.01	0	0.01	0.03	0.09	0.27	0.34	0.1	0.23	0.52	0.1
	B	0.02	0.03	0.01	0	0	0	0	0.01	0.01	0.02	0.06	0.09	0.04	0.09	0.11	0.02
	C	0.01	0.01	0.01	0	0.01	0	0	0.01	0.01	0.01	0.05	0.06	0.02	0.06	0.09	0.01
	D	0.06	0.07	0.05	0.01	0.01	0	0.01	0.05	0.1	0.16	0.33	0.4	0.35	1	0.96	0.07
	E	0.04	0.06	0.03	0.01	0.02	0.01	0.02	0.1	0.11	0.16	0.41	0.77	0.98	2.58	1.56	0.11
	F	0.02	0.03	0.02	0.01	0.01	0	0.01	0.06	0.03	0.02	0.07	0.29	0.42	1.19	1.18	0.09
	G	0	0	0	0	0	0	0	0.03	0.01	0.01	0.01	0.05	0.08	0.17	0.63	0.05

Table K–3. Joint Frequency Distribution for the Hanford Site 200 Areas at a 61-Meter Height *(continued)*

Average Windspeed (meters per second)	Pasquill Atmospheric Stability Class	Percentage of Time Wind Blows from the Indicated Direction															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
9.6	A	0.01	0.02	0.03	0	0	0	0	0	0	0.04	0.17	0.2	0.05	0.12	0.35	0.02
	B	0	0.01	0.01	0	0	0	0	0	0	0.01	0.05	0.05	0.01	0.03	0.07	0
	C	0	0.01	0.01	0	0	0	0	0	0	0.01	0.03	0.03	0	0.02	0.06	0
	D	0.01	0.03	0.02	0	0	0	0	0.02	0.06	0.15	0.33	0.26	0.14	0.65	0.65	0.01
	E	0.01	0.03	0.04	0.01	0	0	0	0.05	0.13	0.17	0.36	0.34	0.21	1	0.91	0.01
	F	0	0	0	0	0	0	0	0	0.01	0.01	0.03	0.05	0.04	0.12	0.16	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02	0.08	0
12.5	A	0	0	0	0	0	0	0	0	0	0.01	0.11	0.09	0.02	0.04	0.18	0
	B	0	0	0	0	0	0	0	0	0	0	0.04	0.02	0.01	0.01	0.05	0
	C	0	0	0	0	0	0	0	0	0	0.01	0.02	0.02	0.01	0.01	0.04	0
	D	0	0	0.01	0	0	0	0	0.01	0.06	0.14	0.28	0.15	0.03	0.3	0.45	0
	E	0	0.01	0.01	0	0	0	0	0.02	0.05	0.12	0.18	0.11	0.03	0.3	0.26	0
	F	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.9	A	0	0	0	0	0	0	0	0	0	0.01	0.04	0.02	0.01	0	0.03	0
	B	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0.01	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0.01	0
	D	0	0	0	0	0	0	0	0	0.01	0.08	0.11	0.03	0.01	0.02	0.04	0
	E	0	0	0	0	0	0	0	0	0	0.03	0.06	0.04	0.01	0.03	0.04	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.8	A	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.02	0.02	0.02	0.01	0	0	0
	E	0	0	0	0	0	0	0	0	0	0.01	0.04	0.01	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: To convert meters to feet, multiply by 3.281.
Source: Burk 2007.

Table K–4. Joint Frequency Distribution for the Hanford Site 200 Areas at a 9-Meter Height

Average Windspeed (meters per second)	Pasquill Atmospheric Stability Class	Percentage of Time Wind Blows from the Indicated Direction															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0.78	A	0.29	0.31	0.34	0.27	0.28	0.25	0.19	0.17	0.13	0.12	0.12	0.1	0.1	0.13	0.17	0.22
	B	0.12	0.11	0.12	0.09	0.08	0.09	0.07	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.08	0.1
	C	0.09	0.09	0.1	0.05	0.06	0.07	0.06	0.05	0.04	0.03	0.03	0.03	0.03	0.03	0.04	0.06
	D	0.68	0.56	0.57	0.44	0.4	0.39	0.42	0.39	0.3	0.24	0.26	0.3	0.35	0.41	0.55	0.67
	E	0.36	0.29	0.27	0.24	0.27	0.32	0.47	0.4	0.35	0.34	0.48	0.53	0.55	0.52	0.57	0.46
	F	0.24	0.16	0.17	0.17	0.17	0.19	0.27	0.25	0.33	0.34	0.39	0.38	0.41	0.39	0.38	0.3
	G	0.09	0.07	0.1	0.09	0.08	0.08	0.11	0.1	0.1	0.11	0.1	0.1	0.13	0.13	0.14	0.11
2.5	A	0.72	0.53	0.42	0.36	0.46	0.47	0.45	0.28	0.24	0.24	0.32	0.25	0.2	0.29	0.66	0.78
	B	0.18	0.14	0.11	0.11	0.1	0.13	0.13	0.07	0.08	0.08	0.09	0.08	0.08	0.13	0.27	0.28
	C	0.16	0.11	0.09	0.08	0.07	0.1	0.1	0.08	0.04	0.04	0.07	0.06	0.05	0.09	0.21	0.22
	D	0.62	0.36	0.29	0.27	0.37	0.4	0.49	0.34	0.23	0.23	0.31	0.39	0.52	0.96	1.56	1.08
	E	0.25	0.15	0.13	0.14	0.23	0.31	0.38	0.38	0.33	0.32	0.63	1.13	2.04	2.26	1.69	0.56
	F	0.12	0.06	0.06	0.06	0.09	0.14	0.3	0.45	0.42	0.5	0.89	1.78	2.15	2.12	1.55	0.44
	G	0.04	0.02	0.02	0.03	0.03	0.03	0.08	0.19	0.2	0.24	0.37	0.75	0.62	0.69	0.59	0.11
4.5	A	0.21	0.22	0.16	0.06	0.08	0.04	0.02	0.04	0.05	0.14	0.27	0.4	0.2	0.35	0.76	0.27
	B	0.05	0.07	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.09	0.13	0.08	0.13	0.23	0.06
	C	0.03	0.03	0.01	0	0.01	0	0.01	0.01	0.01	0.02	0.06	0.08	0.04	0.09	0.18	0.04
	D	0.12	0.12	0.07	0.03	0.05	0.03	0.03	0.08	0.11	0.21	0.36	0.53	0.58	1.18	1.36	0.18
	E	0.05	0.05	0.04	0.02	0.02	0.01	0.04	0.12	0.15	0.19	0.46	0.91	1.24	2.28	1.57	0.11
	F	0	0	0	0.01	0.01	0	0.01	0.07	0.04	0.03	0.12	0.39	0.31	0.53	0.52	0.03
	G	0	0	0	0	0	0	0	0.02	0.01	0.01	0.04	0.2	0.04	0.17	0.21	0.01
7.0	A	0.02	0.06	0.05	0.01	0	0	0	0	0.01	0.05	0.25	0.37	0.09	0.2	0.5	0.07
	B	0	0.01	0.01	0	0	0	0	0	0.01	0.02	0.06	0.09	0.03	0.04	0.12	0.01
	C	0	0	0.01	0	0	0	0	0	0.01	0.01	0.04	0.06	0.02	0.04	0.09	0
	D	0.01	0.03	0.04	0.01	0	0	0	0.02	0.1	0.2	0.43	0.39	0.2	0.7	0.92	0.02
	E	0.01	0.03	0.03	0.01	0	0	0	0.05	0.14	0.21	0.39	0.29	0.17	0.57	0.76	0.01
	F	0	0	0	0	0	0	0	0	0.01	0	0.01	0.01	0.01	0.01	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table K–4. Joint Frequency Distribution for the Hanford Site 200 Areas at a 9-Meter Height *(continued)*

Average Windspeed (meters per second)	Pasquill Atmospheric Stability Class	Percentage of Time Wind Blows from the Indicated Direction															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
9.6	A	0	0	0	0	0	0	0	0	0	0.01	0.1	0.13	0.04	0.05	0.16	0
	B	0	0	0	0	0	0	0	0	0	0	0.04	0.03	0.01	0.01	0.04	0
	C	0	0	0	0	0	0	0	0	0	0	0.02	0.02	0.01	0.01	0.03	0
	D	0	0	0.01	0	0	0	0	0	0.04	0.11	0.22	0.13	0.03	0.1	0.23	0
	E	0	0	0.01	0	0	0	0	0.01	0.01	0.04	0.08	0.06	0.02	0.06	0.1	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.5	A	0	0	0	0	0	0	0	0	0	0.01	0.02	0.02	0	0	0.02	0
	B	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.03	0.03	0.03	0.01	0.01	0	0
	E	0	0	0	0	0	0	0	0	0	0.01	0.02	0.01	0	0	0.01	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.9	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.8	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: To convert meters to feet, multiply by 3.281.
Source: Burk 2007.

K.2.1.1.3.2 Population Data

The analysis considered the impacts on the populations residing within an 80-kilometer (50-mile) radius of the sources of emissions on the 200 Area plateau, the WTP, STTS-East, and STTS-West: 447,354; 451,556; and 488,897 people, respectively. The population data used in the analysis were taken from the 2000 census. Data from this year were used to provide a common basis for comparing impacts among the alternatives. Projections of future population growth were not been made because the long duration of some alternatives would make such projections extremely speculative. Population distributions within 80 kilometers (50 miles) of the WTP, STTS-East, and STTS-West are shown in Figures K–2 through K–4 respectively. These figures illustrate the population distribution used in the calculations conducted with the GENII computer code. Concentric circles shown in each figure are centered on the locations discussed above and have the following radii: 1.6 kilometers (1 mile), 3.2 kilometers (2 miles), 4.8 kilometers (3 miles), 6.4 kilometers (4 miles), 8.0 kilometers (5 miles), 16 kilometers (10 miles), 32 kilometers (20 miles), 48 kilometers (30 miles), 64 kilometers (40 miles), and 80 kilometers (50 miles). The population in each sector was calculated using data from the 2000 census (Census 2007a, 2007b). All sectors located within 8.0 kilometers (5 miles) and many of the sectors located within 16 kilometers (10 miles) of the center points have zero populations because no one is allowed to reside on the Hanford Site.

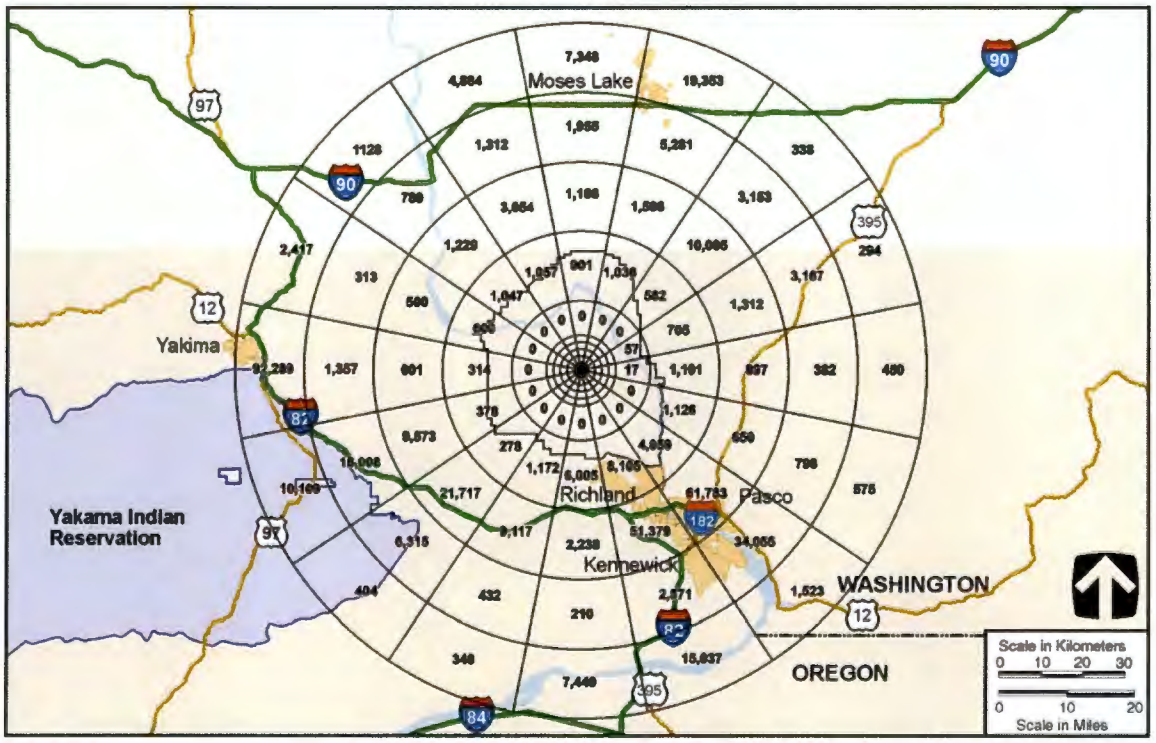

Figure K–2. Population Distribution Within 80 Kilometers (50 Miles) of the Waste Treatment Plant

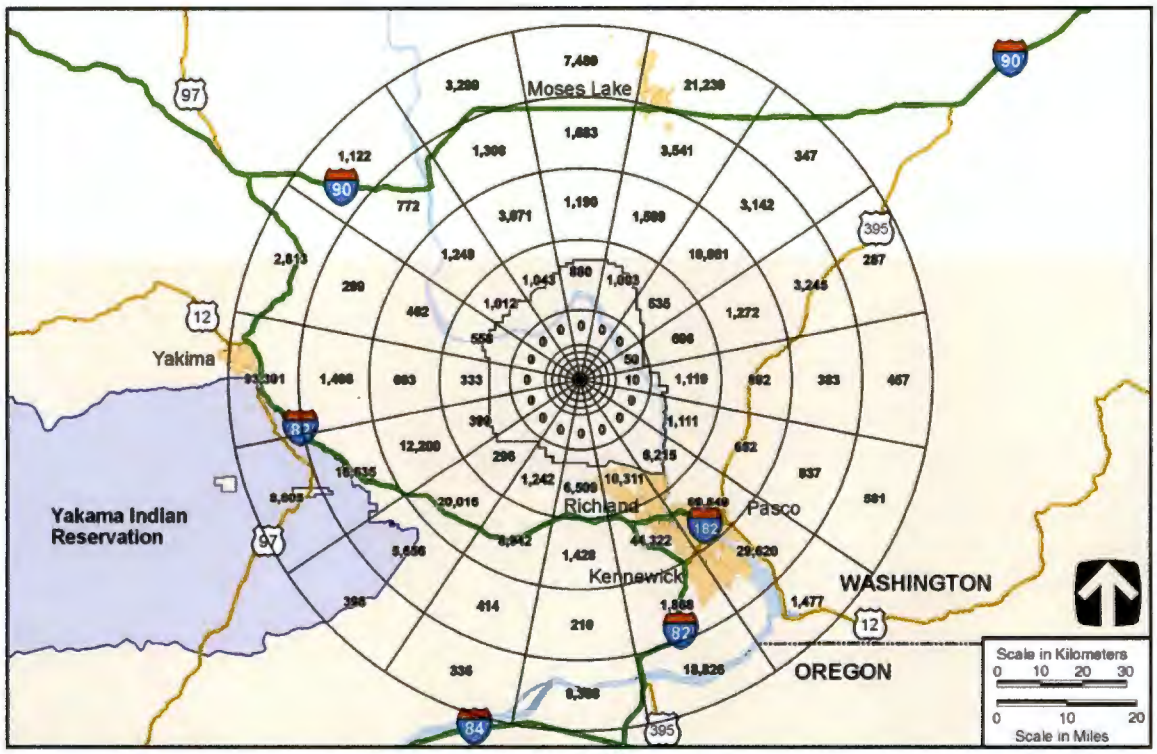

Figure K–3. Population Distribution Within 80 Kilometers (50 Miles) of the 200-East Area Supplemental Treatment Technology Site

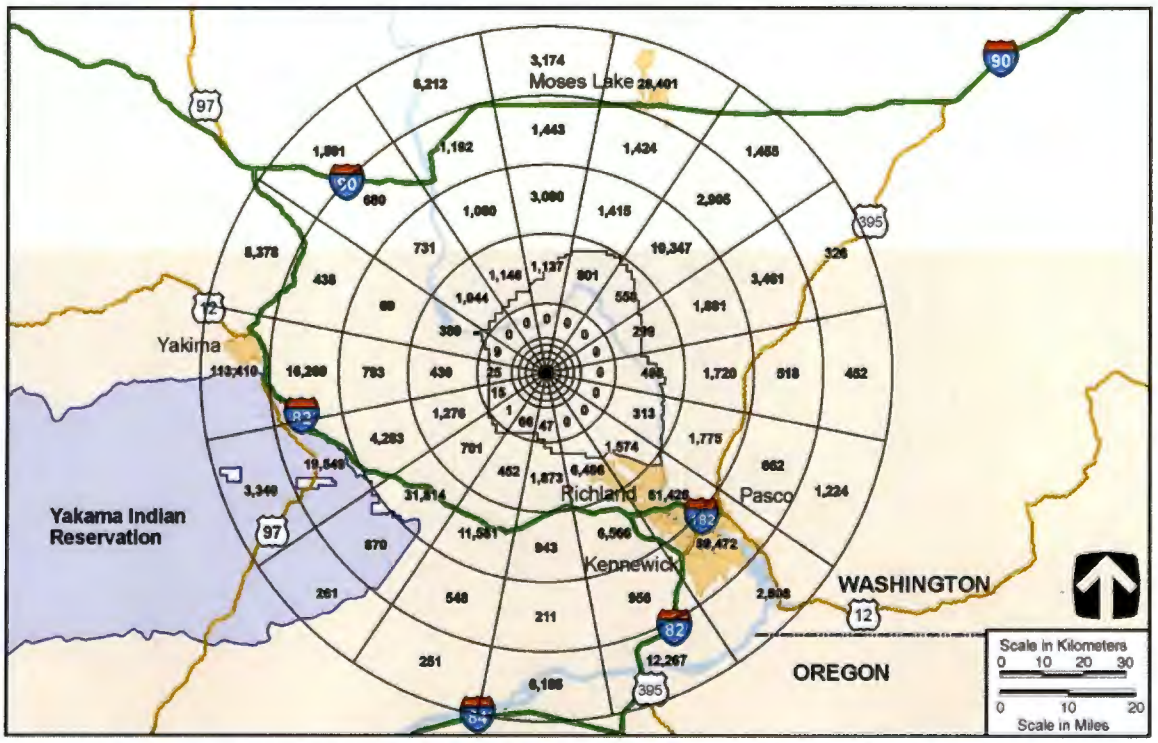

Figure K–4. Population Distribution Within 80 Kilometers (50 Miles) of the 200-West Area Supplemental Treatment Technology Site

K.2.1.1.3.3 Exposure Data

During normal operations of managing, retrieving, pretreating, and treating tank waste and deactivating and closing tanks and tank farm facilities, the general population would be exposed to atmospheric emissions. Exposure parameters for evaluating dose to the general population, the MEI, and the onsite MEI were primarily based on parameters from the *Hanford Site Risk Assessment Methodology (HSRAM)* (DOE 1995). As discussed below, the *HSRAM* parameters were modified, combined, or replaced where there was a reasonable basis for doing so. The parameters used for the general population, the MEI, and the onsite MEI are shown in Table K–5. Certain inputs to the GENII computer code required the number of hours per year that an exposure could occur. A full year was defined as 8,766 hours, or 365.25 days, to account for leap years.

Table K–5. Exposure Input Parameters for Members of the Public

Medium	Exposure Pathway	Rate	Reference
Population			
Air (plume)	External	8,766 hours per year	Napier et al. 1988
	Internal – inhalation	20 cubic meters per day	DOE 1995
Soil	External	2,192 hours per year	Napier et al. 1988
	Internal – ingestion	120 milligrams per day	EPA 2000a
Food[a]	Internal – ingestion of:		
	Leafy vegetable	21 kilograms per year	Beyeler et al. 1999
	Other vegetable	29.2 kilograms per year	DOE 1995
	Fruit	15.3 kilograms per year	DOE 1995
	Grain	14 kilograms per year	Beyeler et al. 1999
	Meat	27.8 kilograms per year	DOE 1995
	Dairy	110 kilograms per year	DOE 1995
	Poultry	28.5 kilograms per year	Beyeler et al. 1999
	Eggs	19 kilograms per year	Beyeler et al. 1999
Maximally Exposed Individual			
Air (plume)	External	8,766 hours per year	Napier et al. 1988
	Internal – inhalation	20 cubic meters per day	DOE 1995
Soil	External	4,380 hours per year	Napier et al. 1988
	Internal – ingestion	120 milligrams per day	EPA 2000a
Food[a]	Internal – ingestion of:		
	Leafy vegetable	65 kilograms per year	Beyeler et al. 1999, DOE and Ecology 1996
	Other vegetable	120 kilograms per year	DOE and Ecology 1996
	Fruit	120 kilograms per year	DOE and Ecology 1996
	Grain	90 kilograms per year	Beyeler et al. 1999
	Meat	27.8 kilograms per year	DOE and Ecology 1996
	Dairy	110 kilograms per year	DOE 1995
	Poultry	28.5 kilograms per year	Beyeler et al. 1999
	Eggs	19 kilograms per year	Beyeler et al. 1999
Onsite Maximally Exposed Individual			
Air (plume)	External	2,000 hours per year	DOE 1995
	Internal – inhalation	2,000 hours per year	DOE 1995
Soil	External	1,168 hours per year	DOE 1995
	Internal – ingestion	50 milligrams per day	DOE 1995

[a] Food consumption rates represent the portion of the diet consisting of contaminated food.

Note: To convert cubic meters to cubic feet, multiply by 35.315; milligrams to ounces, by 0.00003527; kilograms to pounds, by 2.2046.

Members of the public would be exposed via two pathways by the passing plume. They would receive an external dose 24 hours per day from direct exposure to the passing plume. They also would receive an internal dose from breathing 20 cubic meters (706 cubic feet) of contaminated air per day (DOE 1995). Respiration of resuspended radionuclides that have been deposited on the ground was also included in the dose from inhalation.

Radionuclides deposited on the ground represent another means of exposure because they may cause an external exposure to individuals near the contamination. In this analysis, it was assumed that an average member of the public would be exposed 25 percent of the time, 2,192 hours, during the entire year, and the MEI would be exposed 50 percent of the time, 4,380 hours per year. Soil could also be inadvertently ingested, resulting in an internal dose. The *HSRAM* assumes ingestion rates of 200 milligrams (0.71 ounces) per day for children and 100 milligrams (0.35 ounces) per day for adults. In this analysis, a single rate of 120 milligrams (0.42 ounces) per day was used (EPA 2000a). This is the weighted average of the values in the *HSRAM*—ingestion of 200 milligrams (0.71 ounces) per day over a 6-year period and ingestion of 100 milligrams (0.35 ounces) per day over a 24-year period.

Exposure of members of the public was also assumed to occur as a result of a portion of their diet coming from fruits and vegetables grown in a family garden. These fruits and vegetables could become contaminated by the deposition of radioactive materials. When consumed, the radioactive materials would result in an internal dose. Consistent with the *HSRAM*, members of the general public were assumed to consume 15.3 kilograms (33.7 pounds) of fruit and 29.2 kilograms (64.2 pounds) of non-leafy vegetables per year that have become contaminated by deposition of radioactive material (DOE 1995). Additionally, individuals were assumed to consume 21 kilograms (46.2 pounds) per year of leafy vegetables and 14 kilograms (30.8 pounds) per year of grains that have become contaminated (Beyeler et al. 1999). The MEI was assumed to consume a larger portion of his or her diet from fruits and vegetables grown in a family garden. Annual consumption was assumed to be 120 kilograms (264 pounds) of fruit, 120 kilograms (264 pounds) of non-leafy vegetables, 65 kilograms (143 pounds) of leafy vegetables, and 90 kilograms (198 pounds) of grains (Beyeler et al. 1999; DOE and Ecology 1996).

Analysis of the radiological impact on members of the public was based on an assumption that a portion of their diet would come from animal products from livestock raised in the area. Consuming forage that has been contaminated through the deposition of radioactive material would expose the animals. A person was assumed to consume 27.8 kilograms (61.2 pounds) of meat per year, consisting of 27.4 kilograms (60.3 pounds) of beef and 0.4 kilograms (0.9 pounds) of venison (DOE 1995). The consumption rate of contaminated dairy products was assumed to be 110 kilograms (242 pounds) per year (DOE 1995). The entire annual intake of 28.5 kilograms (62.7 pounds) of poultry and 19 kilograms (41.8 pounds) of eggs was assumed to come from local sources (Beyeler et al. 1999). The MEI consumption of meat, poultry, eggs, and dairy products was assumed to be the same as consumption by the members of the public.

Exposure parameter values for the onsite MEI dose analysis are shown in Table K–5. The onsite MEI was assumed to be exposed during the workday. Exposure to the passing plume and inhalation were assumed to occur for a normal 40-hour work week, or about 2,000 hours per year. Exposure to deposited materials on the ground was assumed to occur for only a portion of this time, about 1,168 hours per year. Ingestion of resuspended soil would result in consumption of 50 milligrams (0.0018 ounces) per day.

K.2.1.1.3.4 Source Terms

Doses and risks to the public from the atmospheric release of radionuclides during normal operations were estimated for the year of maximum impact and for the life of the project for each Tank Closure alternative. The atmospheric releases were evaluated as arising from three locations: the WTP, STTS-East, and STTS-West. Therefore, six sets of source terms were developed for each Tank Closure alternative.

Radionuclides that would dominate the dose to the public through the air pathway were selected for detailed analysis. These were the radionuclides that are known to be the main contributors to the air pathway dose or that are of specific interest. To ensure that no major radionuclides were eliminated from the detailed analysis, a screening analysis was performed. In the screening analysis, it was assumed that one millionth of the tank farms' Best-Basis Inventory would enter an air stream through a treatment system that would remove 99.95 percent of the particulates. Exceptions were hydrogen-3 (tritium), carbon-14, and iodine-129, all of which would likely be in a gaseous state, are easily volatilized, and are poorly captured in air treatment systems. In the screening analysis, the entire Best-Basis Inventory of these three radionuclides was assumed to be released. Inhalation dose conversion factors (Eckerman, Wolburst, and Richardson 1988) were multiplied by the released inventory to determine the radionuclides in the tank farm inventory of greatest potential impact. Table K–6 lists the radionuclides considered in the detailed dose analysis. These radionuclides account for 99.99 percent of the dose estimated from the screening analysis. A second screening analysis was done that assumed that the air treatment system removed 99 percent of the iodine-129. This assumption is consistent with the way iodine-129 releases from the WTP, Bulk Vitrification Facilities, and Cast Stone Facilities were modeled in the dose analysis. This second screening also showed that the radionuclides selected for detailed analysis were responsible for 99.99 percent of the estimated dose.

Table K–6. Radionuclides Included in Air Pathway Dose Analysis

Radionuclide	Symbol
Hydrogen-3 (tritium)	H-3
Carbon-14	C-14
Cobalt-60	Co-60
Strontium-90	Sr-90
Technetium-99	Tc-99
Iodine-129	I-129
Cesium-137	Cs-137
Uranium[a]	U
Plutonium-238	Pu-238
Plutonium-239 and -240	Pu-239, Pu-240
Plutonium-241	Pu-241
Americium-241	Am-241

[a] Uranium inventories include the isotopes uranium-233, uranium-234, uranium-235, and uranium-238.

Estimates of the release of radionuclides associated with the Tank Closure alternatives evaluated in this *TC & WM EIS* were derived from data packages that defined the various activities needed to execute the tank closure project. These data packages defined the resource and labor requirements, radiological and nonradiological air emissions, worker dose, waste generation, and scope and duration of activities, such as installing risers (access ports into the underground tanks), retrieving waste from tanks (determined by retrieval technology), processing waste, removing and filling tanks, and other closure activities. Various combinations of these activities form the Tank Closure alternatives.

The data package activities had to be scaled to correspond to the Tank Closure alternatives evaluated in this EIS. Scaling is proportionally adjusting the values in the data packages to account for differences in the assumptions or basis of each alternative. Scaling accounts for a number of differences, including the duration of an activity and the number of actions performed as part of an activity. For example, the amount of a radionuclide emitted from processing 99 percent of the tank waste would remain essentially the same for a given treatment technology under any of the alternatives, but the annual release might change depending on the number of years taken to process the waste under a specific alternative. Scaling was used to adjust the emissions to account for the number of years of operations for a particular alternative compared with the duration assumed in the data packages. Similarly, if a data package activity was developed based on the installation of 50 new risers but the alternative requires 75 new risers, the

resource requirements, emissions, and other data associated with the activity would be increased by 50 percent to scale the data to match the alternative. The scaled data are included in the scaled data sets.

Estimated emissions for the treatment facilities (e.g., the Pretreatment Facility and WTP) presented in the scaled data sets (SAIC 2007a, 2008) were conservatively based on a reduction factor of 2,000 for particulate emissions. This factor represents the reduction associated with a single stage of high-efficiency particulate air (HEPA) filters. The air treatment equipment currently proposed for the WTP includes a number of other technologies that would further reduce emissions to the atmosphere, including, for example, scrubbers, high-efficiency mist eliminators, and a second stage of HEPA filters. The source terms from the treatment facilities were adjusted by a factor of 100 for particulates and iodine-129 to take credit equivalent to that provided by a second set of HEPA filters (for particulates) or caustic scrubbers and other treatments (for iodine). This adjustment still resulted in an overestimation of the radionuclides in the treatment facility air discharges because no credit was taken for other air treatment technologies that would be employed. No reduction factors were applied to tritium and carbon-14 emissions. They are treated as gaseous emissions that would not be abated by the air treatment technologies.

The source terms for the WTP and STTS-East and -West were based on the estimated annual emissions from the scaled data sets (SAIC 2007a, 2008). Then the radiological emissions, or a portion thereof, were assigned to one of the three locations. Emissions associated with pretreatment or vitrification of tank waste, de-encapsulation and vitrification of cesium and strontium, or deactivation of the associated facilities were attributed to the WTP. Radiological emissions from all other activities are divided between STTS-East and -West, based on the actions and facilities involved. For example, emissions from tank waste retrieval via a particular technology were divided between the two locations based on the proportion of tanks in the 200-East and 200-West Areas on which the technology would be used. Similarly, emissions from supplemental treatment technologies such as bulk vitrification, cast stone, or steam reforming were assigned to the appropriate area to reflect the assumptions employed in developing a specific alternative.

The timeframe over which each activity would occur was determined for all of the activities associated with an alternative. The total annual emissions for each of the three locations were determined by summing the emissions from each activity that would be ongoing during a year. In most cases, the year of maximum impact was immediately apparent because the emissions from the WTP and supplemental treatment technologies would contribute most to variability in the release of radionuclides and these activities would operate simultaneously; when necessary to distinguish which year would result in the maximum impact, emissions from different years were evaluated. Tables K–7 through K–19 present the emissions for the year of maximum impact (based on the population and MEI doses in Tables K–20 through K–45) and the year in which those emissions would occur under each Tank Closure alternative.

Total emissions over the operational life of the project were also calculated for the WTP, the 200-East Area, and the 200-West Area for each Tank Closure alternative. The total emissions were calculated by summing the releases for each location across all the years of release. The results are also presented in Tables K–7 through K–19. For the life-of-project emissions, the timespan presented in the tables reflects the portion of the project in which radiological emissions were projected to occur. Except for Tank Closure Alternatives 6A and 6B, which include clean closure of all of the tank farms, each alternative would have an administrative control period or a postclosure care period. Under Tank Closure Alternatives 1 and 2A, which do not include any closure, life-of-project emissions would include those that occur over the administrative control period. The postclosure care periods were not included in the timespan for the life-of-project emissions for the other Tank Closure alternatives because no radiological emissions are expected to occur.

Table K–7. Tank Closure Alternative 1 Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2107) (curies)			Annual Emissions in Year of Maximum Impact (2008) (curies)		
	Waste Treatment Plant[a]	200-East Area STTS	200-West Area STTS	Waste Treatment Plant[a]	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	0	6.1×10^{4}	5.9×10^{4}	0	6.1×10^{2}	5.9×10^{2}
Carbon-14	0	0	0	0	0	0
Cobalt-60	0	2.9	2.8	0	2.9×10^{-2}	2.8×10^{-2}
Strontium-90	0	3.3×10^{-1}	3.2×10^{-1}	0	6.4×10^{-3}	6.2×10^{-3}
Technetium-99	0	0	0	0	0	0
Iodine-129	0	7.3×10^{-1}	7.1×10^{-1}	0	1.4×10^{-2}	1.3×10^{-2}
Cesium-137	0	4.0	3.9	0	7.9×10^{-2}	7.5×10^{-2}
Uranium	0	1.9	1.8	0	1.9×10^{-2}	1.8×10^{-2}
Plutonium-238	0	0	0	0	0	0
Plutonium-239, -240	0	6.5×10^{-8}	6.1×10^{-8}	0	1.7×10^{-9}	1.2×10^{-9}
Plutonium-241	0	0	0	0	0	0
Americium-241	0	5.0×10^{-8}	4.6×10^{-8}	0	1.5×10^{-9}	9.6×10^{-10}

[a] There would be no emissions from the Waste Treatment Plant because it would not operate under this alternative.

Key: STTS=Supplemental Treatment Technology Site.

Table K–8. Tank Closure Alternative 2A Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2193) (curies)			Annual Emissions in Year of Maximum Impact (2093) (curies)		
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Waste Treatment Plant	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	1.2×10^{4}	6.1×10^{4}	5.9×10^{4}	0	0	0
Carbon-14	3.1×10^{3}	0	0	0	0	0
Cobalt-60	4.0×10^{-2}	2.9	2.8	0	0	0
Strontium-90	4.0×10^{2}	6.0×10^{-1}	5.8×10^{-1}	1.0×10^{2}	0	0
Technetium-99	1.5×10^{-1}	0	0	0	0	0
Iodine-129	4.8×10^{-1}	1.3	1.3	0	0	0
Cesium-137	5.8×10^{2}	7.3	7.1	2.4×10^{2}	0	0
Uranium	4.7×10^{-3}	1.9	1.8	0	0	0
Plutonium-238	2.4×10^{-2}	1.2×10^{-7}	3.2×10^{-7}	0	0	0
Plutonium-239, -240	4.1×10^{-1}	1.6×10^{-5}	4.1×10^{-5}	0	1.0×10^{-9}	0
Plutonium-241	6.2×10^{-1}	0	0	0	0	0
Americium-241	7.2×10^{-1}	1.6×10^{-6}	3.5×10^{-6}	0	0	0

Key: STTS=Supplemental Treatment Technology Site.

Table K–9. Tank Closure Alternative 2B Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2045) (curies)			Annual Emissions in Year of Maximum Impact (2040) (curies)		
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Waste Treatment Plant	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	1.2×10^{4}	0	0	4.6×10^{2}	0	0
Carbon-14	3.1×10^{3}	0	0	1.2×10^{2}	0	0
Cobalt-60	4.1×10^{-2}	0	0	1.6×10^{-3}	0	0
Strontium-90	4.2×10^{2}	1.2×10^{-1}	1.2×10^{-1}	1.2×10^{2}	3.2×10^{-3}	3.1×10^{-3}
Technetium-99	1.5×10^{-1}	0	0	5.7×10^{-3}	0	0
Iodine-129	4.8×10^{-1}	2.7×10^{-1}	2.6×10^{-1}	1.8×10^{-2}	7.0×10^{-3}	6.7×10^{-3}
Cesium-137	5.8×10^{2}	1.5	1.4	2.5×10^{2}	3.9×10^{-2}	3.8×10^{-2}
Uranium	4.7×10^{-3}	0	0	1.8×10^{-4}	0	0
Plutonium-238	2.4×10^{-2}	5.6×10^{-7}	7.6×10^{-7}	9.3×10^{-4}	1.5×10^{-7}	1.5×10^{-7}
Plutonium-239, -240	4.1×10^{-1}	7.2×10^{-5}	9.7×10^{-5}	1.6×10^{-2}	1.9×10^{-5}	1.9×10^{-5}
Plutonium-241	6.3×10^{-1}	0	0	2.4×10^{-2}	0	0
Americium-241	7.2×10^{-1}	5.9×10^{-6}	7.8×10^{-6}	2.8×10^{-2}	1.5×10^{-6}	1.5×10^{-6}

Key: STTS=Supplemental Treatment Technology Site.

Table K–10. Tank Closure Alternative 3A Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2042) (curies)			Annual Emissions in Year of Maximum Impact (2040) (curies)		
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Waste Treatment Plant	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	3.5×10^{3}	4.6×10^{3}	3.9×10^{3}	0	2.1×10^{1}	1.8×10^{1}
Carbon-14	9.6×10^{2}	1.2×10^{3}	9.9×10^{2}	0	5.3	4.5
Cobalt-60	3.3×10^{-2}	3.5×10^{-3}	3.4×10^{-3}	0	1.6×10^{-5}	1.5×10^{-5}
Strontium-90	4.0×10^{2}	1.8×10^{-1}	2.4	1.0×10^{2}	2.1×10^{-5}	1.1×10^{-2}
Technetium-99	4.4×10^{-2}	5.4×10^{-4}	4.8×10^{-2}	0	2.6×10^{-4}	2.1×10^{-4}
Iodine-129	1.4×10^{-1}	4.2×10^{-1}	3.8×10^{-1}	0	8.3×10^{-4}	7.0×10^{-4}
Cesium-137	5.6×10^{2}	2.5	2.3×10^{1}	2.4×10^{2}	5.2×10^{-3}	1.0×10^{-1}
Uranium	4.3×10^{-3}	1.1×10^{-4}	1.5×10^{-4}	0	4.9×10^{-7}	6.8×10^{-7}
Plutonium-238	2.1×10^{-2}	6.8×10^{-5}	3.0×10^{-4}	0	7.5×10^{-10}	1.3×10^{-6}
Plutonium-239, -240	3.7×10^{-1}	8.0×10^{-4}	5.4×10^{-3}	0	1.4×10^{-8}	2.4×10^{-5}
Plutonium-241	5.6×10^{-1}	1.2×10^{-3}	8.0×10^{-3}	0	2.0×10^{-8}	3.6×10^{-5}
Americium-241	6.0×10^{-1}	2.4×10^{-3}	7.0×10^{-3}	0	3.6×10^{-8}	3.2×10^{-5}

Key: STTS=Supplemental Treatment Technology Site.

Table K–11. Tank Closure Alternative 3B Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2042) (curies)			Annual Emissions in Year of Maximum Impact (2040) (curies)		
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Waste Treatment Plant	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	3.5×10^{3}	4.6×10^{-2}	3.9×10^{-2}	0	2.1×10^{-4}	1.8×10^{-4}
Carbon-14	9.6×10^{2}	1.2×10^{-2}	9.9×10^{-3}	0	5.3×10^{-5}	4.5×10^{-5}
Cobalt-60	3.3×10^{-2}	7.7×10^{-5}	6.7×10^{-5}	0	3.1×10^{-7}	3.0×10^{-7}
Strontium-90	4.0×10^{2}	1.9×10^{-1}	1.5×10^{-1}	1.0×10^{2}	4.1×10^{-7}	2.1×10^{-4}
Technetium-99	1.0×10^{-1}	4.6×10^{-5}	9.5×10^{-4}	0	5.1×10^{-8}	4.3×10^{-6}
Iodine-129	1.4×10^{-1}	2.4×10^{-1}	2.3×10^{-1}	0	8.3×10^{-9}	7.0×10^{-9}
Cesium-137	5.6×10^{2}	1.4	1.7	2.4×10^{2}	1.0×10^{-4}	2.0×10^{-3}
Uranium	4.3×10^{-3}	6.7×10^{-6}	3.4×10^{-6}	0	9.7×10^{-9}	1.4×10^{-8}
Plutonium-238	2.1×10^{-2}	6.9×10^{-5}	7.1×10^{-6}	0	1.5×10^{-11}	2.7×10^{-8}
Plutonium-239, -240	3.7×10^{-1}	8.2×10^{-4}	2.8×10^{-4}	0	1.3×10^{-9}	4.8×10^{-7}
Plutonium-241	5.6×10^{-1}	1.2×10^{-3}	1.7×10^{-4}	0	4.0×10^{-10}	7.2×10^{-7}
Americium-241	6.0×10^{-1}	2.4×10^{-3}	1.6×10^{-4}	0	7.3×10^{-10}	6.3×10^{-7}

Key: STTS=Supplemental Treatment Technology Site.

Table K–12. Tank Closure Alternative 3C Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2042) (curies)			Annual Emissions in Year of Maximum Impact (2040) (curies)		
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Waste Treatment Plant	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	3.5×10^{3}	4.6×10^{3}	3.9×10^{3}	0	2.1×10^{1}	1.8×10^{1}
Carbon-14	9.6×10^{2}	1.2×10^{3}	9.9×10^{2}	0	5.3	4.5
Cobalt-60	3.3×10^{-2}	3.5×10^{-3}	3.4×10^{-3}	0	1.6×10^{-5}	1.5×10^{-5}
Strontium-90	4.0×10^{2}	1.9×10^{-1}	2.4	1.0×10^{2}	2.1×10^{-5}	1.1×10^{-2}
Technetium-99	1.0×10^{-1}	5.7×10^{-2}	4.8×10^{-2}	0	2.6×10^{-4}	2.1×10^{-4}
Iodine-129	1.4×10^{-1}	4.2×10^{-1}	3.8×10^{-1}	0	8.3×10^{-4}	7.0×10^{-4}
Cesium-137	5.6×10^{2}	2.5	2.3×10^{1}	2.4×10^{2}	5.2×10^{-3}	1.0×10^{-1}
Uranium	4.3×10^{-3}	1.1×10^{-4}	1.5×10^{-4}	0	4.9×10^{-7}	6.8×10^{-7}
Plutonium-238	2.1×10^{-2}	6.9×10^{-5}	3.0×10^{-4}	0	7.5×10^{-10}	1.3×10^{-6}
Plutonium-239, -240	3.7×10^{-1}	8.0×10^{-4}	5.4×10^{-3}	0	1.4×10^{-8}	2.4×10^{-5}
Plutonium-241	5.6×10^{-1}	1.2×10^{-3}	8.0×10^{-3}	0	2.0×10^{-8}	3.6×10^{-5}
Americium-241	6.0×10^{-1}	2.4×10^{-3}	7.0×10^{-3}	0	3.6×10^{-8}	3.2×10^{-5}

Key: STTS=Supplemental Treatment Technology Site.

Table K–13. Tank Closure Alternative 4 Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2045) (curies)			Annual Emissions in Year of Maximum Impact (2043) (curies)		
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Waste Treatment Plant	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	3.6×10^{3}	4.8×10^{-2}	3.9×10^{3}	0	2.8×10^{-6}	2.8×10^{-6}
Carbon-14	9.7×10^{2}	1.2×10^{-2}	1.0×10^{3}	0	2.7×10^{-7}	2.7×10^{-7}
Cobalt-60	3.4×10^{-2}	2×10^{-4}	3.6×10^{-3}	0	2.2×10^{-7}	2.2×10^{-7}
Strontium-90	4.0×10^{2}	2.1	4.9	1.0×10^{2}	5.8×10^{-3}	5.8×10^{-3}
Technetium-99	4.4×10^{-2}	1.6×10^{-3}	4.8×10^{-2}	0	2.0×10^{-6}	2.0×10^{-6}
Iodine-129	1.4×10^{-1}	2.6×10^{-1}	4.1×10^{-1}	0	3.7×10^{-9}	3.7×10^{-9}
Cesium-137	5.6×10^{2}	2.5	2.5×10^{1}	2.4×10^{2}	4.7×10^{-3}	4.7×10^{-3}
Uranium	4.4×10^{-3}	5.6×10^{-5}	2.0×10^{-4}	0	2.5×10^{-7}	2.5×10^{-7}
Plutonium-238	2.1×10^{-2}	1.3×10^{-4}	3.6×10^{-4}	0	4.6×10^{-7}	4.6×10^{-7}
Plutonium-239, -240	3.7×10^{-1}	2.8×10^{-3}	8.0×10^{-3}	0	2.6×10^{-5}	2.6×10^{-5}
Plutonium-241	5.7×10^{-1}	2.1×10^{-3}	9.0×10^{-3}	0	4.4×10^{-6}	4.4×10^{-6}
Americium-241	6.1×10^{-1}	4.4×10^{-3}	9.8×10^{-3}	0	5.5×10^{-6}	5.5×10^{-6}

Key: STTS=Supplemental Treatment Technology Site.

Table K–14. Tank Closure Alternative 5 Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2036) (curies)			Annual Emissions in Year of Maximum Impact (2034) (curies)		
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Waste Treatment Plant	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	5.8×10^{3}	1.6×10^{-2}	3.5×10^{3}	3.6	1.0×10^{-4}	2.2×10^{1}
Carbon-14	1.5×10^{3}	4.1×10^{-3}	9.0×10^{2}	9.1	2.5×10^{-5}	5.6
Cobalt-60	4.1×10^{-2}	3.1×10^{-5}	3.1×10^{-3}	5.4×10^{-5}	1.5×10^{-7}	1.9×10^{-5}
Strontium-90	3.8×10^{2}	1.6×10^{-1}	2.2	1.0×10^{2}	2.0×10^{-7}	1.3×10^{-2}
Technetium-99	2.1×10^{-1}	4.3×10^{-4}	4.3×10^{-2}	8.8×10^{-4}	2.4×10^{-6}	2.7×10^{-4}
Iodine-129	2.3×10^{-1}	2.0×10^{-1}	3.3×10^{-1}	1.4×10^{-6}	4.0×10^{-9}	8.8×10^{-4}
Cesium-137	5.4×10^{2}	1.1	2.3×10^{1}	2.4×10^{2}	4.9×10^{-5}	1.4×10^{-1}
Uranium	4.3×10^{-3}	4.8×10^{-6}	1.4×10^{-4}	1.7×10^{-6}	4.6×10^{-9}	8.6×10^{-7}
Plutonium-238	1.9×10^{-2}	6.2×10^{-5}	2.7×10^{-4}	2.6×10^{-9}	7.1×10^{-12}	1.7×10^{-6}
Plutonium-239, -240	3.4×10^{-1}	6.8×10^{-4}	4.9×10^{-3}	4.5×10^{-8}	1.1×10^{-9}	3.0×10^{-5}
Plutonium-241	5.1×10^{-1}	1.1×10^{-3}	7.3×10^{-3}	6.8×10^{-8}	1.9×10^{-10}	4.5×10^{-5}
Americium-241	5.5×10^{-1}	2.2×10^{-3}	6.4×10^{-3}	1.3×10^{-7}	3.5×10^{-10}	3.9×10^{-5}

Key: STTS=Supplemental Treatment Technology Site.

Table K–15. Tank Closure Alternative 6A, Base Case, Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2168) (curies)			Annual Emissions in Year of Maximum Impact (2163) (curies)		
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Waste Treatment Plant	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	1.2×10^{4}	6.0×10^{1}	5.7×10^{-1}	0	7.7×10^{-2}	7.7×10^{-2}
Carbon-14	3.1×10^{3}	1.1×10^{1}	1.0×10^{-1}	0	1.4×10^{-2}	1.4×10^{-2}
Cobalt-60	4.1×10^{-2}	2.7×10^{-3}	7.6×10^{-5}	0	2.7×10^{-6}	2.7×10^{-6}
Strontium-90	4.3×10^{2}	2.2×10^{1}	6.9×10^{-1}	1.0×10^{2}	2.1×10^{-2}	2.1×10^{-2}
Technetium-99	1.5×10^{-1}	3.8×10^{-2}	3.7×10^{-4}	0	5.0×10^{-5}	5.0×10^{-5}
Iodine-129	4.8×10^{-1}	1.2	8.0×10^{-3}	0	1.9×10^{-4}	1.9×10^{-4}
Cesium-137	6.4×10^{2}	7.0×10^{1}	6.6×10^{-1}	2.4×10^{2}	8.3×10^{-2}	8.3×10^{-2}
Uranium	4.7×10^{-3}	2.2×10^{-3}	2.1×10^{-5}	0	2.8×10^{-6}	2.8×10^{-6}
Plutonium-238	2.4×10^{-2}	1.2×10^{-3}	1.2×10^{-5}	0	1.8×10^{-6}	1.5×10^{-6}
Plutonium-239, -240	4.1×10^{-1}	1.4×10^{-2}	6.5×10^{-4}	0	4.9×10^{-5}	1.2×10^{-5}
Plutonium-241	6.3×10^{-1}	8.2×10^{-3}	9.2×10^{-5}	0	1.0×10^{-5}	1.0×10^{-5}
Americium-241	7.3×10^{-1}	1.6×10^{-2}	8.8×10^{-4}	0	1.4×10^{-5}	1.1×10^{-5}

Key: STTS=Supplemental Treatment Technology Site.

Table K–16. Tank Closure Alternative 6A, Option Case, Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2168) (curies)			Annual Emissions in Year of Maximum Impact (2163) (curies)		
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Waste Treatment Plant	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	1.2×10^{4}	1.4×10^{3}	1.4×10^{3}	0	1.9	1.9
Carbon-14	3.1×10^{3}	1.4×10^{1}	1.4×10^{1}	0	1.9×10^{-2}	1.9×10^{-2}
Cobalt-60	4.1×10^{-2}	5.0×10^{-3}	5.0×10^{-3}	0	5.4×10^{-6}	5.4×10^{-6}
Strontium-90	4.3×10^{2}	2.6×10^{1}	2.6×10^{1}	1.0×10^{2}	2.3×10^{-2}	2.3×10^{-2}
Technetium-99	1.5×10^{-1}	5.6×10^{-2}	5.6×10^{-2}	0	7.3×10^{-5}	7.3×10^{-5}
Iodine-129	4.8×10^{-1}	1.3	1.3	0	2.7×10^{-4}	2.7×10^{-4}
Cesium-137	6.4×10^{2}	7.2×10^{1}	7.2×10^{1}	2.4×10^{2}	8.5×10^{-2}	8.5×10^{-2}
Uranium	4.7×10^{-3}	3.0×10^{-3}	3.0×10^{-3}	0	3.8×10^{-6}	3.8×10^{-6}
Plutonium-238	2.4×10^{-2}	2.3×10^{-3}	2.3×10^{-3}	0	3.3×10^{-6}	3.0×10^{-6}
Plutonium-239, -240	4.1×10^{-1}	9.1×10^{-2}	9.1×10^{-2}	0	1.5×10^{-4}	1.1×10^{-4}
Plutonium-241	6.3×10^{-1}	6.3×10^{-2}	6.3×10^{-2}	0	8.1×10^{-5}	8.1×10^{-5}
Americium-241	7.3×10^{-1}	3.4×10^{-2}	3.4×10^{-2}	0	3.1×10^{-5}	2.8×10^{-5}

Key: STTS=Supplemental Treatment Technology Site.

Table K–17. Tank Closure Alternative 6B, Base Case, Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2100) (curies)			Annual Emissions in Year of Maximum Impact (2040) (curies)		
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Waste Treatment Plant	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	1.2×10^{4}	5.9×10^{1}	5.9×10^{1}	4.6×10^{2}	7.7×10^{-1}	7.7×10^{-1}
Carbon-14	3.1×10^{3}	1.1×10^{1}	1.1×10^{1}	1.2×10^{2}	1.4×10^{-1}	1.4×10^{-1}
Cobalt-60	4.1×10^{-2}	2.7×10^{-3}	2.7×10^{-3}	1.6×10^{-3}	5.0×10^{-5}	3.9×10^{-5}
Strontium-90	4.1×10^{2}	2.2×10^{1}	2.2×10^{1}	1.1×10^{2}	4.3×10^{-1}	3.2×10^{-1}
Technetium-99	1.5×10^{-1}	3.8×10^{-2}	3.8×10^{-2}	5.7×10^{-3}	5.0×10^{-4}	5.0×10^{-4}
Iodine-129	4.8×10^{-1}	4.1×10^{-1}	4.0×10^{-1}	1.8×10^{-2}	8.9×10^{-3}	8.6×10^{-3}
Cesium-137	5.8×10^{2}	6.5×10^{1}	6.5×10^{1}	2.5×10^{2}	8.7×10^{-1}	8.7×10^{-1}
Uranium	4.7×10^{-3}	2.2×10^{-3}	2.2×10^{-3}	1.8×10^{-4}	2.8×10^{-5}	2.8×10^{-5}
Plutonium-238	2.4×10^{-2}	1.2×10^{-3}	1.2×10^{-3}	9.3×10^{-4}	1.5×10^{-5}	1.5×10^{-5}
Plutonium-239, -240	4.1×10^{-1}	1.4×10^{-2}	1.4×10^{-2}	1.6×10^{-2}	3.0×10^{-4}	2.1×10^{-4}
Plutonium-241	6.3×10^{-1}	8.1×10^{-3}	8.1×10^{-3}	2.4×10^{-2}	1.1×10^{-4}	1.1×10^{-4}
Americium-241	7.2×10^{-1}	1.6×10^{-2}	1.7×10^{-2}	2.8×10^{-2}	4.3×10^{-4}	2.8×10^{-4}

Key: STTS=Supplemental Treatment Technology Site.

Table K–18. Tank Closure Alternative 6B, Option Case, Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2100) (curies)			Annual Emissions in Year of Maximum Impact (2040) (curies)		
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Waste Treatment Plant	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	1.2×10^{4}	1.4×10^{3}	1.4×10^{3}	4.6×10^{2}	1.9×10^{1}	1.9×10^{1}
Carbon-14	3.1×10^{3}	1.4×10^{1}	1.4×10^{1}	1.2×10^{2}	1.9×10^{-1}	1.9×10^{-1}
Cobalt-60	4.1×10^{-2}	5.0×10^{-3}	5.0×10^{-3}	1.6×10^{-3}	8.6×10^{-5}	6.6×10^{-5}
Strontium-90	4.1×10^{2}	2.5×10^{1}	2.5×10^{1}	1.1×10^{2}	5.3×10^{-1}	3.4×10^{-1}
Technetium-99	1.5×10^{-1}	5.6×10^{-2}	5.6×10^{-2}	5.7×10^{-3}	7.3×10^{-4}	7.3×10^{-4}
Iodine-129	4.8×10^{-1}	4.7×10^{-1}	4.6×10^{-1}	1.8×10^{-2}	9.7×10^{-3}	9.4×10^{-3}
Cesium-137	5.8×10^{2}	6.7×10^{1}	6.7×10^{1}	2.5×10^{2}	9.0×10^{-1}	8.9×10^{-1}
Uranium	4.7×10^{-3}	3.0×10^{-3}	3.0×10^{-3}	1.8×10^{-4}	3.8×10^{-5}	3.8×10^{-5}
Plutonium-238	2.4×10^{-2}	2.3×10^{-3}	2.3×10^{-3}	9.3×10^{-4}	3.0×10^{-5}	3.0×10^{-5}
Plutonium-239, -240	4.1×10^{-1}	9.1×10^{-2}	9.1×10^{-2}	1.6×10^{-2}	1.3×10^{-3}	1.2×10^{-3}
Plutonium-241	6.3×10^{-1}	6.3×10^{-2}	6.3×10^{-2}	2.4×10^{-2}	8.2×10^{-4}	8.1×10^{-4}
Americium-241	7.2×10^{-1}	3.3×10^{-2}	3.3×10^{-2}	2.8×10^{-2}	7.3×10^{-4}	4.4×10^{-4}

Key: STTS=Supplemental Treatment Technology Site.

Table K–19. Tank Closure Alternative 6C Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project (2006–2045) (curies)			Annual Emissions in Year of Maximum Impact (2040) (curies)		
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Waste Treatment Plant	200-East Area STTS	200-West Area STTS
Hydrogen-3 (tritium)	1.2×10^{4}	0	0	4.6×10^{2}	0	0
Carbon-14	3.1×10^{3}	0	0	1.2×10^{2}	0	0
Cobalt-60	4.1×10^{-2}	0	0	1.6×10^{-3}	0	0
Strontium-90	4.1×10^{2}	1.2×10^{-1}	1.2×10^{-1}	1.1×10^{2}	3.2×10^{-3}	3.1×10^{-3}
Technetium-99	1.5×10^{-1}	0	0	5.7×10^{-3}	0	0
Iodine-129	4.8×10^{-1}	2.7×10^{-1}	2.6×10^{-1}	1.8×10^{-2}	7.0×10^{-3}	6.7×10^{-3}
Cesium-137	5.8×10^{2}	1.5	1.4	2.5×10^{2}	3.9×10^{-2}	3.8×10^{-2}
Uranium	4.7×10^{-3}	0	0	1.8×10^{-4}	0	0
Plutonium-238	2.4×10^{-2}	5.6×10^{-7}	7.6×10^{-7}	9.3×10^{-4}	1.5×10^{-7}	1.5×10^{-7}
Plutonium-239, -240	4.1×10^{-1}	7.2×10^{-5}	9.6×10^{-5}	1.6×10^{-2}	1.9×10^{-5}	1.9×10^{-5}
Plutonium-241	6.3×10^{-1}	0	0	2.4×10^{-2}	0	0
Americium-241	7.2×10^{-1}	5.9×10^{-6}	7.8×10^{-6}	2.8×10^{-2}	1.5×10^{-6}	1.5×10^{-6}

Key: STTS=Supplemental Treatment Technology Site.

K.2.1.1.4 Results

The results of the dose analyses are presented in this section. Tables K–20 through K–32 show the estimated doses to the population living within 80 kilometers (50 miles) of the 200 Areas over the life of the project and during the year of maximum impact under each Tank Closure alternative. Tables K–33 through K–45 show the estimated doses to the MEI over the life of the project and during the year of maximum impact under each Tank Closure alternative. The year of maximum impact was determined by considering the combined impacts on the population or the MEI from the three emission source locations: the WTP, STTS-East, and STTS-West. For purposes of comparison, the National Emission Standards for Hazardous Air Pollutants annual dose limit to an individual member of the public is 10 millirem (0.01 rem) per year for all emission sources from a DOE site (40 CFR 61.90–61.97).

For activities that occur over a number of years, an average emission was assumed for each year. This approach can result in the peak impact spanning a number of years rather than occurring in a single year. Under all Tank Closure alternatives except Alternative 1, the year in which cesium and strontium would be de-encapsulated and processed at the WTP would result in the largest annual impacts.

Note that some of the alternatives would take much longer than others to complete; this difference would affect the population dose. As a result of the duration of some of the alternatives, the exposed population could include multiple generations. The radioactive inventories were not adjusted to account for the differences in the duration of the alternatives (radioactive decay over time would reduce the radioactivity of each radionuclide); however, the analyses still support a general comparison of the impacts on the offsite population and MEI.

Table K–20. Tank Closure Alternative 1 Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant[b]	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant[b]	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	0	2.6×10^{1}	2.5×10^{1}	5.0×10^{1}	0	2.6×10^{-1}	2.5×10^{-1}	5.0×10^{-1}
Carbon-14	0	0	0	0	0	0	0	0
Cobalt-60	0	1.3	1.3	2.6	0	1.3×10^{-2}	1.3×10^{-2}	2.6×10^{-2}
Strontium-90	0	2.2×10^{-1}	2.1×10^{-1}	4.4×10^{-1}	0	4.3×10^{-3}	4.1×10^{-3}	8.5×10^{-3}
Technetium-99	0	0	0	0	0	0	0	0
Iodine-129	0	1.4×10^{1}	1.3×10^{1}	2.7×10^{1}	0	2.7×10^{-1}	2.6×10^{-1}	5.2×10^{-1}
Cesium-137	0	2.1	2.1	4.2	0	4.2×10^{-2}	4.0×10^{-2}	8.2×10^{-2}
Uranium	0	2.6×10^{2}	2.5×10^{2}	5.2×10^{2}	0	2.6	2.5	5.2
Plutonium-238	0	0	0	0	0	0	0	0
Plutonium-239, -240	0	3.4×10^{-5}	3.2×10^{-5}	6.6×10^{-5}	0	9.2×10^{-7}	6.4×10^{-7}	1.6×10^{-6}
Plutonium-241	0	6.4×10^{-7}	6.0×10^{-7}	1.2×10^{-6}	0	0	0	0
Americium-241	0	2.7×10^{-5}	2.5×10^{-5}	5.2×10^{-5}	0	7.9×10^{-7}	5.2×10^{-7}	1.3×10^{-6}
Total	0	3.1×10^{2}	2.9×10^{2}	6×10^{2}	0	3.2	3.1	6.3
Number of latent cancer fatalities[c]				0 (4×10^{-1})				0 (4×10^{-3})

[a] The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area STTS, respectively. There is no regulatory standard for a population dose.

[b] There would be no emissions from the Waste Treatment Plant because it would not operate under this alternative.

[c] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–21. Tank Closure Alternative 2A Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	1.6	2.6×10^{1}	2.5×10^{1}	5.2×10^{1}	0	0	0	0
Carbon-14	7.2×10^{1}	0	0	7.2×10^{1}	0	0	0	0
Cobalt-60	5.7×10^{3}	1.3	1.3	2.6	0	0	0	0
Strontium-90	8.5×10^{1}	4.0×10^{-1}	3.9×10^{-1}	8.6×10^{1}	2.2×10^{1}	0	0	2.2×10^{1}
Technetium-99	1.8×10^{-3}	0	0	1.8×10^{-3}	0	0	0	0
Iodine-129	2.7	2.5×10^{1}	2.4×10^{1}	5.2×10^{1}	0	0	0	0
Cesium-137	9.3×10^{1}	3.9	3.7	1.0×10^{2}	3.8×10^{1}	0	0	3.8×10^{1}
Uranium	2.1×10^{-1}	2.6×10^{2}	2.5×10^{2}	5.2×10^{2}	0	0	0	0
Plutonium-238	3.7	5.9×10^{-5}	1.5×10^{-4}	3.7	0	0	0	0
Plutonium-239, -240	6.5×10^{1}	8.6×10^{-3}	2.2×10^{-2}	6.5×10^{1}	0	5.3×10^{-7}	0	5.3×10^{-7}
Plutonium-241	1.3	1.6×10^{-4}	4.0×10^{-4}	1.3	0	0	0	0
Americium-241	1.2×10^{2}	8.8×10^{-4}	1.9×10^{-3}	1.2×10^{2}	0	0	0	0
Total	4.5×10^{2}	3.2×10^{2}	3.1×10^{2}	1.1×10^{3}	6.0×10^{1}	5.3×10^{-7}	0	6.0×10^{1}
Number of latent cancer fatalities[b]				1 (0.6)				0 (4×10^{-2})

[a] The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area STTS, respectively. There is no regulatory standard for a population dose.

[b] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–22. Tank Closure Alternative 2B Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	1.6	0	0	1.6	6.0×10^{-2}	0	0	6.0×10^{-2}
Carbon-14	7.2×10^{1}	0	0	7.2×10^{1}	2.7	0	0	2.7
Cobalt-60	5.7×10^{-3}	0	0	5.7×10^{-3}	2.2×10^{-4}	0	0	2.2×10^{-4}
Strontium-90	8.9×10^{1}	8.2×10^{-2}	7.9×10^{-2}	8.9×10^{1}	2.6×10^{1}	2.2×10^{-3}	2.1×10^{-3}	2.6×10^{1}
Technetium-99	1.8×10^{-3}	0	0	1.8×10^{-3}	6.8×10^{-5}	0	0	6.8×10^{-5}
Iodine-129	2.7	5.1	4.8	1.3×10^{1}	1.0×10^{-1}	1.3×10^{-1}	1.3×10^{-1}	3.7×10^{-1}
Cesium-137	9.3×10^{1}	7.9×10^{-1}	7.6×10^{-1}	9.5×10^{1}	4.0×10^{1}	2.1×10^{-2}	2.0×10^{-2}	4.0×10^{1}
Uranium	2.1×10^{-1}	0	0	2.1×10^{-1}	7.9×10^{-3}	0	0	7.9×10^{-3}
Plutonium-238	3.7	2.7×10^{-4}	3.6×10^{-4}	3.7	1.4×10^{-1}	7.0×10^{-5}	7.0×10^{-5}	1.4×10^{-1}
Plutonium-239, -240	6.5×10^{1}	3.8×10^{-2}	5.1×10^{-2}	6.5×10^{1}	2.6	9.9×10^{-3}	9.9×10^{-3}	2.7
Plutonium-241	1.3	7.1×10^{-4}	9.6×10^{-4}	1.3	7.4×10^{-2}	0	0	7.4×10^{-2}
Americium-241	1.2×10^{2}	3.2×10^{-3}	4.2×10^{-3}	1.2×10^{2}	4.4	7.9×10^{-4}	7.9×10^{-4}	4.4
Total	4.5×10^{2}	6.0	5.7	4.6×10^{2}	7.6×10^{1}	1.7×10^{-1}	1.6×10^{-1}	7.6×10^{1}
Number of latent cancer fatalities[b]				0 (3×10^{-1})				0 (5×10^{-2})

[a] The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area, respectively. There is no regulatory standard for a population dose.

[b] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–23. Tank Closure Alternative 3A Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	4.6×10^{-1}	1.9	1.6	4.0	0	8.8×10^{-3}	7.4×10^{-3}	1.6×10^{-2}
Carbon-14	2.2×10^{1}	8.8×10^{1}	7.4×10^{1}	1.8×10^{2}	0	4.0×10^{-1}	3.3×10^{-1}	7.3×10^{-1}
Cobalt-60	4.7×10^{-3}	1.6×10^{-3}	1.5×10^{-3}	7.7×10^{-3}	0	7.0×10^{-6}	6.8×10^{-6}	1.4×10^{-5}
Strontium-90	8.4×10^{1}	1.2×10^{-1}	1.6	8.6×10^{1}	2.2×10^{1}	1.4×10^{-5}	7.1×10^{-3}	2.2×10^{1}
Technetium-99	5.3×10^{-4}	2.2×10^{-5}	1.9×10^{-3}	2.4×10^{-3}	0	1.0×10^{-5}	8.6×10^{-6}	1.9×10^{-5}
Iodine-129	8.0×10^{-1}	8.0	7.3	1.6×10^{1}	0	1.6×10^{-2}	1.3×10^{-2}	2.9×10^{-2}
Cesium-137	8.9×10^{1}	1.3	1.2×10^{1}	1.0×10^{2}	3.8×10^{1}	2.7×10^{-3}	5.3×10^{-2}	3.8×10^{1}
Uranium	1.9×10^{-1}	1.6×10^{-2}	2.1×10^{-2}	2.3×10^{-1}	0	6.8×10^{-5}	9.6×10^{-5}	1.6×10^{-4}
Plutonium-238	3.1	3.3×10^{-2}	1.4×10^{-1}	3.3	0	3.6×10^{-7}	6.4×10^{-4}	6.4×10^{-4}
Plutonium-239, -240	5.9×10^{1}	4.2×10^{-1}	2.9	6.3×10^{1}	0	7.4×10^{-6}	1.3×10^{-2}	1.3×10^{-2}
Plutonium-241	1.1	7.9×10^{-3}	5.4×10^{-2}	1.2	0	2.0×10^{-7}	3.6×10^{-4}	3.6×10^{-4}
Americium-241	1.0×10^{2}	1.3	3.8	1.1×10^{2}	0	2.0×10^{-5}	1.7×10^{-2}	1.7×10^{-2}
Total	3.6×10^{2}	1.0×10^{2}	1.0×10^{2}	5.7×10^{2}	6.0×10^{1}	4.2×10^{-1}	4.5×10^{-1}	6.1×10^{1}
Number of latent cancer fatalities[b]				0 (3×10^{-1})				0 (4×10^{-2})

[a] The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area STTS, respectively. There is no regulatory standard for a population dose.

[b] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–24. Tank Closure Alternative 3B Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	4.6×10^{-1}	2.0×10^{-5}	1.6×10^{-5}	4.6×10^{-1}	0	8.8×10^{-8}	7.4×10^{-8}	1.6×10^{-7}
Carbon-14	2.2×10^{1}	8.9×10^{-4}	7.4×10^{-4}	2.2×10^{1}	0	4.0×10^{-6}	3.3×10^{-6}	7.3×10^{-6}
Cobalt-60	4.7×10^{-3}	3.5×10^{-5}	3.0×10^{-5}	4.7×10^{-3}	0	1.4×10^{-7}	1.4×10^{-7}	2.8×10^{-7}
Strontium-90	8.4×10^{1}	1.2×10^{-1}	1.0×10^{-1}	8.5×10^{1}	2.2×10^{1}	2.8×10^{-7}	1.4×10^{-4}	2.2×10^{1}
Technetium-99	1.2×10^{-3}	1.8×10^{-6}	3.8×10^{-5}	1.2×10^{-3}	0	2.0×10^{-9}	1.7×10^{-7}	1.7×10^{-7}
Iodine-129	8.0×10^{-1}	4.5	4.3	9.7	0	1.6×10^{-7}	1.3×10^{-7}	2.9×10^{-7}
Cesium-137	8.9×10^{1}	7.4×10^{-1}	9.2×10^{-1}	9.1×10^{1}	3.8×10^{1}	5.5×10^{-5}	1.1×10^{-3}	3.8×10^{1}
Uranium	1.9×10^{-1}	9.3×10^{-4}	4.8×10^{-4}	1.9×10^{-1}	0	1.4×10^{-6}	1.9×10^{-6}	3.3×10^{-6}
Plutonium-238	3.1	3.3×10^{-2}	3.4×10^{-3}	3.2	0	7.2×10^{-9}	1.3×10^{-5}	1.3×10^{-5}
Plutonium-239, -240	5.9×10^{1}	4.4×10^{-1}	1.5×10^{-1}	6.0×10^{1}	0	6.7×10^{-7}	2.5×10^{-4}	2.5×10^{-4}
Plutonium-241	1.1	8.1×10^{-3}	2.8×10^{-3}	1.2	0	3.9×10^{-9}	7.2×10^{-6}	7.2×10^{-6}
Americium-241	1.0×10^{2}	1.3	8.4×10^{-2}	1.0×10^{2}	0	3.9×10^{-7}	3.4×10^{-4}	3.4×10^{-4}
Total	3.6×10^{2}	7.2	5.6	3.8×10^{2}	6.0×10^{1}	6.2×10^{-5}	1.8×10^{-3}	6.0×10^{1}
Number of latent cancer fatalities[b]				0 (2×10^{-1})				0 (4×10^{-2})

a The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area STTS, respectively. There is no regulatory standard for a population dose.

b The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–25. Tank Closure Alternative 3C Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	4.6×10^{-1}	1.9	1.6	4.0	0	8.8×10^{-3}	7.4×10^{-3}	1.6×10^{-2}
Carbon-14	2.2×10^{1}	8.8×10^{1}	7.4×10^{1}	1.8×10^{2}	0	4.0×10^{-1}	3.3×10^{-1}	7.3×10^{-1}
Cobalt-60	4.7×10^{-3}	1.6×10^{-3}	1.5×10^{-3}	7.7×10^{-3}	0	7.0×10^{-6}	6.8×10^{-6}	1.4×10^{-5}
Strontium-90	8.4×10^{1}	1.3×10^{-1}	1.6	8.6×10^{1}	2.2×10^{1}	1.4×10^{-5}	7.1×10^{-3}	2.2×10^{1}
Technetium-99	1.2×10^{-3}	2.3×10^{-3}	1.9×10^{-3}	5.4×10^{-3}	0	1.0×10^{-5}	8.6×10^{-6}	1.9×10^{-5}
Iodine-129	8.0×10^{-1}	8.0	7.3	1.6×10^{1}	0	1.6×10^{-2}	1.3×10^{-2}	2.9×10^{-2}
Cesium-137	8.9×10^{1}	1.3	1.2×10^{1}	1.0×10^{2}	3.8×10^{1}	2.7×10^{-3}	5.3×10^{-2}	3.8×10^{1}
Uranium	1.9×10^{-1}	1.6×10^{-2}	2.1×10^{-2}	2.3×10^{-1}	0	6.8×10^{-5}	9.6×10^{-5}	1.6×10^{-4}
Plutonium-238	3.1	3.3×10^{-2}	1.4×10^{-1}	3.3	0	3.6×10^{-7}	6.4×10^{-4}	6.4×10^{-4}
Plutonium-239, -240	5.9×10^{1}	4.2×10^{-1}	2.9	6.3×10^{1}	0	7.4×10^{-6}	1.3×10^{-2}	1.3×10^{-2}
Plutonium-241	1.1	7.9×10^{-3}	5.4×10^{-2}	1.2	0	2.0×10^{-7}	3.6×10^{-4}	3.6×10^{-4}
Americium-241	1.0×10^{2}	1.3	3.8	1.1×10^{2}	0	2.0×10^{-5}	1.7×10^{-2}	1.7×10^{-2}
Total	3.6×10^{2}	1×10^{2}	1×10^{2}	5.7×10^{2}	6.0×10^{1}	4.2×10^{-1}	4.5×10^{-1}	6.1×10^{1}
Number of latent cancer fatalities[b]				0 (3×10^{-1})				0 (4×10^{-2})

a The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area STTS, respectively. There is no regulatory standard for a population dose.

b The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–26. Tank Closure Alternative 4 Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	4.7×10^{-1}	2.0×10^{-5}	1.7	2.1	0	1.2×10^{-9}	1.2×10^{-9}	2.4×10^{-9}
Carbon-14	2.2×10^{1}	9.0×10^{-4}	7.5×10^{1}	9.7×10^{1}	0	2.0×10^{-8}	2.0×10^{-8}	4.0×10^{-8}
Cobalt-60	4.7×10^{-3}	9.0×10^{-5}	1.6×10^{-3}	6.4×10^{-3}	0	1.0×10^{-7}	1.0×10^{-7}	2.0×10^{-7}
Strontium-90	8.5×10^{1}	1.4	3.3	9.0×10^{1}	2.2×10^{1}	3.9×10^{-3}	3.9×10^{-3}	2.2×10^{1}
Technetium-99	5.3×10^{-4}	6.4×10^{-5}	1.9×10^{-3}	2.5×10^{-3}	0	8.1×10^{-8}	8.1×10^{-8}	1.6×10^{-7}
Iodine-129	8.1×10^{-1}	4.9	7.7	1.3×10^{1}	0	7.0×10^{-8}	7.0×10^{-8}	1.4×10^{-7}
Cesium-137	9.0×10^{1}	1.3	1.3×10^{1}	1.0×10^{2}	3.8×10^{1}	2.5×10^{-3}	2.5×10^{-3}	3.8×10^{1}
Uranium	1.9×10^{-1}	7.9×10^{-3}	2.8×10^{-2}	2.3×10^{-1}	0	3.5×10^{-5}	3.5×10^{-5}	6.9×10^{-5}
Plutonium-238	3.2	6.4×10^{-2}	1.7×10^{-1}	3.4	0	2.2×10^{-4}	2.2×10^{-4}	4.4×10^{-4}
Plutonium-239, -240	6.0×10^{1}	1.5	4.2	6.5×10^{1}	0	1.4×10^{-2}	1.4×10^{-2}	2.7×10^{-2}
Plutonium-241	1.2	2.8×10^{-2}	7.9×10^{-2}	1.3	0	4.4×10^{-5}	4.4×10^{-5}	8.8×10^{-5}
Americium-241	1.0×10^{2}	2.4	5.3	1.1×10^{2}	0	3.0×10^{-3}	3.0×10^{-3}	6.0×10^{-3}
Total	3.7×10^{2}	1.2×10^{1}	1.1×10^{2}	4.9×10^{2}	6.0×10^{1}	2.3×10^{-2}	2.3×10^{-2}	6.0×10^{1}
Number of latent cancer fatalities[b]				0 (3×10^{-1})				0 (4×10^{-2})

[a] The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area STTS, respectively. There is no regulatory standard for a population dose.

[b] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–27. Tank Closure Alternative 5 Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	7.6×10^{-1}	6.8×10^{-6}	1.5	2.2	4.7×10^{-4}	4.2×10^{-8}	9.2×10^{-3}	9.7×10^{-3}
Carbon-14	3.5×10^{1}	3.1×10^{-4}	6.8×10^{1}	1.0×10^{2}	2.1×10^{-1}	1.9×10^{-6}	4.2×10^{-1}	6.3×10^{-1}
Cobalt-60	5.8×10^{-3}	1.4×10^{-5}	1.4×10^{-3}	7.1×10^{-3}	7.5×10^{-6}	6.7×10^{-8}	8.5×10^{-6}	1.6×10^{-5}
Strontium-90	8.0×10^{1}	1.1×10^{-1}	1.5	8.2×10^{1}	2.2×10^{1}	1.3×10^{-7}	8.8×10^{-3}	2.2×10^{1}
Technetium-99	2.6×10^{-3}	1.7×19^{-5}	1.7×10^{-3}	4.3×10^{-3}	1.1×10^{-5}	9.8×10^{-8}	1.1×10^{-5}	2.1×10^{-5}
Iodine-129	1.3	3.7	6.3	1.1×10^{1}	8.2×10^{-6}	7.6×10^{-8}	1.7×10^{-2}	1.7×10^{-2}
Cesium-137	8.7×10^{1}	6.0×10^{-1}	1.2×10^{1}	1.0×10^{2}	3.8×10^{1}	2.6×10^{-5}	7.3×10^{-2}	3.8×10^{1}
Uranium	1.9×10^{-1}	6.8×10^{-4}	1.9×10^{-2}	2.1×10^{-1}	7.3×10^{-5}	6.5×10^{-7}	1.2×10^{-4}	1.9×10^{-4}
Plutonium-238	2.9	3.0×10^{-2}	1.3×10^{-1}	3.0	3.9×10^{-7}	3.4×10^{-9}	8.0×10^{-4}	8.0×10^{-4}
Plutonium-239, -240	5.4×10^{1}	3.6×10^{-1}	2.6	5.7×10^{1}	7.6×10^{-6}	6.0×10^{-7}	1.6×10^{-2}	1.6×10^{-2}
Plutonium-241	1.0	6.7×10^{-3}	4.9×10^{-2}	1.1	2.1×10^{-7}	1.9×10^{-9}	4.5×10^{-4}	4.5×10^{-4}
Americium-241	9.3×10^{1}	1.2	3.5	9.8×10^{1}	2.0×10^{-5}	1.9×10^{-7}	2.1×10^{-2}	2.1×10^{-2}
Total	3.6×10^{2}	6.0	9.5×10^{1}	4.6×10^{2}	6.0×10^{1}	3.0×10^{-5}	5.6×10^{-1}	6.1×10^{1}
Number of latent cancer fatalities[b]				0 (3×10^{-1})				0 (4×10^{-2})

[a] The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area STTS, respectively. There is no regulatory standard for a population dose.

[b] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–28. Tank Closure Alternative 6A, Base Case, Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	1.6	2.5×10^{-2}	2.4×10^{-4}	1.6	0	3.2×10^{-5}	3.2×10^{-5}	6.5×10^{-5}
Carbon-14	7.2×10^{1}	7.9×10^{-1}	7.6×10^{-3}	7.3×10^{1}	0	1.0×10^{-3}	1.0×10^{-3}	2.1×10^{-3}
Cobalt-60	5.7×10^{-3}	1.2×10^{-3}	3.4×10^{-5}	6.9×10^{-3}	0	1.2×10^{-6}	1.2×10^{-6}	2.4×10^{-6}
Strontium-90	9.0×10^{1}	1.5×10^{1}	4.6×10^{-1}	1.1×10^{2}	2.2×10^{1}	1.4×10^{-2}	1.4×10^{-2}	2.2×10^{1}
Technetium-99	1.8×10^{-3}	1.5×10^{-3}	1.5×10^{-5}	3.3×10^{-3}	0	2.0×10^{-6}	2.0×10^{-6}	4.0×10^{-6}
Iodine-129	2.8	2.4×10^{1}	1.5×10^{-1}	2.6×10^{1}	0	3.6×10^{-3}	3.6×10^{-3}	7.3×10^{-3}
Cesium-137	1.0×10^{2}	3.7×10^{1}	3.5×10^{-1}	1.4×10^{2}	3.8×10^{1}	4.4×10^{-2}	4.4×10^{-2}	3.8×10^{1}
Uranium	2.1×10^{-1}	3.1×10^{-1}	2.9×10^{-3}	5.2×10^{-1}	0	4.0×10^{-4}	4.0×10^{-4}	7.9×10^{-4}
Plutonium-238	3.7	5.7×10^{-1}	6.0×10^{-3}	4.2	0	8.8×10^{-4}	7.4×10^{-4}	1.6×10^{-3}
Plutonium-239, -240	6.5×10^{1}	7.3	3.4×10^{-1}	7.3×10^{1}	0	2.6×10^{-2}	6.2×10^{-3}	3.2×10^{-2}
Plutonium-241	1.3	1.4×10^{-1}	6.4×10^{-3}	1.4	0	1.0×10^{-4}	1.0×10^{-4}	2.0×10^{-4}
Americium-241	1.2×10^{2}	8.9	4.7×10^{-1}	1.3×10^{2}	0	7.5×10^{-3}	5.9×10^{-3}	1.3×10^{-2}
Total	4.6×10^{2}	9.3×10^{1}	1.8	5.6×10^{2}	6.0×10^{1}	9.7×10^{-2}	7.6×10^{-2}	6.0×10^{1}
Number of latent cancer fatalities[b]				0 (3×10^{-1})				0 (4×10^{-2})

[a] The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area STTS, respectively. There is no regulatory standard for a population dose.

[b] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–29. Tank Closure Alternative 6A, Option Case, Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	1.6	6.0×10^{-1}	6.0×10^{-1}	2.8	0	7.8×10^{-4}	7.8×10^{-4}	1.6×10^{-3}
Carbon-14	7.2×10^{1}	1.1	1.1	7.4×10^{1}	0	1.4×10^{-3}	1.4×10^{-3}	2.8×10^{-3}
Cobalt-60	5.7×10^{-3}	2.3×10^{-3}	2.3×10^{-3}	1.0×10^{-2}	0	2.4×10^{-6}	2.4×10^{-6}	4.9×10^{-6}
Strontium-90	9.0×10^{1}	1.8×10^{1}	1.8×10^{1}	1.3×10^{2}	2.2×10^{1}	1.5×10^{-2}	1.5×10^{-2}	2.2×10^{1}
Technetium-99	1.8×10^{-3}	2.2×10^{-3}	2.2×10^{-3}	6.3×10^{-3}	0	2.9×10^{-6}	2.9×10^{-6}	5.8×10^{-6}
Iodine-129	2.8	2.5×10^{1}	2.4×10^{1}	5.1×10^{1}	0	5.1×10^{-3}	5.1×10^{-3}	1.0×10^{-2}
Cesium-137	1.0×10^{2}	3.8×10^{1}	3.8×10^{1}	1.8×10^{2}	3.8×10^{1}	4.5×10^{-2}	4.5×10^{-2}	3.8×10^{1}
Uranium	2.1×10^{-1}	4.1×10^{-1}	4.1×10^{-1}	1.0	0	5.4×10^{-4}	5.4×10^{-4}	1.1×10^{-3}
Plutonium-238	3.7	1.1	1.1	5.9	0	1.6×10^{-3}	1.4×10^{-3}	3.0×10^{-3}
Plutonium-239 -240	6.5×10^{1}	4.8×10^{1}	4.8×10^{1}	1.6×10^{2}	0	7.7×10^{-2}	5.8×10^{-2}	1.3×10^{-1}
Plutonium-241	1.3	9.0×10^{-1}	9.0×10^{-1}	3.1	0	8.0×10^{-4}	8.0×10^{-4}	1.6×10^{-3}
Americium-241	1.2×10^{2}	1.8×10^{1}	1.8×10^{1}	1.6×10^{2}	0	1.7×10^{-2}	1.5×10^{-2}	3.2×10^{-2}
Total	4.6×10^{2}	1.5×10^{2}	1.5×10^{2}	7.6×10^{2}	6.0×10^{1}	1.6×10^{-1}	1.4×10^{-1}	6.0×10^{1}
Number of latent cancer fatalities[b]				0 (5×10^{-1})				0 (4×10^{-2})

[a] The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area STTS, respectively. There is no regulatory standard for a population dose.

[b] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–30. Tank Closure Alternative 6B, Base Case, Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	1.6	2.5×10^{-2}	2.5×10^{-2}	1.6	6.0×10^{-2}	3.2×10^{-4}	3.2×10^{-4}	6.0×10^{-2}
Carbon-14	7.2×10^{1}	7.9×10^{-1}	7.9×10^{-1}	7.3×10^{1}	2.7	1.0×10^{-2}	1.0×10^{-2}	2.8
Cobalt-60	5.7×10^{-3}	1.2×10^{-3}	1.2×10^{-3}	8.1×10^{-3}	2.2×10^{-4}	2.2×10^{-5}	1.8×10^{-5}	2.6×10^{-4}
Strontium-90	8.5×10^{1}	1.5×10^{1}	1.5×10^{1}	1.1×10^{2}	2.4×10^{1}	2.9×10^{-1}	2.2×10^{-1}	2.4×10^{1}
Technetium-99	1.8×10^{-3}	1.5×10^{-3}	1.5×10^{-3}	4.8×10^{-3}	6.8×10^{-5}	2.0×10^{-5}	2.0×10^{-5}	1.1×10^{-4}
Iodine-129	2.7	7.9	7.6	1.8×10^{1}	1.0×10^{-1}	1.7×10^{-1}	1.6×10^{-1}	4.4×10^{-1}
Cesium-137	9.3×10^{1}	3.5×10^{1}	3.5×10^{1}	1.6×10^{2}	4.0×10^{1}	4.6×10^{-1}	4.6×10^{-1}	4.1×10^{1}
Uranium	2.1×10^{-1}	3.1×10^{-1}	3.1×10^{-1}	8.2×10^{-1}	7.9×10^{-3}	4.0×10^{-3}	4.0×10^{-3}	1.6×10^{-2}
Plutonium-238	3.7	5.7×10^{-1}	5.7×10^{-1}	4.8	1.4×10^{-1}	7.4×10^{-3}	7.4×10^{-3}	1.5×10^{-1}
Plutonium-239, -240	6.5×10^{1}	7.3	7.4	8.0×10^{1}	2.6	1.6×10^{-1}	1.1×10^{-1}	2.9
Plutonium-241	1.3	1.4×10^{-1}	1.4×10^{-1}	1.5	7.4×10^{-2}	1.1×10^{-3}	1.1×10^{-3}	7.6×10^{-2}
Americium-241	1.2×10^{2}	8.9	9.0	1.4×10^{2}	4.4	2.3×10^{-1}	1.5×10^{-1}	4.8
Total	4.5×10^{2}	7.5×10^{1}	7.5×10^{1}	6.0×10^{2}	7.4×10^{1}	1.3	1.1	7.6×10^{1}
Number of latent cancer fatalities[b]				0 (4×10^{-1})				0 (5×10^{-2})

[a] The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area STTS, respectively. There is no regulatory standard for a population dose.

[b] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–31. Tank Closure Alternative 6B, Option Case, Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	1.6	6.0×10^{-1}	6.0×10^{-1}	2.8	6.0×10^{-2}	7.8×10^{-3}	7.8×10^{-3}	7.5×10^{-2}
Carbon-14	7.2×10^{1}	1.1	1.1	7.4×10^{1}	2.7	1.4×10^{-2}	1.4×10^{-2}	2.8
Cobalt-60	5.7×10^{-3}	2.2×10^{-3}	2.2×10^{-3}	1.0×10^{-2}	2.2×10^{-4}	3.9×10^{-5}	3.0×10^{-5}	2.9×10^{-4}
Strontium-90	8.5×10^{1}	1.7×10^{1}	1.7×10^{1}	1.2×10^{2}	2.4×10^{1}	3.6×10^{-1}	2.3×10^{-1}	2.4×10^{1}
Technetium-99	1.8×10^{-3}	2.2×10^{-3}	2.2×10^{-3}	6.3×10^{-3}	6.8×10^{-5}	2.9×10^{-5}	2.9×10^{-5}	1.3×10^{-4}
Iodine-129	2.7	9.0	8.8	2.0×10^{1}	1.0×10^{-1}	1.8×10^{-1}	1.8×10^{-1}	4.7×10^{-1}
Cesium-137	9.3×10^{1}	3.6×10^{1}	3.6×10^{1}	1.6×10^{2}	4.0×10^{1}	4.8×10^{-1}	4.7×10^{-1}	4.1×10^{1}
Uranium	2.1×10^{-1}	4.2×10^{-1}	4.2×10^{-1}	1.0	7.9×10^{-3}	5.4×10^{-3}	5.4×10^{-3}	1.9×10^{-2}
Plutonium-238	3.7	1.1	1.1	5.9	1.4×10^{-1}	1.5×10^{-2}	1.4×10^{-2}	1.7×10^{-1}
Plutonium-239, -240	6.5×10^{1}	4.8×10^{1}	4.8×10^{1}	1.6×10^{2}	2.5	7.1×10^{-1}	6.3×10^{-1}	3.8
Plutonium-241	1.3	9.0×10^{-1}	9.0×10^{-1}	3.1	7.4×10^{-2}	8.1×10^{-3}	8.1×10^{-3}	9.0×10^{-2}
Americium-241	1.2×10^{2}	1.8×10^{1}	1.8×10^{1}	1.6×10^{2}	4.7	4.0×10^{-1}	2.4×10^{-1}	5.3
Total	4.5×10^{2}	1.3×10^{2}	1.3×10^{2}	7.1×10^{2}	7.4×10^{1}	2.2	1.8	7.8×10^{1}
Number of latent cancer fatalities[b]				0 (4×10^{-1})				0 (5×10^{-2})

[a] The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area STTS, respectively. There is no regulatory standard for a population dose.

[b] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–32. Tank Closure Alternative 6C Impacts on the Population During Normal Operations

Radionuclides	Dose over Life of Project (person-rem)[a]				Dose in Year of Maximum Impact (person-rem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	1.6	0	0	1.6	6.0×10^{-2}	0	0	6.0×10^{-2}
Carbon-14	7.2×10^{1}	0	0	7.2×10^{1}	2.7	0	0	2.7
Cobalt-60	5.7×10^{-3}	0	0	5.7×10^{-3}	2.2×10^{-4}	0	0	2.2×10^{-4}
Strontium-90	8.5×10^{1}	8.2×10^{-2}	7.9×10^{-2}	8.5×10^{1}	2.4×10^{1}	2.2×10^{-3}	2.1×10^{-3}	2.4×10^{1}
Technetium-99	1.8×10^{-3}	0	0	1.8×10^{-3}	6.8×10^{-5}	0	0	6.8×10^{-5}
Iodine-129	2.7	5.1	4.9	1.3×10^{1}	1.0×10^{-1}	1.3×10^{-1}	1.3×10^{-1}	3.7×10^{-1}
Cesium-137	9.3×10^{1}	7.9×10^{-1}	7.6×10^{-1}	9.5×10^{1}	4.0×10^{1}	2.1×10^{-2}	2.0×10^{-2}	4.0×10^{1}
Uranium	2.1×10^{-1}	0	0	2.1×10^{-1}	7.9×10^{-3}	0	0	7.9×10^{-3}
Plutonium-238	3.7	2.7×10^{-4}	3.6×10^{-4}	3.7	1.4×10^{-1}	7.0×10^{-5}	7.0×10^{-5}	1.4×10^{-1}
Plutonium-239, -240	6.5×10^{1}	3.8×10^{-2}	5.1×10^{-2}	6.5×10^{1}	2.6	9.9×10^{-3}	9.9×10^{-3}	2.7
Plutonium-241	1.3	7.1×10^{-4}	9.6×10^{-4}	1.3	7.4×10^{-2}	0	0	7.4×10^{-2}
Americium-241	1.2×10^{2}	3.2×10^{-3}	4.2×10^{-3}	1.2×10^{2}	4.4	7.9×10^{-4}	7.9×10^{-4}	4.4
Total	4.5×10^{2}	6.0	5.7	4.6×10^{2}	7.4×10^{1}	1.7×10^{-1}	1.6×10^{-1}	7.4×10^{1}
Number of latent cancer fatalities[b]				0 (3×10^{-1})				0 (4×10^{-2})

[a] The reported result is the collective dose for a population of approximately 463,000, the average of the populations of 447,354; 451,556; and 488,897 that live within 80 kilometers (50 miles) of the Waste Treatment Plant, 200-East Area STTS, and 200-West Area STTS, respectively. There is no regulatory standard for a population dose.

[b] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–33. Tank Closure Alternative 1 Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)[a]				Dose in Year of Maximum Impact (millirem per year)[b]			
	Waste Treatment Plant[c]	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant[c]	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	0	1.0	5.2×10^{-1}	1.6	0	1.0×10^{-2}	5.2×10^{-3}	1.6×10^{-2}
Carbon-14	0	0	0	0	0	0	0	0
Cobalt-60	0	4.4×10^{-2}	2.2×10^{-2}	6.6×10^{-2}	0	4.4×10^{-4}	2.2×10^{-4}	6.6×10^{-4}
Strontium-90	0	1.3×10^{-2}	6.4×10^{-3}	1.9×10^{-2}	0	2.4×10^{-4}	1.2×10^{-4}	3.7×10^{-4}
Technetium-99	0	0	0	0	0	0	0	0
Iodine-129	0	5.5×10^{-1}	2.8×10^{-1}	8.3×10^{-1}	0	1.1×10^{-2}	5.4×10^{-3}	1.6×10^{-2}
Cesium-137	0	7.3×10^{-2}	3.8×10^{-2}	1.1×10^{-1}	0	1.4×10^{-3}	7.3×10^{-4}	2.1×10^{-3}
Uranium	0	6	3.1	9.1	0	6.0×10^{-2}	3.1×10^{-2}	9.1×10^{-2}
Plutonium-238	0	0	0	0	0	0	0	0
Plutonium-239, -240	0	7.8×10^{-7}	3.9×10^{-7}	1.2×10^{-6}	0	2.1×10^{-8}	7.7×10^{-9}	2.9×10^{-8}
Plutonium-241	0	0	0	0	0	0	0	0
Americium-241	0	6.6×10^{-7}	3.0×10^{-7}	9.5×10^{-7}	0	1.9×10^{-8}	6.3×10^{-9}	2.5×10^{-8}
Total	0	7.7	3.9	1.2×10^{1}	0	8.3×10^{-2}	4.2×10^{-2}	1.3×10^{-1}
Lifetime risk of a latent cancer fatality				7×10^{-6}				8×10^{-8}

[a] Impacts are provided for comparison to other alternatives. The life-of-project dose would not be received by one individual person due to the duration of this alternative. The dose from 70 years of exposure at the average annual dose rate would be 8 millirem, with a corresponding lifetime risk of a latent cancer fatality of 5×10^{-6}.

[b] The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

[c] There would be no emissions from the Waste Treatment Plant because it would not operate under this alternative.

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–34. Tank Closure Alternative 2A Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)[a]				Dose in Year of Maximum Impact (millirem per year)[b]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	2.8×10^{-2}	1.0	5.2×10^{-1}	1.6	0	0	0	0
Carbon-14	1.7	0	0	1.7	0	0	0	0
Cobalt-60	8.1×10^{-5}	4.4×10^{-2}	2.2×10^{-2}	6.6×10^{-2}	0	0	0	0
Strontium-90	2.1	2.3×10^{-2}	1.2×10^{-2}	2.1	6.4×10^{-1}	0	0	6.4×10^{-1}
Technetium-99	6.2×10^{-5}	0	0	6.2×10^{-5}	0	0	0	0
Iodine-129	4.8×10^{-2}	9.9×10^{-1}	5.1×10^{-1}	1.5	0	0	0	0
Cesium-137	1.5	1.3×10^{-1}	6.8×10^{-2}	1.7	7.2×10^{-1}	0	0	7.2×10^{-1}
Uranium	2.1×10^{-3}	6.0	3.1	9.1	0	0	0	0
Plutonium-238	3.7×10^{-2}	1.4×10^{-6}	1.8×10^{-6}	3.7×10^{-2}	0	0	0	0
Plutonium-239, -240	6.9×10^{-1}	1.9×10^{-4}	2.6×10^{-4}	6.9×10^{-1}	0	7.8×10^{-9}	0	7.8×10^{-9}
Plutonium-241	2.0×10^{-2}	0	0	2.0×10^{-2}	0	0	0	0
Americium-241	1.2	2.1×10^{-5}	2.3×10^{-5}	1.2	0	0	0	0
Total	7.3	8.3	4.2	2.0×10^{1}	1.4	7.8×10^{-9}	0	1.4
Lifetime risk of a latent cancer fatality				1×10^{-5}				8×10^{-7}

[a] Impacts are provided for comparison to other alternatives. The life-of-project dose would not be received by one individual person due to the duration of this alternative. The dose from 70 years of exposure at the average annual dose rate would be 7.4 millirem, with a corresponding lifetime risk of a latent cancer fatality of 4×10^{-6}.

[b] The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–35. Tank Closure Alternative 2B Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)				Dose in Year of Maximum Impact (millirem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	3.3×10^{-2}	0	0	3.3×10^{-2}	1.2×10^{-3}	0	0	1.2×10^{-3}
Carbon-14	2.2	0	0	2.2	8.2×10^{-2}	0	0	8.2×10^{-2}
Cobalt-60	1.0×10^{-4}	0	0	1.0×10^{-4}	3.9×10^{-6}	0	0	3.9×10^{-6}
Strontium-90	2.6	3.0×10^{-3}	1.7×10^{-3}	2.6	7.6×10^{-1}	7.9×10^{-5}	4.6×10^{-5}	7.6×10^{-1}
Technetium-99	7.4×10^{-5}	0	0	7.4×10^{-5}	2.8×10^{-6}	0	0	2.8×10^{-6}
Iodine-129	5.8×10^{-2}	1.3×10^{-1}	7.4×10^{-2}	2.6×10^{-1}	2.2×10^{-3}	3.4×10^{-3}	1.9×10^{-3}	7.6×10^{-3}
Cesium-137	1.7	1.8×10^{-2}	1.0×10^{-2}	1.8	7.4×10^{-1}	4.7×10^{-4}	2.7×10^{-4}	7.5×10^{-1}
Uranium	2.5×10^{-3}	0	0	2.5×10^{-3}	9.5×10^{-5}	0	0	9.5×10^{-5}
Plutonium-238	4.4×10^{-2}	3.9×10^{-6}	3.1×10^{-6}	4.4×10^{-2}	1.7×10^{-3}	1.0×10^{-6}	6.0×10^{-7}	1.7×10^{-3}
Plutonium-239, -240	8.1×10^{-1}	5.6×10^{-4}	4.4×10^{-4}	8.1×10^{-1}	3.1×10^{-2}	1.5×10^{-4}	8.6×10^{-5}	3.1×10^{-2}
Plutonium-241	2.4×10^{-2}	0	0	2.4×10^{-2}	9.1×10^{-4}	0	0	9.1×10^{-4}
Americium-241	1.4	4.6×10^{-5}	3.7×10^{-5}	1.4	5.5×10^{-2}	1.2×10^{-5}	6.9×10^{-6}	5.5×10^{-2}
Total	8.9	1.5×10^{-1}	8.6×10^{-2}	9.2	1.7	4.1×10^{-3}	2.4×10^{-3}	1.7
Lifetime risk of a latent cancer fatality				5×10^{-6}				1×10^{-6}

[a] The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–36. Tank Closure Alternative 3A Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)				Dose in Year of Maximum Impact (millirem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	8.1×10^{-3}	7.9×10^{-2}	3.5×10^{-2}	1.2×10^{-1}	0	2.3×10^{-4}	1.2×10^{-4}	3.5×10^{-4}
Carbon-14	5.4×10^{-1}	4.9	2.2	7.7	0	1.4×10^{-2}	7.1×10^{-3}	2.1×10^{-2}
Cobalt-60	6.7×10^{-5}	5.2×10^{-5}	2.6×10^{-5}	1.5×10^{-4}	0	1.5×10^{-7}	8.8×10^{-8}	2.4×10^{-7}
Strontium-90	2.0	7.1×10^{-3}	4.9×10^{-2}	2.1	6.4×10^{-1}	5.1×10^{-7}	1.6×10^{-4}	6.4×10^{-1}
Technetium-99	1.8×10^{-5}	1.7×10^{-6}	7.6×10^{-5}	9.6×10^{-5}	0	5.1×10^{-7}	2.6×10^{-7}	7.7×10^{-7}
Iodine-129	1.4×10^{-2}	3.2×10^{-1}	1.5×10^{-1}	4.9×10^{-1}	0	4.1×10^{-4}	2.0×10^{-4}	6.1×10^{-4}
Cesium-137	1.4	4.5×10^{-2}	2.3×10^{-1}	1.7	7.2×10^{-1}	6.2×10^{-5}	7.1×10^{-4}	7.2×10^{-1}
Uranium	1.9×10^{-3}	3.6×10^{-4}	2.6×10^{-4}	2.5×10^{-3}	0	9.7×10^{-7}	8.2×10^{-7}	1.8×10^{-6}
Plutonium-238	3.1×10^{-2}	7.5×10^{-4}	1.7×10^{-3}	3.4×10^{-2}	0	5.2×10^{-9}	5.5×10^{-6}	5.5×10^{-6}
Plutonium-239, -240	6.3×10^{-1}	9.6×10^{-3}	3.5×10^{-2}	6.7×10^{-1}	0	1.1×10^{-7}	1.1×10^{-4}	1.1×10^{-4}
Plutonium-241	1.8×10^{-2}	2.7×10^{-4}	9.6×10^{-4}	1.9×10^{-2}	0	3.0×10^{-9}	3.1×10^{-6}	3.1×10^{-6}
Americium-241	1.0	3.2×10^{-2}	4.6×10^{-2}	1.1	0	2.9×10^{-7}	1.5×10^{-4}	1.5×10^{-4}
Total	5.7	5.4	2.7	1.4×10^{1}	1.4	1.5×10^{-2}	8.6×10^{-3}	1.4
Lifetime risk of a latent cancer fatality				8×10^{-6}				8×10^{-7}

[a] The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–37. Tank Closure Alternative 3B Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)				Dose in Year of Maximum Impact (millirem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	9.5×10^{-3}	5.1×10^{-7}	2.6×10^{-7}	9.5×10^{-3}	0	2.3×10^{-9}	1.2×10^{-9}	3.5×10^{-9}
Carbon-14	6.6×10^{-1}	3.2×10^{-5}	1.6×10^{-5}	6.6×10^{-1}	0	1.4×10^{-7}	7.1×10^{-8}	2.1×10^{-7}
Cobalt-60	8.3×10^{-5}	7.5×10^{-7}	3.9×10^{-7}	8.4×10^{-5}	0	3.0×10^{-9}	1.8×10^{-9}	4.8×10^{-9}
Strontium-90	2.5	4.5×10^{-3}	2.3×10^{-3}	2.5	6.4×10^{-1}	1.0×10^{-8}	3.1×10^{-6}	6.4×10^{-1}
Technetium-99	5.0×10^{-5}	9.1×10^{-8}	1.1×10^{-6}	5.1×10^{-5}	0	1.0×10^{-10}	5.1×10^{-9}	5.2×10^{-9}
Iodine-129	1.7×10^{-2}	1.2×10^{-1}	6.6×10^{-2}	2.0×10^{-1}	0	4.1×10^{-9}	2.0×10^{-9}	6.1×10^{-9}
Cesium-137	1.7	1.7×10^{-2}	1.2×10^{-2}	1.7	7.2×10^{-1}	1.2×10^{-6}	1.4×10^{-5}	7.2×10^{-1}
Uranium	2.3×10^{-3}	1.3×10^{-5}	4.1×10^{-6}	2.3×10^{-3}	0	1.9×10^{-8}	1.6×10^{-8}	3.6×10^{-8}
Plutonium-238	3.8×10^{-2}	4.8×10^{-4}	2.9×10^{-5}	3.8×10^{-2}	0	1.0×10^{-10}	1.1×10^{-7}	1.1×10^{-7}
Plutonium-239, -240	7.4×10^{-1}	6.4×10^{-3}	1.3×10^{-3}	7.5×10^{-1}	0	9.8×10^{-9}	2.2×10^{-6}	2.2×10^{-6}
Plutonium-241	2.1×10^{-2}	1.8×10^{-4}	1.5×10^{-5}	2.2×10^{-2}	0	5.9×10^{-11}	6.2×10^{-8}	6.2×10^{-8}
Americium-241	1.2	1.9×10^{-2}	7.3×10^{-4}	1.2	0	5.7×10^{-9}	3.0×10^{-6}	3.0×10^{-6}
Total	6.8	1.6×10^{-1}	8.3×10^{-2}	7.1	1.4	1.4×10^{-6}	2.3×10^{-5}	1.4
Lifetime risk of a latent cancer fatality				4×10^{-6}				8×10^{-7}

[a] The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–38. Tank Closure Alternative 3C Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)				Dose in Year of Maximum Impact (millirem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	8.1×10^{-3}	7.9×10^{-2}	3.5×10^{-2}	1.2×10^{-1}	0	2.3×10^{-4}	1.2×10^{-4}	3.5×10^{-4}
Carbon-14	5.4×10^{-1}	4.9	2.2	7.7	0	1.4×10^{-2}	7.1×10^{-3}	2.1×10^{-2}
Cobalt-60	6.7×10^{-5}	5.2×10^{-5}	2.6×10^{-5}	1.5×10^{-4}	0	1.5×10^{-7}	8.8×10^{-8}	2.4×10^{-7}
Strontium-90	2.0	7.2×10^{-3}	4.9×10^{-2}	2.1	6.4×10^{-1}	5.1×10^{-7}	1.6×10^{-4}	6.4×10^{-1}
Technetium-99	4.2×10^{-5}	1.8×10^{-4}	7.6×10^{-5}	2.9×10^{-4}	0	5.1×10^{-7}	2.6×10^{-7}	7.7×10^{-7}
Iodine-129	1.4×10^{-2}	3.2×10^{-1}	1.5×10^{-1}	4.9×10^{-1}	0	4.1×10^{-4}	2.0×10^{-4}	6.1×10^{-4}
Cesium-137	1.4	4.5×10^{-2}	2.3×10^{-1}	1.7	7.2×10^{-1}	6.2×10^{-5}	7.1×10^{-4}	7.2×10^{-1}
Uranium	1.9×10^{-3}	3.6×10^{-4}	2.6×10^{-4}	2.5×10^{-3}	0	9.7×10^{-7}	8.2×10^{-7}	1.8×10^{-6}
Plutonium-238	3.1×10^{-2}	7.6×10^{-4}	1.7×10^{-3}	3.4×10^{-2}	0	5.2×10^{-9}	5.5×10^{-6}	5.5×10^{-6}
Plutonium-239, -240	6.3×10^{-1}	9.6×10^{-3}	3.5×10^{-2}	6.7×10^{-1}	0	1.1×10^{-7}	1.1×10^{-4}	1.1×10^{-4}
Plutonium-241	1.8×10^{-2}	2.7×10^{-4}	9.6×10^{-4}	1.9×10^{-2}	0	3.0×10^{-9}	3.1×10^{-6}	3.1×10^{-6}
Americium-241	1.0	3.2×10^{-2}	4.6×10^{-2}	1.1	0	2.9×10^{-7}	1.5×10^{-4}	1.5×10^{-4}
Total	5.7	5.4	2.7	1.4×10^{1}	1.4	1.5×10^{-2}	8.6×10^{-3}	1.4
Lifetime risk of a latent cancer fatality				8×10^{-6}				8×10^{-7}

[a] The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–39. Tank Closure Alternative 4 Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)				Dose in Year of Maximum Impact (millirem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	9.0×10^{-3}	6.7×10^{-7}	3.2×10^{-2}	4.1×10^{-2}	0	3.1×10^{-11}	1.9×10^{-11}	4.9×10^{-11}
Carbon-14	6.0×10^{-1}	4.2×10^{-5}	2.0	2.6	0	7.2×10^{-10}	4.2×10^{-10}	1.1×10^{-9}
Cobalt-60	7.8×10^{-5}	2.6×10^{-6}	2.6×10^{-5}	1.1×10^{-4}	0	2.2×10^{-9}	1.3×10^{-9}	3.5×10^{-9}
Strontium-90	2.3	6.7×10^{-2}	8.9×10^{-2}	2.5	6.4×10^{-1}	1.4×10^{-4}	8.7×10^{-5}	6.4×10^{-1}
Technetium-99	2.0×10^{-5}	4.2×10^{-6}	7.3×10^{-5}	9.7×10^{-5}	0	4.1×10^{-9}	2.4×10^{-9}	6.5×10^{-9}
Iodine-129	1.6×10^{-2}	1.7×10^{-1}	1.5×10^{-1}	3.3×10^{-1}	0	1.8×10^{-9}	1.1×10^{-9}	2.9×10^{-9}
Cesium-137	1.6	3.7×10^{-2}	2.2×10^{-1}	1.8	7.2×10^{-1}	5.6×10^{-5}	3.3×10^{-5}	7.2×10^{-1}
Uranium	2.1×10^{-3}	1.6×10^{-4}	3.3×10^{-4}	2.6×10^{-3}	0	4.9×10^{-7}	3.0×10^{-7}	7.9×10^{-7}
Plutonium-238	3.4×10^{-2}	1.3×10^{-3}	2.0×10^{-3}	3.7×10^{-2}	0	3.2×10^{-6}	1.9×10^{-6}	5.1×10^{-6}
Plutonium-239, -240	6.7×10^{-1}	2.8×10^{-2}	4.7×10^{-2}	7.5×10^{-1}	0	2.0×10^{-4}	1.2×10^{-4}	3.2×10^{-4}
Plutonium-241	1.9×10^{-2}	4.2×10^{-4}	1.0×10^{-3}	2.1×10^{-2}	0	6.7×10^{-7}	3.8×10^{-7}	1.0×10^{-6}
Americium-241	1.2	4.8×10^{-2}	6.0×10^{-2}	1.3	0	4.4×10^{-5}	2.6×10^{-5}	7.0×10^{-5}
Total	6.4	3.5×10^{-1}	2.6	9.3	1.4	4.5×10^{-4}	2.7×10^{-4}	1.4
Lifetime risk of a latent cancer fatality				6×10^{-6}				8×10^{-7}

[a] The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–40. Tank Closure Alternative 5 Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)				Dose in Year of Maximum Impact (millirem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	1.6×10^{-2}	1.8×10^{-7}	2.3×10^{-2}	3.9×10^{-2}	9.7×10^{-6}	1.1×10^{-9}	1.4×10^{-4}	1.5×10^{-4}
Carbon-14	1.1	1.1×10^{-5}	1.4	2.5	6.3×10^{-3}	6.8×10^{-8}	8.9×10^{-3}	1.5×10^{-2}
Cobalt-60	1.0×10^{-4}	3.0×10^{-7}	1.8×10^{-5}	1.2×10^{-4}	1.3×10^{-7}	1.4×10^{-9}	1.1×10^{-7}	2.5×10^{-7}
Strontium-90	2.3	3.9×10^{-3}	3.3×10^{-2}	2.4	6.4×10^{-1}	4.8×10^{-9}	1.9×10^{-4}	6.4×10^{-1}
Technetium-99	1.1×10^{-4}	8.5×10^{-7}	5.2×10^{-5}	1.6×10^{-4}	4.4×10^{-7}	4.9×10^{-9}	3.2×10^{-7}	7.7×10^{-7}
Iodine-129	2.8×10^{-2}	9.6×10^{-2}	9.6×10^{-2}	2.2×10^{-1}	1.7×10^{-7}	2.0×10^{-9}	2.5×10^{-4}	2.5×10^{-4}
Cesium-137	1.6	1.4×10^{-2}	1.7×10^{-1}	1.8	7.2×10^{-1}	5.9×10^{-7}	9.8×10^{-4}	7.2×10^{-1}
Uranium	2.3×10^{-3}	9.7×10^{-6}	1.7×10^{-4}	2.4×10^{-3}	8.9×10^{-7}	9.3×10^{-9}	1.0×10^{-6}	1.9×10^{-6}
Plutonium-238	3.4×10^{-2}	4.3×10^{-4}	1.1×10^{-3}	3.6×10^{-2}	4.6×10^{-9}	5.0×10^{-11}	6.8×10^{-6}	6.9×10^{-6}
Plutonium-239, -240	6.7×10^{-1}	5.3×10^{-3}	2.3×10^{-2}	7.0×10^{-1}	8.9×10^{-8}	8.8×10^{-9}	1.4×10^{-4}	1.4×10^{-4}
Plutonium-241	2.0×10^{-2}	1.6×10^{-4}	6.3×10^{-4}	2.0×10^{-2}	2.6×10^{-9}	2.8×10^{-11}	3.9×10^{-6}	3.9×10^{-6}
Americium-241	1.1	1.7×10^{-2}	3.0×10^{-2}	1.1	2.5×10^{-7}	2.7×10^{-9}	1.9×10^{-4}	1.9×10^{-4}
Total	6.9	1.4×10^{-1}	1.8	8.9	1.4	6.9×10^{-7}	1.1×10^{-2}	1.4
Lifetime risk of a latent cancer fatality				5×10^{-6}				8×10^{-7}

[a] The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–41. Tank Closure Alternative 6A, Base Case, Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)[a]				Dose in Year of Maximum Impact (millirem per year)[b]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	3.3×10^{-2}	6.6×10^{-4}	3.8×10^{-6}	3.3×10^{-2}	0	8.5×10^{-7}	5.1×10^{-7}	1.4×10^{-6}
Carbon-14	2.2	2.8×10^{-2}	1.6×10^{-4}	2.2	0	3.7×10^{-5}	2.2×10^{-5}	5.9×10^{-5}
Cobalt-60	1.0×10^{-4}	2.6×10^{-5}	4.4×10^{-7}	1.3×10^{-4}	0	2.6×10^{-8}	1.6×10^{-8}	4.2×10^{-8}
Strontium-90	2.6	5.4×10^{-1}	1.0×10^{-2}	3.2	6.4×10^{-1}	5.1×10^{-4}	3.1×10^{-4}	6.4×10^{-1}
Technetium-99	7.4×10^{-5}	7.7×10^{-5}	4.4×10^{-7}	1.5×10^{-4}	0	9.9×10^{-8}	6.0×10^{-8}	1.6×10^{-7}
Iodine-129	5.8×10^{-2}	6.1×10^{-1}	2.3×10^{-3}	6.7×10^{-1}	0	9.4×10^{-5}	5.5×10^{-5}	1.5×10^{-4}
Cesium-137	1.9	8.4×10^{-1}	4.7×10^{-3}	2.8	7.2×10^{-1}	9.9×10^{-4}	5.9×10^{-4}	7.2×10^{-1}
Uranium	2.5×10^{-3}	4.4×10^{-3}	2.5×10^{-5}	6.9×10^{-3}	0	5.7×10^{-6}	3.4×10^{-6}	9.1×10^{-6}
Plutonium-238	4.4×10^{-2}	8.3×10^{-3}	5.1×10^{-5}	5.2×10^{-2}	0	1.3×10^{-5}	6.3×10^{-6}	1.9×10^{-5}
Plutonium-239, -240	8.2×10^{-1}	1.1×10^{-1}	3.0×10^{-3}	9.3×10^{-1}	0	3.8×10^{-4}	5.4×10^{-5}	4.4×10^{-4}
Plutonium-241	2.4×10^{-2}	1.2×10^{-3}	7.9×10^{-6}	2.5×10^{-2}	0	1.6×10^{-6}	8.9×10^{-7}	2.4×10^{-6}
Americium-241	1.5	1.3×10^{-1}	4.1×10^{-3}	1.6	0	1.1×10^{-4}	5.1×10^{-5}	1.6×10^{-4}
Total	9.2	2.3	2.5×10^{-2}	1.1×10^{1}	1.4	2.1×10^{-3}	1.1×10^{-3}	1.4
Lifetime risk of a latent cancer fatality				7×10^{-6}				8×10^{-7}

[a] Impacts are provided for comparison to other alternatives. The life-of-project dose would not be received by one individual person due to the duration of this alternative. The dose from 70 years of exposure at the average annual dose rate would be 4.9 millirem, with a corresponding lifetime risk of a latent cancer fatality of 3×10^{-6}.

[b] The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–42. Tank Closure Alternative 6A, Option Case, Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)[a]				Dose in Year of Maximum Impact (millirem per year)[b]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	2.8×10^{-2}	2.4×10^{-2}	1.3×10^{-2}	6.5×10^{-2}	0	2.1×10^{-5}	1.2×10^{-5}	3.3×10^{-5}
Carbon-14	1.8	6.0×10^{-2}	3.2×10^{-2}	1.8	0	5.0×10^{-5}	3.0×10^{-5}	8.0×10^{-5}
Cobalt-60	8.1×10^{-5}	7.5×10^{-5}	4.0×10^{-5}	2.0×10^{-4}	0	5.2×10^{-8}	3.1×10^{-8}	8.4×10^{-8}
Strontium-90	2.2	9.9×10^{-1}	5.3×10^{-1}	3.7	6.4×10^{-1}	5.5×10^{-4}	3.4×10^{-4}	6.4×10^{-1}
Technetium-99	6.2×10^{-5}	1.7×10^{-4}	9.0×10^{-5}	3.3×10^{-4}	0	1.5×10^{-7}	8.7×10^{-8}	2.3×10^{-7}
Iodine-129	4.8×10^{-2}	9.7×10^{-1}	5.0×10^{-1}	1.5	0	1.3×10^{-4}	7.8×10^{-5}	2.1×10^{-4}
Cesium-137	1.6	1.3	6.9×10^{-1}	3.6	7.2×10^{-1}	1.0×10^{-3}	6.0×10^{-4}	7.2×10^{-1}
Uranium	2.1×10^{-3}	9.5×10^{-3}	5.0×10^{-3}	1.7×10^{-2}	0	7.7×10^{-6}	4.6×10^{-6}	1.2×10^{-5}
Plutonium-238	3.7×10^{-2}	2.6×10^{-2}	1.4×10^{-2}	7.6×10^{-2}	0	2.3×10^{-5}	1.2×10^{-5}	3.6×10^{-5}
Plutonium-239, -240	7.0×10^{-1}	1.1	5.8×10^{-1}	2.4	0	1.1×10^{-3}	5.0×10^{-4}	1.6×10^{-3}
Plutonium-241	2.0×10^{-2}	1.4×10^{-2}	7.5×10^{-3}	4.2×10^{-2}	0	1.2×10^{-5}	7.0×10^{-6}	1.9×10^{-5}
Americium-241	1.2	4.4×10^{-1}	2.2×10^{-1}	1.9	0	2.4×10^{-4}	1.3×10^{-4}	3.7×10^{-4}
Total	7.6	4.9	2.6	1.5×10^{1}	1.4	3.2×10^{-3}	1.7×10^{-3}	1.4
Lifetime risk of a latent cancer fatality				9×10^{-6}				8×10^{-7}

a Impacts are provided for comparison to other alternatives. The life-of-project dose would not be received by one individual person due to the duration of this alternative. The dose from 70 years of exposure at the average annual dose rate would be 6.5 millirem, with a corresponding lifetime risk of a latent cancer fatality of 4×10^{-6}.

b The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–43. Tank Closure Alternative 6B, Base Case, Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)[a]				Dose in Year of Maximum Impact (millirem per year)[b]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	3.0×10^{-2}	8.3×10^{-4}	4.9×10^{-4}	3.1×10^{-2}	1.2×10^{-3}	8.5×10^{-6}	5.1×10^{-6}	1.3×10^{-3}
Carbon-14	1.9	3.7×10^{-2}	2.1×10^{-2}	2.0	8.2×10^{-2}	3.7×10^{-4}	2.2×10^{-4}	8.3×10^{-2}
Cobalt-60	9.3×10^{-5}	3.4×10^{-5}	1.9×10^{-5}	1.5×10^{-4}	3.9×10^{-6}	4.8×10^{-7}	2.3×10^{-7}	4.6×10^{-6}
Strontium-90	2.3	6.9×10^{-1}	3.9×10^{-1}	3.4	7.0×10^{-1}	1.0×10^{-2}	4.8×10^{-3}	7.2×10^{-1}
Technetium-99	6.8×10^{-5}	1.0×10^{-4}	5.7×10^{-5}	2.3×10^{-4}	2.8×10^{-6}	1.0×10^{-6}	6.0×10^{-7}	4.4×10^{-6}
Iodine-129	5.3×10^{-2}	2.6×10^{-1}	1.5×10^{-1}	4.7×10^{-1}	2.2×10^{-3}	4.4×10^{-3}	2.5×10^{-3}	9.1×10^{-3}
Cesium-137	1.6	9.8×10^{-1}	5.9×10^{-1}	3.2	7.4×10^{-1}	1.0×10^{-2}	6.1×10^{-3}	7.6×10^{-1}
Uranium	2.3×10^{-3}	6.1×10^{-3}	3.5×10^{-3}	1.2×10^{-2}	9.5×10^{-5}	5.7×10^{-5}	3.4×10^{-5}	1.9×10^{-4}
Plutonium-238	3.9×10^{-2}	1.1×10^{-2}	6.4×10^{-3}	5.7×10^{-2}	1.7×10^{-3}	1.1×10^{-4}	6.3×10^{-5}	1.9×10^{-3}
Plutonium-239, -240	7.3×10^{-1}	1.4×10^{-1}	8.2×10^{-2}	9.5×10^{-1}	3.1×10^{-2}	2.3×10^{-3}	9.7×10^{-4}	3.4×10^{-2}
Plutonium-241	2.1×10^{-2}	1.6×10^{-3}	9.0×10^{-4}	2.4×10^{-2}	9.1×10^{-4}	1.6×10^{-5}	9.2×10^{-6}	9.3×10^{-4}
Americium-241	1.4	1.8×10^{-1}	1.0×10^{-1}	1.7	5.5×10^{-2}	3.4×10^{-3}	1.3×10^{-3}	6.0×10^{-2}
Total	8.1	2.3	1.3	1.2×10^{1}	1.6	3.2×10^{-2}	1.6×10^{-2}	1.7
Lifetime risk of a latent cancer fatality				7×10^{-6}				1×10^{-6}

a Impacts are provided for comparison to other alternatives. The life-of-project dose would not be received by one individual person due to the duration of this alternative. The dose from 70 years of exposure at the average annual dose rate would be 8.7 millirem, with a corresponding lifetime risk of a latent cancer fatality of 5×10^{-6}.

b The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–44. Tank Closure Alternative 6B, Option Case, Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)[a]				Dose in Year of Maximum Impact (millirem per year)[b]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	2.8×10^{-2}	2.4×10^{-2}	1.3×10^{-2}	6.5×10^{-2}	1.2×10^{-3}	2.1×10^{-4}	1.2×10^{-4}	1.6×10^{-3}
Carbon-14	1.7	6.0×10^{-2}	3.2×10^{-2}	1.8	8.2×10^{-2}	5.0×10^{-4}	3.0×10^{-4}	8.3×10^{-2}
Cobalt-60	8.1×10^{-5}	7.5×10^{-5}	3.9×10^{-5}	2.0×10^{-4}	3.9×10^{-6}	8.4×10^{-7}	3.8×10^{-7}	5.1×10^{-6}
Strontium-90	2.1	9.7×10^{-1}	5.1×10^{-1}	3.5	7.0×10^{-1}	1.3×10^{-2}	5.1×10^{-3}	7.2×10^{-1}
Technetium-99	6.2×10^{-5}	1.7×10^{-4}	9.0×10^{-5}	3.3×10^{-4}	2.8×10^{-6}	1.5×10^{-6}	8.7×10^{-7}	5.2×10^{-6}
Iodine-129	4.8×10^{-2}	3.5×10^{-1}	1.8×10^{-1}	5.9×10^{-1}	2.2×10^{-3}	4.7×10^{-3}	2.7×10^{-3}	9.7×10^{-3}
Cesium-137	1.5	1.2	6.5×10^{-1}	3.3	7.4×10^{-1}	1.1×10^{-2}	6.3×10^{-3}	7.6×10^{-1}
Uranium	2.1×10^{-3}	9.5×10^{-3}	5.0×10^{-3}	1.7×10^{-2}	9.5×10^{-5}	7.7×10^{-5}	4.6×10^{-5}	2.2×10^{-4}
Plutonium-238	3.7×10^{-2}	2.6×10^{-2}	1.4×10^{-2}	7.6×10^{-2}	1.7×10^{-3}	2.1×10^{-4}	1.2×10^{-4}	2.0×10^{-3}
Plutonium-239, -240	6.9×10^{-1}	1.1	5.8×10^{-1}	2.4	3.1×10^{-2}	1.0×10^{-2}	5.4×10^{-3}	4.7×10^{-2}
Plutonium-241	2.0×10^{-2}	1.4×10^{-2}	7.5×10^{-3}	4.2×10^{-2}	9.1×10^{-4}	1.2×10^{-4}	7.0×10^{-5}	1.1×10^{-3}
Americium-241	1.2	4.3×10^{-1}	2.1×10^{-1}	1.9	5.5×10^{-2}	5.8×10^{-3}	2.1×10^{-3}	6.3×10^{-2}
Total	7.3	4.2	2.2	1.4×10^{1}	1.6	4.6×10^{-2}	2.2×10^{-2}	1.7
Lifetime risk of a latent cancer fatality				8×10^{-6}				1×10^{-6}

[a] Impacts are provided for comparison to other alternatives. The life-of-project dose would not be received by one individual person due to the duration of this alternative. The dose from 70 years of exposure at the average annual dose rate would be 10 millirem, with a corresponding lifetime risk of a latent cancer fatality of 6×10^{-6}.

[b] The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

Table K–45. Tank Closure Alternative 6C Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Dose over Life of Project (millirem)				Dose in Year of Maximum Impact (millirem per year)[a]			
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources
Hydrogen-3 (tritium)	3.3×10^{-2}	0	0	3.3×10^{-2}	1.2×10^{-3}	0	0	1.2×10^{-3}
Carbon-14	2.2	0	0	2.2	8.2×10^{-2}	0	0	8.2×10^{-2}
Cobalt-60	1.0×10^{-4}	0	0	1.0×10^{-4}	3.9×10^{-6}	0	0	3.9×10^{-6}
Strontium-90	2.5	3.0×10^{-3}	1.7×10^{-3}	2.5	7.0×10^{-1}	7.9×10^{-5}	4.6×10^{-5}	7.0×10^{-1}
Technetium-99	7.4×10^{-5}	0	0	7.4×10^{-5}	2.8×10^{-6}	0	0	2.8×10^{-6}
Iodine-129	5.8×10^{-2}	1.3×10^{-1}	7.4×10^{-2}	2.6×10^{-1}	2.2×10^{-3}	3.4×10^{-3}	2.0×10^{-3}	7.6×10^{-3}
Cesium-137	1.7	1.8×10^{-2}	1.0×10^{-2}	1.8	7.4×10^{-1}	4.7×10^{-4}	2.7×10^{-4}	7.5×10^{-1}
Uranium	2.5×10^{-3}	0	0	2.5×10^{-3}	9.5×10^{-5}	0	0	9.5×10^{-5}
Plutonium-238	4.4×10^{-2}	3.9×10^{-6}	3.1×10^{-6}	4.4×10^{-2}	1.7×10^{-3}	1.0×10^{-6}	6.0×10^{-7}	1.7×10^{-3}
Plutonium-239, -240	8.1×10^{-1}	5.6×10^{-4}	4.4×10^{-4}	8.1×10^{-1}	3.1×10^{-2}	1.5×10^{-4}	8.6×10^{-5}	3.1×10^{-2}
Plutonium-241	2.4×10^{-2}	0	0	2.4×10^{-2}	9.1×10^{-4}	0	0	9.1×10^{-4}
Americium-241	1.4	4.6×10^{-5}	3.7×10^{-5}	1.4	5.5×10^{-2}	1.2×10^{-5}	6.9×10^{-6}	5.5×10^{-2}
Total	8.8	1.5×10^{-1}	8.6×10^{-2}	9.1	1.6	4.1×10^{-3}	2.4×10^{-3}	1.6
Lifetime risk of a latent cancer fatality				5×10^{-6}				1×10^{-6}

[a] The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Note: Sums and products presented in the table may differ from those calculated from table entries due to rounding.

Key: STTS=Supplemental Treatment Technology Site.

An onsite MEI would receive a dose from emissions from the WTP, STTS-East, and STTS-West. Table K–46 presents the doses from each source location, the sum of those doses, and the associated risk of an LCF for the life of the project under each Tank Closure alternative. These data are provided for comparison among the alternatives, recognizing that some of the alternatives (Alternatives 1; 2A; 6A, Base and Option Cases; and 6B, Base and Option Cases) would span multiple generations. Table K–47 presents the doses and associated risks for the year or years of projected maximum impact. The location of the onsite MEI would be affected by the relative amounts of emissions from the three source areas, the WTP, STTS-East, and STTS-West.

Table K–46. Tank Closure Alternatives – Impacts on the Onsite Maximally Exposed Individual Over the Life of the Project During Normal Operations

Tank Closure Alternative	Dose (millirem)				Lifetime Risk of an LCF	Location
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources		
1[a]	0	1.1	6.5×10^{-1}	1.8	1×10^{-6}	CGS
2A[a]	0.76	1.1	6.5×10^{-1}	2.6	2×10^{-6}	CGS
2B	1.0	1.7×10^{-3}	2.2×10^{-4}	1.0	6×10^{-7}	LIGO
3A	0.90	2.2×10^{-2}	1.1×10^{-2}	9.3×10^{-1}	6×10^{-7}	LIGO
3B	0.90	2.4×10^{-3}	4.1×10^{-4}	9.0×10^{-1}	5×10^{-7}	LIGO
3C	0.90	2.2×10^{-2}	1.1×10^{-2}	9.3×10^{-1}	6×10^{-7}	LIGO
4	0.90	7.7×10^{-3}	1.5×10^{-2}	9.3×10^{-1}	6×10^{-7}	LIGO
5	0.83	2.0×10^{-3}	1.0×10^{-2}	8.4×10^{-1}	5×10^{-7}	LIGO
6A Base Case[a]	1.0	1.1×10^{-1}	9.5×10^{-4}	1.2	7×10^{-7}	LIGO
6A Option Case[a]	0.78	3.3×10^{-1}	2.0×10^{-1}	1.3	8×10^{-7}	CGS
6B Base Case[a]	1.0	1.1×10^{-1}	2.5×10^{-2}	1.2	7×10^{-7}	LIGO
6B Option Case[a]	0.76	3.3×10^{-1}	2.0×10^{-1}	1.3	8×10^{-7}	CGS
6C	1.0	1.7×10^{-3}	2.2×10^{-4}	1.0	6×10^{-7}	LIGO

[a] The life-of-project dose would not be received by one individual person due to the duration of these alternatives. The dose and lifetime risk of an LCF from 40 years of exposure at the average annual dose rate would be: Alternative 1 – 0.71 millirem, 4×10^{-7} LCF risk; Alternative 2A – 0.55 millirem, 3×10^{-7} LCF risk; Alternative 6A, Base Case – 0.28 millirem, 2×10^{-7} LCF risk; Alternative 6A, Option Case – 0.32 millirem, 2×10^{-7} LCF risk; Alternative 6B, Base Case – 0.49 millirem, 3×10^{-7} LCF risk; Alternative 6B, Option Case – 0.54 millirem, 3×10^{-7} LCF risk.

Key: CGS=Columbia Generating Station; LCF=latent cancer fatality; LIGO=Laser Interferometer Gravitational-Wave Observatory; STTS=Supplemental Treatment Technology Site.

Table K–47. Tank Closure Alternatives – Impacts on the Onsite Maximally Exposed Individual in the Year of Maximum Impact During Normal Operations

Tank Closure Alternative	Dose (millirem per year)[a]				Lifetime Risk of an LCF	Location
	Waste Treatment Plant	200-East Area STTS	200-West Area STTS	Combined Sources		
1	0	1.1×10^{-2}	6.5×10^{-3}	1.8×10^{-2}	1×10^{-8}	CGS
2A	5.8×10^{-2}	7.6×10^{-10}	0	5.8×10^{-2}	4×10^{-8}	LIGO
2B	9.7×10^{-2}	5.8×10^{-5}	1.4×10^{-5}	9.7×10^{-2}	6×10^{-8}	LIGO
3A	5.8×10^{-2}	8.6×10^{-5}	4.9×10^{-5}	5.8×10^{-2}	4×10^{-8}	LIGO
3B	5.8×10^{-2}	1.1×10^{-7}	7.5×10^{-7}	5.8×10^{-2}	4×10^{-8}	LIGO
3C	5.8×10^{-2}	8.6×10^{-5}	4.9×10^{-5}	5.8×10^{-2}	4×10^{-8}	LIGO
4	5.8×10^{-2}	3.3×10^{-5}	1.7×10^{-5}	5.8×10^{-2}	4×10^{-8}	LIGO
5	5.8×10^{-2}	5.0×10^{-5}	6.3×10^{-5}	5.8×10^{-2}	4×10^{-8}	LIGO
6A Base Case	5.8×10^{-2}	1.5×10^{-4}	2.3×10^{-5}	5.9×10^{-2}	4×10^{-8}	LIGO
6A Option Case	5.8×10^{-2}	2.3×10^{-4}	7.9×10^{-5}	5.9×10^{-2}	4×10^{-8}	LIGO
6B Base Case	9.4×10^{-2}	1.7×10^{-3}	3.8×10^{-4}	9.6×10^{-2}	6×10^{-8}	LIGO
6B Option Case	9.4×10^{-2}	2.7×10^{-3}	9.5×10^{-4}	9.8×10^{-2}	6×10^{-8}	LIGO
6C	9.4×10^{-2}	5.8×10^{-5}	1.4×10^{-5}	9.4×10^{-2}	6×10^{-8}	LIGO

Table K–47. Tank Closure Alternatives – Impacts on the Onsite Maximally Exposed Individual in the Year of Maximum Impact During Normal Operations *(continued)*

[a] The regulatory limit for exposure of an individual to radiological air emissions from U.S. Department of Energy facilities is 10 millirem per year (40 CFR 61.90–61.97).

Key: CGS=Columbia Generating Station; LCF=latent cancer fatality; LIGO=Laser Interferometer Gravitational-Wave Observatory; STTS=Supplemental Treatment Technology Site.

K.2.1.2 Impacts on Workers During Normal Operations

This section describes the methodologies used to evaluate the impacts of waste treatment and closure activities on Hanford workers. Two groups of workers were considered in the evaluation—project radiation workers who are engaged in the waste treatment and closure activities and nearby, noninvolved workers. Different methodologies were used to determine the radiological impacts on these two receptors.

K.2.1.2.1 Project Radiation Workers

Project radiation workers are exposed to radiation through the performance of activities related to the retrieval and processing of tank waste and the deactivation and closure of tank farm facilities. External exposure to radiation is the principal cause of doses to radiation workers.

Doses to radiation workers under each Tank Closure alternative were estimated using data provided in the scaled data sets developed to support this *TC & WM EIS* (SAIC 2007a, 2008). The data sets present conservative estimates of expected worker doses for a range of activities that make up the Tank Closure alternatives. Those estimates were based on a number of factors, including dose rates and doses associated with current tank farm operations, engineering studies of related activities, and conservative engineering estimates for accomplishing particular scopes of work. Scaled data sets representing the Tank Closure alternatives included in this *TC & WM EIS* include scaled estimates of the radiation worker labor hours required to accomplish the activities that make up an alternative and the associated radiation doses.

Total doses associated with each Tank Closure alternative were estimated by summing the dose estimates for each activity that is a component of the alternative, resulting in the project dose estimates shown in Table K–48. These results are presumed to overestimate the dose that would likely be received by the worker population. A number of factors contributed to the conservatism. Conservative dose estimates were included in the original data packages to ensure that they represented the upper range of expected doses associated with performing the activities. Linear scaling of the resources, labor hours, and doses to develop the alternatives added to the conservatism because there was no recognition of economies of scale or changes in annual resource needs commensurate with changes in the duration of activities. For example, the annual labor requirements for operating a facility to process a given amount of material were the same whether the processing period would be 30 years or 80 years. Consequently, the conservatism in the project doses may be greater for alternatives with long operating periods. Through the application of administrative and engineering controls to maintain exposure as low as is reasonably achievable, actual total radiation worker doses from executing an alternative would likely be lower than the estimates.

Data from the scaled data sets were used to develop an estimate of the average annual dose per work year for each Tank Closure alternative. Doses to radiation workers were calculated based on a full-time equivalent (FTE) worker, who was assumed to have a 2,080-hour work year for the purposes of this dose evaluation. The time and dose associated with the various activities that make up an alternative vary, resulting in comparatively low dose rates for some activities and high dose rates for others. In practice, DOE and its contractors would implement controls to limit the exposure of individual workers for all activities in accordance with regulations and guidance (10 CFR 835; DOE Standard 1098-99). Therefore, the average FTE doses calculated for each alternative are not necessarily representative of the actual

doses that would be received by individual workers. Rather, they represent an overestimation of the average dose that a worker would receive.

The average dose per FTE under an alternative was calculated by dividing the total radiation worker dose by the number of FTEs. The number of FTEs was determined by dividing the total radiation worker labor hours by 2,080 hours per work year. An average dose for an FTE radiation worker assumed to be involved with the project for an entire working career was also calculated for each alternative. The career dose was estimated by multiplying the average annual FTE dose by 40 years. The average dose per FTE and the average career dose are shown in Table K–48.

Table K–48. Tank Closure Alternatives – Radiation Worker Impacts and Labor Estimates

	Life-of-Project Collective Worker Impact		Life-of-Project Full-Time Equivalent Radiation Worker Labor		Average Annual Impact per Full-Time Equivalent Radiation Worker		Average Project Impact per Full-Time Equivalent Radiation Worker[a]	
Alternative	**Dose (person-rem)**	**LCFs[b]**	**Hours**	**Years**	**Dose (millirem/year)**	**LCFs[c]**	**Dose (millirem)**	**LCFs**
1	2.8×10^{2}	0 (0.2)	4.07×10^{6}	2,000	1.4×10^{2}	9×10^{-5}	5.7×10^{3}	3×10^{-3}
2A	2.3×10^{4}	13	2.72×10^{8}	131,000	1.7×10^{2}	1×10^{-4}	6.9×10^{3}	4×10^{-3}
2B	1.1×10^{4}	7	1.44×10^{8}	69,100	1.6×10^{2}	1×10^{-4}	6.4×10^{3}	4×10^{-3}
3A	1.0×10^{4}	6	1.36×10^{8}	65,600	1.6×10^{2}	1×10^{-4}	6.3×10^{3}	4×10^{-3}
3B	1.0×10^{4}	6	1.32×10^{8}	63,400	1.6×10^{2}	9×10^{-5}	6.3×10^{3}	4×10^{-3}
3C	1.1×10^{4}	6	1.41×10^{8}	67,600	1.6×10^{2}	1×10^{-4}	6.4×10^{3}	4×10^{-3}
4	4.3×10^{4}	26	1.74×10^{8}	83,800	5.2×10^{2}	3×10^{-4}	2.1×10^{4}	1×10^{-2}
5	8.8×10^{3}	5	1.24×10^{8}	59,400	1.5×10^{2}	9×10^{-5}	5.9×10^{3}	4×10^{-3}
6A Base Case	1.2×10^{5}	72	6.02×10^{8}	289,000	4.2×10^{2}	2×10^{-4}	1.7×10^{4}	1×10^{-2}
6A Option Case	1.2×10^{5}	75	6.47×10^{8}	311,000	4.0×10^{2}	2×10^{-4}	1.6×10^{4}	1×10^{-2}
6B Base Case	8.2×10^{4}	49	1.96×10^{8}	94,100	8.7×10^{2}	5×10^{-4}	3.5×10^{4}	2×10^{-2}
6B Option Case	8.5×10^{4}	51	2.25×10^{8}	108,000	7.9×10^{2}	5×10^{-4}	3.2×10^{4}	2×10^{-2}
6C	1.1×10^{4}	7	1.44×10^{8}	69,100	1.6×10^{2}	1×10^{-4}	6.4×10^{3}	4×10^{-3}

a Full-time equivalent radiation worker project dose and individual risk of an LCF from 40 years of occupational exposure.

b Increased number of LCFs for the worker population as a result of the radiation dose received under the alternative. If zero, the number in parentheses is the value calculated by multiplying the dose by the risk factor of 0.0006 LCFs per person-rem.

c The increased individual risk of an LCF from one year of occupational exposure.

Key: LCF=latent cancer fatality.

K.2.1.2.2 Noninvolved Workers

Doses were also estimated for a noninvolved worker, i.e., a person working at the site who is incidentally exposed due to the radiological emissions associated with the Tank Closure alternatives. The GENII model described in Section K.2.1.1.2 was used to estimate doses to noninvolved workers. The exposure parameters for a noninvolved worker were different from those used for an offsite member of the public. Because the worker was assumed to spend only a work shift at the site, exposure to and inhalation of the radioactive plume was assumed to occur only for a portion of the day. It was also assumed that a portion of the worker's job is performed outdoors, resulting in exposure to deposited material. The outdoor activity was assumed to result in ingestion of contaminated soil suspended by wind or work activities. Unlike doses to members of the offsite population, there was no assumption that any portion of the exposure associated with work would result from consumption of radioactively contaminated fruits, vegetables, or animal products. Table K–49 shows the parameters used for the dose analysis of noninvolved workers.

Table K–49. Dose Assessment Parameters for Noninvolved Workers

Medium	Exposure Pathway	Rate	Reference
Air (plume)	Internal – inhalation	20 cubic meters per day	DOE 1995
	Internal – inhalation	2,000 hours per year	DOE 1995
	External	2,000 hours per year	Consistent with inhalation exposure
Soil	External	1,168 hours per year	DOE 1995
	Internal – ingestion	50 milligrams per day	DOE 1995

Note: To convert cubic meters to cubic feet, multiply by 35.315; milligrams to ounces, by 0.00003527.

As discussed in Section K.2.1.1.1, for purposes of assessing the impacts of radiological emissions, all emissions were assigned to one of three sources; the WTP, STTS-East, or STTS-West.

Doses to a noninvolved worker were evaluated for a location in the 200-East Area and a location in the 200-West Area. The locations selected are near the assumed emission sources in facilities that are expected to be staffed on a daily basis. In the 200-East Area, the noninvolved worker was assumed to be at the 242-A Evaporator, about 0.7 kilometers (760 yards) west of the WTP and 0.6 kilometers (660 yards) north-northwest of STTS-East.

In the 200-West Area, two locations were considered for the noninvolved worker. The Environmental Restoration Disposal Facility (ERDF) was selected for detailed analysis after determining that the impact on a noninvolved worker located there would be higher than that on one located at the 222-S Laboratory. The ERDF is about 1.1 kilometers (1,200 yards) east of the STTS-West, while the 222-S Laboratory is southwest of the STTS-West.

Doses to a noninvolved worker at the 242-A Evaporator under each Tank Closure alternative were determined for releases from the STTS-East and the WTP, based on releases of 1 curie of each radionuclide identified in Table K–6. The dose to a noninvolved worker at the ERDF under each Tank Closure alternative was determined for releases from the STTS-West, based on 1-curie releases. The doses to noninvolved workers were scaled based on the estimated releases from the WTP, STTS-East, and STTS-West under each Tank Closure alternative (see Tables K–7 through K–19) over the life of the project and during the years of maximum impact. The doses to noninvolved workers in the year(s) of maximum impact are presented in Table K–50. Although the emissions that would impact a noninvolved worker or an MEI would be the same, the year(s) of maximum impact for these receptors may be different. The emissions from the STTSs would comprise a mix of sources, such as routine tank farm operations, tank waste retrieval activities, supplemental waste treatment, and tank closure, each of which would occur in a different time period during the project. The year(s) of maximum impact for a noninvolved worker at the ERDF would occur when the STTS-West emissions were largest. Similarly, the year(s) of maximum impact for a noninvolved worker at the 242-A Evaporator would be when emissions from the WTP, STTS-East, or both were largest. At a distance of more than 9.6 kilometers (6 miles), the MEI would be exposed to a combination of emissions from the WTP and STTS-East and -West; consequently, the combined impacts of all three emission sources could affect the year of maximum impact. However, the peak impacts on the MEI and noninvolved worker at the 242-A Evaporator would be dominated by the emissions from processing cesium and strontium at the WTP under all Tank Closure alternatives except Alternatives 1 and 2A. The alternatives have been conceptualized such that all of the cesium and strontium from capsules would be processed in a single year at the WTP, resulting in increased cesium and strontium emissions that year. Alternative 1 does not include cesium and strontium processing, and peak impacts under Alternative 2A would occur from continuing tank emissions during the period of administrative control and emissions occurring during deactivation of the WTP.

Table K–50. Tank Closure Alternatives – Impacts on Noninvolved Workers in the Year(s) of Maximum Impact During Normal Operations

Tank Closure Alternative	Noninvolved Worker at 242-A Evaporator					Noninvolved Worker at ERDF		
	Dose from 200-East Area STTS (millirem per year)	Dose from WTP (millirem per year)	Total Dose (millirem per year)	Lifetime Risk of a Latent Cancer Fatality	Year(s) of Maximum Impact	Dose from 200-West Area STTS (millirem per year)	Lifetime Risk of a Latent Cancer Fatality	Year(s) of Maximum Impact
1	2.5×10^{-1}	0	2.5×10^{-1}	2×10^{-7}	2008	7.1×10^{-1}	4×10^{-7}	2008
2A	2.5×10^{-1}	4.4×10^{-2}	3.0×10^{-1}	2×10^{-7}	2094–2095	7.1×10^{-1}	4×10^{-7}	2094–2193
2B	4.2×10^{-3}	2.9×10^{-1}	2.9×10^{-1}	2×10^{-7}	2040	4.2×10^{-3}	2×10^{-9}	2040
3A	1.5×10^{-3}	1.7×10^{-1}	1.8×10^{-1}	1×10^{-7}	2040	1.4×10^{-1}	9×10^{-8}	2018–2019
3B	9.9×10^{-7}	1.7×10^{-1}	1.7×10^{-1}	1×10^{-7}	2040	4.2×10^{-3}	3×10^{-9}	2018–2019
3C	1.5×10^{-3}	1.7×10^{-1}	1.8×10^{-1}	1×10^{-7}	2040	1.4×10^{-1}	9×10^{-8}	2018–2019
4	1.7×10^{-3}	1.7×10^{-1}	1.8×10^{-1}	1×10^{-7}	2043	2.0×10^{-1}	1×10^{-7}	2034–2039
5	0	1.7×10^{-1}	1.7×10^{-1}	1×10^{-7}	2034	1.8×10^{-1}	1×10^{-7}	2018–2019
6A Base Case	4.2×10^{-3}	1.7×10^{-1}	1.8×10^{-1}	1×10^{-7}	2163	7.5×10^{-2}	4×10^{-8}	2054–2061
6A Option Case	9.9×10^{-3}	1.7×10^{-1}	1.8×10^{-1}	1×10^{-7}	2163	2.0×10^{-1}	1×10^{-7}	2138–2140
6B Base Case	5.2×10^{-2}	2.8×10^{-1}	3.3×10^{-1}	2×10^{-7}	2040	1.1×10^{-1}	7×10^{-8}	2040
6B Option Case	1.2×10^{-1}	2.8×10^{-1}	4.0×10^{-1}	2×10^{-7}	2040	2.8×10^{-1}	2×10^{-7}	2040
6C	1.4×10^{-3}	2.8×10^{-1}	2.8×10^{-1}	2×10^{-7}	2040	4.2×10^{-3}	2×10^{-9}	2040

Note: Total may not equal the sum of the contributions due to rounding.

Key: ERDF=Environmental Restoration Disposal Facility; STTS=Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Table K–51. Tank Closure Alternatives – Impacts on Noninvolved Workers over the Life of the Project During Normal Operations

Tank Closure Alternative	Noninvolved Worker at 242-A Evaporator				Noninvolved Worker at ERDF		Years of Project Emissions
	Dose from 200-East Area STTS (millirem)	Dose from WTP (millirem)	Total Dose (millirem)	Lifetime Risk of a Latent Cancer Fatality	Dose from 200-West Area STTS (millirem)	Lifetime Risk of a Latent Cancer Fatality	
1[a]	2.5×10^{1}	0	2.5×10^{1}	2×10^{-5}	7.1×10^{1}	4×10^{-5}	2006–2107
2A[a]	2.5×10^{1}	3.0	2.8×10^{1}	2×10^{-5}	7.1×10^{1}	4×10^{-5}	2006–2193
2B	2.2×10^{-2}	3.0	3.0	2×10^{-6}	6.5×10^{-2}	4×10^{-8}	2006–2045
3A	5.1×10^{-1}	2.6	3.1	2×10^{-6}	3.2	2×10^{-6}	2006–2042
3B	2.2×10^{-2}	2.6	2.8	2×10^{-6}	1.2×10^{-1}	7×10^{-8}	2006–2042
3C	5.1×10^{-1}	2.6	3.1	2×10^{-6}	3.2	2×10^{-6}	2006–2042
4	4.3×10^{-1}	2.7	3.1	2×10^{-6}	4.2	3×10^{-6}	2006–2045
5	1.6×10^{-1}	2.4	2.6	2×10^{-6}	3.0	2×10^{-6}	2006–2036
6A Base Case[a]	2.6	3.1	5.6	3×10^{-6}	2.8×10^{-1}	2×10^{-7}	2006–2168
6A Option Case[a]	7.3	3.1	1.0×10^{1}	6×10^{-6}	2.1×10^{1}	1×10^{-5}	2006–2168
6B Base Case[a]	2.5	3.0	5.5	3×10^{-6}	7.3	4×10^{-6}	2006–2100
6B Option Case[a]	7.2	3.0	1.0×10^{1}	6×10^{-6}	2.1×10^{1}	1×10^{-5}	2006–2100
6C	2.2×10^{-2}	3.0	3.0	2×10^{-6}	6.5×10^{-2}	4×10^{-8}	2006–2045

[a] The life-of-project dose would not be received by one individual person due to the duration of these alternatives. The dose and lifetime risk of an LCF for the noninvolved worker with the larger impact from 40 years of exposure at the average annual dose rate would be: Alternative 1 – 28 millirem, 2×10^{-5} LCF risk; Alternative 2A – 15 millirem, 9×10^{-6} LCF risk; Alternative 6A, Base Case – 1.4 millirem, 8×10^{-7} LCF risk; Alternative 6A, Option Case – 5.2 millirem, 3×10^{-6} LCF risk; Alternative 6B, Base Case – 3.1 millirem, 2×10^{-6} LCF risk; Alternative 6B, Option Case – 8.8 millirem, 5×10^{-6} LCF risk.

Note: Total may not equal the sum of the contributions due to rounding.

Key: ERDF=Environmental Restoration Disposal Facility; LCF=latent cancer fatality; STTS=Supplemental Treatment Technology Site; WTP=Waste Treatment Plant.

Doses to noninvolved workers from emissions over the entire duration of each Tank Closure alternative are shown in Table K–51. Note that these project doses are presented for comparison purposes only. The duration of some of the alternatives (in particular, Alternatives 1; 2A; 6A, Base and Option Cases; and 6B, Base and Option Cases) would make it impossible for a single worker to receive the dose from the project's total emissions.

K.2.1.2.3 Chemical Risks to Workers

Workers involved in performing activities associated with the storage, retrieval, and processing of tank waste and the closure of the tank farm facilities could be exposed to chemical vapors. Chemical exposure is a concern because the tanks are continuously vented to the atmosphere, and workers would need to access parts of the tank farm system to monitor or retrieve the waste. The primary route of chemical exposure to workers during routine operations was assumed to be inhalation.

Exposures to tank farm vapors have been reported by workers since 1987. Between July 1987 and May 1993, 19 vapor exposure events involving 34 workers were reported (Osborne et al. 1995). These workers reported musty and foul odors, including the smell of ammonia, emanating from several single-shell tanks (SSTs) (Osborne and Huckaby 1994). They also reported effects such as headaches, burning sensations in the nose and throat, nausea, and impaired pulmonary functioning (Osborne et al. 1995).

In 1992, DOE and Westinghouse Hanford Company, which operated the tank farms at that time, determined that the tank farm vapor emissions had not been adequately characterized and represented a potential health risk to workers in the immediate vicinity of the tanks (Osborne and Huckaby 1994). To address this potential health risk, workers in certain areas of the tank farms (e.g., within the buffer zone of tank 214-C-103) were required to use supplied-air respirators (Osborne and Huckaby 1994). The Tank Vapor Issue Resolution Program was established in 1992 to characterize waste tank headspace vapors and understand their impact if they migrated into the workers' breathing zones (Osborne and Huckaby 1994).

In 1993, the Defense Nuclear Facilities Safety Board issued Recommendation 93-5, which indicated the need for better characterization of tank waste and headspace gases to understand the hazards present. As a result, an extensive tank waste characterization program was initiated that included process history and waste transfer records analysis, solid- and liquid-phase sampling and analysis, and vapor sampling and analysis (Cash 2004).

Between 1992 and 1997, headspace gas samples were collected from 109 SSTs (Stock and Huckaby 2000), primarily from SSTs that had passive ventilation. Some headspace vapor samples were also taken from double-shell tanks; however, all double-shell tanks have active ventilation, which greatly diminishes vapors (Cash 2004). Over 1,200 chemical species were identified as a result of this sampling effort (Stock and Huckaby 2000). By the end of 1996, the potential for hazardous vapor exposure had been analyzed, and acceptable controls were put in place. Based on the results of tank sample analysis and extensive reviews by outside oversight committees, including the Worker Health and Safety Subpanel of the DOE Tanks Advisory Panel, the vapor issue as known at that time was closed. Worker protection controls were implemented in the tank farms around those tanks known to contain larger amounts of noxious gases. The subpanel agreed that the implemented controls were adequate to protect the tank farm workers (Cash 2004).

Using sampling and monitoring data, a tank farm industrial hygiene program was implemented to prevent worker exposure to chemicals above occupational exposure limits. Among other actions designed to ensure worker protection, a tank farm health and safety plan was developed and implemented in 1993 and has been revised as necessary. The plan set action limits for organic chemical agents and ammonia that are below national occupational exposure limits. It further established case-by-case monitoring

requirements based on the specific tank located near where the work is to be performed and the nature of the work activity (CH2M HILL 2003a).

From 1997 until 1999, waste-disturbing activities were minimal. Interim stabilization of the SSTs resumed in 1999 under an enforceable consent decree with the State of Washington (Consent Decree No. CT-99-5076-EPS). This waste-disturbing activity increased during late 2001 and early 2002, and several negative evaluation reports were made by tank farm workers with concerns about odors in and around specific tank farms (Cash 2004).

In early 2002, workers were asked to report all smells or odors, and procedures were developed that required a medical evaluation of any worker exhibiting symptoms due to vapor exposure (CH2M HILL 2004a). In 2002, 19 workers reported vapor smells and received medical evaluations. Between January 1, 2003, and September 30, 2003, 40 workers reported vapor smells and received medical evaluations (CH2M HILL 2003a). Efforts to understand and address this increase were made in 2002 and were made the subject of a project in September 2003 to accelerate progress on resolving vapor issues (CH2M HILL 2004b).

A September 2003 report by the Government Accountability Project (GAP) (GAP 2003) stated that there had been an increase in the number of workers reporting deleterious effects of exposure to the chemical vapors in tank farms. The report was generally critical of the quality and adequacy of the exposure monitoring program and alleged that workers were sick and injured as a result of being exposed to vapors from HLW tanks and other toxic and carcinogenic substances. The GAP report and subsequent GAP statements also alleged that there were instances of improper medical record-keeping, including falsification of records and collusion to undermine worker compensation claims. Further, the GAP alleged that there had been instances in which injuries and illnesses had not been properly reported.

In February 2004, the Secretary of Energy directed the DOE Office of Independent Oversight and Performance Assurance (OA) to evaluate the GAP report allegations and assess past practices and current operations to determine whether additional actions were needed to ensure a safe work environment at Hanford. OA conducted an investigation of selected aspects of worker safety and health systems at Hanford from February through April 2004. The OA team consisted of 23 experts from various disciplines, including occupational medicine, industrial hygiene, radiological protection, nuclear engineering, waste management, environmental protection, chemistry, maintenance, operations, and management systems.

The April 2004 OA report (DOE 2004a) identified 18 individual findings, including deficiencies or weaknesses related to the following:

- Hazards analysis, exposure control, and exposure assessment
- Engineering practices and operational controls that threaten tank integrity and control of vapor emissions
- Processes for defining and investigating vapor exposure issues and managing corrective actions
- Classification and reporting of injury and illness cases
- DOE oversight and coordination of contractor industrial hygiene and occupational medicine programs

In its report, the OA team observed that there were no known instances of tank farm worker vapor exposures that exceeded regulatory limits. However, the team concluded that longstanding deficiencies in the characterization of tank farm vapors and the industrial hygiene program were such that the site could

not adequately assure that all exposures were below regulatory limits. Furthermore, to ensure that the vapor exposure issues would be fully addressed, OA reported that improvements were needed in various management systems, including engineering processes, industrial hygiene programs, integrated safety management implementation, communications, contractor feedback systems, and DOE Office of River Protection (ORP) line management oversight. The OA team identified an overarching weakness in that the strategy for protecting workers from vapors was not adequately defined and documented at a level that could be translated into a set of engineered controls, administrative controls, and personal protective equipment.

At the time of the assessment, the OA team determined that the contractor had adopted an "as low as is reasonably achievable" approach as the starting point for addressing this weakness, but had not yet characterized tank vapors (i.e., the chemicals of concern and conditions under which they are likely to be released) or established a technically sound industrial hygiene program that would provide for adequate sampling and monitoring of breathing zones and personnel air. The OA report also concluded that the Richland Operations Office had not established the necessary interfaces between prime contractors and the occupational medicine program to ensure the integration of occupational medicine program services as required by DOE directives and contractor requirements. Data on OSHA recordable accidents and in the Computerized Accident/Incident Reporting System (CAIRS) (see Section K.4) were found not to be as reliable as they should have been. Also, the CAIRS database was not being updated in a timely manner to reflect new information or the discovery of errors or omissions.

On the positive side, the OA report stated that the interim actions instituted by ORP and the contractor, which included respiratory protection for most work performed in tank farms, provided assurance that most of the immediate concerns were being addressed. Ongoing and planned actions regarding tank characterization, sampling, and personnel monitoring were seen as providing a good framework for developing longer-term solutions. The OA team found Hanford Environmental Health Foundation clinical practices and protocols to be consistent with standard occupational medical practices. The OA team found no substantiation of any of the health-related GAP allegations except for isolated instances of incomplete treatment information being provided to contractor record-keeping case managers. Although the need for some improvements was noted, OA concluded that the number and type of discrepancies identified in their investigation did not negate the overall usefulness of injury and illness metrics as a tool for monitoring safety performance and focusing attention on problem areas or trends. No indication of significant or pervasive underreporting of injuries and illnesses was noted, and most injury and illness events were found to be appropriately categorized. No egregious examples of misreporting were identified. This finding was consistent with a later Office of the Inspector General report of an independent review, which noted that the medical files were in good order (Friedman 2004).

Due to the increase in vapor exposure reports, mandatory respiratory protection for workers within the tank farm boundaries was implemented in March 2004 (Aromi 2004). In April 2004, a requirement for supplied-air respirators was implemented because of concerns about the amount of nitrous oxide in the tank vapors and the effectiveness of air-purifying respirators. Other actions taken to address vapor exposure issues included the following:

- Personal sampling devices were put into use to characterize tank farm worker breathing-zone vapor concentrations to better understand the exposure potential for various tasks. As of June 3, 2004, a total of 326 personal breathing-zone samples had been collected (124 for volatile organic compounds, 88 for ammonia, and 114 for nitrous oxide). Preliminary analysis of 79 of the nitrous oxide samples showed typical breathing-zone concentrations of less than 1 part per million (ppm) compared with the 50 ppm Threshold Limit Value established by ACGIH. Of the 29 ammonia samples for which analysis was complete, 17 showed less than detectable levels, while 12 showed levels ranging from 0.04 to 0.24 ppm, less than 1 percent of the 25 ppm Threshold Limit Value for ammonia.

- To better understand nitrous oxide emissions from tanks, samples were obtained from the breather filter openings for all 149 SSTs. Results of the sample analyses are provided in *Results of Nitrous Oxide Monitoring Equipment Tests and Badge Monitoring Non-personnel Area Tests Within Hanford Single Shell Tank Farms* and are summarized as follows (Schofield 2004):
  - Results from 62 samples taken from 10 selected tanks believed to have high nitrous oxide concentrations in the tank headspace showed that the 24-hour time-weighted average concentrations at a distance of 0.9 to 1.5 meters (3 to 5 feet) from the breather filters were all below 1.0 ppm. Results from an additional 25 samples showed no 24-hour time-weighted average concentrations above 1.0 ppm at a distance of 46 centimeters (18 inches) from the breather filters on 5 selected tanks with high nitrous oxide concentrations in the tank headspace.
  - Results for 12-hour and 24-hour samples taken directly from the tank breather filter outlets showed, out of 343 samples, only 30 with time-weighted average concentrations above 1 ppm and 6 above 10 ppm. The highest value was 38 ppm, and the remaining 307 samples were less than 1.0 ppm.
- Tank headspace gas and vapor samples were obtained, and the 16 SSTs in the C tank farm were the first to be sampled. Data from these samples were used to monitor changes in vapor chemistry over time and determine appropriate protective measures (CH2M HILL 2004c).
- Other actions taken included installation of active ventilation systems, stack extensions to raise vapors above the worker breathing zone, and enhanced worker training (CH2M HILL 2004c).

An April 2005 assessment of the tank farms industrial hygiene program by ORP concluded that the program complied with applicable DOE and OSHA regulations and standards and was effective in protecting tank farm workers from industrial hazards (Schepens 2005). The assessment also sampled 57 of the 101 corrective actions arising from the April 2004 OA report (DOE 2004a) and verified adequate implementation for all 57. The assessment noted that the contractor had a plan to implement engineering controls in the tank farms to elevate exhaust points, and, in some cases, provide exhaust fans to minimize worker exposure. A number of key actions, including some engineering controls, had already been implemented, and all workers entering areas where they might be exposed to tank vapors were being required to use respiratory protection. It was also noted that the use of respiratory protection introduced several new hazards. From January 1, 2004, to March 30, 2005, about 33 percent of workplace injuries (mainly muscle strains, slips, and trips and falls) could be directly related to the use of a self-contained breathing apparatus (SCBA), which caused reduced visibility. Respiratory tract irritation from breathing the very dry air supplied by SCBAs was also noted (Schepens 2005).

On July 27, 2007, about 320 liters (85 gallons) of tank waste were spilled during a transfer from tank 241-S-102; the resulting Type A Accident Investigation Report identified several worker chemical exposure issues associated with the spill (DOE 2007a). A number of workers identified odors, experienced symptoms, or expressed concerns about their potential exposure to chemicals from the spill. Two individuals approached the spill location about 10 minutes after the leak and may have been exposed to tank vapors. One person noticed a strong odor and later reported symptoms, while the other, only a few feet away, did not. Others who reported symptoms were outside the tank farm fence, at least 40 meters (130 feet) from the leak location. Workers were sheltered for an extended time in a very warm mobile office building without ventilation, which may have contributed to the stress, concern, and symptoms (headaches) reported by some. There was no industrial hygiene sampling or monitoring for a chemical vapor release for more than 13 hours following the spill. However, any chemical vapors would have dissipated quickly and would have been difficult to measure quantitatively under the best of circumstances. Dispersion modeling conducted in the days following the spill indicated that, even in the maximum reasonably foreseeable case scenario with conservative assumptions, only individuals inside

the S tank farm fence would have been subjected to chemical concentrations at or above the applicable occupational exposure limit. The accident investigation report concluded that the contractor needed to better integrate industrial hygiene into its response to abnormal events that may involve chemical releases. It was also concluded that the Hanford fire department needed to improve the performance of its emergency medical technicians in the areas of documentation of patient encounters and communications with the site occupational medical services provider. The need for more-frequent review of patient records by physicians and enhanced documentation of patient encounters was also identified (DOE 2007a).

Estimates of worker exposure to chemicals and the resulting health effects are highly dependent on modeling assumptions. If a worker were assumed to be very close to the chemical emission point, the predicted consequences might vary from zero to extreme (severe, irreversible health effects), depending on the assumed duration of the release and exposure and the location of the worker with respect to the emission point and wind direction. Therefore, no attempt was made to estimate involved worker exposure to chemical releases associated with routine operations. Through compliance with applicable requirements and the scrutiny provided by internal and external review of chemical exposure issues, it is expected that involved worker exposure would be maintained below the thresholds identified by OSHA and ACGIH.

Because a noninvolved worker was assumed to be some distance away, it is possible to model exposures using average meteorological conditions at the site. Impacts on a noninvolved worker from carcinogenic and noncarcinogenic chemicals, ammonia, benzene, 1,3-butadiene, formaldehyde, mercury, toluene, and xylene were modeled. The modeling and risk assessment approach is described in Appendix G. The resulting toxic chemical concentrations and associated Hazard Quotients and risks are presented in Chapter 4, Section 4.1.4, for each Tank Closure alternative. The Hazard Index (the sum of the individual Hazard Quotients for all noncarcinogenic toxic chemicals) would be less than 1 under all alternatives, indicating that concentrations would be below a level requiring action to protect the noninvolved worker. The risk of cancer from exposure to the carcinogenic chemicals (benzene, 1,3-butadiene, and formaldehyde) would be on the order of 1 in 100,000 or less under all Tank Closure alternatives.

K.2.2 FFTF Decommissioning Alternatives

K.2.2.1 Impacts on the Public During Normal Operations

The methodology employed to evaluate impacts on the public and workers from decommissioning FFTF is similar to that discussed in Section K.2.1 for evaluating impacts of tank closure activities. Under FFTF Decommissioning Alternative 1: No Action, current impacts that are part of the Hanford baseline as presented in Chapter 3 would continue. The following sections address differences in scenarios and assumptions affecting human health impacts due to radiological emissions under FFTF Decommissioning Alternative 2: Entombment, and FFTF Decommissioning Alternative 3: Removal. Unless noted otherwise, assumptions described in Section K.2.1 also apply to the FFTF decommissioning radiological impacts analysis.

K.2.2.1.1 Approach

FFTF Decommissioning alternatives comprise three activities: (1) facility disposition (decommissioning of FFTF and auxiliary buildings), (2) disposition of remote-handled special components (RH-SCs), and (3) disposition of contaminated bulk sodium. Disposition of RH-SCs and bulk sodium would occur either at Hanford or the Materials and Fuels Complex (MFC) at INL; therefore, the three activities were evaluated separately.

Under normal operations, radiological releases could occur from any of the activities listed above. Deactivation activities were previously evaluated in the *Environmental Assessment, Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, Fast Flux Test Facility (FFTF) Project, Hanford Site, Richland, Washington* (DOE 2006). Based on the environmental assessment, DOE found no significant impact on the offsite population. The impact on an MEI was estimated to be 0.00026 millirem per year, assuming all of the tritium contamination was released to the environment (DOE 2006:4-2). Impacts of deactivation activities would be the same under all FFTF Decommissioning alternatives and were not included in the alternatives' dose estimates.

Impacts were evaluated for the same public receptors as the Tank Closure alternatives (described in the introduction to Section K.2): the offsite population, an MEI, and an onsite MEI. Impacts on an MEI due to FFTF emissions were evaluated for the dominant downwind directions; the MEI was identified as being about 9.1 kilometers (5.6 miles) to the southeast, across the river from the 300 Area. Ground-level radiological emissions were assumed for facility disposition activities or disposition of bulk sodium in a new facility at Hanford. This conservative assumption resulted in overestimation of the impacts. Emissions associated with the potential treatment of RH-SCs at Hanford would emanate from the 200-West Area near the T Plant complex. The same source location assumed for the 200-West Area tank closure emissions was assumed for the RH-SC emissions, i.e., STTS-West. This assumption resulted in conservative estimates of the impacts to members of the public.

FFTF Decommissioning Alternatives 2 and 3 include options for processing RH-SCs, bulk sodium, or both at the INL MFC. The MEI would be about 5.2 kilometers (3.2 miles) south-southeast of the MFC. A release height of 24 meters (78 feet) was assumed, based on the building and stack heights presented in the facility conceptual design report (ANL-W 2004:27, 53).

K.2.2.1.2 Modeling

The GENII computer code was used to evaluate impacts on the offsite populations of Hanford and INL.

K.2.2.1.3 Input Parameters

Input parameters for the GENII computer code included items that are a function of the location of the action being taken. For FFTF Decommissioning alternatives, the input parameters that were different than those used in evaluating Tank Closure alternatives were the meteorological data, population data, and radiological source terms.

K.2.2.1.3.1 Meteorological Data

FFTF Decommissioning alternatives could include activities that occur at FFTF (the Hanford 400 Area), the INL MFC, or the Hanford 200-West Area. Meteorological data for evaluating offsite impacts of activities that would occur in the Hanford 200-West Area were the same as those used in evaluating emissions from STTS-West for the Tank Closure alternatives (see Table K–4). Meteorological data for activities that would occur at FFTF (facility disposition or disposition of bulk sodium) are presented in Table K–52. These data represent 10-year averages of data collected from 1997 through 2006 at the 9-meter (30-foot) height at the FFTF Meteorological Station (Burk 2007). Wind rose representations of these data are included in Chapter 3, Section 3.2.4. Meteorological data for activities occurring at the INL MFC are presented in Table K–53. These data are based on meteorological data collected at the MFC Meteorological Station from 2000 through 2004.

Table K–52. Joint Frequency Distribution for the Hanford Site 400 Area (Fast Flux Test Facility) at a 9-Meter Height

Average Windspeed (meters per second)	Pasquill Atmospheric Stability Class	Percentage of Time Wind Blows from the Indicated Direction															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0.78	A	0.13	0.14	0.12	0.11	0.13	0.17	0.13	0.11	0.11	0.08	0.08	0.06	0.06	0.05	0.06	0.1
	B	0.04	0.05	0.07	0.04	0.05	0.05	0.07	0.05	0.05	0.04	0.03	0.02	0.03	0.03	0.02	0.04
	C	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.02	0.03	0.03	0.02	0.03
	D	0.27	0.29	0.24	0.22	0.25	0.26	0.3	0.26	0.26	0.25	0.23	0.21	0.21	0.25	0.33	0.27
	E	0.27	0.22	0.21	0.21	0.21	0.2	0.25	0.3	0.36	0.35	0.35	0.33	0.36	0.35	0.41	0.3
	F	0.29	0.21	0.18	0.13	0.15	0.14	0.21	0.24	0.3	0.3	0.3	0.26	0.29	0.27	0.32	0.27
	G	0.09	0.08	0.06	0.06	0.05	0.06	0.07	0.08	0.1	0.12	0.1	0.09	0.1	0.11	0.09	0.11
2.5	A	0.43	0.49	0.41	0.34	0.4	0.48	0.57	0.55	0.64	0.43	0.22	0.14	0.15	0.13	0.18	0.28
	B	0.18	0.16	0.12	0.07	0.09	0.1	0.19	0.17	0.19	0.13	0.08	0.04	0.04	0.05	0.07	0.14
	C	0.14	0.12	0.07	0.06	0.08	0.09	0.15	0.1	0.15	0.1	0.03	0.03	0.02	0.04	0.07	0.11
	D	0.68	0.67	0.45	0.31	0.28	0.33	0.7	0.82	0.89	0.63	0.4	0.22	0.25	0.38	0.78	0.87
	E	0.66	0.55	0.37	0.21	0.19	0.27	0.63	1.03	1.18	1.19	0.62	0.46	0.47	0.66	1.08	0.95
	F	0.57	0.54	0.31	0.15	0.1	0.16	0.47	0.88	1.08	0.94	0.52	0.28	0.21	0.31	0.75	0.72
	G	0.28	0.24	0.13	0.04	0.03	0.05	0.14	0.31	0.32	0.27	0.17	0.08	0.06	0.12	0.31	0.31
4.5	A	0.4	0.46	0.24	0.07	0.09	0.12	0.21	0.25	0.83	0.74	0.28	0.17	0.16	0.13	0.19	0.27
	B	0.14	0.11	0.03	0.02	0.02	0.02	0.06	0.09	0.22	0.27	0.09	0.07	0.04	0.05	0.08	0.12
	C	0.08	0.07	0.03	0.01	0.01	0.01	0.04	0.05	0.15	0.19	0.05	0.03	0.04	0.03	0.05	0.09
	D	0.4	0.27	0.1	0.06	0.05	0.08	0.3	0.56	0.87	1.02	0.39	0.24	0.18	0.4	0.97	0.83
	E	0.23	0.18	0.1	0.03	0.01	0.03	0.36	0.98	0.99	1.19	0.54	0.28	0.27	0.57	1.43	0.96
	F	0.17	0.14	0.07	0.01	0.01	0.01	0.27	1.13	0.87	0.77	0.24	0.05	0.04	0.07	0.61	0.68
	G	0.06	0.06	0.03	0	0	0	0.13	0.46	0.27	0.17	0.04	0.01	0	0.01	0.23	0.29
7.0	A	0.1	0.16	0.06	0.01	0	0.01	0.02	0.02	0.23	0.66	0.4	0.19	0.12	0.12	0.19	0.09
	B	0.02	0.02	0.01	0	0	0	0.01	0.01	0.04	0.16	0.11	0.05	0.02	0.02	0.06	0.05
	C	0.02	0.01	0.01	0	0	0	0.01	0.01	0.04	0.15	0.08	0.05	0.02	0.01	0.05	0.02
	D	0.07	0.07	0.03	0.01	0	0	0.03	0.07	0.28	0.84	0.49	0.23	0.16	0.29	0.75	0.21
	E	0.04	0.05	0.03	0	0	0	0.05	0.1	0.31	0.77	0.56	0.18	0.12	0.3	0.67	0.1
	F	0.01	0.01	0.01	0	0	0	0.01	0.07	0.13	0.26	0.08	0.01	0.01	0.01	0.05	0.02
	G	0	0	0	0	0	0	0.01	0.09	0.05	0.07	0.04	0.01	0	0	0.01	0.01

Table K–52. Joint Frequency Distribution for the Hanford Site 400 Area (Fast Flux Test Facility) at a 9-Meter Height *(continued)*

Average Windspeed (meters per second)	Pasquill Atmospheric Stability Class	Percentage of Time Wind Blows from the Indicated Direction															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
9.6	A	0	0.01	0.01	0.01	0	0	0	0	0.02	0.12	0.16	0.13	0.08	0.03	0.1	0.02
	B	0	0	0	0	0	0	0	0	0.01	0.02	0.06	0.03	0.02	0.01	0.02	0
	C	0	0	0	0	0	0	0	0	0	0.03	0.04	0.02	0.01	0	0.03	0
	D	0.01	0.02	0.02	0	0	0	0	0.01	0.04	0.23	0.27	0.12	0.06	0.08	0.23	0.02
	E	0.01	0.04	0.03	0	0	0	0.01	0.01	0.03	0.2	0.26	0.07	0.03	0.06	0.12	0.01
	F	0	0	0	0	0	0	0	0	0	0.02	0.02	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0.01	0.02	0	0	0	0	0
12.5	A	0	0	0	0	0	0	0	0	0	0.01	0.05	0.05	0.03	0	0.02	0
	B	0	0	0	0	0	0	0	0	0	0.01	0.03	0.01	0	0	0.01	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0.01	0
	D	0	0	0.01	0	0	0	0	0	0	0.06	0.14	0.05	0.02	0.01	0.04	0
	E	0	0	0.01	0	0	0	0	0	0	0.05	0.08	0.03	0.01	0.01	0.02	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15.9	A	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.02	0.04	0.01	0.01	0	0	0
	E	0	0	0	0	0	0	0	0	0	0.01	0.02	0.01	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18.8	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: To convert meters to feet, multiply by 3.281.
Source: Burk 2007.

Table K–53. Joint Frequency Distribution for the Idaho National Laboratory Materials and Fuels Complex at a 10-Meter Height

Average Windspeed (meters per second)	Pasquill Atmospheric Stability Class	Percentage of Time Wind Blows from the Indicated Direction															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1.2	A	0.32	0.32	0.29	0.23	0.16	0.1	0.13	0.13	0.16	0.19	0.21	0.21	0.24	0.28	0.31	0.3
	B	0.04	0.05	0.07	0.05	0.02	0.01	0	0.01	0.02	0.01	0.01	0	0	0	0.01	0.06
	C	0.04	0.07	0.05	0.03	0.01	0	0.01	0.01	0.01	0.01	0.01	0	0.01	0	0.01	0.06
	D	0.06	0.07	0.09	0.1	0.06	0.02	0.01	0.09	0.11	0.04	0.01	0.01	0	0	0.01	0.05
	E	0.08	0.12	0.11	0.14	0.12	0.05	0.02	0.13	0.15	0.09	0.03	0.01	0	0	0.02	0.04
	F	0.52	0.62	0.73	0.81	0.75	0.66	0.58	0.69	0.67	0.57	0.45	0.37	0.2	0.27	0.35	0.4
1.9	A	0.49	0.55	0.36	0.21	0.13	0.07	0.1	0.12	0.13	0.19	0.3	0.29	0.3	0.3	0.3	0.42
	B	0.12	0.18	0.1	0.04	0.03	0	0.01	0.01	0.03	0.03	0.04	0.03	0.02	0.01	0.02	0.06
	C	0.07	0.17	0.19	0.07	0	0	0	0.01	0.02	0.03	0.03	0.03	0	0	0.01	0.05
	D	0.08	0.26	0.25	0.22	0.1	0.02	0.01	0.11	0.17	0.13	0.05	0.01	0	0	0	0.06
	E	0.11	0.18	0.21	0.23	0.11	0.03	0.02	0.12	0.26	0.19	0.1	0.05	0.01	0.01	0.09	0.08
	F	0.37	0.57	0.65	0.62	0.42	0.27	0.23	0.41	0.63	0.65	0.49	0.35	0.22	0.2	0.19	0.27
2.6	A	0.25	0.44	0.35	0.19	0.13	0.08	0.07	0.15	0.21	0.27	0.34	0.34	0.27	0.13	0.16	0.22
	B	0.12	0.21	0.14	0.04	0.03	0.01	0.01	0.01	0.04	0.06	0.08	0.09	0.05	0.03	0.02	0.04
	C	0.07	0.34	0.19	0.06	0.02	0.01	0.04	0.02	0.03	0.05	0.06	0.05	0.03	0.01	0.01	0.04
	D	0.15	0.68	0.75	0.58	0.16	0.05	0.04	0.31	0.5	0.53	0.27	0.13	0.03	0.01	0.03	0.08
	E	0.08	0.22	0.31	0.36	0.12	0.03	0.05	0.12	0.25	0.21	0.14	0.07	0.05	0.03	0.03	0.05
	F	0.11	0.23	0.3	0.28	0.13	0.08	0.07	0.18	0.26	0.28	0.25	0.18	0.09	0.1	0.08	0.1
3.5	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0.16	0.28	0.36	0.16	0.09	0.07	0.07	0.15	0.29	0.5	0.54	0.4	0.2	0.11	0.1	0.11
	C	0.07	0.32	0.23	0.07	0.02	0.02	0.02	0.09	0.08	0.12	0.14	0.12	0.03	0.03	0.02	0.03
	D	0.26	0.8	0.78	0.72	0.23	0.08	0.14	0.62	1.01	0.93	0.69	0.35	0.1	0.07	0.09	0.18
	E	0.07	0.2	0.22	0.33	0.17	0.06	0.08	0.36	0.34	0.29	0.14	0.08	0.04	0.05	0.03	0.07
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.7	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0.17	0.3	0.37	0.14	0.07	0.05	0.04	0.17	0.43	1.01	0.98	0.49	0.15	0.11	0.1	0.12
	D	0.33	0.72	0.8	0.42	0.16	0.1	0.13	1.09	0.93	1.49	1.46	0.56	0.11	0.11	0.1	0.2
	E	0	0.07	0.12	0.21	0.18	0.05	0.07	0.69	0.16	0.4	0.1	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table K–53. Joint Frequency Distribution for the Idaho National Laboratory Materials and Fuels Complex at a 10-Meter Height *(continued)*

Average Windspeed (meters per second)	Pasquill Atmospheric Stability Class	Percentage of Time Wind Blows from the Indicated Direction															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
6.9	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0.03	0.05	0.05	0.02	0	0.01	0.02	0.03	0.11	0.26	0.34	0.1	0.02	0.02	0.02	0.01
	D	0.45	0.71	0.77	0.21	0.06	0.05	0.04	0.62	1.35	3.49	4.44	1.5	0.14	0.16	0.13	0.23
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.7	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0.27	0.39	0.19	0.05	0.01	0	0.01	0.03	0.5	1.46	4.68	1.79	0.04	0.03	0.03	0.04
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Note: To convert meters to feet, multiply by 3.281.

K.2.2.1.3.2 Population Data

The potentially exposed offsite population used for analysis depends on where an activity would occur. The population potentially exposed to emissions from disposition of FFTF and the auxiliary buildings would be within an 80-kilometer (50-mile) radius centered on the 400 Area. The population data represent results of the 2000 census. Under the Hanford Reuse Option of processing the bulk sodium at Hanford, the same population would be used because the Sodium Reaction Facility would be located in the 400 Area. The distribution of the 80-kilometer (50-mile) population around the 400 Area is shown in Figure K–5.

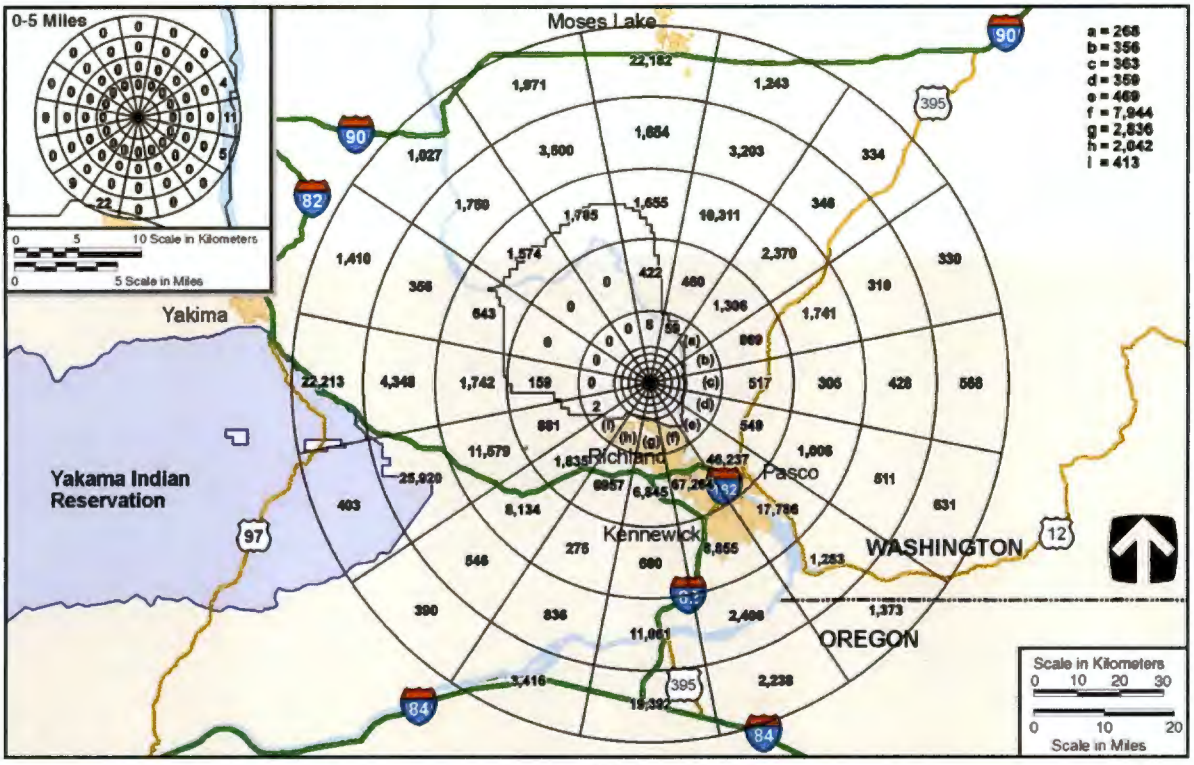

Figure K–5. Population Distribution Within 80 Kilometers (50 Miles) of the Fast Flux Test Facility

The Hanford Option for processing the RH-SCs would be to construct a facility adjacent to the T Plant in the 200-West Area. The same population distribution used for evaluating impacts of tank closure activities that would occur in the 200-West Area was used for evaluating impacts from processing RH-SCs (see Figure K–4). The center of the 80-kilometer (50-mile) region of influence, STTS-West in the southeast corner of 200-West Area, is closer than the T Plant to population centers in the dominant downwind directions, which contributed a degree of conservatism to the analysis.

FFTF Decommissioning Alternatives 2 and 3 include options for processing RH-SCs and bulk sodium in facilities at the INL MFC (the Idaho Option for disposition of RH-SCs and the Idaho Reuse Option for disposition of bulk sodium). The 80-kilometer (50-mile) population distribution used for analysis of impacts from these activities is shown in Figure K–6.

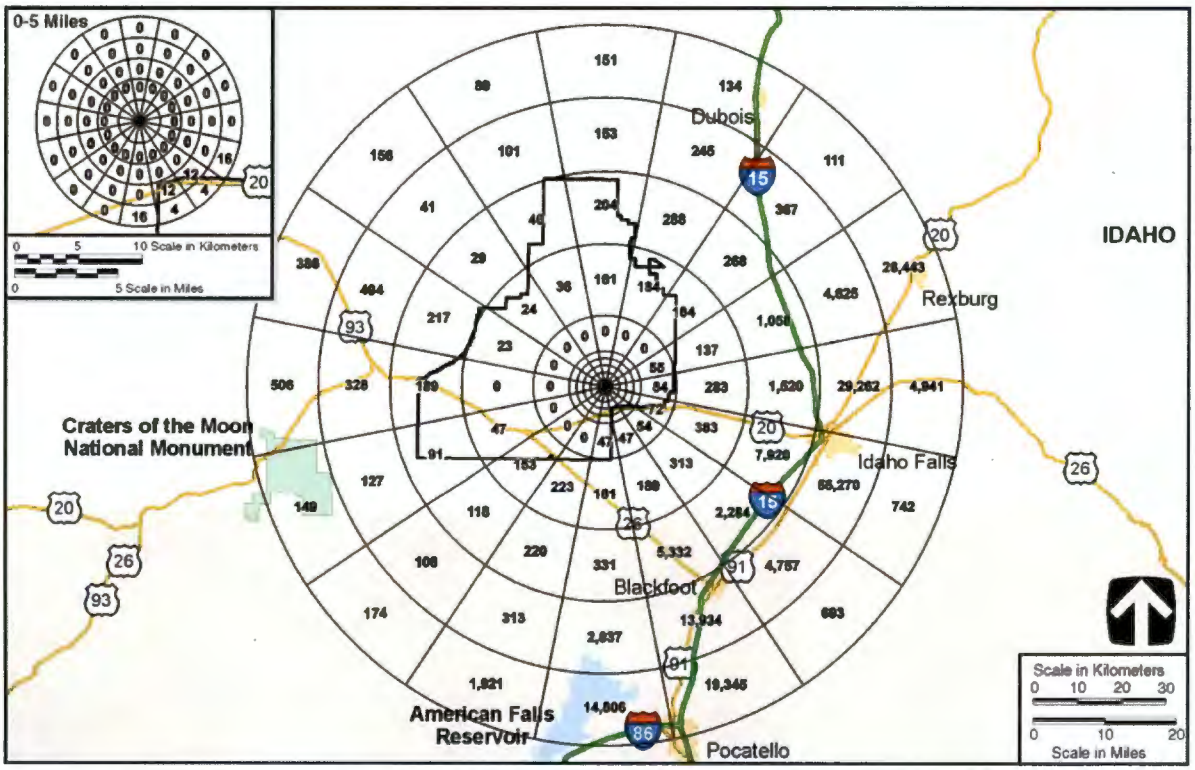

Figure K–6. Population Distribution Within 80 Kilometers (50 Miles) of the Idaho National Laboratory Materials and Fuels Complex

K.2.2.1.3.3 Source Terms

Radioactive emissions could be associated with each of the three activities that make up FFTF decommissioning. Emissions could result from activities to dispose of FFTF and the auxiliary buildings. FFTF Decommissioning Alternative 2 would require filling vessels and rooms that would remain in place prior to being covered by a barrier. Filling the voids could dislodge radioactive contaminants that would then be pushed out of the vessels and rooms as grout replaces the air in the voids. Under FFTF Decommissioning Alternative 3, the demolition practices employed, such as crimping or capping pipes and vessels, would control contamination such that negligible offsite emissions are expected.

Emissions from disposition of RH-SCs could occur at Hanford or INL, depending on which option is selected; the emissions would be the same regardless of location. Disposition of bulk sodium could occur at Hanford or INL. The total project emissions would be slightly higher under the Hanford Reuse Option because decommissioning the Sodium Reaction Facility is an additional activity. Deactivation of the Sodium Processing Facility (SPF) was assumed not to be required at INL because use of the facility would continue to support other activities. Table K–54 presents the source terms from radiological emissions assumed for each of the activities: facility disposition, disposition of RH-SCs, and disposition of bulk sodium.

Table K–54. FFTF Decommissioning Alternatives 2 and 3 – Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project		Annual Emissions in Year(s) of Maximum Impact	
	Curies	Year(s)	Curies	Year(s)
Facility Disposition[a]				
Cesium-137	1.5×10^{-6}	2017	1.5×10^{-6}	2017
Disposition of Remote-Handled Special Components – Hanford or Idaho Option				
Cesium-137	2.6×10^{-4}	2017–2018	1.7×10^{-4}	2017
Disposition of Bulk Sodium – Hanford Reuse Option				
Hydrogen-3 (tritium)	1.3×10^{1}	2017–2019	5.7	2017–2018
Cesium-137	7.3×10^{-4}		3.3×10^{-4}	
Uranium	2.1×10^{-7}		9.5×10^{-8}	
Disposition of Bulk Sodium – Idaho Reuse Option				
Tritium	1.1×10^{1}	2015–2016	5.7	2015–2016
Cesium-137	6.6×10^{-4}		3.3×10^{-4}	
Uranium	1.9×10^{-7}		9.5×10^{-8}	

[a] Emissions apply to Alternative 2 only.
Key: FFTF=Fast Flux Test Facility.

K.2.2.1.4 Results

The radiological impacts on the public due to the FFTF Decommissioning alternatives and options are presented in Table K–55 for the population, in Table K–56 for an MEI, and in Table K–57 for an onsite MEI at Hanford. Impacts under FFTF Decommissioning Alternative 1 are part of the Hanford baseline and are not addressed in this appendix. Impacts of FFTF Decommissioning Alternatives 2 and 3 would include the impacts of facility disposition, disposition of RH-SCs, and disposition of bulk sodium. Based on the calculated collective population dose, no LCFs are expected as a result of any of the alternatives or options; all calculated LCF values are much less than 1. The incremental risk of an LCF to an MEI would be extremely small in all cases; the largest risk over the life of the project would be about 2×10^{-10}, or less than 1 in a billion.

The incremental risk to an onsite MEI assumed to work at the Columbia Generating Station would be even smaller due to the shorter exposure time (a daily work shift) and typical wind direction.

Table K–55. FFTF Decommissioning Alternatives 2 and 3 – Impacts on the Population During Normal Operations

Radionuclides	Life of Project		Year(s) of Maximum Impact	
	Dose (person-rem)	LCFs[a]	Dose (person-rem per year)	LCFs[a]
Alternative 2, Facility Disposition				
Cesium-137	1.0×10^{-6}	0 (6×10^{-10})	1.0×10^{-6}	0 (6×10^{-10})
Alternative 3, Facility Disposition				
	–	–	–	–
Alternative 2 or 3, Disposition of Remote-Handled Special Components – Hanford Option				
Cesium-137	1.4×10^{-4}	0 (8×10^{-8})	9.0×10^{-5}	0 (5×10^{-8})
Alternative 2 or 3, Disposition of Remote-Handled Special Components – Idaho Option				
Cesium-137	1.1×10^{-5}	0 (7×10^{-9})	7.3×10^{-6}	0 (4×10^{-9})

Table K–55. FFTF Decommissioning Alternatives 2 and 3 – Impacts on the Population During Normal Operations *(continued)*

Radionuclides	Life of Project		Year(s) of Maximum Impact	
	Dose (person-rem)	LCFs[a]	Dose (person-rem per year)	LCFs[a]
Alternative 2 or 3, Disposition of Bulk Sodium – Hanford Reuse Option				
Hydrogen-3 (tritium)	6.7×10^{-3}		3.0×10^{-3}	
Cesium-137	4.9×10^{-4}		2.2×10^{-4}	
Uranium	3.8×10^{-5}		1.7×10^{-5}	
Total	7.2×10^{-3}	0 (4×10^{-6})	3.3×10^{-3}	0 (2×10^{-6})
Alternative 2 or 3, Disposition of Bulk Sodium – Idaho Reuse Option				
Tritium	3.9×10^{-4}		1.9×10^{-4}	
Cesium-137	2.8×10^{-5}		1.4×10^{-5}	
Uranium	2.1×10^{-6}		1.0×10^{-6}	
Total	4.2×10^{-4}	0 (3×10^{-7})	2.1×10^{-4}	0 (1×10^{-7})

[a] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Key: FFTF=Fast Flux Test Facility; LCF=latent cancer fatality.

Table K–56. FFTF Decommissioning Alternatives 2 and 3 – Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Life of Project		Year(s) of Maximum Impact		Wind Direction	Distance (kilometers)
	Dose (millirem)	Lifetime Risk of an LCF	Dose (millirem per year)	Lifetime Risk of an LCF		
Alternative 2, Facility Disposition						
Cesium-137	3.0×10^{-8}	2×10^{-14}	3.0×10^{-8}	2×10^{-14}	SE	8.2
Alternative 3, Facility Disposition						
	–	–	–	–	–	–
Alternative 2 or 3, Disposition of Remote-Handled Special Components – Hanford Option						
Cesium-137	2.5×10^{-6}	1×10^{-12}	1.6×10^{-6}	1×10^{-12}	ENE	22.2
Alternative 2 or 3, Disposition of Remote-Handled Special Components – Idaho Option						
Cesium-137	2.1×10^{-6}	1×10^{-12}	1.4×10^{-6}	8×10^{-13}	SSE	5.2
Alternative 2 or 3, Disposition of Bulk Sodium – Hanford Reuse Option						
Hydrogen-3 (tritium)	2.4×10^{-4}		1.1×10^{-4}		SE	8.2
Cesium-137	1.5×10^{-5}		6.6×10^{-6}			
Uranium	7.5×10^{-7}		3.4×10^{-7}			
Total	2.5×10^{-4}	2×10^{-10}	1.2×10^{-4}	7×10^{-11}		
Alternative 2 or 3, Disposition of Bulk Sodium – Idaho Reuse Option						
Tritium	8.5×10^{-5}		4.2×10^{-5}		SSE	5.2
Cesium-137	5.3×10^{-6}		2.7×10^{-6}			
Uranium	2.7×10^{-7}		1.3×10^{-7}			
Total	9.0×10^{-5}	5×10^{-11}	4.5×10^{-5}	3×10^{-11}		

Note: To convert kilometers to miles, multiply by 0.6214.

Key: FFTF=Fast Flux Test Facility; LCF=latent cancer fatality.

Table K–57. FFTF Decommissioning Alternatives 2 and 3 – Impacts on the Hanford Onsite Maximally Exposed Individual During Normal Operations

Radionuclides	Life of Project		Year(s) of Maximum Impact		Wind Direction	Distance (kilometers)
	Dose (millirem)	Lifetime Risk of an LCF	Dose (millirem per year)	Lifetime Risk of an LCF		
Alternative 2, Facility Disposition						
Cesium-137	1.9×10^{-9}	1×10^{-15}	1.9×10^{-9}	1×10^{-15}	NNE	4.5
Alternative 3, Facility Disposition						
	–	–	–	–	–	–
Alternative 2 or 3, Disposition of Remote-Handled Special Components – Hanford Option						
Cesium-137	5.1×10^{-8}	3×10^{-14}	3.4×10^{-8}	2×10^{-14}	ESE	22.7
Alternative 2 or 3, Disposition of Bulk Sodium – Hanford Reuse Option						
Hydrogen-3 (tritium)	2.3×10^{-5}		1.0×10^{-5}		NNE	4.5
Cesium-137	9.4×10^{-7}		4.3×10^{-7}			
Uranium	5.0×10^{-7}		2.3×10^{-7}			
Total	2.4×10^{-5}	1×10^{-11}	1.1×10^{-5}	7×10^{-12}		

Note: To convert kilometers to miles, multiply by 0.6214.
Key: FFTF=Fast Flux Test Facility; Hanford=Hanford Site; LCF=latent cancer fatality.

K.2.2.2 Impacts on Workers During Normal Operations

K.2.2.2.1 Project Radiation Workers

Workers would receive radiation doses from deactivation activities that were previously evaluated in the *Environmental Assessment, Sodium Residuals Reaction/Removal and Other Deactivation Work Activities, Fast Flux Test Facility (FFTF) Project, Hanford Site, Richland, Washington* (DOE 2006). The collective dose to the worker population from deactivation activities would be 576 person-rem (DOE 2006:4-2). This dose would be incurred regardless of which FFTF Decommissioning alternative is selected.

Worker doses would result from maintaining administrative controls (under FFTF Decommissioning Alternative 1) or from facility disposition, disposition of RH-SCs, and disposition of bulk sodium (under FFTF Decommissioning Alternatives 2 and 3). Table K–58 presents the worker doses that would be received from these activities.

Table K–58. FFTF Decommissioning Alternatives – Radiation Worker Impacts and Labor Estimates

Alternative	Life of Project Collective Worker Impact		Life of Project Full-Time Equivalent Radiation Worker Labor		Average Annual Impact per Full-Time Equivalent Radiation Worker		Activity Duration
	Dose (person-rem)	LCFs[a]	Hours	Years	Dose (millirem per year)	Lifetime Risk of an LCF	Years
1	1	0 (6×10^{-4})	4.16×10^{4}	20	50	3×10^{-5}	2008–2107
2	**Facility Disposition**						
	0.37	0 (2×10^{-4})	7.68×10^{3}	4	100	6×10^{-5}	2017
3	**Facility Disposition**						
	6.3	0 (4×10^{-3})	1.31×10^{5}	63	100	6×10^{-5}	2013–2014
2 or 3	**Disposition of Remote-Handled Special Components – Hanford or Idaho Option**						
	1.2	0 (7×10^{-4})	1.25×10^{5}	60	20	1×10^{-5}	2017–2018
	Disposition of Bulk Sodium – Hanford Reuse Option						
	3.7	0 (2×10^{-3})	1.96×10^{5}	94	39	2×10^{-5}	2017–2019
	Disposition of Bulk Sodium – Idaho Reuse Option						
	3.6	0 (2×10^{-3})	1.91×10^{5}	92	39	2×10^{-5}	2014–2016

[a] Increased number of LCFs for the worker population as a result of the radiation dose received under the alternative. If zero, the number in parentheses is the value calculated by multiplying the dose by the risk factor of 0.0006 LCFs per person-rem.
Key: FFTF=Fast Flux Test Facility; LCF=latent cancer fatality.
Source: SAIC 2007b.

K.2.2.2.2 Noninvolved Workers

For the FFTF Decommissioning alternatives, the noninvolved worker that would be potentially affected by either facility disposition or disposition of bulk sodium was assumed to be located in the 300 Area, which is about 9.3 kilometers (5.8 miles) southeast of FFTF. For emissions from the T Plant in the 200-West Area that would result from disposition of RH-SCs at Hanford, the noninvolved worker was assumed to be located at a distance of 100 meters (110 yards) to the east-northeast. For emissions occurring at the INL MFC, the noninvolved worker was assumed to be located at the Experimental Breeder Reactor II (EBR-II) in the MFC, approximately 100 meters (110 yards) away. Table K–59 presents the doses and risks calculated for a noninvolved worker for facility disposition, disposition of bulk sodium, and disposition of RH-SCs. In all cases the doses would be small.

Table K–59. FFTF Decommissioning Alternatives – Impacts on the Noninvolved Worker During Normal Operations

Alternative	Noninvolved Worker Location	Life of Project		Year of Maximum Impact	
		Dose (millirem)	Lifetime Risk of an LCF	Dose (millirem)	Lifetime Risk of an LCF
Facility Disposition					
2	300 Area	6.6×10^{-10}	4×10^{-16}	6.6×10^{-10}	4×10^{-16}
3	300 Area	-	-	-	-
Disposition of Remote-Handled Special Components – Hanford Option					
2 or 3	100 meters east-northeast	2.8×10^{-4}	2×10^{-10}	1.9×10^{-4}	1×10^{-10}
Disposition of Remote-Handled Special Components – Idaho Option					
2 or 3	EBR-II	1.7×10^{-6}	1×10^{-12}	1.1×10^{-6}	7×10^{-13}
Disposition of Bulk Sodium – Hanford Reuse Option					
2 or 3	300 Area	8.0×10^{-6}	5×10^{-12}	3.7×10^{-6}	2×10^{-12}
Disposition of Bulk Sodium – Idaho Reuse Option					
2 or 3	EBR-II	1.1×10^{-4}	7×10^{-11}	5.5×10^{-5}	3×10^{-11}

Key: EBR-II=Experimental Breeder Reactor II; FFTF=Fast Flux Test Facility; LCF=latent cancer fatality.

K.2.3 Waste Management Alternatives

K.2.3.1 Impacts on the Public During Normal Operations

The methodology employed to evaluate the impacts of the Waste Management Alternatives on the public and workers was similar to that discussed in Section K.2.1 for evaluating the impacts of Tank Closure alternatives. Under Waste Management Alternative 1: No Action, currently approved operation of waste treatment facilities would continue; no impacts above those that are part of the current Hanford baseline would result. The scope of the expanded waste treatment activities is the same under Waste Management Alternatives 2 and 3; emissions from the expanded waste treatment activities could result in radiological impacts on the public and are addressed in this section. Differences between Waste Management Alternatives 2 and 3 are in the proposed locations and sizes of waste disposal facilities. As the facilities would receive packaged waste, they are not expected to contribute to offsite doses.

Unless noted otherwise, assumptions in Section K.2.1 also apply to the waste management radiological impacts analysis. The following sections address differences in scenarios and assumptions affecting human health impacts due to radiological emissions from waste management.

K.2.3.1.1 Approach

Waste Management alternatives include treatment, storage, and disposal activities. Existing emissions from the Waste Receiving and Processing Facility (WRAP) and from waste treatment at the T Plant complex would continue under Waste Management Alternative 1. Under Waste Management Alternatives 2 and 3, additional treatment capacity would be added at WRAP and the T Plant complex and additional waste volumes would be processed. These facilities would be located in the 200-West Area. For purposes of evaluating radiological impacts on the public, emissions from waste treatment activities were modeled as originating from a single location, the STTS-West in the southeast corner of 200-West Area, which was the same location used for modeling emissions from the 200-West Area under the Tank Closure and FFTF Decommissioning alternatives.

Waste storage capacity at the Central Waste Complex (CWC) would be expanded under Waste Management Alternatives 2 and 3. Under Waste Management Alternative 2, waste disposal would occur in the 200-East Area Integrated Disposal Facility (IDF-East) and the proposed River Protection Project Disposal Facility (RPPDF) to be located between the 200-East and 200-West Areas. Under Waste Management Alternative 3, in addition to IDF-East and RPPDF, a 200-West Area Integrated Disposal Facility (IDF-West) would be used for waste disposal. Stored waste and waste placed in the disposal facilities would be in packages or large roll-on, roll-off containers; therefore, no radiological emissions with the potential to cause offsite impacts are expected from waste storage and disposal.

K.2.3.1.2 Modeling

The GENII computer code was used to evaluate impacts on the offsite populations of Hanford.

K.2.3.1.3 Input Parameters

The waste treatment facilities would be in the 200-West Area, so many of the GENII input parameters would be the same as those used in modeling impacts from 200-West Area tank closure activities. Common input parameters include meteorological data (see Table K–4) and population distribution (see Figure K–4). The same pathway and exposure assumptions used in the tank closure analysis were used for evaluating waste management impacts (see Section K.2.1.1.3.3).

K.2.3.1.3.1 Source Terms

The emissions of the proposed waste treatment facilities were estimated based on emissions from current treatment facilities. Isotopic data reported in the *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 2006* (Rokkan et al. 2007) for operation of WRAP and Buildings 2706-T/TA were used where available. If no specific alpha-emitting isotopes were reported, the reported gross alpha emissions were used and assumed to be plutonium-239. In the absence of specific beta-emitting isotopes, the reported gross beta emissions were used and assumed to be strontium-90. Emissions for the duration of the waste treatment activities and for the years of maximum impact are presented in Table K–60.

Table K–60. Waste Management Alternatives – Radiological Emissions During Normal Operations

Radionuclides	Emissions over Life of Project		Annual Emissions in Years of Maximum Impact	
	Curies	Years	Curies	Years
Waste Management Alternative 2 or 3				
Strontium-90	7.4×10^{-6}	2013–2051	2.0×10^{-7}	2019–2051
Plutonium-239	9.2×10^{-7}		2.4×10^{-8}	
Americium-241	3.2×10^{-7}		8.8×10^{-9}	

K.2.3.1.4 Results

The radiological impacts of Waste Management Alternative 1 on members of the public are accounted for in analyses of the impacts of ongoing Hanford waste management operations. The impacts of Waste Management Alternatives 2 and 3 would be the same because there are no differences in waste treatment activities between the alternatives. Estimated impacts on the offsite population are presented in Table K–61. Impacts on an MEI assumed to be on the far bank of the Columbia River to the east-northeast are presented in Table K–62. Impacts on an onsite MEI assumed to be at the Laser Interferometer Gravitational-Wave Observatory to the east-southeast of the 200-West Area are presented in Table K–63. Impacts at this location would exceed those at the Columbia Generating Station because it is in the same general direction, but closer to the emission source.

Table K–61. Waste Management Alternatives 2 and 3 – Impacts on the Population During Normal Operations

Radionuclides	Life of Project		Years of Maximum Impact	
	Dose (person-rem)	LCFs[a]	Dose (person-rem)	LCFs[a]
Waste Management Alternative 2 or 3				
Strontium-90	5.0×10^{-6}		1.3×10^{-7}	
Plutonium-239	4.9×10^{-4}		1.3×10^{-5}	
Americium-241	1.7×10^{-4}		4.7×10^{-6}	
Total	6.7×10^{-4}	0 (4×10^{-7})	1.8×10^{-5}	0 (1×10^{-8})

[a] The integer indicates the number of excess latent cancer fatalities that would be expected in the population based on the risk factor of 0.0006 latent cancer fatalities per person-rem; the value in parentheses is the value calculated from the dose and risk factor.

Key: LCF=latent cancer fatality.

Table K–62. Waste Management Alternatives 2 and 3 – Impacts on the Maximally Exposed Individual During Normal Operations

Radionuclides	Life of Project		Years of Maximum Impact		Wind Direction	Distance (kilometers)
	Dose (millirem)	Lifetime Risk of an LCF	Dose (millirem per year)	Lifetime Risk of an LCF		
Waste Management Alternative 2 or 3						
Strontium-90	1.5×10^{-7}		4.0×10^{-9}		ENE	18.2
Plutonium-239	5.9×10^{-6}		1.5×10^{-7}			
Americium-241	2.1×10^{-6}		5.7×10^{-8}			
Total	8.2×10^{-6}	5×10^{-12}	2.1×10^{-7}	1×10^{-13}		

Note: To convert kilometers to miles, multiply by 0.6214.

Key: LCF=latent cancer fatality.

Table K–63. Waste Management Alternatives 2 and 3 – Impacts on the Onsite Maximally Exposed Individual During Normal Operations

Radionuclides	Onsite Maximally Exposed Individual Doses and Risks					
	Life of Project		Years of Maximum Impact		Wind Direction	Distance (kilometers)
	Dose (millirem)	Lifetime Risk of an LCF	Dose (millirem per year)	Lifetime Risk of an LCF		
Waste Management Alternative 2 or 3						
Strontium-90	6.0×10^{-9}		1.6×10^{-10}		ESE	18.4
Plutonium-239	1.6×10^{-6}		4.1×10^{-8}			
Americium-241	5.8×10^{-7}		1.6×10^{-8}			
Total	2.2×10^{-6}	1×10^{-12}	5.7×10^{-8}	3×10^{-14}		

Note: To convert kilometers to miles, multiply by 0.6214.
Key: LCF=latent cancer fatality.

K.2.3.2 Impacts on Workers During Normal Operations

K.2.3.2.1 Project Radiation Workers

Impacts on workers would result from waste treatment and storage activities and from waste disposal operations. Under Waste Management Alternative 1, the impacts of currently operating treatment, storage, and disposal facilities would continue through 2035. Under Waste Management Alternatives 2 and 3, additional worker exposure would occur due to expanded treatment and storage operations beginning in 2013 and continuing through 2051. Waste Management Alternatives 2 and 3 include the same treatment and storage activities, so the worker dose would be the same under both alternatives. Radiation worker doses received from disposal operations would be comparable regardless of the Waste Management alternative, but the worker dose would be affected by the duration of disposal operations, which would depend on the disposal group selected. Disposal groups are based on which Tank Closure alternative is selected (see Chapter 2, Sections 2.5.4.2 and 2.5.4.3). Table K–64 shows the projected worker radiation doses for the Waste Management alternatives and the various disposal groups.

Table K–64. Waste Management Alternatives – Radiation Worker Impacts and Labor Estimates During Normal Operations

Alternative	Life-of-Project Collective Worker Impact		Life-of-Project Full-Time Equivalent Radiation Worker Labor		Average Annual Impact per Full-Time Equivalent Radiation Worker		Activity Duration
	Dose (person-rem)	LCFs[a]	Hours	Years	Dose (millirem per year)	Lifetime Risk of an LCF	Years
1	**Treatment, Storage, and Disposal Operations**						
	37	0 (2×10^{-2})	3.87×10^{5}	186	200	1×10^{-4}	2007–2035
2 or 3	**Treatment and Storage Operations**						
	3.0×10^{3}	2	3.13×10^{7}	15,054	200	1×10^{-4}	2013–2051
2	**Disposal Operations**						
	Disposal Group 1 (for Tank Closure Alternatives 2B, 3A, 3B, 3C, 4, 5, and 6C)						
	360	0 (2×10^{-1})	3.76×10^{6}	1,806	200	1×10^{-4}	2007–2050
	Disposal Group 2 (for Tank Closure Alternatives 2A and 6B)						
	3.6×10^{3}	2	3.69×10^{7}	17,720	200	1×10^{-4}	2007–2100
	Disposal Group 3 (for Tank Closure Alternative 6A)						
	6.4×10^{3}	4	6.67×10^{7}	32,061	200	1×10^{-4}	2007–2165

Table–64. Waste Management Alternatives – Radiation Worker Impacts and Labor Estimates During Normal Operations *(continued)*

Alternative	Life-of-Project Collective Worker Impact		Life-of-Project Full-Time Equivalent Radiation Worker Labor		Average Annual Impact per Full-Time Equivalent Radiation Worker		Activity Duration
	Dose (person-rem)	LCFs[a]	Hours	Years	Dose (millirem per year)	Lifetime Risk of an LCF	Years
3	**Disposal Operations**						
	Disposal Group 1 (for Tank Closure Alternatives 2B, 3A, 3B, 3C, 4, 5, and 6C)						
	360	0 (2×10^{-1})	3.75×10^{6}	1,803	200	1×10^{-4}	2007–2050
	Disposal Group 2 (for Tank Closure Alternatives 2A and 6B)						
	3.5×10^{3}	2	3.67×10^{7}	17,666	200	1×10^{-4}	2007–2100
	Disposal Group 3 (for Tank Closure Alternative 6A)						
	6.4×10^{3}	4	6.64×10^{7}	31,928	200	1×10^{-4}	2007–2165

[a] Increased number of LCFs for the worker population as a result of the radiation dose received under the alternative. If zero, the number in parentheses is the value calculated by multiplying the dose by the risk factor of 0.0006 LCFs per person-rem.

Key: LCF=latent cancer fatality.

Source: SAIC 2007c.

K.2.3.2.2 Noninvolved Workers

Radiological emissions from waste treatment activities could potentially impact noninvolved workers. Waste disposal operations are not expected to result in emissions during normal operations because the waste would be received and disposed of in packages. Under Waste Management Alternative 1: No Action, no additional impacts beyond those included in the baseline would occur. Differences between Waste Management Alternatives 2 and 3 are due to locations and operations of disposal facilities; therefore, the impacts on a noninvolved worker, which are based on treatment facility emissions, would be the same under Waste Management Alternatives 2 and 3.

Emissions from waste management facilities were treated as coming from a single source for purposes of evaluating potential impacts on a noninvolved worker. Additionally, a conservative assumption was made that the emission source would be at ground level. A noninvolved worker was assumed to be about 100 meters (110 yards) to the east-northeast of the emission source. The maximum annual dose to a noninvolved worker would be 2.3×10^{-4} millirem; the increased risk of an LCF from this dose would be less than 1 in 1 billion. Emissions from waste management treatment activities would occur from 2013 through 2051. If the same noninvolved worker were exposed over the duration of the waste treatment activities, the worker would receive a dose of 8.7×10^{-3}; this dose corresponds to an increased lifetime risk of an LCF of 5×10^{-9}, much less than 1 in a million.

K.3 ACCIDENT ANALYSIS

K.3.1 Introduction

Accident analyses for the *TC & WM EIS* alternatives were performed to estimate the impacts on workers and the public from reasonably foreseeable accidents. The analyses were performed in accordance with NEPA guidelines, including the process for the selection of accidents, definition of accident scenarios, and estimation of potential impacts. The sections that follow describe the methodology and assumptions used, as well as the accident selection process, selected accident scenarios, and consequences and risks of

the accidents evaluated. The accident scenario descriptions are intended to give the informed reader a general understanding of how the accident source terms were developed and how the releases from one event might compare to another.

K.3.2 Overview of Methodology and Assumptions

K.3.2.1 Modeling and Analysis of Airborne Radiological Releases

The radiological impacts of airborne releases from accidents at the facilities involved in the *TC & WM EIS* alternatives were calculated using the MELCOR Accident Consequences Code System (MACCS) computer code, Version 1.13.1 (MACCS2). A detailed description of the MACCS model is provided in *MELCOR Accident Consequences Code System (MACCS)* (NRC 1990). The enhancements incorporated in MACCS2 are described in the *Code Manual for MACCS2*, Vol. 1, *User's Guide* (Chanin and Young 1997). This section presents the MACCS2 data specific to the accident analyses.

MACCS2 description. The MACCS2 computer code is used to estimate the radiological doses and health effects that could result from postulated accidental releases of radioactive materials to the atmosphere. The specific release characteristics can consist of up to four Gaussian plumes that are often referred to simply as "plumes"; these specifications are designated a "source term."

The radioactive materials released are modeled as being dispersed in the atmosphere while being transported by the prevailing wind. During transport, whether or not there is precipitation, particulate material can be modeled as being deposited on the ground. If contamination levels exceed a user-specified criterion, mitigating actions can be triggered to limit radiation exposures.

Two aspects of the code's structure are fundamental to understanding its calculations: (1) the calculations are divided into modules and phases and (2) the region surrounding the facility is divided into a polar coordinate grid. These concepts are described in the following paragraphs.

MACCS2 is divided into three primary modules: ATMOS, EARLY, and CHRONC. Three phases of exposure are defined as emergency, intermediate, and long-term. The relationship among the code's three modules and three phases of exposure are summarized below.

The ATMOS module performs all of the calculations pertaining to atmospheric transport, dispersion, and deposition, as well as the radioactive decay that occurs before release and while the material is in the atmosphere. It uses a Gaussian plume model with Pasquill-Gifford dispersion parameters. The phenomena treated include building wake effects, buoyant plume rise, plume dispersion during transport, wet and dry deposition, and radioactive decay and ingrowth. The results of the calculations are stored for use by EARLY and CHRONC. In addition to the air and ground concentrations, ATMOS stores information on wind direction, arrival and departure times, and plume dimensions.

The EARLY module models the period immediately following a radioactive release. This period is commonly referred to as the emergency phase. The emergency phase begins at each successive downwind distance point when the first plume of the release arrives. The duration of the emergency phase is specified by the user; it can range from 1 to 7 days. The exposure pathways considered during this period are direct external exposure to radioactive material in the plume (cloud shine), exposure from inhalation of radionuclides in the cloud (cloud inhalation), exposure to radioactive material deposited on the ground (ground shine), inhalation of resuspended material (resuspension inhalation), and skin dose from material deposited on the skin. Mitigating actions that can be specified for the emergency phase include evacuation, sheltering, and dose-dependent relocation.

The CHRONC module performs all of the calculations pertaining to the intermediate and long-term phases. CHRONC calculates the individual health effects that result from both direct exposure to

contaminated ground and inhalation of resuspended materials, as well as indirect health effects caused by the consumption of contaminated food and water by individuals who could reside both on and off the computational grid.

The intermediate phase begins at each successive downwind distance point upon conclusion of the emergency phase. The user can configure the calculations with an intermediate phase up to 1 year long. Alternatively, the user can configure the calculations with no intermediate phase, so that the long-term phase begins immediately upon conclusion of the emergency phase.

Intermediate phase models are implemented on the assumption that the radioactive plume has passed and the only exposure sources (ground shine and resuspension inhalation) are from material deposited on the ground. It is for this reason that MACCS2 requires that the total duration of a radioactive release be limited to 4 days. Potential doses from food and water during this period are not considered.

The mitigating action model for the intermediate phase is very simple. If the intermediate phase dose criterion is satisfied, the resident population is assumed to be present and subject to radiation exposure from ground shine and resuspension for the entire intermediate phase. If the intermediate phase exposure exceeds the dose criterion, the population is assumed to have relocated to uncontaminated areas for the entire intermediate phase.

The long-term phase begins at each successive downwind distance point upon conclusion of the intermediate phase. The exposure pathways considered during this period are ground shine, resuspension inhalation, and ingestion of food and water.

The exposure pathways considered are those resulting from material deposited on the ground. A number of protective measures, such as decontamination, temporary interdiction, and condemnation, can be modeled in the long-term phase to reduce doses to user-specified levels. The decisions on mitigating action in the long-term phase are based on two factors: (1) whether land at a specific location and time is suitable for human habitation (habitability) and (2) whether land at a specific location and time is suitable for agricultural production (ability to farm).

All of the calculations of MACCS2 are stored based on a polar coordinate spatial grid. Treatment differs somewhat between calculations of the emergency phase and calculations of the intermediate and long-term phases. The region potentially affected by a release is represented with a (r, θ) grid system centered on the location of the release. The radius, r, represents downwind distance. The angle, θ, is the angular offset from the north, going clockwise.

The user specifies the number of radial divisions as well as their endpoint distances. The angular divisions used to define the spatial grid are fixed in the code. They correspond to the 16 points of the compass; each division is 22.5 degrees wide. The 16 points of the compass are used in the United States to express wind direction. The compass sectors are referred to as the "coarse grid."

Because emergency phase calculations use dose-response models for early fatalities and early injuries that can be highly nonlinear, these calculations are performed on a finer grid basis than the calculations of the intermediate and long-term phases. For this reason, the calculations of the emergency phase are performed with the 16 compass sectors divided into three, five, or seven equal, angular subdivisions. The subdivided compass sectors are referred to as the "fine grid."

Two types of doses may be calculated by the code: acute and lifetime.

Acute doses are calculated to estimate deterministic health effects that can result from high doses delivered at high dose rates. Such conditions may occur in the immediate vicinity of a nuclear facility following hypothetical severe accidents in which confinement and/or containment failure has occurred.

Examples of the health effects based on acute doses are early fatality, prodromal vomiting (a precursory symptom of disease), and hypothyroidism (insufficient production of the thyroid hormone).

Lifetime doses are the conventional measure of detriment used for radiological protection. These are 50-year dose commitments to specific tissues (e.g., red marrow and lungs) or a weighted sum of tissue doses defined by the ICRP and referred to as "effective dose." Lifetime doses may be used to calculate the stochastic (probabilistic) health effect risk resulting from exposure to radiation. MACCS2 uses the calculated lifetime dose in cancer risk calculations.

MACCS2 implementation. As implemented, the MACCS2 model evaluated doses due to inhalation of airborne material, as well as direct (external) exposure to the passing plume. These two modes of exposure represent the major portion of the dose that an individual would receive due to a *TC & WM EIS* alternative facility accident. The longer-term effects of airborne radioactive material deposited on the ground after a postulated accident, including the resuspension and subsequent inhalation of radioactive material and the ingestion of contaminated crops, were not modeled for this EIS. These pathways have been studied and found to contribute insignificantly to the total dose compared with inhalation of radioactive material in the passing plume; they are also controllable through cleanup and other mitigation measures. Hence, the deposition velocity of the radioactive material was set to zero, so that material that might otherwise be deposited on surfaces would remain airborne and available for inhalation. This method results in a higher degree of conservatism compared with dose results that would be obtained if deposition and resuspension were taken into account.

The impacts were assessed for the offsite population surrounding the 200-East and 200-West Areas, FFTF, and the INL MFC; the MEI; and a noninvolved worker. The impacts on involved workers were addressed qualitatively because no adequate method exists for calculating meaningful consequences at or near the location where an accident could occur. Involved workers are also fully trained in emergency procedures, including response to potential accidents.

The offsite population is defined as the general public residing within 80 kilometers (50 miles) of the site. The population distribution for each proposed site is based on U.S. Department of Commerce state population data (Census 2007a, 2007b). These data were fitted to a polar coordinate grid with 16 angular sectors aligned with the 16 compass directions, with radial intervals that extend outward to 80 kilometers (50 miles). The offsite populations within 80 kilometers (50 miles) of the 200-East and 200-West Areas were estimated to be 451,556 and 488,897 persons, respectively. The population within 80 kilometers (50 miles) of FFTF was estimated to be 357,391, and the INL MFC population was estimated to be 205,962. For this analysis, no credit was taken for emergency response evacuations or temporary relocation of the public.

The MEI is defined as a hypothetical individual member of the public who would receive the maximum dose from an accident. This individual is usually assumed to be located at a site boundary. However, because there are public access points within the Hanford boundary, the MEI could be at any of these onsite locations.

The MEI location was determined for each *TC & WM EIS* alternative. The MEI location at Hanford can vary based on the type and location of an accident. For this analysis, the MEI was assumed to be located 8.6 kilometers (5.4 miles) southwest of the 200-East Area facilities, 3.6 kilometers (2.3 miles) south of the 200-West Area facilities, and 6.8 kilometers (4.2 miles) east of FFTF. The MEI for the INL MFC was assumed to be located 5.5 kilometers (3.4 miles) to the south-southeast.

A noninvolved worker is defined as an onsite worker who is not directly involved in the facility activity pertaining to the accident. The noninvolved worker was assumed to be exposed to all or part of the

release without any protection. For some scenarios, workers would evacuate the area after becoming aware of the emergency, thereby reducing their exposure potential.

Doses to the offsite population, the MEI, and a noninvolved worker were calculated based on site-specific meteorological conditions. Site-specific meteorology was represented by 1 year of hourly windspeed, atmospheric stability, and rainfall data at each site. The MACCS2 calculations produced statistical distributions based on the meteorological conditions. For these analyses, the results presented were based on mean meteorological conditions, which produce more-realistic consequences than the 95th percentile condition sometimes used in accident analyses for safety analysis reports. The 95th percentile condition represents low-probability meteorological conditions that are not exceeded more than 5 percent of the time.

The health risk coefficient for determining the likelihood of an LCF for low doses or dose rates is 0.0006 LCFs per rem, applied to individual workers and members of the public (see Section K.1.1.3). For high doses or dose rates, a health risk coefficient of 0.0012 applies for individual workers and members of the public. The higher health risk coefficient applies when individual doses exceed 20 rem.

K.3.2.2 Modeling and Analysis of Airborne Chemical Releases

One of the computer models included in the DOE Safety Software Central Registry, the Emergency Prediction Information Code (EPIcode), was selected to obtain estimates of atmospheric dispersion and resultant downwind concentrations of hazardous chemicals (DOE 2004b; Homann 2003). The codes included in the central registry have been determined to be compliant with the DOE Safety Software Quality Assurance requirements. These codes are routinely used by DOE to perform calculations and develop data used to establish the safety basis for DOE facilities and their operation and to support the variety of safety analyses and evaluations developed for these facilities.

EPIcode uses the Gaussian dispersion model to determine plume dispersion. The Gaussian model computes airborne concentrations at a given distance based on: (1) amount released, (2) effective release height, (3) windspeed at the release height, (4) inversion layer, and (5) standard deviation of the integrated concentration distribution both in the crosswind direction (sigma-y) and the vertical direction (sigma-z). Both sigma-y and sigma-z depend on the Pasquill stability class (classification according to the degree of atmospheric turbulence, described below) and the terrain. EPIcode allows selection of either standard (rural) or urban terrain. The standard terrain assumes surface roughness lengths ranging from 0.01 to 0.1 meters (0.03 to 0.3 feet). The urban terrain accounts for increased dispersion due to large urban structures. Standard terrain was conservatively selected for all scenarios even though there are various large structures at Hanford. This choice resulted in higher downwind concentrations.

EPIcode accounts for plume depletion processes, by which very small particles and gases or vapors are deposited on or incorporated within surfaces as a result of turbulent diffusion and Brownian motion (random movement of small particles suspended in liquid or gas caused by collisions with molecules of the surrounding medium). Chemical reactions; impaction; and other biological, chemical, and physical processes combine to keep material that is deposited from becoming re-entrained. As this material is deposited, the plume above becomes depleted. EPIcode uses a source-depletion algorithm to adjust the air concentration in the plume to account for this removal of material. This integrated effect of all removal processes is represented in the plume depletion equation by a deposition velocity term. The code does not account for wind shifts, terrain steering effects, chemical reactions, dense gas effects, or radioactive materials (see Homann 2003).

EPIcode was used to model chemical concentrations in air at each receptor for each release scenario. Each chemical release was assumed to be at ground level. Seven Pasquill stability classes were defined, ranging from A (extremely unstable) to D (neutral) to G (extremely stable). A neutral atmospheric

stability (stability class D) and a windspeed of 5 meters (16.4 feet) per second were used for all EPIcode simulations in this document. The most frequent stability class at Hanford is D.

K.3.2.3 Accident Frequencies

Accident frequency or probability reflects the likelihood of occurrence of an unplanned event during operations that could potentially cause the release of hazardous materials and harm the public, workers, and environment. The unit of measure for accident frequency in this EIS is usually expressed as occurrences per unit of time.

Risk is the overall measure of an accident's potential for endangering the health and safety of workers and the public. As explained in Section K.3.7, an accident's risk is calculated by the mathematical product of the accident's frequency of occurrence and its consequences and is expressed in terms of LCFs per year.

Accident scenarios and frequencies used in this EIS were based on extensive studies that are documented in safety analysis reports and related documents. The accident frequencies in these reports typically reflect the effects of mitigating factors designed to prevent or minimize the magnitude of hazardous materials released. The accident frequencies used in this EIS were conservatively adjusted to reflect unmitigated conditions that result in higher releases of hazardous materials, and thus, higher consequences. Because of uncertainties in the factors that affect an accident's frequency, many were initially expressed as a range. For estimating risk, the higher, conservative end of the estimated frequency range was used in the multiplication of frequency and consequences.

K.3.2.4 Secondary Impacts

Secondary impacts occur due to deposition of radioactive material or chemicals from a plume released during an accident. Although further exposure to humans can occur from deposited material, the radiation dose or chemical exposure associated with the passing plume dominates human health impacts. However, for NEPA purposes, other impacts of deposition are also important. These impacts, discussed further in Section K.3.8 (for radiological releases) and Section K.3.9 (for chemical releases), may result in imposition of protective actions and temporary access restrictions to contaminated land or property.

For radiological releases, the MACCS2 code was used to estimate the level of ground contamination caused by deposition from a passing radioactive plume. The level of contamination is measured in units of microcuries per square meter at specified distances from the accident location. Releases were assumed to occur at ground level with no thermal lift. Mean meteorological conditions were assumed and the deposition velocity was set to 0.01 meters (0.03 feet) per second. The EPA level of concern was set to 0.1 microcuries per square meter. For the analyzed chemical release scenarios, a combination of quantitative and qualitative means was used to assess the secondary impacts in Section K.3.9.

K.3.3 Radiological Accident Analyses

In accordance with DOE NEPA guidelines, an EIS should contain a representative set of accidents that includes various types, such as fire, explosion, mechanical impact, criticality, spill, human error, natural phenomena, and external events. DOE's Office of NEPA Policy and Compliance provides guidance for preparing accident analyses in EISs in *Recommendations for Analyzing Accidents Under the National Environmental Policy Act* (DOE 2002). This document clarifies and supplements *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements* (DOE 2004c).

Facility accidents fall into three broad categories: (1) internally initiated operational events, (2) externally initiated events, and (3) natural phenomena. The first category, internally initiated operational events, includes accidents such as fires, explosions, criticalities, spills, floods, mechanical impacts, and human errors. The second category, externally initiated events, includes airplane crashes, land vehicle impacts,

and accidents at adjacent facilities that could impact DOE facilities. The third category, natural phenomena, includes earthquakes, tornados, lightning, high winds, floods, fires, and other naturally occurring events. Other accidents could be identified in each category specific to a facility's operations, design, location, and mission. Intentional acts by terrorists or saboteurs are not considered accidents in the context of NEPA; however, potential impacts of international destructive acts are addressed in Section K.3.11.

For this *TC & WM EIS*, a large number of potential accidents were considered in each category. The sources of these accident descriptions, which include identification, definition, and assessment of impacts, are documented in safety analysis reports for the WTP, Pretreatment Facility, LAW Vitrification Facility, and HLW Vitrification Facility. Other documents prepared in support of these safety analysis reports and related EISs were also referenced as needed.

From the large list of accident scenarios, a number were selected that were consistent with NEPA purposes and supportive of public interests and DOE decisions associated with this *TC & WM EIS*. Screening criteria for accident selection and further analysis included the following:

- Applicability (i.e., is the accident scenario applicable to this *TC & WM EIS*?)
- Likelihood of occurrence (i.e., is the accident's occurrence reasonably foreseeable?)
- Material at risk (MAR) (i.e., does the accident scenario involve a significant amount of hazardous MAR as a source term?)
- Magnitude of impacts (i.e., how would the accident's impacts illustrate the range of possible consequences and risks for workers and the public for a particular accident category such as fire or spill?)
- Differentiation of alternatives (i.e., would the accident's impacts help to differentiate between alternatives for decision making purposes?)
- Public interest (i.e., is the accident scenario one that is of particular interest and concern to the public?)

The results of the process of accident selection are provided in Sections K.3.4 for Tank Closure alternatives, K.3.5 for FFTF Decommissioning alternatives, and K.3.6 for Waste Management alternatives. These sections describe the accident scenarios and corresponding source terms developed for the *TC & WM EIS* alternatives. The spectrum of accidents discussed below was used to determine the range of consequences (public and worker doses) and associated risks. Additional assumptions were made when further information was required to clarify the accident condition, update various parameters, or facilitate the evaluation process. The assumptions are referenced in each accident description.

Assuming the occurrence of a postulated accident, the source term is the amount of respirable radioactive material released to the air, in terms of curies or grams. The airborne source term is typically estimated by the following equation:

$$\text{Source term} = MAR \times DR \times ARF \times RF \times LPF$$

where:

MAR	=	material at risk
DR	=	damage ratio
ARF	=	airborne release fraction
RF	=	respirable fraction
LPF	=	leak path factor

The MAR is the amount of radionuclides (in curies of activity or grams for each radionuclide) available to be acted upon by a given physical stress. The MAR is specific to a given process in the facility of interest. It is not necessarily the total quantity of material present, but rather the amount of material in the scenario of interest postulated to be available for release.

The DR is the fraction of material exposed to the effects of the energy, force, or stress generated by the postulated event. For the accident scenarios discussed in this analysis, the value of the DR ranges from 0.1 to 1.0.

The ARF is the fraction of material that becomes airborne due to the accident. In this analysis, ARFs were obtained from applicable source documents or the DOE Handbook, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, Vol. 1, *Analysis of Experimental Data* (DOE Handbook 3010-94).

The RF is the fraction of the material with a 10-micron (0.0004-inch) or less aerodynamic-equivalent diameter particle size that could be retained in the respiratory system following inhalation. The RF values are also taken from applicable source documents or the DOE Handbook (DOE Handbook 3010-94).

The LPF accounts for the action of removal mechanisms (e.g., containment systems, filtration, deposition) to reduce the amount of airborne radioactivity ultimately released to occupied spaces in the facility or the environment. The LPF values were taken from applicable sources when possible. Otherwise, an LPF of 1.0 (i.e., no reduction) was assigned. An LPF of 1.0 was also assigned in accident scenarios involving a major failure of confinement barriers.

For example, if for a particular waste process vessel accident, the MAR is 100 curies of a specified radionuclide in a fixed amount of tank waste, the DR is 0.5, the ARF is 0.01, the RF is 0.02, and the LPF is 0.05, the source term would be calculated as follows:

$$\text{Source term} = MAR \times DR \times ARF \times RF \times LPF = 100 \times 0.5 \times 0.01 \times 0.02 \times 0.05 = 0.0005 \text{ curies}$$

In other words, a process vessel contains 100 curies of a radionuclide that is at risk of being released to the environment. Because of an accident, for example, vessel failure, 50 percent (the DR is 0.5) of the vessel's contents are released to the immediate area, 1.0 percent (the ARF is 0.01) becomes airborne, and 2.0 percent (the RF is 0.02) of the airborne material is of respirable size. Depending on the nature of the accident, availability of filtration equipment, and other mitigating factors, 5 percent (the LPF is 0.05) of the respirable airborne material is released to the environment. The net effect is the release of 0.0005 curies of the radionuclide.

K.3.4 Tank Closure Accident Scenarios

This section describes the tank waste storage, retrieval, treatment, and handling accident scenarios applicable to the Tank Closure alternatives. The scenarios, selected in accordance with the process and criteria described in Section K.3.3, are organized according to facility or activity, and their applicability to the alternatives is shown in Table K–65. Many of the accident impacts are based on unmitigated releases, meaning that no credit is taken for HEPA filtration or other design features that may limit the amount of radioactive material released to the environment. Assessing accident impacts based on unmitigated releases is particularly applicable to accident scenarios initiated by seismic events, which were assumed to cause failure of the filtration systems or other mitigating features. In these cases, the lower frequency of the accident reflects the seismic initiating event's effects on mitigating features and accident risk. If these accident scenarios were initiated by events internal to the facility and operations, the HEPA filters and other mitigating features would have a high likelihood of functioning properly, thereby reducing the amount of radioactivity released to the environment. However, the frequency of accident occurrence in these cases would be higher, which would be reflected in the accident's resultant risk. The alphanumeric code following the accident's title (e.g., HL11) corresponds with the accident's description in the tables of this section and in Chapter 4, Section 4.1.11; it is provided to facilitate cross-referencing between tables and accident descriptions.

Table K–65. Tank Closure Alternatives – Applicability of Radiological Accident Scenarios

Accident Scenario[a]	Alternative										
	1	2A	2B	3A	3B	3C	4	5	6A	6B	6C
Spray release from jumper pit during waste retrieval–unmitigated (TK51)	–	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Spray leak in transfer line during excavation–unmitigated (PT23)	–	Y	Y	Y	Y	Y	Y	Y	–	Y	Y
Pretreatment Facility waste feed receipt vessel or piping leak–unmitigated (PT22)	–	Y	Y	Y	Y	Y	Y	Y	–	Y	Y
Seismically induced failure of HLW melter feed preparation vessels–unmitigated (6 MTG/day) (HL11)	–	Y	Y	Y	Y	Y	Y	Y	–	Y	Y
Seismically induced failure of HLW melter feed preparation vessels–unmitigated (15 MTG/day) (HL11)	–	–	–	–	–	–	–	–	Y	–	–
HLW molten glass spill caused by HLW melter failure–unmitigated (6 MTG/day) (HL14)	–	Y	Y	Y	Y	Y	Y	Y	-	Y	Y
HLW molten glass spill caused by HLW melter failure–unmitigated (15 MTG/day) (HL14)	–	–	–	–	–	–	–	–	Y	–	–
Seismically induced LAW Vitrification Facility collapse and failure–unmitigated (30 MTG/day) (LA31)	–	Y	–	Y	Y	Y	Y	–	–	–	–
Seismically induced LAW Vitrification Facility collapse and failure–unmitigated (45 MTG/day) (LA31)	–	–	–	–	–	–	–	Y	–	–	–
Seismically induced LAW Vitrification Facility collapse and failure–unmitigated (90 MTG/day) (LA31)	–	–	Y	–	–	–	–	–	–	Y	Y
Seismically induced WTP collapse and failure–unmitigated (HLW 6 MTG/day; LAW 30 MTG/day) (WT41)	–	Y	–	Y	Y	Y	Y	–	–	–	–
Seismically induced WTP collapse and failure–unmitigated (HLW 6 MTG/day; LAW 45 MTG/day) (WT41)	–	–	–	–	–	–	–	Y	–	–	–
Seismically induced WTP collapse and failure–unmitigated (HLW 6 MTG/day; LAW 90 MTG/day) (WT41)	–	–	Y	–	–	–	–	–	–	Y	Y

Table K–65. Tank Closure Alternatives – Applicability of Radiological Accident Scenarios *(continued)*

Accident Scenario[a]	Alternative										
	1	2A	2B	3A	3B	3C	4	5	6A	6B	6C
Seismically induced WTP collapse and failure–unmitigated (HLW 15 MTG/day; LAW 0 MTG/day) (WT41)	–	–	–	–	–	–	–	–	Y	–	–
Cast stone feed receipt tank failure–unmitigated (200-East Area) (CS71)	–	–	–	–	Y	–	Y	Y	–	–	–
Cast stone feed receipt tank failure–unmitigated (200-West Area) (CS71)	–	–	–	–	Y	–	–	–	–	–	–
Mixed TRU waste/MLLW liquid sludge transfer line spray leak–unmitigated (200-East Area) (TR81)	–	–	–	Y	Y	Y	Y	Y	–	–	–
Mixed TRU waste/MLLW liquid sludge transfer line spray leak–unmitigated (200-West Area) (TR81)	–	–	–	Y	Y	Y	Y	Y	–	–	–
Bulk vitrification waste receipt tank failure–unmitigated (200-East Area) (BV61)	–	–	–	Y	–	–	–	–	–	–	–
Bulk vitrification waste receipt tank failure–unmitigated (200-West Area) (BV61)	–	–	–	Y	–	–	Y	Y	–	–	–
Steam reforming feed receipt tank failure–unmitigated (200-West Area) (SRF1)	–	–	–	–	–	Y	–	–	–	–	–
Steam reforming feed receipt tank failure–unmitigated (200-East Area) (SRF1)	–	–	–	–	–	Y	–	–	–	–	–
Seismically induced waste tank dome collapse–unmitigated (TK53)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
IHLW glass canister drop–unmitigated (SH91)	–	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

[a] The alphanumeric code following the accident's title (e.g., TK51) corresponds with the code in the accident's description in Section K.3.4 and Chapter 4, Section 4.1.11.

Key: HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; LAW=low-activity waste; MLLW=mixed low-level radioactive waste; MTG/day=metric tons of glass per day; TRU=transuranic; WTP=Waste Treatment Plant; Y=yes.

K.3.4.1 HLW Vitrification Facility

K.3.4.1.1 Seismically Induced Failure of HLW Melter Feed Preparation Vessels—Unmitigated (HL11)

This accident scenario involves seismically induced structural failure of two HLW melter feed preparation vessels containing the most concentrated waste materials in the HLW Vitrification Facility. The resultant leaks would drain the tanks, creating internal pools of liquid 10 to 34 centimeters (about 4 to 13 inches) deep in each room, with subsequent entrainment of aerosols in the airflow across the liquid surface. HEPA filters were assumed to fail as a result of the seismic event. The MAR would be in 58,300 liters (15,400 gallons) of HLW (BNI 2005). An initial ARF of 0.00005 would apply to the vessels' contents as they spill to the floor. A continuing airborne release of 4×10^{-7} per hour of the spilled material due to entrainment from the pool surface was assumed to contribute to worker exposure for a period of 8 hours and to public exposure for 24 hours. The RFs would be 0.8 for aerosols formed as the waste spills and 1.0 for aerosols entrained from the pool surface (Lindquist 2006a). The LPF would be 1.0 for the unmitigated case.

The frequency of the accident was estimated to be in the range of 0.00005 to 0.0005 per year (Woolfolk 2007a). For risk calculation purposes, a conservative frequency of 0.0005 per year was assumed.

K.3.4.1.2 HLW Melter Feed Preparation Vessel Failure—Mitigated (HL12)

This accident scenario involves structural failure of an HLW melter feed preparation vessel caused by internal release mechanisms. The resultant leak would drain the tank in 8 hours, creating an internal pool of liquid 10 to 34 centimeters (about 4 to 13 inches) deep in the room with subsequent entrainment of aerosols in the airflow across the liquid. HEPA filters were assumed to be operational. The MAR would be in the contents of a single vessel, 29,100 liters (7,700 gallons) of HLW received from the Pretreatment Facility (BNI 2005). An initial ARF of 0.00005 would apply to the vessel's contents as they spill to the floor. Continuing airborne release at a rate of 4×10^{-7} of the spilled material per hour due to entrainment from the pool surface was assumed to contribute to worker exposure for a period of 8 hours and to public exposure for 24 hours. The RFs would be 0.8 for aerosols formed as the waste spills and 1.0 for aerosols entrained from the pool surface. The LPF would be 2.5×10^{-5} (Lindquist 2006a). This accident's impacts would be less than those of the seismically induced failure of HLW melter feed preparation vessels (HL11) and were not analyzed further.

K.3.4.1.3 Overflow—Mitigated (HL13)

This accident scenario involves overflow of an HLW melter feed preparation vessel into the melter cave sumps and then into the bermed area of the melter cave; the overflow would be caused by excessive volume transfer from the pretreatment vessel or by transfer of material from the pretreatment vessel when the melter feed preparation vessel is full. The MAR would be in 29,100 liters (7,700 gallons) of HLW received from the Pretreatment Facility (BNI 2005). An initial ARF of 0.00005 would apply to the vessel's contents as they spill to the floor. A continuing airborne release of 4×10^{-7} of the spilled material per hour due to entrainment from the pool surface was assumed to contribute to worker exposure for a period of 8 hours and to public exposure for 24 hours. The RFs would be 0.8 for aerosols formed as the waste spills and 1.0 for aerosols entrained from the pool surface. The LPF would be 2.5×10^{-5} (Lindquist 2006a). This accident's impacts would be less than those of the seismically induced failure of HLW melter feed preparation vessels (HL11) and were not analyzed further.

K.3.4.1.4 HLW Molten Glass Spill Caused by HLW Melter Failure—Unmitigated (HL14)

This accident scenario involves a seismically induced catastrophic failure of the HLW melter shell, causing molten glass at 1,150 °C (2,100 °F) to flow out into the HLW melter cave and pour tunnel. Rapid steam generation from the feed material would continue for 1 hour. The depth of the spilled molten glass would vary from 0.03 to 0.46 meters (0.09 to 1.51 feet), depending on the surface area. A depth of 1 centimeter (0.4 inches) was conservatively assumed to maximize the amount of cesium released from the glass as it cools (BNI 2004). HEPA filters were assumed to have failed as a result of the seismic event, resulting in an unfiltered release of radioactive material. The LPF was thereby assumed to be 1.0. The frequency of the accident was estimated to be in the range of 0.00005 to 0.0005 per year (Woolfolk 2007b). For risk calculation purposes, a conservative frequency of 0.0005 per year was assumed.

K.3.4.1.5 HLW Molten Glass Spill Caused by Failed Melter—Mitigated (HL15)

This accident scenario involves a catastrophic failure of the HLW melter shell, causing molten glass at 1,150 °C (2,100 °F) to flow out into the HLW melter cave and pour tunnel. Rapid steam generation from the feed material would continue for 1 hour. The depth of the spilled molten glass would vary from 0.03 to 0.46 meters (0.09 to 1.51 feet), depending on the surface area. A depth of 1 centimeter (0.4 inches) was conservatively assumed to maximize the amount of cesium released from the glass as it cools (BNI 2004). HEPA filters were assumed to be operational, resulting in a filtered release of radioactive material. The LPF was estimated to be 2.5×10^{-5} (Lindquist 2006a). This accident's impacts

would be less than those of the unmitigated scenario for the HLW melter failure (HL14) and were not analyzed further.

K.3.4.2 Pretreatment Facility

K.3.4.2.1 Dropped Ultrafilter Module—Mitigated (PT21)

This accident scenario involves a plugged ultrafilter module lifted for replacement using the hot cell crane. The module would be lifted to the maximum height and then a failure of the crane, hook, or lifting device would allow it to fall to the hot cell floor. The dropped module would create a radioactive aerosol that would be released into the hot cell with the potential for migrating into other areas and the environment. The MAR would be in 38.8 liters (10.2 gallons) of HLW. The ARF and RF were estimated to be 0.001 and 0.1, respectively (Woolfolk 2007b). The LPF was estimated to be 2.5×10^{-5} (Lindquist 2006a). This accident's impacts would be less than those of other Pretreatment Facility accidents and were not analyzed further.

K.3.4.2.2 Pretreatment Facility Waste Feed Receipt Vessel or Piping Leak—Unmitigated (PT22)

This accident scenario involves a seismically induced failure of one of four waste feed receipt process vessels or submerged transfer lines. Contributing failure mechanisms include corrosion, erosion, thermal cycling fatigue, faulty welds, or chemical/waste incompatibilities. The entire vessel's contents would spill from the vessel or piping to the floor of the cell due to failure of either the vessel's nozzles or the transfer line within the cell. HEPA filters were assumed to be inoperative, resulting in an unfiltered release of radioactive material. The MAR would be in 1.53 million liters (0.40 million gallons) of untreated waste. An initial ARF of 0.00005 would apply to the vessel's contents as they spill to the floor. A continuing airborne release of 4×10^{-7} of the spilled material per hour due to entrainment from the pool surface was assumed to contribute to worker exposure for a period of 8 hours and to public exposure for 24 hours. The RFs would be 0.8 for aerosols formed as the waste spills and 1.0 for aerosols entrained from the pool surface (Woolfolk 2007b). The LPF would be 1.0 for the unmitigated case (the LPF would be 2.5×10^{-5} for the mitigated case) (Lindquist 2006a). The frequency of the accident was estimated to be in the range of 0.00005 to 0.0005 per year (Woolfolk 2007b). For risk calculation purposes, a conservative frequency of 0.0005 per year was assumed.

K.3.4.2.3 Spray Leak in Transfer Line During Excavation—Unmitigated (PT23)

This accident scenario involves failure of the coaxial transfer piping that delivers waste from the tank farms to the Pretreatment Facility due to an excavation accident. The outer pipe wall was postulated to break so that the waste is released directly to the environment.

The MAR would be in a waste stream transferring 1,080 liters (285 gallons) per hour for 8 hours from the tank farms to the Pretreatment Facility. The release rate was estimated to be 0.30 liters (0.08 gallons) per second. The ARF and RF were estimated to be 0.0001 and 1.0, respectively. The LPF for the excavation case was estimated to be 1.0. The frequency of the accident was estimated to be 0.0001 per year (Woolfolk 2007b).

K.3.4.3 LAW Vitrification Facility

K.3.4.3.1 Seismically Induced LAW Vitrification Facility Collapse and Failure—Unmitigated (LA31)

This accident scenario involves a seismically induced failure of LAW vessels, product glass containers, melters, and HEPA filters. The MAR is the sum of the radionuclide inventories in 17 major process vessels (Medsker 2007). The product of ARF × RF was estimated to be 0.00005 (Lindquist 2006a). The

LPF was estimated to be 1.0. The frequency of the accident was estimated to be in the range of 0.00005 to 0.0005 per year (Medsker 2007). For risk calculation purposes, a conservative frequency of 0.0005 per year was assumed.

K.3.4.4 Waste Treatment Plant

K.3.4.4.1 Seismically Induced Waste Treatment Plant Collapse and Failure—Unmitigated (WT41)

This accident involves a seismically induced catastrophic failure of the WTP. The MAR is all radioactive materials in the WTP vessels, glass containers, melters, filters, transfer pipes, and other equipment. The material was postulated to spill or fall and to be subjected to impact by falling debris. The Pretreatment Facility MAR is the product of the vessel capacities (Woolfolk 2007b) and radionuclide concentrations (Hassan 2007) for 17 pretreatment process streams that contain significant amounts of radioactivity. The LAW Vitrification Facility MAR is the sum of the radionuclide inventories in 17 major process vessels (Medsker 2007). The HLW Vitrification Facility MAR is the product of the process vessel capacities (Woolfolk 2007a) and the radionuclide concentrations (BNI 2005) for seven process streams that contain significant amounts of radioactivity. To represent the different alternatives, the MAR values for the Pretreatment, LAW Vitrification, and HLW Vitrification Facilities were assumed to be proportional to the immobilized high-level radioactive waste (IHLW) and immobilized low-activity waste (ILAW) production rates. Total MAR values were calculated for WTP production rates (IHLW × ILAW) of 6 × 30, 6 × 90, 6 × 45, and 15 × 0 metric tons of glass per day. An initial airborne respirable release fraction (ARF × RF) of 0.00005 would apply to liquid waste that spills to the floor. A continuing airborne release of 4×10^{-7} of the spilled material per hour due to entrainment from the pool surface was assumed to contribute to worker exposure for a period of 8 hours and to public exposure for 24 hours (Lindquist 2006a). The HEPA filtration system was assumed to fail, resulting in unfiltered releases to the environment (an LPF of 1.0). The frequency of the accident was estimated to be in the range of 0.00005 to 0.0005 per year (Woolfolk 2007b). For risk calculation purposes, a conservative frequency of 0.0005 was assumed.

K.3.4.5 Tank Waste Storage and Retrieval

K.3.4.5.1 Spray Release from Jumper Pit During Waste Retrieval—Unmitigated (TK51)

This accident scenario involves a spray release of pressurized liquid from a mispositioned jumper in an SST double-contained receiver tank pump pit that services the transfer from the double-contained receiver tank to the double-shell tank or pumps into or out of a receiver tank. A jumper is a short connection pipe that is used in a jumper or pump pit to route tank waste from one line to another when transferring waste to a specific location. It was postulated that a jumper is mispositioned and pinhole leaks develop at both ends of the jumper. All spray particles were assumed to evaporate to less than 10 microns before reaching the ground. All of the spray was considered respirable. The respirable release (MAR × ARF × RF) would be in 52 liters (14 gallons) of untreated tank waste (Shire et al. 1995). The frequency of this accident was estimated to be 0.011 per year (DOE and Ecology 1996).

K.3.4.5.2 Hydrogen Deflagration in Waste Storage Tanks—Mitigated (TK52)

This accident scenario involves hydrogen generated in tank waste that rises into the tank headspace and reaches the concentration necessary for combustion. Ignition would occur in the tank headspace during a 1-hour period when the gas concentration would exceed the lower flammability limit. Turbulence accompanying rapid combustion would suspend waste as aerosols, and pressure would drive some of the particulates out of the ventilation system into the environment. The MAR would be in 500,000 liters (130,000 gallons) of waste tank constituents. The product of ARF × RF was estimated to be 6.5×10^{-6}.

The LPF was estimated to be 0.75 due to mitigation of the aerosol by soil collapsing into the tank (Shire et al. 1995). The estimated impacts of this accident would be represented by other storage and retrieval accident impacts and have not been analyzed further.

K.3.4.5.3 Seismically Induced Waste Tank Dome Collapse—Unmitigated (TK53)

This accident scenario involves radiological and chemical contaminants in the tank headspace that were conservatively assumed to be available for release. The collapse of a portion of the dome and overburden would compress the vapor in the headspace as they descend, enhancing the vapor release rate by a sudden pressure difference. Assumptions for each tank included a respirable concentration of contaminants in the headspace of 10 milligrams per cubic meter, a liquid specific gravity of 1.0, and a headspace volume of 935 cubic meters (1,223 cubic yards). The MAR, representative of all tanks, would be in 0.1 liters (0.026 gallons) of vapor and 410,000 liters (108,000 gallons) of salt cake, sludge, and liquid. The product of ARF × RF was estimated to be 1.0 for aerosols in the headspace and 0.00002 for solids and liquids. The LPF was estimated to be 1.0. Entrainment from the material splashed out of the tank would contribute an additional 4.6×10^{-6} liters per second to the source term (Shire et al. 1995). The reference for this scenario (Shire et al. 1995) cites an earthquake with a frequency of 0.00004 per year as the possible initiator. However, for risk calculation purposes, a conservative frequency of 0.0005 per year was assumed, consistent with the frequency used for earthquake scenarios involving severe damage to the WTP.

K.3.4.5.4 Rapid Exothermic Ferrocyanide-Nitrate Reaction (TK54)

A postulated accident of concern is the occurrence of a sustainable, rapid exothermic ferrocyanide-nitrate (or nitrite) reaction in the stored waste. Such a sustainable, rapid exothermic reaction could produce sufficient heat and evolve gases to pressurize the tank headspace, releasing aerosolized waste from the tank vents and potentially damaging the tank's structure.

Waste tank operations at Hanford during the 1950s used ferrocyanide in a number of waste tanks to scavenge cesium-137 from waste supernatant, which led to the formation of ferrocyanide-containing sludge that settled in layers in a number of waste tanks. As a result of these operations, approximately 140 metric tons of ferrocyanide (as $Fe(CN)^{+4}$) were added to 18 SSTs at Hanford. Ferrocyanide, in sufficiently high concentrations and mixed with oxidizing material such as sodium nitrate/nitrite, can react exothermically or even explode when heated to high temperatures.

The risk posed by the continued storage of ferrocyanide wastes in Hanford underground storage tanks has been studied extensively. Waste sample data coupled with laboratory experiments show that the ferrocyanide has decomposed (aged) to inert chemicals through radiolysis and hydrolysis and that the wastes cannot combust or explode (WHC 1996). As a result, all 18 ferrocyanide tanks are categorized as safe and this event has not been analyzed further.

K.3.4.6 Supplemental Treatment—Bulk Vitrification

K.3.4.6.1 Bulk Vitrification Waste Receipt Tank Failure—Unmitigated (BV61)

This accident scenario involves a seismically induced failure of a waste receipt tank used in the bulk vitrification waste treatment process in either the 200-East or 200-West Area. Contributing failure mechanisms might include corrosion, erosion, thermal cycling fatigue, faulty welds, or chemical/waste incompatibilities. The entire vessel's contents would spill from the vessel or piping to the floor of the cell where the tank is located. HEPA filters were assumed to be inoperative, resulting in an unfiltered release of radioactive material. The MAR would be in 129,000 liters (34,100 gallons) of waste (CH2M HILL 2003b). An initial ARF of 0.00005 would apply to the vessel's contents as they spill to the floor. A continuing airborne release of 4×10^{-7} of the spilled material per hour due to entrainment from the pool surface was assumed to contribute to worker exposure for a period of 8 hours and to public exposure for

24 hours. The RFs would be 0.8 for aerosols formed as the waste spills and 1.0 for aerosols entrained from the pool surface (DOE Handbook 3010-94). The LPF would be 1.0 for the unmitigated case (2.5×10^{-5} for the mitigated case) (Lindquist 2006a). The frequency of the accident was estimated to be in the range of 0.00005 to 0.0005 per year (Woolfolk 2007b). For risk calculation purposes, a conservative frequency of 0.0005 per year was assumed.

K.3.4.7 Supplemental Treatment—Cast Stone

K.3.4.7.1 Cast Stone Feed Receipt Tank Failure—Unmitigated (CS71)

This accident scenario involves a seismically induced failure of a feed receipt and storage tank used in the cast stone waste treatment process in either the 200-East or 200-West Area. Contributing failure mechanisms may include corrosion, erosion, thermal cycling fatigue, faulty welds, or chemical/waste incompatibilities. The entire vessel's contents would spill from the vessel or piping to the floor of the cell where the tank is located. HEPA filters were assumed to be inoperative, resulting in an unfiltered release of radioactive material. The MAR would be in 129,000 liters (34,100 gallons) of waste (CH2M HILL 2003b). An initial ARF of 0.00005 would apply to the vessel's contents as they spilled to the floor. A continuing airborne release of 4×10^{-7} of the spilled material per hour due to entrainment from the pool surface was assumed to contribute to worker exposure for a period of 8 hours and to public exposure for 24 hours. The RFs would be 0.8 for aerosols formed as the waste spills and 1.0 for aerosols entrained from the pool surface (DOE Handbook 3010-94). The LPF would be 1.0 for the unmitigated case (2.5×10^{-5} for the mitigated case) (Lindquist 2006a). The frequency of the accident was estimated to be in the range of 0.00005 to 0.0005 per year (Woolfolk 2007b). For risk calculation purposes, a conservative frequency of 0.0005 per year was assumed.

K.3.4.8 Supplemental Treatment—Steam Reforming

K.3.4.8.1 Steam Reforming Feed Receipt Tank Failure—Unmitigated (SRF1)

This accident scenario involves a seismically induced failure of a feed receipt tank used in the steam reforming waste treatment process in either the 200-East or 200-West Area. Contributing failure mechanisms may include corrosion, erosion, thermal cycling fatigue, faulty welds, or chemical/waste incompatibilities. The entire vessel's contents would spill from the vessel or piping to the floor of the cell where the tank is located. HEPA filters were assumed to be inoperative, resulting in an unfiltered release of radioactive material. The MAR would be in 129,000 liters (34,100 gallons) of waste (CH2M HILL 2003b). An initial ARF of 0.00005 would apply to the vessel's contents as they spill to the floor. A continuing airborne release of 4×10^{-7} of the spilled material per hour due to entrainment from the pool surface was assumed to contribute to worker exposure for a period of 8 hours and to public exposure for 24 hours. The RFs would be 0.8 for aerosols formed as the waste spills and 1.0 for aerosols entrained from the pool surface (DOE Handbook 3010-94). The LPF would be 1.0 for the unmitigated case (2.5×10^{-5} for the mitigated case) (Lindquist 2006a). The frequency of the accident was estimated to be in the range of 0.00005 to 0.0005 per year (Woolfolk 2007b). For risk calculation purposes, a conservative frequency of 0.0005 per year was assumed.

K.3.4.9 Supplemental Treatment—Remote-Handled TRU Waste

K.3.4.9.1 Mixed TRU Waste/Mixed Low-Level Radioactive Waste Liquid Sludge Transfer Line Spray Leak—Unmitigated (TR81)

This accident scenario involves a seismically induced break and spray leak in the TRU waste treatment system in the 200-East or 200-West Area. A spray leak could occur when waste slurry is transferred from the retrieval system to the feed receipt tanks. A small hole or orifice could develop in the transfer line, resulting in a spray leak. The MAR was based on a leak rate of 0.22 liters (0.06 gallons) per second for

the duration of the assumed exposure (8 hours for the noninvolved worker, 24 hours for the MEI and population). The ARF was estimated to be 0.0001. The RF and LPF were estimated to be 1.0 (Woolfolk 2007a). The frequency of the accident was estimated to be in the range of 0.00005 to 0.0005 per year (Woolfolk 2007b). For risk calculation purposes, a conservative frequency of 0.0005 per year was assumed.

K.3.4.10 Waste Product Storage and Handling

K.3.4.10.1 IHLW Glass Canister Drop (SH91)

An IHLW glass canister drop was postulated at the 200-East Area IHLW Interim Storage Facilities. The height of the drop was assumed to be 16.8 meters (55 feet). The MAR would be in 1,220 liters (322 gallons) of glass IHLW. The DR was conservatively assumed to be 1. The product of the ARF and RF was estimated to be 0.0000943. The LPF was estimated to be 0.1. The resulting source term for material released to the environment was based on 0.0115 liters (0.003 gallons) of respirable glass particles. The frequency of the initiating event was estimated to be in the range of 0.1 to 0.01 per year (Woolfolk 2007a). With credit given for controls that would lower the frequency of the initiating event and reduce the actual aerosol release, a frequency of 0.001 per year was assumed for risk calculation purposes. The impacts of this accident represent the upper end of the range of waste product storage and handling accidents.

K.3.4.10.2 ILAW Glass Canister Drop (SH92)

An ILAW glass canister drop was postulated at the 200-East Area ILAW Interim Storage Facilities. The height of the drop was assumed to be 9.5 meters (31 feet). The MAR would be in 6,000 kilograms (13,228 pounds) of waste. The DR was estimated to be 0.5, meaning that only 50 percent of the canister's contents would be damaged by the impact. The product of the ARF and RF was estimated to be 0.000048 (BNI 2002). The LPF was estimated to be 1.0. The resulting source term for material released to the environment was based on 0.145 kilograms (0.32 pounds) of waste. The frequency of the accident was assumed to be the same as that of the IHLW canister drop (SH91), 0.001 per year. The estimated impacts of this accident would be less than those of the IHLW glass canister drop (SH91) and were not analyzed further.

K.3.4.10.3 Bulk Vitrification Glass Canister Drop (SH93)

A bulk vitrification glass canister drop was postulated at the 200-East Area storage facility. The height of the drop was assumed to be 2 meters (6.6 feet). The MAR would be in 27,600 kilograms (60,900 pounds) of waste (CH2M HILL 2003b). The DR was estimated to be 0.5, meaning that only 50 percent of the container's contents would be damaged by the impact. The product of the ARF and RF from the impaction stress was estimated to be 9.8×10^{-6} (DOE Handbook 3010-94). The LPF was estimated to be 1.0. The resulting source term for material released to the environment was 0.135 kilograms (0.298 pounds) of waste. The frequency of the accident was assumed to be the same as that of the IHLW canister drop (SH91), 0.001 per year. The estimated impacts of this accident would be less than those of the IHLW glass canister drop (SH91) and were not analyzed further.

K.3.4.10.4 Cast Stone Storage Canister Drop (SH94)

A cast stone storage canister drop was postulated at the 200-East Area storage facility. The height of the drop was assumed to be 2 meters (6.6 feet). The MAR would be in 25,000 kilograms (55,100 pounds) of waste (CH2M HILL 2003c). The DR was estimated to be 0.5, meaning that only 50 percent of the container's contents would be damaged by the impact. The product of the ARF and RF from the impaction stress was estimated to be 9.8×10^{-6} (DOE Handbook 3010-94). The LPF was estimated to be 1.0. The resulting source term for material released to the environment was 0.123 kilograms

(0.27 pounds) of waste. The frequency of the accident was assumed to be the same as that of the IHLW canister drop (SH91), 0.001 per year. The estimated impacts of this accident would be less than those of the IHLW glass canister drop (SH91) and were not analyzed further.

K.3.5 Fast Flux Test Facility Accident Scenarios

This section describes the accident scenarios applicable to the FFTF Decommissioning alternatives. Four of the scenarios involve fires that consume radioactively contaminated sodium metal formerly used as FFTF coolant or reactor coolant system components containing radioactive materials. Two other fire scenarios involve inventories of sodium that was formerly used in other reactors, is now stored at Hanford, and would be converted to sodium hydroxide along with the FFTF sodium for use on site under FFTF Decommissioning Alternatives 2 and 3. The scenarios are attributed to a variety of initiating events, including aircraft crash, material defect, human error, and high winds. Each one might also be initiated by a seismic event of sufficient magnitude to cause severe damage to structures in which the sodium is stored. Applicability of scenarios to the FFTF Decommissioning alternatives is shown in Table K–66. All of the accident impacts were based on unmitigated releases, meaning that no credit is taken for HEPA filtration, structural confinement, or other engineered features that may limit the amount of radioactive material released to the environment. The alphanumeric code following the accident's title (e.g., SSF1) corresponds with the accident's description in the tables of this section and in Chapter 4, Section 4.2.11; it is provided to facilitate cross-referencing between tables and accident descriptions.

Table K–66. FFTF Decommissioning Alternatives – Radiological Accident Scenario Applicability

Accident Scenario[a]	Alternative 1	Alternatives 2 and 3			
		Disposition of RH-SCs		Disposition of Bulk Sodium	
		Hanford Option	Idaho Option	Hanford Reuse Option	Idaho Reuse Option
Sodium Storage Facility fire (SSF1)	Y	Y	Y	Y	Y
Hanford sodium storage tank failure (HSTF1)	Y	Y	Y	Y	Y
Remote-handled special component fire (RHSC1)	–	Y	Y	Y	Y
Hallam Reactor sodium fire (HSF1)	Y	Y	Y	Y	Y
Sodium Reactor Experiment sodium fire (SRE1)	Y	Y	Y	Y	Y
INL Sodium Processing Facility storage tank failure (INLSPF1)	–	–	–	–	Y

[a] The alphanumeric code following the accident's title (e.g., SSF1) corresponds with the code in the accident's description in Section K.3.5.

Key: FFTF=Fast Flux Test Facility; Hanford=Hanford Site; INL=Idaho National Laboratory; RH-SCs=remote-handled special components; Y=yes.

K.3.5.1 Accidents in the Hanford 400 Area

K.3.5.1.1 Sodium Storage Facility Fire (SSF1)

This accident scenario involves a postulated aircraft crash into the FFTF Sodium Storage Facility (SSF) that breaches all four sodium storage tanks and ignites the sodium metal within them. Although the SSF tanks would contain contaminated primary coolant mixed with relatively clean secondary coolant, it was conservatively assumed that the radionuclide inventory levels for the primary sodium represent the mix.

The MAR would be the entire 984,000-liter (260,000-gallon) inventory of sodium stored in the SSF (ANL-W and Fluor Hanford 2002). The surface of each tank was assumed to burn at the standard rate for an open pool of sodium on a steel liner, 10.8 grams per square meter per second (8 pounds per square foot per hour) (Himes 1996). The combined surface area for all four tanks is approximately 224 square meters (2,410 square feet) (WHC 1994). These factors would result in a burn rate of approximately 8,700 kilograms per hour (19,200 pounds per hour). Therefore, it would take approximately 105 hours for the entire contents of the tanks to burn. No credit was taken for any mitigation of the release by the building features; the LPF is therefore considered to be 1. Although Hanford safety analyses indicated that the probability of an accidental aircraft crash into a specific hazardous facility is less than 1×10^{-6} per year, the frequency of this scenario was conservatively assumed to be 1×10^{-6} per year (CH2M HILL 2003d).

K.3.5.1.2 Hanford Sodium Storage Tank Failure (HSTF1)

This accident was postulated to result from a large leak due to growth of a metal defect in one SSF storage tank. The contents of the tank would spill onto the steel floor of the secondary containment (an area of approximately 581 square meters [6,250 square feet]) and burn, releasing a sodium hydroxide aerosol plume (WHC 1994). Exposure to the burning pool of sodium was assumed to breach the other three tanks, causing the entire SSF inventory of 984,000 liters (260,000 gallons) of sodium to spill onto the floor and burn (ANL-W and Fluor Hanford 2002). Using the standard burn rate for an open pool of sodium on a steel liner, 10.8 grams per square meter per second (8 pounds per square foot per hour), the burn rate was estimated to be 22,600 kilograms per hour (49,800 pounds per hour), and the fire duration was estimated to be approximately 41 hours (Himes 1996). The estimated frequency of this scenario, based on the frequency of tank leaks, is 0.00001 per year (Bowman 1994).

K.3.5.1.3 Remote-Handled Special Component Fire (RHSC1)

This scenario represents the upper range of impacts from possible accidents involving removal and transport of the FFTF RH-SCs. A handling mishap was postulated to cause a breach of the largest, most radioactive component (the primary cold trap), resulting in exposure of the contained radioactive sodium to water and air. A portion (30 percent) of the sodium was assumed to burn, releasing the radionuclides in that amount of sodium as well as an equal percentage of the total cesium-137 and cobalt-60 inventory estimated to be in the cold trap. Ground-level release to the atmosphere was assumed. The sodium was assumed to have the radioactive characteristics of FFTF primary sodium (ANL-W and Fluor Hanford 2002). The amount of sodium burned would equal 750 kilograms (1,650 pounds). Additionally, 30 percent of the 470 curies of cesium-137 and 70 curies of cobalt-60 retained within the cold trap medium would be released (141 and 21 curies, respectively) (CEES 2006). For purposes of this analysis, this scenario was assumed to be initiated by human error and assigned a frequency of 0.01 per year (Fluor Hanford 2004a). This accident could also occur at the INL MFC under the Idaho Option for disposition of RH-SCs.

K.3.5.2 Accidents in the Hanford 200-West Area

K.3.5.2.1 Hallam Reactor Sodium Fire (HSF1)

Sodium formerly used as coolant in the Hallam Reactor is stored as a solid in five tanks in the 2727-W Building in the Hanford 200-West Area. Two tanks are full, one is half-full, and the remaining two contain only residual heels. In this scenario, the building would be damaged by high winds, causing a roof support beam to puncture a tank, releasing the cover gas. Rainwater would run down the beam and enter the tank, starting a fire from the exothermic reaction between sodium and water. The entire contents of the tank, 59,600 kilograms (131,000 pounds) of sodium, would burn and be released at ground level

over a period of 67 hours. The frequency of this accident was estimated to be 0.00002 per year (Himes 1996).

K.3.5.2.2 Sodium Reactor Experiment Sodium Fire (SRE1)

Sodium formerly used as coolant in the Sodium Reactor Experiment (SRE) is stored as a solid in drums in the South Alkali Metal Storage Modules near the 200-West Area Solid Waste Operations Complex (SWOC). In this scenario, a vehicle impacts a single storage module and come to rest inside of it. The module contains 20 drums, each of which holds 168 kilograms (370 pounds) of sodium (Fluor Hanford 2004b). The fuel from the vehicle was assumed to drain into the module reservoir and ignite, burning the total amount of sodium in the 20 drums (3,360 kilograms or 7,410 pounds) in approximately 15 hours. For purposes of this analysis, this scenario was assumed to be initiated by human error and was assigned a frequency of 0.01 per year (Fluor Hanford 2004a).

K.3.5.3 Accidents at Idaho National Laboratory

K.3.5.3.1 INL Sodium Processing Facility Storage Tank Failure (INLSPF1)

The accident associated with disposition of bulk sodium at the INL SPF with the largest expected impacts would be a failure of the secondary sodium drain tank located in the EBR-II secondary sodium boiler building with an accompanying fire. The structure and associated features were assumed to provide no mitigation of the release. Although this storage tank would contain a mixture of bulk sodium, it was conservatively assumed that the radionuclide inventory levels for the FFTF primary sodium represent the mixture. Failure of the tank would result in a spill of its working capacity of 56,800 liters (15,000 gallons) of molten sodium (ANL-W and Fluor Hanford 2002). The burn rate was estimated to be 2,250 kilograms per hour (5,000 pounds per hour) and the duration was estimated to be 24 hours. The estimated frequency of this accident, based on the frequency of tank leaks, is 0.00001 per year (Bowman 1994).

K.3.6 Waste Management Accident Scenarios

The documented safety analysis for solid waste operations (DSASW) (Fluor Hanford 2007) identifies and analyzes a range of potential accidents at the Hanford low-level radioactive waste burial grounds (LLBGs), CWC, T Plant complex, and WRAP. These four facilities compose SWOC, which performs the solid waste management function for Hanford. The accidents analyzed in the DSASW represent a range of severity (consequences) and frequency and provide the basis for SWOC operating controls and limits. The solid waste management operations covered by the DSASW would continue under each of the three Waste Management alternatives examined in this *TC & WM EIS*. Under Waste Management Alternatives 2 and 3, new facilities or expansions of existing facilities would be required and there would be limited shipments of low-level radioactive waste (LLW) and mixed low-level radioactive waste (MLLW) to Hanford from other DOE sites. Accordingly, each of the scenarios analyzed in the current DSASW or some updated and refined version of it would be applicable to each of the Waste Management alternatives. The frequency and human health risk from a particular type of accident may vary somewhat as a function of the volume of waste that is managed and/or the duration (years) of each specific waste management component under each Waste Management alternative. Under Waste Management Alternative 1 (No Action), construction of IDF-East would be discontinued in 2008. Therefore, accidents associated with the onsite disposal of ILAW are not applicable to Waste Management Alternative 1. Scenarios for accidents involving ILAW were taken from *Project 520, Immobilized Low-Activity Waste Disposal Facility, Preliminary Documented Safety Analysis* (Burbank 2002). Applicability of the accident scenarios to the Waste Management alternatives is shown in Table K–67.

Table K–67. Waste Management Alternatives – Accident Scenario Applicability

Accident Scenario[a]	Alternative		
	1	2	3
Single-drum deflagration (SWOC FIR-1)	Y	Y	Y
Medium fire inside facility (SWOC FIR-6)	Y	Y	Y
Glovebox or greenhouse fire (SWOC FIR-8)	Y	Y	Y
Large fire of waste containers outside facility (SWOC FIR-4)	Y	Y	Y
Handling spill of single waste container (SWOC SP-2)	Y	Y	Y
Large handling spill of boxes or multiple waste containers (SWOC SP-3A)	Y	Y	Y
Spill of single large-diameter container (SWOC SP-4)	Y	Y	Y
Design-basis seismic event (SWOC NPH-1)	Y	Y	Y
Beyond-design-basis accident (SWOC NPH-2)	Y	Y	Y
Range fire (SWOC EE-1)	Y	Y	Y
Aircraft crash (SWOC EE-2)	Y	Y	Y
Earthmover shears tops off six ILAW containers (ILAW1)	–	Y	Y
Crushing of ILAW containers by falling crane boom (ILAW2)	–	Y	Y

[a] The alphanumeric code following the accident's title (e.g., SWOC FIR-1) corresponds with the code in the accident's description in Section K.3.6.

Key: ILAW=immobilized low-activity waste; Y=yes.

Source: Burbank 2002; Fluor Hanford 2007.

K.3.6.1 Solid Waste Operations Complex Accidents

Appendix D identifies total inventories of waste. However, only a portion of those totals would be subject to the accidents hypothesized in the scenarios at any given time. Waste would be received and managed in accordance with waste acceptance criteria and operational controls established on the basis of the DSASW results. Therefore, the quantities of radioactive material in individual waste packages and the total amounts in specific locations would be controlled such that accident source terms for reasonably foreseeable scenarios would be no greater than those assumed in the DSASW and used in these EIS calculations.

The DSASW describes and analyzes a range of severities for several accident types. Because the potential for all of the scenarios would be present regardless of the Waste Management alternative selected, a detailed examination of each scenario does little to discriminate between the alternatives or inform the decision-making process. Accordingly, only selected representative DSASW scenarios with relatively higher human health impacts are described here for several event types (e.g., fires, spills, natural phenomena). The other DSASW scenarios of each type are summarized with respect to their salient features, frequencies, and consequences. Consistent with the DSASW accident descriptions, the SWOC accident source terms are specified as plutonium-239 dose-equivalent curies (Pu-239 DE-curies), the amount of plutonium-239 (in curies) that would deliver the same radiation dose to an exposed individual or population as the mixture of radionuclides that would actually be released if an accident occurred.

Plutonium-239 Dose-Equivalent Curies (Pu-239 DE-curies)

- Dose equivalence is a method of expressing amounts of radionuclide mixtures in terms of the amount of a single radionuclide that, if inhaled, would produce the same dose to an individual as the mixture.
- Transuranic (TRU) waste managed at the Hanford Site Solid Waste Operations Complex (SWOC) are contaminated with mixtures of several different radionuclides, including plutonium-238, -239, -240, and -241; americium-241; and others.
- SWOC safety documents use a value of 0.165 plutonium-239 dose-equivalent curies per gram of TRU isotopes to calculate doses to workers and the public from accidents involving TRU waste.

K.3.6.1.1 Fires and Deflagrations

K.3.6.1.1.1 Single-Drum Deflagration (SWOC FIR-1)

The single-container (i.e., drum) deflagration event would result from the ignition of accumulated flammable gases (e.g., hydrogen) or a chemical reaction between incompatible materials. This scenario could occur in any SWOC facility, indoors or outdoors, and during many activities. It was postulated to occur at the LLBGs because that location has the greatest number of containers susceptible to the scenario. Ignition of the flammable gases was postulated to result in lid loss and ejection of a fraction of the container's contents, followed by partial or total combustion of both the ejected portion of the waste and the waste remaining in the container. However, the resulting fire was not postulated to propagate to other waste containers. The highest inventory selected for a hypothetical single standard drum at SWOC was selected as 82.5 Pu-239 DE-curies of TRU waste material, of which 5 percent (4.13 Pu-239 DE-curies) was assumed to be ejected by the deflagration. ARF and RF values of 0.001 and 1.0, respectively, apply to the material that is ejected, yielding a source term contribution of 0.0041 Pu-239 DE-curies. Both the ejected material and the material remaining in the container (78.4 Pu-239 DE-curies) would be subject to burning, resulting in additional release of radioactive material (Fluor Hanford 2007).

A DR of 0.18 was assumed for the ejected material because it was calculated that the radiant energy from the deflagration would only be sufficient to ignite 18 percent of the material. The ARFs for ejected plastics (31 percent of ejected material) and nonplastic combustibles (34 percent of ejected material) were assumed to be 0.05 and 0.01, respectively. The RFs and LPFs were assumed to be 1.0 (Fluor Hanford 2007). The contribution to the source term from this material is 0.0145 Pu-239 DE-curies.

For the waste that remains in the container, the DR and LPF were assumed to be 1.0. The combustible portion (65 percent) was treated as packaged waste (ARF of 0.0005, RF of 1.0). The noncombustible portion (35 percent) was assumed to have an ARF of 0.006 and an RF of 0.01. The contribution to the source term from this material is 0.0267 Pu-239 DE-curies (Fluor Hanford 2007).

The cumulative source term would be 0.045 Pu-239 DE-curies. Without credit for any controls, the frequency of this accident was estimated to be greater than 0.001 per year (Fluor Hanford 2007). For purposes of this analysis, the frequency was assumed to be 0.01 per year.

K.3.6.1.1.2 Medium Fire Inside Facility (SWOC FIR-6)

A medium fire is one in which several containers are subject to a fire. The postulated scenario involves failure of the WRAP Automated Stacker/Retrieval System (AS/RS), which would cause a pallet of four drums to fall, breaching the drums and spilling some of their contents. The falling pallet would also sever the AS/RS hydraulic lines, releasing up to 53 liters (14 gallons) of hydraulic fluid. The hydraulic fluid would ignite due to heating from nearby equipment or an electrical short circuit, engulfing the breached drums. An additional 48 drums in the storage rack would be heated by the fire and lose their lids, ejecting part of their contents. Both the ejected contents and the contents remaining in the drum would burn in the fire. The fire would not propagate through the facility.

The MAR for the scenario would be the sum of the 4 drums dropped and the 48 drums enveloped by the burning puddle of hydraulic fluid. The resulting source term would be 0.83 Pu-239 DE-curies. Without credit for any controls, the frequency of this accident was estimated to be greater than 0.01 per year (Fluor Hanford 2007). For purposes of this analysis, the frequency of this accident was estimated to be 0.01 per year.

K.3.6.1.1.3 Glovebox or Greenhouse Fire (SWOC FIR-8)

This scenario was postulated to occur in a WRAP glovebox line (either the TRU waste or TRU waste/LLW line) where a maximum of eight drums would be present. Only two of the drums were considered to represent uncontained waste. The other drums in the TRU waste glovebox would be considered packaged waste and would be represented by a closed, intact container on the transfer car. A variety of initiating events could cause the fire, such as the presence of flammable or combustible materials and ignition sources within the waste being repackaged or electrical or static ignition sources. This postulated fire was assumed to engulf all open waste being processed in the glovebox line. Staged drums outside the glovebox line would not become involved in the fire. The MAR would be the radioactive inventory of eight containers involved in the accident: four containers at 33 Pu-239 DE-curies each, two containers at 12.4 Pu-239 DE-curies each, and two containers at 2.3 Pu-239 DE-curies each. The MAR used to calculate the source term from the glovebox would be combined with the 2.3 Pu-239 DE-curies of MAR from the HEPA filter for a total of 164 Pu-239 DE-curies. The cumulative source term value would be 1.6 Pu-239 DE-curies derived from the burning of the waste material. The glovebox fire accident is one of a group of accidents hypothesized for SWOC. The impacts of such a fire would be larger than those of others such as a greenhouse fire. Without credit for any controls, the frequency of this accident was estimated to be greater than 0.01 per year (Fluor Hanford 2007). For purposes of this analysis, the frequency was assumed to be 0.01 per year.

K.3.6.1.1.4 Large Fire of Waste Containers Outside Facility (SWOC FIR-4)

This scenario postulates that a transport vehicle crashes into an outside stored waste array, causing spills and vehicle damage that create a flammable fuel pool that ignites and burns the stored waste and the transported waste containers. This scenario is based on a fire at the T Plant, but it could occur at any SWOC facility. Waste containers are stored or staged outside in stacks when they need to be transferred to other facilities or when they are received from offsite generators during waste management operations. These waste container pick-up and drop-off activities are typically performed using tractor-trailers that carry up to 80 containers and travel close to the stored or staged waste. Operator error or mechanical failure of the vehicle could cause loss of control, causing the vehicle to travel at high speed into the stored or staged waste array. The high-energy impact was postulated to overturn or otherwise impact the trailer so that the drums on it are thrown violently from the vehicle, impacted, and breached. The 80 containers were assumed to land in a burning fuel pool, and 100 percent of the drum contents were conservatively assumed to burn as unconfined waste. The collision would also impact a stored waste array of 384 drums, breaching 12 containers by direct impact and spilling 100 percent of their contents, which would also burn unconfined. The other 372 drums would experience varying degrees of damage and lid loss, and different portions of their contents would burn as contained or uncontained waste. The total MAR involved in the fire would be 2,310 Pu-239 DE-curies, of which 14 Pu-239 DE-curies would be ultimately released to the atmosphere. The frequency of the initiating event (truck impact) was estimated to be greater than 0.01 per year, but a truck impact resulting in a large fire was estimated to have a frequency of less than 0.01 per year (Fluor Hanford 2007). For purposes of this analysis, the frequency was assumed to be 0.01 per year.

K.3.6.1.1.5 Other Solid Waste Operations Complex Fire/Deflagration Scenarios

The DSASW describes and analyzes an additional seven fire scenarios. Table K–68 shows how the source terms (and therefore, the consequences) of those scenarios compare with the four scenarios detailed above (shown in bold font). The scenarios are arranged by source term, in ascending order.

Table K–68. Fire and Deflagration Scenarios Analyzed in the DSASW

Source Term (Pu-239 DE-curies)	Description	DSASW Designator	Frequency
0.0052	Fire of large-diameter container in T Plant	FIR-10	U
0.0045	**Single-drum deflagration**	**FIR-1**	**A**
0.063	Vapor cloud explosions and boiling liquid expanding vapor explosions	FIR-9	EU
0.83	**Medium fire inside facility**	**FIR-6**	**A**
1.6	Small fire inside facility	FIR-5	A
1.6	Small fire of waste containers outside facility	FIR-2	A
2.0	Medium fire of waste containers outside facility	FIR-3	A
1.6	**Glovebox or greenhouse fire**	**FIR-8**	**A**
7.0	Large fire inside facility	FIR-7	U
7.4	Large fire inside facility with aisle spacing	FIR-7A ·	U
14	**Large fire of waste containers outside facility**	**FIR-4**	**U**

Note: Entries evaluated in this environmental impact statement are in **bold** text.

Key: A=anticipated (frequency $>10^{-2}$ per year); DSASW=documented safety analysis for solid waste operations; EU=extremely unlikely (10^{-4} per year > frequency > 10^{-6} per year); Pu-239 DE-curies=plutonium-239 dose-equivalent curies; U=unlikely (10^{-2} per year > frequency $>10^{-4}$ per year).

K.3.6.1.2 Spills and Sprays

K.3.6.1.2.1 Handling Spill of Single Waste Container (SWOC SP-2)

Waste containers can be impacted physically or lose confinement from various causes during storage and handling. Material-handling equipment (e.g., forklifts) or other vehicles can inadvertently impact waste containers—puncturing, crushing, or toppling them. Raised or suspended loads can drop onto waste containers as a result of lifting equipment failure or improper rigging. This scenario postulates that waste handling operations cause a single-container spill during retrieval of TRU waste drums from buried stacks of TRU waste. The MAR for this scenario would be 82.5 Pu-239 DE-curies of TRU waste. The DR would be 1.0 for mechanical release from the drop of a corroded drum. The ARF and RF values for external impact on packaged waste in drums would be 0.001 and 0.1, respectively. The resultant source term for the single-container spill would be 0.0083 Pu-239 DE-curies. The frequency of this accident was estimated to be 0.01 per year (Fluor Hanford 2007).

K.3.6.1.2.2 Large Handling Spill of Boxes or Multiple Waste Containers (SWOC SP-3A)

This multiple-container spill was postulated to occur as the result of a large, heavy waste box dropping onto TRU waste containers stored or staged in arrays. The large waste box was assumed to be concrete and large enough to impact several stacked waste containers. Based on the dimensions of the waste box, 48 drums would be directly impacted and two layers of drums directly beneath the impacted drums (48 drums each) would also be damaged, for a total of 144 drums plus the waste box. The MAR would be 82.5 Pu-239 DE-curies for the waste box and 818 Pu-239 DE-curies for the 144 impacted containers. The resultant source term would be 0.041 Pu-239 DE-curies. Without credit for any controls, the frequency of this accident was estimated to be greater than 0.01 per year (Fluor Hanford 2007). For purposes of this analysis, the frequency was assumed to be 0.01 per year.

K.3.6.1.2.3 Spill of Single Large-Diameter Container (SWOC SP-4)

A large-diameter container (LDC) spill was postulated to occur in the 221-T Canyon Building because it is the only location where an LDC is removed from its shipping cask or lifted over other LDCs or blanket fuel assemblies in a storage cell. The drop scenario assumes that the LDC contains dry, high-activity sludge. Based on the largest expected inventory for this sludge mix, the total content (MAR) would be 1,610 Pu-239 DE-curies in 3,800 kilograms (8,380 pounds) of sludge. Applying a conservative ARF and RF of 0.0025, the source term for this scenario would be 0.4 Pu-239 DE-curies. No credit was taken for confinement provided by the T Plant structure or systems. Without credit for any controls, the frequency of this accident was estimated to be greater than 0.01 per year (Fluor Hanford 2007). For purposes of this analysis, the frequency was assumed to be 0.01 per year.

K.3.6.1.2.4 Other Solid Waste Operations Complex Spill/Spray Scenarios

The DSASW describes and analyzes an additional five spill/spray scenarios. Table K–69 shows how the source terms (and therefore, the consequences) of these scenarios compare with the scenarios detailed above (shown in bold font). The scenarios are arranged by source term, in ascending order.

Table K–69. Spill and Spray Scenarios Analyzed in the DSASW

Source Term (Pu-239 DE-curies)	Description	DSASW Designator	Frequency
0.0021	Spray release event	SP-7	A
0.0083	**Handling spill of single waste container**	**SP-2**	**A**
0.012	Waste container spill due to vehicle collision	SP-1	A
0.014	Handling spill of multiple waste containers	SP-3	A
0.017	Glovebox spill due to loss of confinement	SP-6	A
0.024	Spill of multiple large-diameter containers	SP-5	A
0.041	**Large handling spill of boxes or multiple waste containers**	**SP-3A**	**A**
0.4	**Spill of single large-diameter container**	**SP-4**	**A**

Note: Entries evaluated in this environmental impact statement are in **bold** text.
Key: A=anticipated (frequency $>10^{-2}$ per year); DSASW=documented safety analysis for solid waste operations; Pu-239 DE-curies=plutonium-239 dose-equivalent curies.
Source: Fluor Hanford 2007.

K.3.6.1.3 Natural Phenomena

K.3.6.1.3.1 Design-Basis Seismic Event (SWOC NPH-1)

A design-basis seismic event was postulated to impact the four SWOC facilities and result in the release of radioactive materials. All exposed waste containers stored outside would topple. Unstacked waste containers and the bottom tiers of stacked waste containers would not fail because they were assumed to be robust and able to survive a fall of less than 1.2 meters (4 feet). It was conservatively assumed that all stacked waste containers above the first tier would topple and spill. Most waste containers stored inside structures qualified to seismic performance category (PC)-2 parameters (DOE Standard 1021-93) would topple. Waste containers would topple and spill, except for fuel assemblies stored in the pool cell of the 221-T Canyon Building, sludge stored in LDCs in storage arrays in cells in the 221-T Canyon Building, unstacked containers, and the bottom tiers of stacked containers. The event would cause structures not qualified to PC-2 parameters to fail and buildings to collapse, causing waste containers stored inside to spill. Waste containers stored inside would be impacted and breached by falling objects (e.g., lights, fire suppression sprinkler lines) and other overhead equipment not seismically rated in structures that are qualified to PC-2 parameters. The total source term would be the sum of 0.027 Pu-239 DE-curies (LLBGs), 0.35 Pu-239 DE-curies (CWC), 0.005 Pu-239 DE-curies (T Plant), and

0.0038 Pu-239 DE-curies (WRAP), for a total of 0.39 Pu-239 DE-curies. Impacts from this event are larger than those for all other design-basis natural phenomena impacts (lightning, high wind/tornado, flood, volcano, snow loading). The frequency of this accident was estimated to be 0.001 per year (Fluor Hanford 2007).

K.3.6.1.3.2 Beyond-Design-Basis Accident (SWOC NPH-2)

A beyond-design-basis earthquake was postulated to impact the four SWOC facilities and result in the release of radioactive materials. All exposed waste containers stored outside would topple. Unstacked waste containers and the bottom tiers of stacked waste containers would not spill because they were assumed to be robust and able to survive a fall of less than 1.2 meters (4 feet). It was conservatively assumed that all stacked waste containers above the first tier would topple and spill. All structures would collapse, impacting waste containers stored inside and causing them to spill. Waste containers stored inside would be impacted and breached by falling objects (e.g., lights, fire suppression sprinkler lines, structural members) and other overhead equipment. The total source term would be the sum of 0.027 Pu-239 DE-curies (LLBGs), 0.35 Pu-239 DE-curies (CWC), 0.50 Pu-239 DE-curies (T Plant), and 0.57 Pu-239 DE-curies (WRAP), for a total of 1.5 Pu-239 DE-curies. Because this earthquake would be stronger than the design-basis seismic event, the frequency would be lower (less than 0.001). However, a quantitative estimate of the frequency of this event was not made. Therefore, for analysis purposes, the frequency was assumed to be 0.001 for purposes of this analysis (Fluor Hanford 2007).

K.3.6.1.4 External Events

K.3.6.1.4.1 Range Fire (SWOC EE-1)

The postulated range fire would encroach on SWOC facility structures, vehicles, and stacked waste, burning waste containers and releasing radioactive materials. Range fires can impact all SWOC facilities. The CWC was selected to represent the most conservative analysis of impacts of a range fire event because it is the westernmost facility, closest to a large amount of natural vegetation. It also has the largest inventory (17,500 waste containers located in the 2403-WD Waste Storage Building). The 2403-WD Waste Storage Building also was considered more vulnerable than buildings constructed of less combustible materials (i.e., the 221-T Canyon Building, WRAP structure). Because of the lack of combustibles inside the building, not all containers would be affected. The fire was postulated to affect 1,019 drums. The resultant source term would be 7.0 Pu-239 DE-curies. Without credit for any controls, the frequency of this accident was estimated to be greater than 0.01 per year (Fluor Hanford 2007). For the purposes of this analysis, the frequency was assumed to be 0.01 per year.

K.3.6.1.4.2 Aircraft Crash (SWOC EE-2)

An aircraft crash into SWOC facilities was postulated to forcefully impact the CWC 2403-WD Waste Storage Building, penetrate the building, and impact waste containers stacked three tiers high. The impact would breach containers and puncture the aircraft fuel tank, causing a pool fire. The exposed MAR would burn, and the pool fire would cause additional damage and release of MAR through lid loss and partial ejection of contents, lid loss and contained burning, and lid seal failure with pyrolysis (chemical change brought about by the action of heat). The SWOC facilities considered for selection as the crash location with the largest impact were the structures at the LLBGs, CWC, WRAP, and T Plant that contain a relatively high amount of MAR. The CWC 2403-WD Waste Storage Building was selected as the accident location because (1) it contains the largest vulnerable "footprint," (2) it is expected to provide little protection to the MAR, and (3) with 17,500 stacked waste containers, it contains the greatest amount of vulnerable MAR of all SWOC facilities. The aircraft crash impacts would be larger than those for accident scenarios involving other SWOC structures and areas. The total source term is 16 Pu-239 DE-curies. The frequency of this accident was estimated to be 0.00003 per year (Fluor Hanford 2007).

K.3.6.1.5 Criticality

The DSASW analyzes two criticality events: a liquid criticality at the T Plant (CR-1) and a solid waste criticality (CR-2). The DSASW shows that radiation doses to workers in the immediate vicinity might be in the range where severe radiation injury or death could result (337 rem from CR-1 and 467 rem from CR-2 to a worker 100 meters [110 yards] from the accident). The dose to the maximum offsite individual would be 0.12 rem from CR-1 and 0.2 rem from CR-2. Both criticalities were determined to be "beyond extremely unlikely" (because the frequency is less than one in a million per year, they are not considered "reasonably foreseeable" events for the purposes of this *TC & WM EIS*) (Fluor Hanford 2007).

K.3.6.2 ILAW Disposal Accidents

K.3.6.2.1 Earthmover Shears Tops Off Six ILAW Containers (ILAW1)

An earthmover was assumed to be pushing fill dirt over the tops of rows of ILAW containers when the blade shears the tops off of six containers. The blade force exerted by the earthmover was assumed to be entirely expended in shattering and grinding vitrified waste, producing a total release of 94 cubic centimeters (5.7 cubic inches) of ILAW glass particles in the respirable size range. More than 99 percent of the potential dose from the aerosol would be due to releases of strontium-90 (0.00666 curies), plutonium-238 (3.52×10^{-7} curies), plutonium-239 (0.0000115 curies), plutonium-240 (1.96×10^{-6} curies), and americium-241 (0.000122 curies). The estimated frequency of this accident is between 0.01 and 1 per year (Burbank 2002). For purposes of this analysis, it was assigned a frequency value of 0.1.

K.3.6.2.2 Crushing of ILAW Containers by Falling Crane Boom (ILAW2)

A crane is used to lift ILAW containers from the transporter and place them in the burial trench. It was assumed that the crane boom falls into the trench and strikes part of the exposed container array. The impact energy of the falling boom was assumed to be entirely expended in shattering and grinding the vitrified waste, producing a total release of 846 cubic centimeters (52 cubic inches) of ILAW glass particles in the respirable size range. More than 99 percent of the potential dose from the aerosol would be due to releases of strontium-90 (0.0599 curies), plutonium-238 (3.17×10^{-6} curies), plutonium-239 (0.000104 curies), plutonium-240 (0.0000176 curies), and americium-241 (0.0011 curies). The estimated frequency of this accident is between 0.01 and 1 per year (Burbank 2002). For purposes of this analysis, the frequency was assumed to be 0.1 per year.

K.3.7 Radiological Impacts of Accidents

The consequences of a radiological accident to workers and the public can be expressed in a number of ways. Three ways are used in this *TC & WM EIS*. The first is individual dose expressed in terms of rem or millirem for a worker or member of the public and collective dose expressed in terms of person-rem for a population of workers or members of the public. The second is a postexposure effect that reflects the likelihood of an LCF for an exposed individual or the expected number of LCFs in a population of exposed individuals. Individual or public exposure to radiation occurs if there is an accident involving radioactive materials, which leads to the third measure, risk. Risk is the mathematical product of the

probability (or frequency) that the accident occurs and the LCF consequences. Risk is calculated as follows:

$$R_i = D_i \times F \times P$$

or

$$R_p = D_p \times F \times P$$

where:

R_i	=	risk of an LCF for an individual receiving a dose D_i
R_p	=	risk of a number of LCFs for a population receiving a collective dose D_p
D_i	=	dose to a worker or member of the public, rem or millirem
D_p	=	collective dose to a population of workers or members of the public, person-rem
F	=	dose-to-LCF conversion factor, which is 0.0006 LCFs per rem (for an individual) or person-rem (for a population)
P	=	probability or frequency of the accident, usually expressed on a per-year basis

Once the source term, the amount of radioactive material released to the environment for each accident scenario, is determined, the radiological consequences are calculated. The calculations and resulting impacts vary depending on how the release is dispersed, what material is involved, and which receptor is being considered.

For example, if the dose to the MEI or worker is 10 rem, the probability of an LCF for an individual is $10 \times 0.0006 = 0.006$, where 0.0006 is the dose-to-LCF conversion factor. If the MEI or worker receives a dose exceeding 20 rem, the dose-to-LCF conversion factor is doubled to 0.0012. Thus, if the MEI receives a dose of 30 rem, the probability of an LCF is $30 \times 0.0012 = 0.036$. For an individual, the calculated probability of an LCF would be in addition to the probability of cancer from all other causes.

For the population, the same dose-to-LCF conversion factor is used to estimate the number of LCFs. The calculated number of LCFs in the population is in addition to the number of cancer fatalities that would result from all other causes. The MACCS2 computer code is used to calculate the dose to an average individual living in a particular geographic area (sector) near the site. The individual dose is then multiplied by the number of people in that sector and the appropriate dose-to-LCF conversion factor to estimate the probability of an LCF within the entire sector's population. The probabilities for all sectors are then summed to produce an estimate of the total probability of an LCF (or total number of LCFs) in the population living within 80 kilometers (50 miles) of the site.

K.3.7.1 Radiological Impacts of Tank Closure Accidents

For the Tank Closure No Action Alternative, severe accidents involving waste tanks are represented by a seismically induced waste tank dome collapse. Table K–70 shows the consequences for this accident. Table K–71 shows the frequency and annual cancer risks for this accident.

Table K–70. Tank Closure Alternative – 1 Radiological Consequences of Accidents[a]

Accident[c, d]	Maximally Exposed Individual		Offsite Population[b]		Noninvolved Worker	
	Dose (rem)	LCF[e]	Dose (person-rem)	LCFs[f]	Dose (rem)	LCF[e]
Seismically induced waste tank dome collapse – unmitigated (TK53)	0.00021	1×10^{-7}	0.96	0 (0.0006)	0.22	0.0001

[a] The doses presented here result from accident releases of radioactive materials to the atmosphere and are from direct exposure to the plume and inhalation only. Doses from other pathways, such as consumption of foodstuffs and exposure to radioactive material deposited on the ground, are small by comparison.

[b] Based on a population of 488,897 persons residing within 80 kilometers (50 miles) of the 200-West Area.

[c] The alphanumeric code following the accident's title (i.e., TK53) corresponds with the code in the accident's description in Section K.3.4.

[d] The accidents listed were analyzed because they had the highest consequences and/or risks in their category (e.g., leak, spill, mechanical impact, natural phenomena). In some instances, more than one accident is in a category to include similar accidents at different facilities. For some categories (e.g., criticality, flooding), no accidents are listed because either none are applicable or the risks of accidents in the categories are very low.

[e] Increased likelihood of an LCF for an individual, assuming the accident occurs.

[f] The reported value is the projected number of LCFs in the population, assuming the accident occurs, and is therefore presented as a whole number. When the reported value is zero, the result calculated by multiplying the collective dose to the population by the risk factor (0.0006 LCFs per person-rem) is shown in parentheses.

Key: LCF=latent cancer fatality.

Table K–71. Tank Closure Alternative – 1 Annual Cancer Risks from Accidents

Accident[a, b]	Frequency	Risk of Latent Cancer Fatality		
		Maximally Exposed Individual[c]	Offsite Population[d, e]	Noninvolved Worker[c]
Seismically induced waste tank dome collapse – unmitigated (TK53)	0.0005	6×10^{-11}	0 (3×10^{-7})	7×10^{-8}

[a] The alphanumeric code following the accident's title (i.e., TK53) corresponds with the code in the accident's description in Section K.3.4.

[b] The accidents listed were analyzed because they had the highest consequences and/or risks in their category (e.g., leak, spill, mechanical impact, natural phenomena). In some instances, more than one accident is in a category to include similar accidents at different facilities. For some categories (e.g., criticality, flooding), no accidents are listed because either none are applicable or the risks of accidents in the categories are very low.

[c] Increased risk to the individual of an LCF, taking into account the probability (frequency) of the accident.

[d] The reported value is the projected number of LCFs in the population, based on the accident probability (frequency), and is therefore presented as a whole number. When the reported value is zero, the result calculated by multiplying the collective dose to the population by the risk factor (0.0006 LCFs per person-rem) is shown in parentheses.

[e] Based on a population of 488,897 persons residing within 80 kilometers (50 miles) of the 200-West Area.

Key: LCF=latent cancer fatality.

The following tables (Tables K–72 through K–91) provide the accident consequences for each Tank Closure action alternative. For each alternative, there are two tables showing the impacts. The first table presents the consequences (doses and LCFs) assuming the accident occurs—that is, not reflecting the frequency of accident occurrence. The second table shows accident risks that are obtained by multiplying the LCF values in the first table by the frequency of the corresponding accident.

Table K–72. Tank Closure Alternative – 2A Radiological Consequences of Accidents[a]

Accident[c, d]	Maximally Exposed Individual		Offsite Population[b]		Noninvolved Worker	
	Dose (rem)	LCF[e]	Dose (person-rem)	LCFs[f]	Dose (rem)	LCF[e]
Spray release from jumper pit during waste retrieval – unmitigated (TK51)	0.0013	8×10^{-7}	5.8	0 (0.003)	1.4	0.0008
Spray leak in transfer line during excavation – unmitigated (PT23)	0.007	4×10^{-6}	94	0 (0.06)	24	0.03
Pretreatment Facility waste feed receipt vessel or piping leak – unmitigated (PT22)	0.88	0.0005	12,000	7	2,900	1
Seismically induced failure of HLW melter feed preparation vessels – unmitigated (HL11) (6 MTG/day)	0.011	7×10^{-6}	150	0 (0.09)	33	0.04
HLW molten glass spill caused by HLW melter failure – unmitigated (HL14) (6 MTG/day)	0.019	0.00001	250	0 (0.1)	63	0.08
Seismically induced LAW Vitrification Facility collapse and failure – unmitigated (LA31) (30 MTG/day)	0.000014	9×10^{-9}	0.19	0 (0.0001)	0.043	0.00003
Seismically induced WTP collapse and failure – unmitigated (WT41) (6×30 MTG/day)	4.3	0.003	58,000	35	13,000	1
Seismically induced waste tank dome collapse – unmitigated (TK53)	0.00021	1×10^{-7}	0.96	0 (0.0006)	0.22	0.0001
IHLW glass canister drop – unmitigated (SH91)	0.00026	2×10^{-7}	3.5	0 (0.002)	0.91	0.0005

[a] The doses presented here result from accident releases of radioactive materials to the atmosphere and are from direct exposure to the plume and inhalation only. Doses from other pathways, such as consumption of foodstuffs and exposure to radioactive material deposited on the ground, are small by comparison.

[b] Based on populations of 451,556 and 488,897 persons residing within 80 kilometers (50 miles) of the 200-East and 200-West Areas, respectively.

[c] The alphanumeric code following the accident's title (e.g., TK51) corresponds with the code in the accident's description in Section K.3.4. The term "Z × Y MTG/day," read as "Z by Y MTG/day," refers to a WTP design capacity of Z MTG/day of HLW and Y MTG/day of LAW; for example, 6 × 30, 6 × 45, 6 × 90, or 15 × 0 MTG/day.

[d] The accidents listed were analyzed because they had the highest consequences and/or risks in their category (e.g., leak, spill, mechanical impact, natural phenomena). In some instances, more than one accident is in a category to include similar accidents at different facilities. For some categories (e.g., criticality, flooding), no accidents are listed because either none are applicable or the risks of accidents in the categories are very low.

[e] Increased likelihood of an LCF, assuming the accident occurs, except at high individual doses (hundreds of rem or more) where acute radiation injury may cause death within weeks. Value cannot exceed 1.

[f] The reported value is the projected number of LCFs in the population, assuming the accident occurs, and is therefore presented as a whole number. When the reported value is zero, the result calculated by multiplying the collective dose to the population by the risk factor (0.0006 LCFs per person-rem) is shown in parentheses.

Key: HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; LAW=low-activity waste; LCF=latent cancer fatality; MTG/day=metric tons of glass per day; WTP=Waste Treatment Plant.

Table K–73. Tank Closure Alternative – 2A Annual Cancer Risks from Accidents

Accident[a, b]	Frequency	Risk of LCF		
		Maximally Exposed Individual[c]	Offsite Population[d, e]	Noninvolved Worker[c]
Spray release from jumper pit during waste retrieval – unmitigated (TK51)	0.011	8×10^{-9}	0 (0.00004)	9×10^{-6}
Spray leak in transfer line during excavation – unmitigated (PT23)	0.0001	4×10^{-10}	0 (6×10^{-6})	3×10^{-6}
Pretreatment Facility waste feed receipt vessel or piping leak – unmitigated (PT22)	0.0005	3×10^{-7}	0 (0.004)	0.002
Seismically induced failure of HLW melter feed preparation vessels – unmitigated (HL11) (6 MTG/day)	0.0005	3×10^{-9}	0 (0.00005)	0.00002
HLW molten glass spill caused by HLW melter failure – unmitigated (HL14) (6 MTG/day)	0.0005	6×10^{-9}	0 (7×10^{-5})	4×10^{-5}
Seismically induced LAW Vitrification Facility collapse and failure – unmitigated (LA31) (30 MTG/day)	0.0005	4×10^{-12}	0 (6×10^{-8})	1×10^{-8}
Seismically induced WTP collapse and failure – unmitigated (WT41) (6×30 MTG/day)	0.0005	1×10^{-6}	0 (0.02)	0.008
Seismically induced waste tank dome collapse – unmitigated (TK53)	0.0005	6×10^{-11}	0 (3×10^{-7})	7×10^{-8}
IHLW glass canister drop – unmitigated (SH91)	0.001	2×10^{-10}	0 (2×10^{-6})	5×10^{-7}

[a] The alphanumeric code following the accident's title (e.g., TK51) corresponds with the code in the accident's description in Section K.3.4. The term "Z × Y MTG/day," read as "Z by Y MTG/day," refers to a WTP design capacity of Z MTG/day of HLW and Y MTG/day of LAW; for example, 6 × 30, 6 × 45, 6 × 90, or 15 × 0 MTG/day.

[b] The accidents listed were analyzed because they had the highest consequences and/or risks in their category (e.g., leak, spill, mechanical impact, natural phenomena). In some instances, more than one accident is in a category to include similar accidents at different facilities. For some categories (e.g., criticality, flooding), no accidents are listed because either none are applicable or the risks of accidents in the categories are very low.

[c] Increased risk to the individual of an LCF, taking into account the probability (frequency) of the accident.

[d] The reported value is the projected number of LCFs in the population, based on the accident probability (frequency), and is therefore presented as a whole number. When the reported value is zero, the result calculated by multiplying the collective dose to the population by the risk factor (0.0006 LCFs per person-rem) is shown in parentheses.

[e] Based on populations of 451,556 and 488,897 persons residing within 80 kilometers (50 miles) of the 200-East and 200-West Areas, respectively.

Key: HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; LAW=low-activity waste; LCF=latent cancer fatality; MTG/day=metric tons of glass per day; WTP=Waste Treatment Plant.

Table K–74. Tank Closure Alternative – 2B Radiological Consequences of Accidents[a]

Accident[c, d]	Maximally Exposed Individual		Offsite Population[b]		Noninvolved Worker	
	Dose (rem)	LCF[e]	Dose (person-rem)	LCFs[f]	Dose (rem)	LCF[e]
Spray release from jumper pit during waste retrieval – unmitigated (TK51)	0.0013	8×10^{-7}	5.8	0 (0.003)	1.4	0.0008
Spray leak in transfer line during excavation – unmitigated (PT23)	0.007	4×10^{-6}	94	0 (0.06)	24	0.03
Pretreatment Facility waste feed receipt vessel or piping leak – unmitigated (PT22)	0.88	0.0005	12,000	7	2,900	1
Seismically induced failure of HLW melter feed preparation vessels – unmitigated (HL11) (6 MTG/day)	0.011	7×10^{-6}	150	0 (0.09)	33	0.04
HLW molten glass spill caused by HLW melter failure – unmitigated (HL14) (6 MTG/day)	0.019	0.00001	250	0 (0.1)	63	0.08
Seismically induced LAW Vitrification Facility collapse and failure – unmitigated (LA31) (90 MTG/day)	0.000043	3×10^{-8}	0.57	0 (0.0003)	0.13	0.00008
Seismically induced WTP collapse and failure – unmitigated (WT41) (6×90 MTG/day)	4.3	0.003	58,000	35	13,000	1
Seismically induced waste tank dome collapse – unmitigated (TK53)	0.00021	1×10^{-7}	0.96	0 (0.0006)	0.22	0.0001
IHLW glass canister drop – unmitigated (SH91)	0.00026	2×10^{-7}	3.5	0 (0.002)	0.91	0.0005

[a] The doses presented here result from accident releases of radioactive materials to the atmosphere and are from direct exposure to the plume and inhalation only. Doses from other pathways, such as consumption of foodstuffs and exposure to radioactive material deposited on the ground, are small by comparison.

[b] Based on populations of 451,556 and 488,897 persons residing within 80 kilometers (50 miles) of the 200-East and 200-West Areas, respectively.

[c] The alphanumeric code following the accident's title (e.g., TK51) corresponds with the code in the accident's description in Section K.3.4. The term "Z × Y MTG/day," read as "Z by Y MTG/day," refers to a WTP design capacity of Z MTG/day of HLW and Y MTG/day of LAW; for example, 6 × 30, 6 × 45, 6 × 90, or 15 × 0 MTG/day.

[d] The accidents listed were analyzed because they had the highest consequences and/or risks in their category (e.g., leak, spill, mechanical impact, natural phenomena). In some instances, more than one accident is in a category to include similar accidents at different facilities. For some categories (e.g., criticality, flooding), no accidents are listed because either none are applicable or the risks of accidents in the categories are very low.

[e] Increased likelihood of an LCF, assuming the accident occurs, except at high individual doses (hundreds of rem or more) where acute radiation injury may cause death within weeks. Value cannot exceed 1.

[f] The reported value is the projected number of LCFs in the population, assuming the accident occurs, and is therefore presented as a whole number. When the reported value is zero, the result calculated by multiplying the collective dose to the population by the risk factor (0.0006 LCFs per person-rem) is shown in parentheses.

Key: HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; LAW=low-activity waste; LCF=latent cancer fatality; MTG/day=metric tons of glass per day; WTP=Waste Treatment Plant.

Table K–75. Tank Closure Alternative – 2B Annual Cancer Risks from Accidents

Accident[a, b]	Frequency	Risk of LCF		
		Maximally Exposed Individual[c]	Offsite Population[d, e]	Noninvolved Worker[c]
Spray release from jumper pit during waste retrieval – unmitigated (TK51)	0.011	8×10^{-9}	0 (0.00004)	9×10^{-6}
Spray leak in transfer line during excavation – unmitigated (PT23)	0.0001	4×10^{-10}	0 (6×10^{-6})	3×10^{-6}
Pretreatment Facility waste feed receipt vessel or piping leak – unmitigated (PT22)	0.0005	3×10^{-7}	0 (0.004)	0.002
Seismically induced failure of HLW melter feed preparation vessels – unmitigated (HL11) (6 MTG/day)	0.0005	3×10^{-9}	0 (0.00005)	0.00002
HLW molten glass spill caused by HLW melter failure – unmitigated (HL14) (6 MTG/day)	0.0005	6×10^{-9}	0 (7×10^{-5})	4×10^{-5}
Seismically induced LAW Vitrification Facility collapse and failure – unmitigated (LA31) (90 MTG/day)	0.0005	1×10^{-11}	0 (2×10^{-7})	4×10^{-8}
Seismically induced WTP collapse and failure – unmitigated (WT41) (6×90 MTG/day)	0.0005	1×10^{-6}	0 (0.02)	0.008
Seismically induced waste tank dome collapse – unmitigated (TK53)	0.0005	6×10^{-11}	0 (3×10^{-7})	7×10^{-8}
IHLW glass canister drop – unmitigated (SH91)	0.001	2×10^{-10}	0 (2×10^{-6})	5×10^{-7}

a The alphanumeric code following the accident's title (e.g., TK51) corresponds with the code in the accident's description in Section K.3.4. The term "Z × Y MTG/day," read as "Z by Y MTG/day," refers to a WTP design capacity of Z MTG/day of HLW and Y MTG/day of LAW; for example, 6 × 30, 6 × 45, 6 × 90, or 15 × 0 MTG/day.

b The accidents listed were analyzed because they had the highest consequences and/or risks in their category (e.g., leak, spill, mechanical impact, natural phenomena). In some instances, more than one accident is in a category to include similar accidents at different facilities. For some categories (e.g., criticality, flooding), no accidents are listed because either none are applicable or the risks of accidents in the categories are very low.

c Increased risk to the individual of an LCF, taking into account the probability (frequency) of the accident.

d The reported value is the projected number of LCFs in the population, based on the accident probability (frequency), and is therefore presented as a whole number. When the reported value is zero, the result calculated by multiplying the collective dose to the population by the risk factor (0.0006 LCFs per person-rem) is shown in parentheses.

e Based on populations of 451,556 and 488,897 persons residing within 80 kilometers (50 miles) of the 200-East and 200-West Areas, respectively.

Key: HLW=high-level radioactive waste; IHLW=immobilized high-level radioactive waste; LAW=low-activity waste; LCF=latent cancer fatality; MTG/day=metric tons of glass per day; WTP=Waste Treatment Plant.