APPENDIX C
EVALUATION OF HUMAN HEALTH EFFECTS FROM NORMAL OPERATIONS

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EVALUATION OF HUMAN HEALTH EFFECTS FROM NORMAL OPERATIONS

C.1 Introduction

This appendix presents detailed information on the potential impacts on humans associated with incident-free (normal) releases of radioactivity from the facilities proposed in this *Draft Surplus Plutonium Disposition Supplemental Environmental Impact Statement (SPD Supplemental EIS)* to be used for the disposition of surplus plutonium. This information supports the human health risk assessments described in Chapter 4, Section 4.1.2, of this *SPD Supplemental EIS*. Site-specific input data used in the evaluation of these human health impacts are provided or referenced, as appropriate. Resulting impacts can be compared to criteria invoked in U.S. Department of Energy (DOE) Order 458.1 for protection of the public (10 millirem per year from airborne pathways and 100 millirem per year total from all pathways); and Title 10 of the *Code of Federal Regulations* (CFR), Part 835, for protection of workers at Savannah River Site (SRS) and Los Alamos National Laboratory (LANL) (5,000 millirem per year).

C.2 Assessment Approach

The dose assessments performed for this *SPD Supplemental EIS* were based on site-specific environmental data, facility-specific data, and assumptions related to various exposure parameters. Appendix F, Section F.10, of the S*urplus Plutonium Disposition Final Environmental Impact Statement (SPD EIS)* (DOE 1999) describes the methods that were used for the assessments for this *SPD Supplemental EIS*. The GENII Version 2 (GENII Environmental Dosimetry System, Version 2] computer code (Version 2.10) was used to calculate the projected doses from normal operations at SRS and LANL. The GENII computer code was developed under quality assurance plans based on the American National Standards Institute Standard NQA-1, is one of the toolbox models that meets DOE Order 414.1C, and is overseen by DOE's Office of Quality Assurance Policy and Assistance. All steps of code development were documented and tested, and hand calculations verified the code's implementation of major transport and exposure pathways for a subset of the radionuclide library. The code was reviewed by the U.S. Environmental Protection Agency (EPA) Science Advisory Board and a separate, EPA-sponsored, independent peer review panel. The quality assurance of GENII Version 2 has been reviewed by DOE (DOE 2003c) and continues to be rigorously reviewed with each updated version released by Pacific Northwest National Laboratory, the developer of the code.

C.2.1 Meteorological Data

The meteorological data used in the SRS and LANL dose assessments were created from joint frequency distribution (JFD) files. A JFD file is a table listing the percentage of time the wind blows in a certain direction, within a certain range of speeds, and within a certain stability class. JFD data for SRS were based on measurements taken at the nearby Vogtle Nuclear Power Plant over a 5-year period (1998 through 2002) at a height of 33 feet (10 meters); JFD data for LANL were based on measurements taken at Technical Area 6 (TA-6) over a 9-year period (1991 through 1999) at a height of 36.7 feet (11.2 meters). Average annual rainfall, meteorological station parameters, and windspeed midpoints were used in the normal operational assessments. **Tables C–1** and **C–2** present the JFD data used in the SRS and LANL analyses.

Table C–1 Savannah River Site Joint Frequency Distribution Data

Average Wind-speed (m/s)	*Stability Class*	*Direction in Which the Wind Blows*															
		S	***SSW***	***SW***	***WSW***	***W***	***WNW***	***NW***	***NNW***	***N***	***NNE***	***NE***	***ENE***	***E***	***ESE***	***SE***	***SSE***
Vogtle Nuclear Power Plant: 10-Meter Height, Based on 1998 through 2002 Meteorological Data																	
0.94	A	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.01
	B	0.01	0	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0	0.01	0	0.01	0	0	0
	C	0.01	0.03	0	0.02	0.02	0.02	0.03	0.02	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.02
	D	0.17	0.18	0.17	0.12	0.18	0.14	0.13	0.17	0.17	0.15	0.18	0.18	0.14	0.15	0.15	0.13
	E	0.28	0.29	0.29	0.3	0.34	0.36	0.37	0.44	0.64	0.41	0.48	0.46	0.41	0.31	0.31	0.19
	F	0.25	0.29	0.28	0.29	0.42	0.35	0.32	0.33	0.45	0.45	0.42	0.49	0.5	0.32	0.23	0.18
	G	0.4	0.27	0.41	0.37	0.44	0.46	0.3	0.32	0.28	0.42	0.55	0.64	0.61	0.39	0.33	0.37
1.66	A	0.02	0.05	0.02	0.03	0.04	0.04	0.02	0.02	0.06	0.04	0.05	0.06	0.04	0.02	0.03	0.01
	B	0.03	0.04	0.03	0.03	0.01	0.03	0.03	0.05	0.03	0.04	0.05	0.02	0.02	0.02	0.02	0.03
	C	0.07	0.03	0.03	0.04	0.06	0.04	0.05	0.03	0.08	0.06	0.06	0.06	0.08	0.06	0.05	0.04
	D	0.36	0.28	0.26	0.26	0.28	0.19	0.22	0.27	0.32	0.25	0.33	0.37	0.33	0.31	0.26	0.27
	E	0.26	0.26	0.32	0.39	0.41	0.48	0.49	0.71	0.68	0.55	0.68	0.66	0.41	0.33	0.3	0.22
	F	0.18	0.13	0.18	0.24	0.33	0.31	0.32	0.3	0.39	0.38	0.66	0.65	0.42	0.33	0.19	0.16
	G	0.13	0.04	0.07	0.18	0.24	0.15	0.14	0.11	0.14	0.3	0.54	0.49	0.41	0.17	0.07	0.1
2.35	A	0.07	0.09	0.08	0.15	0.15	0.12	0.1	0.07	0.09	0.13	0.13	0.14	0.16	0.06	0.04	0.05
	B	0.07	0.07	0.08	0.11	0.09	0.06	0.05	0.04	0.07	0.11	0.11	0.12	0.13	0.06	0.06	0.08
	C	0.15	0.15	0.12	0.15	0.11	0.11	0.09	0.07	0.15	0.13	0.15	0.19	0.22	0.12	0.14	0.15
	D	0.71	0.58	0.67	0.62	0.57	0.36	0.27	0.41	0.52	0.5	0.57	0.61	0.57	0.46	0.46	0.51
	E	0.34	0.46	0.71	0.68	0.73	0.58	0.63	0.72	0.62	0.62	0.74	0.6	0.59	0.45	0.31	0.3
	F	0.14	0.15	0.24	0.38	0.29	0.18	0.14	0.18	0.14	0.24	0.27	0.29	0.16	0.13	0.08	0.09
	G	0.04	0.03	0.03	0.08	0.07	0.04	0.04	0.04	0.06	0.11	0.17	0.13	0.12	0.04	0.01	0.05
3.30	A	0.11	0.07	0.08	0.17	0.24	0.13	0.09	0.05	0.1	0.17	0.2	0.25	0.21	0.13	0.1	0.11
	B	0.1	0.07	0.08	0.09	0.09	0.04	0.03	0.04	0.05	0.11	0.12	0.1	0.14	0.11	0.09	0.14
	C	0.16	0.13	0.14	0.16	0.18	0.1	0.07	0.08	0.1	0.17	0.21	0.17	0.22	0.09	0.12	0.16
	D	0.4	0.45	0.8	0.71	0.39	0.23	0.32	0.25	0.26	0.42	0.43	0.43	0.51	0.46	0.24	0.33
	E	0.25	0.29	0.53	0.44	0.27	0.18	0.34	0.24	0.18	0.29	0.39	0.2	0.37	0.35	0.17	0.16
	F	0.05	0.05	0.06	0.09	0.02	0.01	0.01	0.02	0.01	0.04	0.02	0	0.02	0.01	0.01	0.03
	G	0.01	0	0	0	0	0	0.01	0	0	0.02	0	0	0	0	0	0
4.35	A	0.06	0.04	0.13	0.15	0.1	0.03	0.03	0.04	0.04	0.08	0.11	0.18	0.19	0.1	0.06	0.03
	B	0.07	0.03	0.05	0.09	0.08	0.03	0.03	0.01	0.03	0.04	0.08	0.08	0.11	0.09	0.03	0.04
	C	0.07	0.07	0.06	0.13	0.1	0.03	0.04	0.03	0.04	0.07	0.13	0.1	0.15	0.09	0.06	0.03
	D	0.22	0.13	0.54	0.48	0.21	0.1	0.12	0.16	0.11	0.16	0.21	0.24	0.37	0.29	0.11	0.12
	E	0.05	0.06	0.23	0.17	0.09	0.06	0.11	0.06	0.05	0.11	0.11	0.06	0.12	0.16	0.08	0.04
	F	0	0.02	0.02	0.01	0	0	0	0	0	0	0	0	0.01	0.02	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.87	A	0.01	0.03	0.03	0.07	0.02	0	0.01	0.01	0.01	0.03	0.05	0.06	0.05	0.04	0.04	0
	B	0.01	0.02	0.02	0.05	0.02	0.01	0	0	0.01	0.02	0.05	0.05	0.05	0.08	0.03	0.01
	C	0.01	0.01	0.03	0.04	0	0	0.01	0.03	0.01	0.02	0.05	0.05	0.1	0.11	0.04	0
	D	0.06	0.08	0.16	0.22	0.05	0.02	0.1	0.04	0.02	0.09	0.1	0.13	0.21	0.21	0.08	0.04
	E	0.03	0.03	0.06	0.1	0.05	0.03	0.02	0.02	0.02	0.04	0.03	0.02	0.03	0.07	0.02	0.02
	F	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0.01	0	0
	G	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0	0	0

m/s = meters per second.
Note: To convert meters per second to miles per hour, multiply by 2.237; meters to feet, by 3.2808.

Table C–2 Los Alamos National Laboratory Joint Frequency Distribution Data

Average Wind-speed (m/s)	*Stability Class*	*Direction in Which the Wind Blows*															
		S	***SSW***	***SW***	***WSW***	***W***	***WNW***	***NW***	***NNW***	***N***	***NNE***	***NE***	***ENE***	***E***	***ESE***	***SE***	***SSE***
Technical Area 6: 11.2-Meter Height, Based on 1991 through 1999 Meteorological Data																	
0.78	A	0.11	0.2	0.42	0.73	0.83	0.69	0.75	0.59	0.33	0.17	0.11	0.06	0.06	0.06	0.07	0.07
	B	0.03	0.07	0.13	0.2	0.19	0.13	0.13	0.14	0.11	0.06	0.04	0.02	0.02	0.02	0.02	0.02
	C	0.07	0.14	0.16	0.21	0.23	0.14	0.11	0.16	0.19	0.13	0.07	0.04	0.03	0.03	0.03	0.04
	D	0.75	0.63	0.51	0.39	0.4	0.36	0.36	0.48	0.77	0.78	0.7	0.57	0.52	0.49	0.62	0.65
	E	0.4	0.24	0.15	0.08	0.07	0.08	0.09	0.13	0.24	0.39	0.47	0.41	0.33	0.33	0.41	0.45
	F	0.36	0.2	0.12	0.04	0.05	0.05	0.06	0.07	0.12	0.21	0.39	0.49	0.69	0.61	0.64	0.48
2.45	A	0.07	0.1	0.26	0.4	0.53	0.79	1.16	1.14	0.63	0.22	0.11	0.07	0.07	0.06	0.08	0.07
	B	0.06	0.13	0.32	0.38	0.4	0.43	0.53	0.96	0.82	0.36	0.16	0.1	0.07	0.07	0.09	0.07
	C	0.15	0.42	0.57	0.43	0.51	0.44	0.28	0.98	1.73	0.9	0.47	0.26	0.18	0.16	0.23	0.12
	D	0.92	0.89	0.47	0.17	0.22	0.23	0.13	0.45	1.49	2.51	2.39	1.58	1.32	1.31	1.67	0.93
	E	0.29	0.12	0.05	0.01	0.01	0.02	0.02	0.04	0.14	0.45	0.97	1.86	1.5	1.23	2.66	0.84
	F	0.11	0.04	0	0	0	0	0.01	0.01	0.03	0.04	0.14	0.76	3.12	3.3	1.15	0.3
4.47	A	0.01	0	0	0	0	0	0.01	0.02	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01
	B	0.02	0.02	0.02	0	0	0	0.03	0.16	0.33	0.25	0.18	0.08	0.03	0.02	0.05	0.04
	C	0.06	0.2	0.16	0.02	0.01	0.02	0.03	0.56	1.55	1.01	0.62	0.63	0.38	0.27	0.36	0.08
	D	0.07	0.23	0.05	0.01	0.01	0.01	0	0.11	0.25	0.63	0.61	0.75	1.62	1.74	0.86	0.1
	E	0	0	0	0	0	0	0	0	0	0	0.01	0.03	0.2	0.45	0.05	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0.11	0.18	0	0
6.93	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	0.01	0.01	0	0	0	0	0
	C	0	0.01	0	0	0	0	0	0.01	0.04	0.06	0.05	0.06	0.02	0.02	0.03	0
	D	0.01	0.04	0	0	0	0	0	0.02	0.06	0.16	0.15	0.33	0.88	1.1	0.22	0.01
	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
9.61	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	0.01	0.02	0.12	0.29	0.03	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

m/s = meters per second.
Note: To convert meters per second to miles per hour, multiply by 2.237; meters to feet, by 3.2808.

C.2.2 Population Data

The SRS and LANL population distributions were based on data from the 2010 census (Census 2011) for areas within 50 miles (80 kilometers) of the locations for the proposed facilities. The 2010 populations derived from the census were projected to the year 2020, which was selected as the representative year for full-scale operations, by calculating a linear trend developed using data from the 1990, 2000, and 2010 decennial censuses (Census 1990, 2001, 2011). The populations were spatially distributed on a circular grid with 16 directions and 10 radial distances out to 50 miles (80 kilometers). The grids were centered in F-Area, K-Area, and H-Canyon/S-Area, the locations from which radionuclides were assumed to be released during incident-free operations at SRS, and in TA-55 (the location of the Plutonium Facility [PF-4]) at LANL. During the population distribution allocation process, those individuals who were geographically situated within a sector that was entirely on SRS or LANL property were moved (for the analysis) to an adjoining sector to ensure that no individuals were assessed as if they were living on DOE property. **Tables C–3**, **C–4**, **C–5,** and **C–6** present the population data used for the dose assessments.

Table C–3 Estimated Population Surrounding the Savannah River Site F-Area in the Year 2020

Direction	Distance (miles)									
	0–1	***1–2***	***2–3***	***3–4***	***4–5***	***5–10***	***10–20***	***20–30***	***30–40***	***40–50***
NNE	0	0	0	0	0	656	4,800	3,518	7,694	42,519
NE	0	0	0	0	0	83	3,061	3,636	7,593	29,767
ENE	0	0	0	0	0	0	3,751	4,703	5,559	36,655
E	0	0	0	0	0	0	4,179	5,841	10,017	7,181
ESE	0	0	0	0	0	0	3,827	3,897	2,222	3,072
SE	0	0	0	0	0	0	847	2,813	5,720	11,984
SSE	0	0	0	0	0	0	540	696	1,641	4,168
S	0	0	0	0	0	0	561	1,520	6,420	5,071
SSW	0	0	0	0	0	0	849	2,389	4,894	3,053
SW	0	0	0	0	0	129	1,511	6,768	2,023	2,042
WSW	0	0	0	0	0	185	2,370	4,786	2,493	6,240
W	0	0	0	0	0	417	8,852	15,191	6,868	8,114
WNW	0	0	0	0	0	1,810	6,446	162,172	76,799	17,746
NW	0	0	0	0	0	1,432	18,907	99,702	28,091	4,320
NNW	0	0	0	0	0	1,701	30,484	17,430	12,366	3,588
N	0	0	0	0	0	2,599	35,691	11,508	8,609	11,894
Total Population										**868,681**

Note: Centered on 33.2865 degrees latitude, 81.6776 degrees longitude; to convert miles to kilometers, multiply by 1.6093.
Source: Census 1990, 2001, 2011.

Table C–4 Estimated Population Surrounding the Savannah River Site K-Area in the Year 2020

Direction	Distance (miles)									
	0–1	***1–2***	***2–3***	***3–4***	***4–5***	***5–10***	***10–20***	***20–30***	***30–40***	***40–50***
NNE	0	0	0	0	0	0	2,902	4,316	6,368	21,981
NE	0	0	0	0	0	0	2,615	4,595	4,887	15,086
ENE	0	0	0	0	0	0	3,025	6,005	7,184	25,043
E	0	0	0	0	0	0	6,221	4,117	6,807	4,402
ESE	0	0	0	0	0	70	1,377	3,243	3,169	4,542
SE	0	0	0	0	0	101	573	3,255	6,388	9,070
SSE	0	0	0	0	0	137	437	789	2,642	2,842
S	0	0	0	0	0	105	735	2,577	6,685	7,785
SSW	0	0	0	0	0	130	1,458	2,140	3,934	5,861
SW	0	0	0	0	0	195	1,111	2,202	1,973	2,369
WSW	0	0	0	0	0	255	2,676	7,619	1,830	6,902
W	0	0	0	0	0	199	2,871	5,430	5,251	5,888
WNW	0	0	0	0	0	168	5,136	74,953	46,827	17,351
NW	0	0	0	0	0	102	5,820	126,058	128,104	7,723
NNW	0	0	0	0	0	0	9,829	44,403	16,769	7,836
N	0	0	0	0	0	0	12,539	40,535	7,792	15,063
Total Population										**809,378**

Note: Centered on 33.2113 degrees latitude, 81.6648 degrees longitude; to convert miles to kilometers, multiply by 1.6093.
Source: Census 1990, 2001, 2011.

Table C–5 Estimated Population Surrounding the Savannah River Site H-Canyon/S-Area in the Year 2020

Direction	Distance (miles)									
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50
NNE	0	0	0	0	0	540	3,856	3,583	8,771	49,916
NE	0	0	0	0	0	106	3,071	3,576	7,862	29,112
ENE	0	0	0	0	0	0	4,461	4,026	6,763	46,879
E	0	0	0	0	0	90	5,025	5,504	9,170	6,300
ESE	0	0	0	0	0	95	5,214	2,923	2,358	3,069
SE	0	0	0	0	0	0	1,207	3,931	5,313	11,442
SSE	0	0	0	0	0	0	531	790	2,003	4,788
S	0	0	0	0	0	0	576	1,028	6,318	4,899
SSW	0	0	0	0	0	0	639	2,573	4,883	3,089
SW	0	0	0	0	0	29	1,152	4,688	2,343	1,963
WSW	0	0	0	0	0	24	1,623	7,431	2,512	6,110
W	0	0	0	0	0	211	5,205	20,875	7,684	8,718
WNW	0	0	0	0	0	1,542	4,871	154,496	116,020	15,646
NW	0	0	0	0	0	910	14,490	77,733	27,595	3,876
NNW	0	0	0	0	0	2,460	41,140	22,390	13,315	4,999
N	0	0	0	0	0	1,051	14,991	9,559	7,835	14,500
Total Population										**886,267**

Note: Centered on 33.2913 degrees latitude, 81.6403 degrees longitude; to convert miles to kilometers, multiply by 1.6093.
Source: Census 1990, 2001, 2011.

Table C–6 Estimated Population Surrounding the Los Alamos National Laboratory Plutonium Facility in the Year 2020

Direction	Distance (miles)									
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50
NNE	21	1,114	762	130	0	120	997	1,658	364	249
NE	7	302	888	593	101	396	6,077	6,108	1,644	3,724
ENE	0	0	363	247	37	295	19,447	4,459	2,442	3,801
E	0	0	58	26	31	327	6,413	2,883	1,259	1,944
ESE	0	4	0	10	18	5,611	2,607	51,893	2,926	3,003
SE	0	0	0	0	0	444	2,155	65,473	8,134	552
SSE	0	0	0	0	3	73	927	1,657	1,403	878
S	0	0	0	0	3	31	755	3,230	2,016	9,380
SSW	0	0	0	1	4	32	488	2,704	14,870	142,556
SW	0	0	0	1	2	36	153	880	2,867	32,582
WSW	0	0	0	0	1	36	209	809	1,493	274
W	0	0	0	0	0	62	292	457	416	769
WNW	0	0	30	0	0	56	249	269	1,567	341
NW	0	898	1,610	21	0	32	125	153	155	181
NNW	11	1,158	1,960	229	0	49	157	198	140	159
N	84	782	857	52	0	73	421	485	385	187
Total Population										**447,541**

Note: Centered on 35.8817 degrees latitude, 106.2983 degrees longitude; to convert miles to kilometers, multiply by 1.6093.
Source: Census 1990, 2001, 2011.

C.2.3 Agricultural Data

Ingestion exposures from atmospheric transport include ingestion of farm products and inadvertent ingestion of soil. Farm products include leafy vegetables, other vegetables, cereal grains, fruit, cow's milk, beef, poultry, and eggs. The concentration in plants at the time of harvest was evaluated as the sum of contributions from deposition onto plant surfaces, as well as uptake through the roots. Pathways by which animal products may become contaminated include animal ingestion of contaminated plants, water, and soil. The human consumption rates used in the dose assessments for the maximally exposed individual (MEI) and average exposed individual in the surrounding population were those provided in U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109, *Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR 50,* Appendix I (NRC 1977).

C.2.4 Source Term Data

Table C–7 presents the stack parameters for SRS and LANL facilities. Stack heights and release locations were provided in the responses to the facility data requests supporting this *SPD Supplemental EIS* (DOE/NNSA 2012; LANL 2012; SRNS 2012; WSRC 2008), and the *SPD EIS* (DOE 1999).

Table C–7 Stack Parameters

Stack Parameter	*KIS*	*PDC*	*Immobilization Capability*	*H-Canyon/ HB-Line*	*MFFF* [a]	*PDCF*	*WSB*	*LANL PF-4*
Height (meters)	15.2	24.4	28.0	59.4	36.6	36.6	15.2	9.5
Area (square meters)	0.073	4.7	3.6	14.9	5.3	5.9	1.8	0.679

KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; WSB = Waste Solidification Building.

[a] The same stack would be used for potential releases from fuel fabrication activities at MFFF as well as potential releases from metal oxidation furnaces if they are installed at MFFF.

Note: To convert meters to feet, multiply by 3.2808; square meters to square feet, by 10.764

Source: DOE 1999; DOE/NNSA 2012; LANL 2012; SRNS 2012; WSRC 2008.

Tables C–8 through **C–14,** respectively, present the estimated incident-free radiological releases, based on plutonium-239 dose equivalents, associated with operations at the following SRS facilities: K-Area Interim Surveillance (KIS), the K-Area immobilization capability, H-Canyon/HB-Line processing to the Defense Waste Processing Facility (DWPF), the Mixed Oxide Fuel Fabrication Facility (MFFF) at F-Area, the Pit Disassembly and Conversion Facility (PDCF) at F-Area and the Pit Disassembly and Conversion Project (PDC) at K-Area, the Waste Solidification Building (WSB) at F-Area, and metal oxidation at MFFF. **Table C-15** presents estimated incident-free radiological releases from pit disassembly and conversion activities at LANL's PF-4. Plutonium-equivalent source term estimates were derived using Federal Guidance Report 13 (EPA 1999) dose factors. The source terms were either provided directly or derived from empirical source term data conveyed in responses to facility data requests supporting this *SPD Supplemental EIS* (DOE/NNSA 2012; SRNS 2012; LANL 2012) and the *SPD EIS* (DOE 1999). Source terms were not provided in the data responses for some of the H-Canyon/HB-Line activities addressed in this *SPD Supplemental EIS* (i.e., processing plutonium metal to an oxide for transfer to MFFF, processing non-pit plutonium for disposal at WIPP, and processing non-pit plutonium for fabrication into MOX fuel at MFFF); rather, dose estimates were provided.

Table C–8 Annual Radiological Releases from K-Area Interim Surveillance Capability Activities

Isotope (curies per year)	*All Alternatives*
Plutonium-239 dose equivalent	1.6×10^{-7}

Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999).

Source: SRNS 2012.

Table C–9 Annual Radiological Releases from the Immobilization Capability

Isotope (curies per year)	*Immobilization to DWPF Alternative*
Plutonium-239 dose equivalent	1.8×10^{-6}

DWPF = Defense Waste Processing Facility.
Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999). To convert metric tons to tons, multiply by 1.1023.
Source: SRNS 2012.

Table C–10 Annual Radiological Releases from H-Canyon/HB-Line Processing of Surplus Plutonium to the Defense Waste Processing Facility

Isotope (curies per year)	*H-Canyon/HB-Line to DWPF Alternative*
Plutonium-239 dose equivalent	1.2×10^{-5}

DWPF = Defense Waste Processing Facility.
Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999). To convert metric tons to tons, multiply by 1.1023.
Source: SRNS 2012; WSRC 2008.

Table C–11 Annual Radiological Releases from the Mixed Oxide Fuel Fabrication Facility

Isotope (curies per year)	*Alternative*		
	No Action and Immobilization to DWPF Alternatives	*H-Canyon/HB-Line to DWPF and WIPP Alternatives*	*MOX Fuel Alternative*
Plutonium-239 dose equivalent	1.0×10^{-4}	1.1×10^{-4}	1.2×10^{-4}

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.
Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999). To convert metric tons to tons, multiply by 1.1023.
Source: SRNS 2012; WSRC 2008.

Table C–12 Annual Radiological Releases from the Pit Disassembly and Conversion Facility and the Pit Disassembly and Conversion Project at K-Area

Isotope (curies per year)	*Alternative*	
	PDCF (All Alternatives)	*PDC at K-Area (MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives)*
Plutonium-239 dose equivalent	3.1×10^{-3}	4.0×10^{-3}

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; WIPP = Waste Isolation Pilot Plant.
Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999).
Source: SRNS 2012.

Table C–13 Annual Radiological Releases from the Waste Solidification Building

Isotope (curies per year)	*All Alternatives*
Plutonium-239 dose equivalent	9.3×10^{-5}

Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999).
Source: SRNS 2012.

Table C–14 Annual Radiological Releases from Metal Oxidation at the Mixed Oxide Fuel Fabrication Facility

Isotope (curies per year)	*Alternative*
	Immobilization to DWPF, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives
Plutonium-239 dose equivalent	8.3×10^{-4}

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.
Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999).
Source: SRNS 2011a.

Table C–15 Annual Radiological Releases from Pit Disassembly and Conversion Activities at the Los Alamos National Laboratory Plutonium Facility

Isotope (curies per year)	*Alternative*	
	No Action, Immobilization to DWPF, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives (process 2 metric tons)	***Immobilization to DWPF, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives (process 35 metric tons)***
Plutonium-239 dose equivalent	2.4×10^{-4}	2.0×10^{-3}

DWPF = Defense Waste Processing Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.
Note: Radionuclide releases converted to a plutonium-239-dose-equivalent release using Federal Guidance Report 13 dose factors (EPA 1999). To convert metric tons to tons, multiply by 1.1023.
Source: LANL 2012.

Because activities associated with the K-Area storage only involve receipt, storage, and shipping of materials within certified shipping containers, no airborne radiological emissions would result from these activities.

Under the H-Canyon/HB-Line to DWPF Alternative, DWPF would vitrify surplus plutonium dissolved at H-Canyon/HB-Line with liquid high-level radioactive waste (HLW). Filled canisters of vitrified HLW would be stored at the S-Area Glass Waste Storage Buildings pending their ultimate disposition. It was estimated that the additional production would require an increase in DWPF operations by a range of 2 weeks to 3 months. The plutonium mixed with the HLW would not add any significant contribution to the DWPF normal release source term. Similarly, no plutonium would be released from the can-in-canisters containing immobilized plutonium that would be vitrified at DWPF under the Immobilization to DWPF Alternative. Therefore, no incremental increases in normal releases or impacts on onsite or offsite receptors from DWPF or the Glass Waste Storage Buildings are expected (SRNS 2012; WSRC 2008).

C.2.5 Other Calculation Assumptions

To estimate the radiological impacts of incident-free operation of the plutonium facilities at SRS and LANL, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977):

- Receptors were assumed to be exposed to radioactive material deposited on the ground from facility emissions. Exposure pathways include direct exposure, inhalation, and translocation through the food chain.
- The annual external exposure time to the plume and soil contamination was assumed to be 0.7 years for the MEI.
- The annual external exposure time to the plume and soil contamination was assumed to be 0.5 years for the population.
- The annual inhalation exposure time to the plume was assumed to be 1 year for the MEI and general population.
- The exposed individual and population were assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of adult humans.
- A finite plume (i.e., Gaussian) model was assumed for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of animal products.
- The calculated doses were assumed to be 50-year committed effective doses from 1 year of intake.

In addition to the calculation assumptions listed above, a risk estimator of 0.0006 latent cancer deaths per rem or person-rem (600 cancer deaths per 1 million rem or person-rem) received by workers or members of the public was used in the impact assessments (DOE 2003a).

C.3 Savannah River Site

The following subsections present the potential incident-free radiological impacts that could occur from each of the separate facilities/processes at SRS. Human health risks from construction and normal operations were evaluated for several individual and population groups, including facility workers, a hypothetical MEI at the site boundary, and the regional population.

For the purposes of this *SPD Supplemental EIS*, a worker is a facility worker who is directly or indirectly involved with operations at a facility and might receive an occupational radiation exposure due to direct radiation (neutron, x-ray, beta, or gamma) or through radionuclides released as a part of normal operations. Direct radiation exposure from plutonium materials or contaminants in the material (e.g., americium-241) and residual amounts of similar material (contamination) within the facility would dominate the potential occupational exposure to onsite workers. Noninvolved workers outside of the facility would not be subject to direct radiation exposure due to building shielding and appreciable distances between operational facilities, but could be exposed to operational releases.

Workers at SRS may receive radiation doses slightly above those received by an individual at an offsite location. The 5-year average dose measured using thermoluminescent dosimeters near the burial grounds at the center of the site (E-Area) was 123 millirem; the 5-year average dose at an offsite control location (Highway 301) was 85 millirem. Because the onsite location is near active radioactive waste management operations, the dose may be conservatively high and not representative of other locations at the site. The 5-year average dose at another onsite monitoring location (D-Area) was 74 millirem, lower than the offsite location (SRNS 2009, 2010, 2011b; WSRC 2007, 2008). This implies that there could be no significant difference between doses at onsite and offsite locations. Using the higher onsite location as a basis and adjusting the doses for a 2080-hour work-year, a worker could receive an annual dose of about 9 millirem from being employed at SRS. A 9 millirem dose is an increase of about 3 percent over the average annual dose one would receive from all sources of natural background radiation. The additional dose results in an increased annual risk of a latent fatal cancer of 5×10^{-6} or 1 chance in 200,000.

For this *SPD Supplemental EIS*, all of the materials released due to plutonium operations would be hydrogen-3 (tritium) and particulates (primarily plutonium isotopes and americium-241) that would be released through tall stacks. Particulates would be filtered though high-efficiency particulate air filters, sand filters, or both, before being released. These filter systems are designed to protect the onsite workforce and the public from normal and accidental releases. Normal releases are very small—in the microcurie to millicurie-per-year range in most cases. Monitoring results for SRS are reported in the annual site environmental reports, which indicate that the doses to the onsite populations are primarily from natural background radiation. During some past operations periods, airborne releases from reactor and used fuel operations have occurred, including releases of tritium, noble gases, iodine, and fission products. During recent operations, airborne releases of tritium from tritium operations and fission products from used fuel processing have occurred. As indicated in the annual site environmental reports, normal concentrations of plutonium in the air are very small and are at a level similar to those in other parts of the country.

Radiation Basics

What is radiation? Radiation is energy emitted from unstable (radioactive) atoms in the form of atomic particles or electromagnetic waves. This type of radiation is also known as ionizing radiation because it can produce charged particles (ions) in matter.

What is radioactivity? Radioactivity is produced by the process of radioactive atoms trying to become stable, a process termed "decay." Radiation is emitted in the process. In the United States, radioactivity is commonly measured in units called curies, where 1 curie is equal to 3.7×10^{10} disintegrations (decay transformations) per second. Internationally, radioactivity is generally measured in units called becquerels, where 1 becquerel is equal to 1 disintegration per second (1 curie = 3.7×10^{10} becquerels).

What is radioactive material? Radioactive material is any material containing unstable atoms that emit radiation.

What are the four basic types of ionizing radiation?

Alpha particles — Alpha particles consist of two protons and two neutrons. They can travel only a few centimeters in air and can be stopped easily by a sheet of paper or by the skin's surface.

Beta particles — Beta particles are smaller and lighter than alpha particles and have the mass of a single electron. 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 rays — Gamma rays (and x-rays), unlike alpha or beta particles, are waves of pure energy. Gamma radiation is very penetrating and can travel several hundred feet in the air. Gamma radiation requires a thick wall of concrete, lead, or steel to stop it.

Neutrons — A neutron is an atomic particle that has about one-quarter the weight of an alpha particle. Like gamma radiation, it can easily travel several hundred feet in the air. Neutron radiation is most effectively stopped by materials with high hydrogen content, such as water or plastic.

What are the sources of radiation?

Natural sources of radiation — Sources include cosmic radiation from the sun and outer space; natural radioactive elements in the Earth's crust; natural radioactive elements in the human body; and radon gas from the radioactive decay of uranium that is naturally present in the soil.

Manmade sources of radiation — Sources include medical radiation (x-rays, medical isotopes); consumer products (TVs, luminous dial watches, smoke detectors); nuclear technology (nuclear power plants, industrial x-ray machines); and fallout from past worldwide nuclear weapons tests or accidents (such as at the Chernobyl nuclear plant in Ukraine).

What is radiation dose? Radiation dose is the amount of energy in the form of ionizing radiation absorbed per unit mass of any material. For people, radiation dose is the amount of energy absorbed in human tissue. In the United States, radiation dose is commonly measured in units called rads or rem; a smaller fraction of the rem is the millirem (1/1,000 of 1 rem). Internationally, radiation dose is generally measured in units called sieverts, where 1 rem = 0.01 sievert.

Person-rem (or person-sievert) is a unit of collective radiation dose applied to populations or groups of individuals; it is the sum of the doses received by all the individuals of a specified population.

What is the average annual radiation dose from natural and manmade sources? Globally, humans are exposed constantly to radiation from the solar system and the Earth's rocks and soil. This natural 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. The average individual in the United States annually receives about 625 millirem of radiation dose from all background sources, of which about half is received from natural sources such as cosmic and terrestrial radiation and radon-220 and -222 in homes. Most of the remaining radiation dose is received from diagnostic x-rays and nuclear medicine (NCRP 2009).

What are the effects of radiation on humans? Radiation can cause a variety of adverse health effects in humans. Health impacts of radiation exposure, whether from external or internal sources, generally are identified as somatic (i.e., affecting the exposed individual) or genetic (i.e., affecting descendants of the exposed individual). Radiation is more likely to produce somatic than genetic effects. The somatic risks of most importance are induced cancers. Except for leukemia, which can have an induction period (time between exposure to the carcinogen and cancer diagnosis) of as little as 2 to 7 years, most cancers have an induction period of more than 20 years.

For uniform irradiation of the body, cancer incidence varies among organs and tissues; the thyroid and skin demonstrate a greater sensitivity than other organs. Such cancers, however, also produce relatively low mortality rates because they are relatively amenable to medical treatment. Because fatal cancer is the most serious effect of environmental and occupational radiation exposures, estimates of cancer fatalities, rather than cancer incidence, are herein presented. These estimates are referred to as "latent cancer fatalities" (LCFs) because the cancer may take many years to develop.

Numerical fatal cancer estimates presented herein were obtained using a linear no-threshold (LNT) extrapolation from the nominal risk estimated for lifetime total cancer mortality that results from a large dose of radiation. Use of the LNT approach is the basis for current radiation protection regulations to protect the public and workers. According to the LNT extrapolation, if a certain radiation dose has an associated risk of a cancer, one-tenth of that dose would have one-tenth of the risk. Thus, the cancer risk is not 0, however small the dose. In accordance with DOE guidance, a risk factor of 0.0006 LCFs per rem was used in this *SPD Supplemental EIS* as the conversion factor for all radiological exposures up to 20 rem per individual. A risk factor of 0.0012 was used for individual doses of 20 rem or greater.

How certain are estimates of cancer risk from radiation? There is considerable uncertainty about cancer risks associated with low doses of radiation (i.e., doses well below 10 rem [0.1 sievert]), as well as with the assumption of a linear extrapolation of cancer risk at these low doses.

A number of radiation health scientists and organizations, such as the Health Physics Society, the United Nations Scientific Committee on Effects of Atomic Radiation, the National Council on Radiation Protection and Measurements, the French Academy of Medicine, and the French Academy of Sciences, have expressed reservations that the currently used cancer risk conversion factors, which are based on epidemiological studies at high doses (i.e., doses exceeding 5 to 10 rem), may not apply at low doses. These organizations suggest the effects of small doses are overstated and may in fact not result in any adverse health effects. One of the reasons they cite is the body's natural ability to repair itself from low levels of radiation by stimulating cell repair mechanisms.

As indicated by the results for the offsite MEI, the annual potential doses from normal releases (on the order of 0.01 millirem) are small fractions (approximately 0.003 percent) of the natural background radiation dose of 311 millirem per year (see Chapter 3, Section 3.1.6.1). A conservative estimate of the dose to a noninvolved onsite SRS worker was calculated using the GENII Version 2 computer code. Assuming no shielding, a location 1,000 meters (3,300 feet) from the SRS facility that would result in the highest offsite MEI dose, and 2,080 hours per year of exposure, the noninvolved worker would receive an incremental annual dose of about 0.010 millirem. This dose is small and comparable to the dose received by the MEI. The small doses to noninvolved workers from normal facility operations were not evaluated any further in this *SPD Supplemental EIS*. Doses to the offsite MEI, the offsite population, and the noninvolved worker under accident conditions were evaluated, as described in Appendix D of this *SPD Supplemental EIS*.

C.3.1 K-Area Storage, K-Area Interim Surveillance Capability, K-Area Pit Disassembly and Conversion Project, and Pit Disassembly in K-Area Gloveboxes

C.3.1.1 Construction

There would be no radiological risk to members of the public from potential construction or modification at the K-Area Complex facilities associated with storage, surveillance, or pit disassembly and conversion. Construction worker exposures to radiation derived from other activities at the site, past or present, would be kept as low as reasonably achievable (ALARA). Construction workers would be monitored (badged), as appropriate. Limited demolition, removal, and decontamination actions at K-Area were completed in January 2008; however, it is possible that new construction associated with PDC or pit disassembly gloveboxes could take place within areas that nevertheless exhibit residual contamination levels. PDC construction activities would include 2 years of decontamination and equipment removal from K-Area. The 28 PDC workers involved in decontamination and equipment removal would receive an average annual dose of 18 millirem. This would result in a collective worker dose of 0.5 person-rem per year and a total dose of 1.0 person-rem over the anticipated 2-year construction period (SRNS 2012).

For K-Area glovebox modifications, there would be an average annual dose of 100 millirem to 20 construction workers. This would result in a collective worker dose of 2.0 person-rem per year and 4.0 person-rem over the anticipated 2-year construction period (SRNS 2012).

C.3.1.2 Operations

Under the No Action Alternative, surplus plutonium disposition operations would continue at SRS largely as described and evaluated in the *SPD EIS* (DOE 1999) and subsequent supplement analyses, as well as the *Environmental Impact Statement on the Construction and Operation of a Proposed Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina* (*MFFF EIS*) (NRC 2005). Where planned operations have changed substantially and might affect potential worker radiological exposures, they are noted.

Program activities under the No Action Alternative that would result in doses to workers include the following:

- *K-Area Storage*. Storage of non-pit plutonium in K-Area and gradual transfer to MFFF were previously evaluated in the first supplement analysis for the *SPD EIS* (*SPD EIS SA-1*) (DOE 2003b); the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (*Storage and Disposition PEIS*) (DOE 1996), including its first (SA-1) (DOE 1998), second (SA-2) (DOE 2002), and fourth (SA-4) (DOE 2007) supplement analyses; and the *Environmental Assessment for the Safeguards and Security Upgrades for Storage of Plutonium Materials at the Savannah River Site* (*Safeguards* *and Security EA*) (DOE 2005b). Material storage in the K-Area Complex in support of the surplus plutonium disposition program would continue for about 40 years.[1]

- *KIS*. Operation of KIS would support the ongoing plutonium storage container surveillance mission (DOE 2005b). KIS operations would continue for about 40 years.

Under the Immobilization to DWPF Alternative, the following possible program activities would result in worker doses:

- *K-Area Storage.* Activities at this area would be similar to those as discussed under the No Action Alternative, including removal of shipping containers from storage for transport to other onsite facilities. Worker impacts would be similar to those from current and recent container receipt and placement activities in storage locations. No net increase in worker impacts is expected. K-Area storage operations in support of the surplus plutonium disposition program would continue for 20 years.
- *KIS*. Operation of KIS would support plutonium storage container surveillance (DOE 2005b). KIS operations would continue for 15 years.
- *Pit disassembly.* Under the PF-4 at LANL and H-Canyon/HB-Line and MFFF at SRS Option for pit disassembly and conversion, disassembly of plutonium pits would be performed using equipment installed in a K-Area glovebox with the plutonium being transferred to H-Canyon/HB-Line for oxidation. Pit disassembly operations would continue for 14 years.

Under the MOX Fuel Alternative, the following program activities would result in worker doses:

- *K-Area Storage.* K-Area storage operations in support of the surplus plutonium disposition program, as discussed under the No Action Alternative, would continue for 22 years.
- *KIS.* Operation of KIS would be the same as under the Immobilization to DWPF Alternative. KIS operations would continue for about 7 years.
- *PDC.* Under the option to construct PDC at K-Area to carry out the pit disassembly and conversion function, this facility would operate for a period of 12 years.
- *Pit disassembly.* Pit disassembly would be the same as under the Immobilization to DWPF Alternative, operating for 14 years.

Under the H-Canyon/HB-Line to DWPF Alternative, the following program activities would result in worker doses:

- *K-Area Storage.* K-Area storage operations in support of the surplus plutonium disposition program, as discussed under the No Action Alternative, would continue for 22 years.
- *KIS*. Operation of KIS would be the same as under the Immobilization to DWPF Alternative. KIS operations would continue for about 10 years.
- *PDC.* Operation of PDC at K-Area would be the same as under the MOX Fuel Alternative, operating for a period of 12 years.
- *Pit disassembly*. Pit disassembly would be the same as under the Immobilization to DWPF Alternative, operating for 14 years.

[1] The K-Area Material Storage Area is the principal capability at K-Area for plutonium storage.

Under the WIPP Alternative, program activities that would result in worker doses include the following:

- *K-Area Storage.* K-Area storage operations in support of the surplus plutonium disposition program, as discussed under the No Action Alternative, would continue for 22 years.
- *KIS*. Operation of KIS would be the same as under the Immobilization to DWPF Alternative. KIS operations would continue for about 7 years.
- *PDC.* Operation of PDC at K-Area would be the same as under the MOX Fuel Alternative, operating for a period of 12 years.
- *Pit disassembl*y. Pit disassembly would be the same as under the Immobilization to DWPF Alternative, operating for 14 years.

Under all alternatives, because surplus plutonium activities for K-Area storage only involve receipt, storage, and shipping of materials within certified shipping containers that are not opened, no airborne radiological emissions would occur from these activities during normal operations. At KIS, the shipping packages would be opened and the DOE-STD-3013 containers (DOE 2012) would be opened within a glovebox. Small amounts of plutonium could become airborne within the glovebox and be transported through high-efficiency particulate air filters and a stack to the atmosphere. Workers performing these activities would be exposed to direct gamma and neutron radiation from plutonium in shipping packages, DOE-STD-3013 containers, and gloveboxes. At PDC, it is expected that workers would be exposed to direct gamma and neutron radiation from the handling of pit material. Small amounts of plutonium could become airborne from metal oxidation and be transported through high-efficiency particulate air filters and a stack to the atmosphere. For disassembly of pits within a K-Area glovebox, workers would be exposed to direct gamma and neutron radiation from plutonium. For the option of disassembling pits in K-Area gloveboxes, oxidation of the pit metal would occur in H-Canyon/HB-Line. No emissions of offsite consequence are expected from K-Area glovebox pit disassembly activities.

Table C–16 presents the projected incident-free radiological impacts on workers from storage operations at K-Area. The total numbers of projected LCFs are also reported for the differing periods of operation per alternative. As indicated above, no impacts to the public are expected due to the absence of airborne emissions.

Table C–16 Radiological Impacts on Workers from K-Area Storage Operations

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for K-Area Storage	**40**	**20**	**22**	**22**	**22**
Total Workforce					
Number of radiation workers	24	24	24	24	24
Collective dose (person-rem per year)	8.9	8.9	8.9	8.9	8.9
Annual LCFs [a]	0 (0.005)	0 (0.005)	0 (0.005)	0 (0.005)	0 (0.005)
Life-of-Project LCFs [a]	0 (0.2)	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)
Average Worker					
Dose (millirem per year) [b]	370	370	370	370	370
Annual LCF risk	0.0002	0.0002	0.0002	0.0002	0.0002
Life-of-Project LCF risk	0.009	0.004	0.005	0.005	0.005

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Source: DOE 1998; SRNS 2012.

Tables C–17 through **C–21** present the projected incident-free radiological impacts on workers and the public from operations at KIS and PDC and from pit disassembly activities in K-Area gloveboxes (SRNS 2012; WSRC 2008). The total numbers of projected LCFs are also reported for the differing periods of operation per alternative.

Table C–17 Radiological Impacts on the Public from Operation of the K-Area Interim Surveillance Capability

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for KIS	**40**	**15**	**7**	**10**	**7**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	4.3×10^{-5}	4.3×10^{-5}	4.3×10^{-5}	4.3×10^{-5}	4.3×10^{-5}
Percent of natural background radiation [a]	1.7×10^{-8}	1.7×10^{-8}	1.7×10^{-8}	1.7×10^{-8}	1.7×10^{-8}
Annual LCFs [b]	0 (3×10^{-8})	0 (3×10^{-8})	0 (3×10^{-8})	0 (3×10^{-8})	0 (3×10^{-8})
Life-of-Project LCFs [b]	0 (1×10^{-6})	0 (4×10^{-7})	0 (2×10^{-7})	0 (3×10^{-7})	0 (2×10^{-7})
Maximally Exposed Individual					
Annual dose (millirem)	8.5×10^{-7}	8.5×10^{-7}	8.5×10^{-7}	8.5×10^{-7}	8.5×10^{-7}
Percent of natural background radiation [a]	2.7×10^{-7}	2.7×10^{-7}	2.7×10^{-7}	2.7×10^{-7}	2.7×10^{-7}
Annual LCF risk	5×10^{-13}	5×10^{-13}	5×10^{-13}	5×10^{-13}	5×10^{-13}
Life-of-Project LCF risk	2×10^{-11}	8×10^{-12}	4×10^{-12}	5×10^{-12}	4×10^{-12}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	5.3×10^{-8}	5.3×10^{-8}	5.3×10^{-8}	5.3×10^{-8}	5.3×10^{-8}
Annual LCF risk	3×10^{-14}	3×10^{-14}	3×10^{-14}	3×10^{-14}	3×10^{-14}
Life-of-Project LCF risk	1×10^{-12}	5×10^{-13}	2×10^{-13}	3×10^{-13}	2×10^{-13}

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LCF = latent cancer fatality; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of K-Area in 2020 would receive a dose of about 252,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 809,000 for K-Area).

Table C–18 Radiological Impacts on Workers from Operation of the K-Area Interim Surveillance Capability

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for KIS	**40**	**15**	**7**	**10**	**7**
Total Workforce					
Number of radiation workers	40	40	40	40	40
Collective dose (person-rem per year)	25	25	25	25	25
Annual LCFs [a]	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)
Life-of-Project LCFs [a]	1 (0.6)	0 (0.2)	0 (0.1)	0 (0.2)	0 (0.1)
Average Worker					
Dose (millirem per year) [b]	630	630	630	630	630
Annual LCF risk	0.0004	0.0004	0.0004	0.0004	0.0004
Life-of-Project LCF risk	0.02	0.006	0.003	0.004	0.003

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LCF = latent cancer fatality; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Source: SRNS 2012; WSRC 2008.

Table C–19 Radiological Impacts on the Public from Operation of the Pit Disassembly and Conversion Project in K-Area

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for PDC	**N/A**	**N/A**	**12**	**12**	**12**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	N/A	N/A	0.44	0.44	0.44
Percent of natural background radiation [a]	N/A	N/A	0.00018	0.00018	0.00018
Annual LCFs [b]	N/A	N/A	0 (0.0003)	0 (0.0003)	0 (0.0003)
Life-of-Project LCFs [b]	N/A	N/A	0 (0.003)	0 (0.003)	0 (0.003)
Maximally Exposed Individual					
Annual dose (millirem)	N/A	N/A	0.0061	0.0061	0.0061
Percent of natural background radiation [a]	N/A	N/A	0.0020	0.0020	0.0020
Annual LCF risk	N/A	N/A	4×10^{-9}	4×10^{-9}	4×10^{-9}
Life-of-Project LCF risk	N/A	N/A	4×10^{-8}	4×10^{-8}	4×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	N/A	N/A	0.00055	0.00055	0.00055
Annual LCF risk	N/A	N/A	3×10^{-10}	3×10^{-10}	3×10^{-10}
Life-of-Project LCF risk	N/A	N/A	4×10^{-9}	4×10^{-9}	4×10^{-9}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of K-Area in 2020 would receive a dose of about 252,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 809,000 for K-Area).

Table C–20 Radiological Impacts on Workers from Operation of the Pit Disassembly and Conversion Project in K-Area

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for PDC	**N/A**	**N/A**	**12**	**12**	**12**
Total Workforce					
Number of radiation workers	N/A	N/A	383	383	383
Collective dose (person-rem per year)	N/A	N/A	190	190	190
Annual LCFs [a]	N/A	N/A	0 (0.1)	0 (0.1)	0 (0.1)
Life-of-Project LCFs	N/A	N/A	1 (1.4)	1 (1.4)	1 (1.4)
Average Worker					
Dose (millirem per year) [b]	N/A	N/A	500	500	500
Annual LCF risk	N/A	N/A	0.0003	0.0003	0.0003
Life-of-Project LCF risk	N/A	N/A	0.004	0.004	0.004

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Source: SRNS 2012; WSRC 2008.

Table C–21 Radiological Impacts on Workers from Pit Disassembly Activities in K-Area Gloveboxes

Impact Area	*Alternative*				
	No Action	***Immobilization to DWPF***	***MOX Fuel***	***H-Canyon/ HB-Line to DWPF***	***WIPP***
Operational Years for Pit Disassembly Activities in K-Area Gloveboxes	**N/A**	**14**	**14**	**14**	**14**
Total Workforce					
Number of radiation workers	N/A	50	50	50	50
Collective dose (person-rem per year)	N/A	38	38	38	38
Annual LCFs [a]	N/A	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)
Life-of-Project LCFs [a]	N/A	0 (0.3)	0 (0.3)	0 (0.3)	0 (0.3)
Average Worker					
Dose (millirem per year)	N/A	760	760	760	760
Annual LCF risk	N/A	0.0005	0.0005	0.0005	0.0005
Life-of-Project LCF risk	N/A	0.006	0.006	0.006	0.006

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Source: SRNS 2012; WSRC 2008.

C.3.2 Immobilization Capability in K-Area

C.3.2.1 Construction

There would be no radiological risk to members of the public from the construction of a new immobilization capability at K-Area. The majority of the construction activities would occur in areas where dose rates would be close to background radiation levels, and there would be a limited amount of equipment in place that would require decontamination and removal. Due to the nature of contamination, the external dose rates from this equipment would be low. Total dose rates for the 2 years of decontamination and equipment removal during the construction phase would be about 3.3 person-rem per year; the average estimated dose rate would be about 92 millirem per worker per year for a member of the exposed construction workforce of 72 workers (SRNS 2012). The total construction workforce dose would be 6.6 person-rem over the 2-year period. Construction worker exposures to radiation derived from other activities at the site, past or present, would be kept ALARA. Construction workers would be monitored (badged) as appropriate.

C.3.2.2 Operations

Under the Immobilization to DWPF Alternative, program activities that would result in worker and potentially offsite population doses are the processing of 13.1 metric tons (14.4 tons) of surplus plutonium in a new immobilization capability within K-Area. Processing this material is anticipated to require about 10 years of operation. This period of operation was used for projecting potential total numbers of latent cancers. **Tables C–22** and **C–23** present the projected incident-free radiological impacts of operation of the new immobilization capability.

Table C–22 Radiological Impacts on the Public from Operation of the K-Area Immobilization Capability

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for Immobilization	**N/A**	**10**	**N/A**	**N/A**	**N/A**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	N/A	0.00062	N/A	N/A	N/A
Percent of natural background radiation [a]	N/A	2.5×10^{-7}	N/A	N/A	N/A
Annual LCFs	N/A	0 (4×10^{-7})	N/A	N/A	N/A
Life-of-Project LCFs [b]	N/A	0 (4×10^{-6})	N/A	N/A	N/A
Maximally Exposed Individual					
Annual dose (millirem)	N/A	7.5×10^{-6}	N/A	N/A	N/A
Percent of natural background radiation [a]	N/A	2.4×10^{-6}	N/A	N/A	N/A
Annual LCF risk	N/A	5×10^{-12}	N/A	N/A	N/A
Life-of-Project LCF risk	N/A	5×10^{-11}	N/A	N/A	N/A
Average Exposed Individual within 50 Miles (80 kilometers)[c]					
Annual dose (millirem)	N/A	7.7×10^{-7}	N/A	N/A	N/A
Annual LCF risk	N/A	5×10^{-13}	N/A	N/A	N/A
Life-of-Project LCF risk	N/A	5×10^{-12}	N/A	N/A	N/A

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of K-Area in 2020 would receive a dose of about 252,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facility in 2020 (approximately 809,000 for K-Area).

Table C–23 Radiological Impacts on Workers from Operation of the K-Area Immobilization Capability

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for Immobilization	**N/A**	**10**	**N/A**	**N/A**	**N/A**
Total Workforce					
Number of radiation workers	N/A	314	N/A	N/A	N/A
Collective dose (person-rem per year)	N/A	310	N/A	N/A	N/A
Annual LCFs [a]	N/A	0 (0.2)	N/A	N/A	N/A
Life-of-Project LCFs [a]	N/A	2 (1.9)	N/A	N/A	N/A
Average Worker					
Dose (millirem per year) [b]	N/A	1,000	N/A	N/A	N/A
Annual LCF risk	N/A	0.0006	N/A	N/A	N/A
Life-of-Project LCF risk	N/A	0.006	N/A	N/A	N/A

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Source: SRNS 2012.

C.3.3 H-Canyon/HB-Line

C.3.3.1 Construction

Under any of the action alternatives, implementation of the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion would require modifications at the H-Canyon/HB-Line to support dissolution of metal and conversion to plutonium oxide feed for MFFF (pit disassembly would occur in a K-Area glovebox; see Section C.3.1). Modification activities may result in construction workforce doses (up to an average dose of 25 millirem per year) to 10 workers. Annual workforce doses are not expected to exceed 0.25 person-rem per year; over the 2 years required for these modifications, the workforce would receive a collective dose of 0.50 person-rem (SRNS 2012).

No significant modifications to H-Canyon/HB-Line would be needed to enable processing of surplus plutonium to prepare it for vitrification at DWPF under the H-Canyon/HB-Line to DWPF Alternative. Any equipment modifications or piping realignments would be conducted as part of normal operations.

Under the WIPP Alternative, construction workforce doses (up to an average dose of 58 millirem per worker per year) to 10 workers may result from modifications at the H-Canyon/HB-Line to support preparation of up to 6 metric tons (6.6 tons) of plutonium to WIPP. A total potential construction workforce dose of 1.2 person-rem would occur over the estimated 2-year modification duration (SRNS 2012; WSRC 2008).

Under the MOX Fuel Alternative, H-Canyon/HB-Line may require modifications to dissolve and prepare 4 metric tons (4.4 tons) of non-pit plutonium as feed for MOX fuel fabrication and/or prepare 2 metric tons (2.2 tons) of surplus plutonium for WIPP disposal. The amount of modification work needed to accommodate these actions would depend on the planned processing rate. Modifications would range from minor modifications that would be made as part of normal operations to the level of modifications discussed above for preparation of 6 metric tons (6.6 tons) of non-pit plutonium for WIPP disposal.

There would be no radiological risks to members of the public from any of the potential modification scenarios of H-Canyon/HB-Line.

C.3.3.2 Operations

Processing 6 metric tons of non-pit plutonium for transfer to DWPF. Under the H-Canyon/HB-Line to DWPF Alternative, 6 metric tons (6.6 tons) of surplus non-pit plutonium could be dissolved, processed, and transferred to the liquid radioactive waste tank farm to become part of the feed to the HLW vitrification system at DWPF. No changes are expected in air or liquid emissions and discharges under this processing option. Dissolution, storage, and transfer of surplus plutonium are currently being performed under existing permits (WSRC 2008).

No changes in worker radiological exposure rates at H-Canyon/HB-Line are expected due to this processing option versus other materials normally handled at H-Canyon/HB-Line. H-Canyon/HB-Line missions currently include dissolution, storage, and transfer of surplus plutonium, and controls are in place for limiting personnel doses. Projected doses are estimated for each material type prior to the start of a campaign (WSRC 2008).

The total dose for a previous processing campaign of approximately 0.05 metric tons (0.055 tons) of plutonium-beryllium material was conservatively estimated to result in a collective dose of 0.728 person-rem to all fissile material handlers. Scaling this dose rate to the processing rate of 0.55 metric tons (0.61 tons) per year for processing 6 metric tons (6.6 tons) to DWPF, yields an annual dose of about 8 person-rem. This dose is highly dependent on the material included with the plutonium. An estimated 46 full-time radiation workers would support this H-Canyon/HB-Line processing option during the operational timeframe of this *SPD Supplemental EIS*; however, only 20 to 30 percent of this workforce would be directly involved with the processing of surplus plutonium material; using the above information, the calculated annual dose for these workers would be 580 millirem. Typical doses would be expected to be lower than this calculated value (SRNS 2012). For all workers under this processing option, the SRS ALARA goal of 500 millirem per year was assumed.

Processing this material is expected to require about 13 years of operation under the H-Canyon/HB-Line to DWPF Alternative. This period of operation was used to project the total numbers of LCFs for all receptors.

Processing 10 metric tons of pit and metallic plutonium for transfer to MFFF. Under all of the action alternatives, if the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion were implemented, up to 10 metric tons (11 tons) of surplus plutonium could be processed through the H-Canyon/HB-Line and sent to MFFF. Processing this material is expected to require about 14 years of operation under all action alternatives. This period of operation was used to project the total numbers of LCFs for all receptors.

Processing 4 metric tons of non-pit plutonium for transfer to MFFF. Under the MOX Fuel Alternative, 4 metric tons (4.4 tons) of non-pit plutonium would be processed through H-Canyon/HB-Line and sent to MFFF for MOX fuel. Processing this material is expected to require about 6 years.

Processing non-pit plutonium for shipment to WIPP. Under the MOX Fuel Alternative, 2 metric tons (2.2 tons) of surplus plutonium could be processed through H-Canyon/HB-Line in preparation for ultimate transport to WIPP. Under the WIPP Alternative, 6 metric tons (6.6 tons) could be processed through H-Canyon/HB-Line. Processing this material is expected to require about 10 years of operation under the MOX Fuel Alternative and about 13 years under the WIPP Alternative. These periods of operation were used to project the total numbers of LCFs for all receptors.

Tables C–24 through **C–29** present the projected incident-free radiological impacts at H-Canyon/ HB-Line for all three processing scenarios discussed above.

Table C–24 Radiological Impacts on the Public from Operation of H-Canyon/HB-Line – Processing Surplus Non-Pit Plutonium for Transfer to the Defense Waste Processing Facility

	Alternative				
Impact Area	*No Action*	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for H-Canyon/ HB-Line Processing to DWPF	**N/A**	**N/A**	**N/A**	**13**	**N/A**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	N/A	N/A	N/A	0.0060	N/A
Percent of natural background radiation [a]	N/A	N/A	N/A	2.2×10^{-6}	N/A
Annual LCFs [b]	N/A	N/A	N/A	0 (4×10^{-6})	N/A
Life-of-Project LCFs [b]	N/A	N/A	N/A	0 (5×10^{-5})	N/A
Maximally Exposed Individual					
Annual dose (millirem)	N/A	N/A	N/A	4.3×10^{-5}	N/A
Percent of natural background radiation [a]	N/A	N/A	N/A	1.4×10^{-5}	N/A
Annual LCF risk	N/A	N/A	N/A	3×10^{-11}	N/A
Life-of-Project LCF risk	N/A	N/A	N/A	4×10^{-10}	N/A
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	N/A	N/A	N/A	6.8×10^{-6}	N/A
Annual LCF risk	N/A	N/A	N/A	4×10^{-12}	N/A
Life-of-Project LCF risk	N/A	N/A	N/A	5×10^{-11}	N/A

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of H-Area in 2020 would receive a dose of about 276,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated value is provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facility in 2020 (approximately 886,000 for H-Area).

Note: To convert metric tons to tons, multiply by 1.1023.

Table C–25 Radiological Impacts on Workers from Operation of H-Canyon/HB-Line – Processing Surplus Non-Pit Plutonium for Transfer to the Defense Waste Processing Facility

	Alternative				
Impact Area	*No Action*	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for H-Canyon/ HB-Line Processing to DWPF	**N/A**	**N/A**	**N/A**	**13**	**N/A**
Total Workforce					
Number of radiation workers [a]	N/A	N/A	N/A	14	N/A
Collective dose (person-rem per year)	N/A	N/A	N/A	7.0	N/A
Annual LCFs [b]	N/A	N/A	N/A	0 (0.004)	N/A
Life-of-Project LCFs [b]	N/A	N/A	N/A	0 (0.05)	N/A
Average Worker					
Dose (millirem per year) [c]	N/A	N/A	N/A	500	N/A
Annual LCF risk	N/A	N/A	N/A	0.0003	N/A
Life-of-Project LCF risk	N/A	N/A	N/A	0.004	N/A

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] It was estimated that no more than 30 percent of the 46 radiation workers at H-Canyon would be involved with plutonium processing activities under the H-Canyon/HB-Line to DWPF Alternative (i.e., 14 radiation workers).

[b] Numbers of LCFs in the worker population are whole numbers; the statistically calculated value is provided in parentheses.

[c] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Source: SRNS 2012.

Note: To convert metric tons to tons, multiply by 1.1023.

Table C–26 Radiological Impacts on the Public from Operation of H-Canyon/HB-Line – Pit and Metal Conversion to Oxide for Mixed Oxide Fuel Fabrication

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for H-Canyon/ HB-Line Processing to MFFF	**N/A**	**14**	**14**	**14**	**14**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	N/A	0.26	0.26	0.26	0.26
Percent of natural background radiation [a]	N/A	9.6×10^{-5}	9.6×10^{-5}	9.6×10^{-5}	9.6×10^{-5}
Annual LCFs [b]	N/A	0 (0.0002)	0 (0.0002)	0 (0.0002)	0 (0.0002)
Life-of-Project LCFs [b]	N/A	0 (0.002)	0 (0.002)	0 (0.002)	0 (0.002)
Maximally Exposed Individual					
Annual dose (millirem)	N/A	0.0024	0.0024	0.0024	0.0024
Percent of natural background radiation [a]	N/A	0.00077	0.00077	0.00077	0.00077
Annual LCF risk	N/A	1×10^{-9}	1×10^{-9}	1×10^{-9}	1×10^{-9}
Life-of-Project LCF risk	N/A	2×10^{-8}	2×10^{-8}	2×10^{-8}	2×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	N/A	0.00029	0.00029	0.00029	0.00029
Annual LCF risk	N/A	2×10^{-10}	2×10^{-10}	2×10^{-10}	2×10^{-10}
Life-of-Project LCF risk	N/A	2×10^{-9}	2×10^{-9}	2×10^{-9}	2×10^{-9}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of H-Area in 2020 would receive a dose of about 276,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facility in 2020 (approximately 886,000 for H-Area).

Note: Potential public impacts from the separate processing of 4 metric tons (4.4 tons) of non-pit plutonium for feed to MFFF (applicable under the MOX Fuel Alternative only) would be subsumed within the values provided in the MOX Fuel column.

Source: SRNS 2012.

Table C–27 Radiological Impacts on Workers from Operation of H-Canyon/HB-Line – Pit and Metal Conversion to Oxide for Mixed Oxide Fuel Fabrication

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for H-Canyon/ HB-Line Processing to MFFF	**N/A**	**14**	**14**	**14**	**14**
Total Workforce					
Number of radiation workers	N/A	100	100	100	100
Collective dose (person-rem per year)	N/A	29	29	29	29
Annual LCFs [a]	N/A	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)
Life-of-Project LCFs [a]	N/A	0 (0.2)	0 (0.2)	0 (0.2)	0 (0.2)
Average Worker					
Dose (millirem per year) [b]	N/A	290	290	290	290
Annual LCF risk	N/A	0.0002	0.0002	0.0002	0.0002
Life-of-Project LCF risk	N/A	0.002	0.002	0.002	0.002

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Note: Potential worker impacts from the separate processing of 4 metric tons (4.4 tons) of non-pit plutonium for feed to MFFF (applicable under the MOX Fuel Alternative only) would be subsumed within the values provided in the MOX Fuel column.

Source: SRNS 2012.

Table C–28 Radiological Impacts on the Public from Operation of H-Canyon/HB-Line – Processing to the Waste Isolation Pilot Plant

Impact Area	Alternative				
	No Action	*Immobilization to DWPF*	*MOX Fuel* [a]	*H-Canyon/ HB-Line to DWPF*	*WIPP* [a]
Operational Years for H-Canyon/ HB-Line Processing to WIPP	**N/A**	**N/A**	**10**	**N/A**	**13**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	N/A	N/A	0.26	N/A	0.26
Percent of natural background radiation [b]	N/A	N/A	9.6×10^{-5}	N/A	9.6×10^{-5}
Annual LCFs [c]	N/A	N/A	0 (0.0002)	N/A	0 (0.0002)
Life-of-Project LCFs [c]	N/A	N/A	0 (0.002)	N/A	0 (0.002)
Maximally Exposed Individual					
Annual dose (millirem)	N/A	N/A	0.0024	N/A	0.0024
Percent of natural background radiation [b]	N/A	N/A	0.00077	N/A	0.00077
Annual LCF risk	N/A	N/A	1×10^{-9}	N/A	1×10^{-9}
Life-of-Project LCF risk	N/A	N/A	1×10^{-8}	N/A	2×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [d]					
Annual dose (millirem)	N/A	N/A	0.00029	N/A	0.00029
Annual LCF risk	N/A	N/A	2×10^{-10}	N/A	2×10^{-10}
Life-of-Project LCF risk	N/A	N/A	2×10^{-9}	N/A	2×10^{-9}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Under the MOX Fuel Alternative, 2 metric tons (2.2 tons) of material would be processed; under the WIPP Alternative, 6 metric tons (6.6 tons) of material would be processed.

[b] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of H-Area in 2020 would receive a dose of about 276,000 person-rem.

[c] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[d] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facility in 2020 (approximately 886,000 for H-Area).

Source: SRNS 2012.

Table C–29 Radiological Impacts on Workers from Operation of H-Canyon/HB-Line – Processing to the Waste Isolation Pilot Plant

Impact Area	Alternative				
	No Action	*Immobilization to DWPF*	*MOX Fuel* [a]	*H-Canyon/ HB-Line to DWPF*	*WIPP* [a]
Operational Years for H-Canyon/ HB-Line Processing to WIPP	**N/A**	**N/A**	**10**	**N/A**	**13**
Total Workforce					
Number of radiation workers	N/A	N/A	130	N/A	130
Collective dose (person-rem per year)	N/A	N/A	20	N/A	60
Annual LCFs [b]	N/A	N/A	0 (0.01)	N/A	0 (0.04)
Life-of-Project LCFs [b]	N/A	N/A	0 (0.1)	N/A	0 (0.5)
Average Worker					
Dose (millirem per year) [c]	N/A	N/A	150	N/A	460
Annual LCF risk	N/A	N/A	0.00009	N/A	0.0003
Life-of-Project LCF risk	N/A	N/A	0.0009	N/A	0.004

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Under the MOX Fuel Alternative, 2 metric tons (2.2 tons) of material would be processed; under the WIPP Alternative, 6 metric tons (6.6 tons) of material would be processed.

[b] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Source: SRNS 2012.

C.3.4 Mixed Oxide Fuel Fabrication Facility (including Metal Oxidation)

C.3.4.1 Construction

MFFF is already under construction and the only potential modifications to MFFF would be the installation of metal oxidation furnaces under any of the action alternatives. Approximately 140 construction workers would be involved in this activity over an estimated 3.5-year timeframe. Metal oxidation furnaces would be installed in an area set aside in MFFF (i.e., separate from the fuel fabrication operations), so construction workers would not be expected to receive any occupation radiation doses. There would be no radiological risk to members of the public from these construction activities at MFFF.

C.3.4.2 Operations

Under the No Action Alternative, surplus plutonium disposition operations would continue at SRS largely as described and evaluated in the *SPD EIS* (DOE 1999), the first supplement analysis to the *SPD EIS* (DOE 2003b), and the *MFFF EIS* (NRC 2005). Where planned operations have changed substantially and might affect potential worker radiological exposures, they are noted. Program activities under the No Action Alternative that would result in worker doses include fabrication of 34 metric tons (37.5 tons) of surplus plutonium into MOX fuel at MFFF. This is expected to require about 21 years of operation. The same MFFF throughput and operational time frame apply under the Immobilization to DWPF Alternative.

Under the H-Canyon/HB-Line to DWPF and WIPP Alternatives, operational activities that would result in worker doses at MFFF include processing 34 metric tons (37.5 tons) of surplus plutonium, as previously evaluated, as well as processing 7.1 metric tons (7.8 tons) of additional surplus pit plutonium (not previously analyzed). Processing operations associated with the additional 7.1 metric tons (7.8 tons) of pit plutonium would be similar to those for the other material previously evaluated and would extend the operating life of MFFF by 2 years, to a total of 23 years. Annual worker exposures would be similar to those previously analyzed, but the total exposures would increase in proportion to the extension of the facility's operating life.

Under the MOX Fuel Alternative, operational activities that would result in worker doses at MFFF include processing 34 metric tons (37.5 tons) of surplus plutonium (previously analyzed); an additional 7.1 metric tons (7.8 tons) of surplus pit plutonium (not previously analyzed); and an additional 4 metric tons (4.4 tons) of surplus non-pit plutonium (not previously analyzed), or a total of 45.1 metric tons (49.7 tons) of surplus plutonium. Impacts from MOX fuel fabrication of the additional 7.1 metric tons (7.8 tons) of pit plutonium would be similar to the impacts of processing other material previously evaluated. The impacts of MOX fuel fabrication of 4 metric tons (4.4 tons) of non-pit plutonium after initial preparation of the material at H-Canyon/HB-Line would likewise be similar to the impacts of processing other material previously evaluated. The net effect of processing the additional plutonium under the MOX Fuel Alternative would be to increase the operating life of MFFF to a total of 24 years. Annual worker exposures would be similar to those previously analyzed, but the cumulative exposures would increase in proportion to the extension of the facility's operating life.

Under any of the action alternatives, two of the options for pit disassembly and conversion include the use of metal oxidations furnaces installed in MFFF for converting 35 metric tons (38.6 tons) of surplus plutonium to plutonium oxide. The operations would occur over a period of 20 years.

Tables C–30 and **C–31** present the projected incident-free radiological impacts of MFFF operations. **Tables C–32** and **C–33** present the projected incident-free radiological impacts from operation of metal oxidation furnaces at MFFF.

Table C–30 Radiological Impacts on the Public from Operation of the Mixed Oxide Fuel Fabrication Facility

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for MFFF	**21**	**21**	**24**	**23**	**23**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	0.045	0.045	0.052	0.050	0.050
Percent of natural background radiation [a]	1.7×10^{-5}	1.7×10^{-5}	1.9×10^{-5}	1.9×10^{-5}	1.9×10^{-5}
Annual LCFs [b]	0 (3×10^{-5})	0 (3×10^{-5})	0 (3×10^{-5})	0 (3×10^{-5})	0 (3×10^{-5})
Life-of-Project LCFs [b]	0 (0.0006)	0 (0.0006)	0 (0.0007)	0 (0.0007)	0 (0.0007)
Maximally Exposed Individual					
Annual dose (millirem)	0.00050	0.00050	0.00058	0.00055	0.00055
Percent of natural background radiation [a]	0.00016	0.00016	0.00019	0.00018	0.00018
Annual LCF risk	3×10^{-10}	3×10^{-10}	4×10^{-10}	3×10^{-10}	3×10^{-10}
Life-of-Project LCF risk	6×10^{-9}	6×10^{-9}	8×10^{-9}	8×10^{-9}	8×10^{-9}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	5.2×10^{-5}	5.2×10^{-5}	6.0×10^{-5}	5.7×10^{-5}	5.7×10^{-5}
Annual LCF risk	3×10^{-11}	3×10^{-11}	4×10^{-11}	3×10^{-11}	3×10^{-11}
Life-of-Project LCF risk	7×10^{-10}	7×10^{-10}	9×10^{-10}	8×10^{-10}	8×10^{-10}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of F-Area in 2020 would receive a dose of about 270,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 869,000 for F-Area).

Note: To convert metric tons to tons, multiply by 1.1023.

Table C–31 Radiological Impacts on Workers from Operation of the Mixed Oxide Fuel Fabrication Facility

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for MFFF	**21**	**21**	**24**	**23**	**23**
Total Workforce					
Number of radiation workers	450	450	450	450	450
Collective dose (person-rem per year)	51	51	51	51	51
Annual LCFs [a]	0 (0.03)	0 (0.03)	0 (0.03)	0 (0.03)	0 (0.03)
Life-of-Project LCFs [a]	1 (0.6)	1 (0.6)	1 (0.7)	1 (0.7)	1 (0.7)
Average Worker					
Dose (millirem per year) [b]	110	110	110	110	110
Annual LCF risk	0.00007	0.00007	0.00007	0.00007	0.00007
Life-of-Project LCF risk	0.001	0.001	0.002	0.002	0.002

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Note: To convert metric tons to tons, multiply by 1.1023.

Source: SRNS 2012.

Table C–32 Radiological Impacts on the Public from Operation of Metal Oxidation Furnaces at the Mixed Oxide Fuel Fabrication Facility

Impact Area	Alternative				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for Oxidation at MFFF	**N/A**	**20**	**20**	**20**	**20**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	N/A	0.37	0.37	0.37	0.37
Percent of natural background radiation [a]	N/A	0.00014	0.00014	0.00014	0.00014
Annual LCFs [b]	N/A	0 (0.0002)	0 (0.0002)	0 (0.0002)	0 (0.0002)
Life-of-Project LCFs [b]	N/A	0 (0.004)	0 (0.004)	0 (0.004)	0 (0.004)
Maximally Exposed Individual					
Annual dose (millirem)	N/A	0.0041	0.0041	0.0041	0.0041
Percent of natural background radiation [a]	N/A	0.0013	0.0013	0.0013	0.0013
Annual LCF risk	N/A	2×10^{-9}	2×10^{-9}	2×10^{-9}	2×10^{-9}
Life-of-Project LCF risk	N/A	5×10^{-8}	5×10^{-8}	5×10^{-8}	5×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	N/A	0.00043	0.00043	0.00043	0.00043
Annual LCF risk	N/A	3×10^{-10}	3×10^{-10}	3×10^{-10}	3×10^{-10}
Life-of-Project LCF risk	N/A	5×10^{-9}	5×10^{-9}	5×10^{-9}	5×10^{-9}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of F-Area in 2020 would receive a dose of about 270,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 869,000 for F-Area).

Table C–33 Radiological Impacts on Workers from Operation of Metal Oxidation Furnaces at the Mixed Oxide Fuel Fabrication Facility

Impact Area	Alternative				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for Oxidation at MFFF	**N/A**	**20**	**20**	**20**	**20**
Total Workforce					
Number of radiation workers	N/A	35	35	35	35
Collective dose (person-rem per year)	N/A	2.3	2.3	2.3	2.3
Annual LCFs [a]	N/A	0 (0.001)	0 (0.001)	0 (0.001)	0 (0.001)
Life-of-Project LCFs [a]	N/A	0 (0.03)	0 (0.03)	0 (0.03)	0 (0.03)
Average Worker					
Dose (millirem per year) [b]	N/A	65	65	65	65
Annual LCF risk	N/A	0.00004	0.00004	0.00004	0.00004
Life-of-Project LCF risk	N/A	0.0008	0.0008	0.0008	0.0008

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Source: SRNS 2012.

C.3.5 Pit Disassembly and Conversion Facility in F-Area

C.3.5.1 Construction

There would be no radiological risk to the public from the construction of PDCF. Construction worker exposures to radiation derived from other activities at the site, past or present, would also be kept within ALARA levels. Construction workers would be monitored (badged) as appropriate.

C.3.5.2 Operations

Under the No Action Alternative, surplus plutonium disposition operations would proceed at SRS largely as described and evaluated in the *SPD EIS* (DOE 1999), *SPD EIS SA-1* (DOE 2003b), and *MFFF EIS* (NRC 2005). Program activities under the No Action Alternative that would result in worker doses and radiological emissions include processing surplus plutonium at PDCF over a period of 10 years, as evaluated in the *SPD EIS SA-1* (DOE 2003b) and the *MFFF EIS* (NRC 2005), with transfer of the liquid wastes to WSB.

Under the Immobilization to DWPF, MOX Fuel, H-Canyon/HB-Line to DWPF, and WIPP Alternatives, processing additional pit plutonium would extend the operating life to a total of 12 years (for example, see Chapter 2, Section 2.3). Annual worker and public exposures would be similar to those previously analyzed, but the cumulative exposures would increase in proportion to the extension of the facility's operating life. **Tables C–34** and **C–35** present the projected incident-free radiological impacts of PDCF operations.

Table C–34 Radiological Impacts on the Public from Operation of the Pit Disassembly and Conversion Facility in F-Area

Impact Area	*Alternative*				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for PDCF	**10**	**12**	**12**	**12**	**12**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	0.46	0.46	0.46	0.46	0.46
Percent of natural background radiation [a]	0.00017	0.00017	0.00017	0.00017	0.00017
Annual LCFs [b]	0 (0.0003)	0 (0.0003)	0 (0.0003)	0 (0.0003)	0 (0.0003)
Life-of-Project LCFs [b]	0 (0.003)	0 (0.003)	0 (0.003)	0 (0.003)	0 (0.003)
Maximally Exposed Individual					
Annual dose (millirem)	0.0055	0.0055	0.0055	0.0055	0.0055
Percent of natural background radiation [a]	0.0018	0.0018	0.0018	0.0018	0.0018
Annual LCF risk	3×10^{-9}	3×10^{-9}	3×10^{-9}	3×10^{-9}	3×10^{-9}
Life-of-Project LCF risk	3×10^{-8}	4×10^{-8}	4×10^{-8}	4×10^{-8}	4×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	0.00053	0.00053	0.00053	0.00053	0.00053
Annual LCF risk	3×10^{-10}	3×10^{-10}	3×10^{-10}	3×10^{-10}	3×10^{-10}
Life-of-Project LCF risk	3×10^{-9}	4×10^{-9}	4×10^{-9}	4×10^{-9}	4×10^{-9}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; PDCF = Pit Disassembly and Conversion Facility; WIPP = Waste Isolation Pilot Plant.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of F-Area in 2020 would receive a dose of about 270,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 869,000 for F-Area).

Source: SRNS 2012.

Table C–35 Radiological Impacts on Workers from Operation of the Pit Disassembly and Conversion Facility in F-Area

Impact Area	Alternative				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for PDCF	**10**	**12**	**12**	**12**	**12**
Total Workforce					
Number of radiation workers	383	383	383	383	383
Collective dose (person-rem per year)	190	190	190	190	190
Annual LCFs [a]	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)
Life-of-Project LCFs [a]	1 (1.4)	1 (1.4)	1 (1.4)	1 (1.4)	1 (1.4)
Average Worker					
Dose (millirem per year) [b]	500	500	500	500	500
Annual LCF risk	0.0003	0.0003	0.0003	0.0003	0.0003
Life-of-Project LCF risk	0.003	0.004	0.004	0.004	0.004

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; PDCF = Pit Disassembly and Conversion Facility; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Source: SRNS 2012.

C.3.6 Waste Solidification Building

C.3.6.1 Construction

Potential impacts associated with the construction of WSB were previously analyzed (DOE 2008). No addition construction or modifications are evaluated in the *SPD Supplemental EIS*.

C.3.6.2 Operations

Under all alternatives, surplus plutonium disposition operations would proceed at SRS largely as described and evaluated in the *SPD EIS* (DOE 1999), *SPD EIS SA-1* (DOE 2003b), and the *MFFF EIS* (NRC 2005). Program activities under all alternatives, including processing liquid wastes from MFFF and PDCF, would result in worker doses and radiological air emissions. **Tables C–36** and **C–37** present the projected incident-free radiological impacts of WSB operations.

Table C–36 Radiological Impacts on the Public from Operation of the Waste Solidification Building

Impact Area	Alternative				
	No Action	Immobilization to DWPF	MOX Fuel	H-Canyon/ HB-Line to DWPF	WIPP
Operational Years for WSB	**21**	**23**	**24**	**23**	**23**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	0.031	0.031	0.031	0.031	0.031
Percent of natural background radiation [a]	1.1×10^{-5}	1.1×10^{-5}	1.1×10^{-5}	1.1×10^{-5}	1.1×10^{-5}
Annual LCFs [b]	0 (2×10^{-5})	0 (2×10^{-5})	0 (2×10^{-5})	0 (2×10^{-5})	0 (2×10^{-5})
Life-of-Project LCFs [b]	0 (0.0004)	0 (0.0004)	0 (0.0004)	0 (0.0004)	0 (0.0004)
Maximally Exposed Individual					
Annual dose (millirem)	0.00063	0.00063	0.00063	0.00063	0.00063
Percent of natural background radiation [a]	0.00020	0.00020	0.00020	0.00020	0.00020
Annual LCF risk	4×10^{-10}	4×10^{-10}	4×10^{-10}	4×10^{-10}	4×10^{-10}
Life-of-Project LCF risk	8×10^{-9}	9×10^{-9}	9×10^{-9}	9×10^{-9}	9×10^{-9}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	3.6×10^{-5}	3.6×10^{-5}	3.6×10^{-5}	3.6×10^{-5}	3.6×10^{-5}
Annual LCF risk	2×10^{-11}	2×10^{-11}	2×10^{-11}	2×10^{-11}	2×10^{-11}
Life-of-Project LCF risk	5×10^{-10}	5×10^{-10}	5×10^{-10}	5×10^{-10}	5×10^{-10}

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] The annual natural background radiation dose assumed for SRS is 311 millirem for the average individual; the population within 50 miles (80 kilometers) of F-Area in 2020 would receive a dose of about 270,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 869,000 for F-Area).

Table C–37 Radiological Impacts on Workers from Operation of the Waste Solidification Building

Impact Area	Alternative				
	No Action	Immobilization to DWPF	MOX Fuel	H-Canyon/ HB-Line to DWPF	WIPP
Operational Years for WSB	**21**	**23**	**24**	**23**	**23**
Total Workforce					
Number of radiation workers	50	50	50	50	50
Collective dose (person-rem per year)	25	25	25	25	25
Annual LCFs [a]	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)	0 (0.02)
Life-of-Project LCFs [a]	0 (0.3)	0 (0.3)	0 (0.4)	0 (0.3)	0 (0.3)
Average Worker					
Dose (millirem per year) [b]	500	500	500	500	500
Annual LCF risk	0.0003	0.0003	0.0003	0.0003	0.0003
Life-of-Project LCF risk	0.006	0.007	0.007	0.007	0.007

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Source: SRNS 2012.

C.3.7 Defense Waste Processing Facility

C.3.7.1 Construction

There would be no radiological risk to the public from modifications to DWPF. Construction worker exposures to radiation derived from other activities at the site, past or present, would be kept ALARA. Construction workers would be monitored (badged) as appropriate. Doses associated with modifications would be minimal, resulting in less than 0.1 person-rem to the workforce. DWPF modifications are only expected under the Immobilization to DWPF Alternative (SRNS 2012; WSRC 2008).

C.3.7.2 Operations

All action alternatives, with the exception of the WIPP Alternative, would rely on DWPF to handle the additional material processed through H-Canyon/HB-Line or the immobilization capability. Annual worker exposures would be similar to those previously analyzed in the *Final Environmental Impact Statement, Defense Waste Processing Facility, Savannah River Plant* (DOE 1982) and the *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility* (DOE 1994). The cumulative exposures would increase in proportion to the extension of the facility's operating life.

Under the Immobilization to DWPF Alternative, 13.1 metric tons (14.4 tons) of surplus plutonium in cans would be transferred to DWPF to be encapsulated in canisters of HLW. Although additional HLW canisters would be generated (see Chapter 2, Section 2.2.1), no additional glass would be poured. Glass would simply be poured into additional canisters due to the 12 percent reduction in space for vitrified HLW within the 790 can-in-canister assemblies. No plutonium would be released from the canisters that would be processed at DWPF, so there would be no net increase in normal atmospheric radiological releases from DWPF (SRNS 2012; WSRC 2008).

Under the MOX Fuel Alternative, 4 metric tons (4.4 tons) of non-pit plutonium would be processed at H-Canyon/HB-Line, creating waste that would generate approximately 2 additional canisters; under all action alternatives however, it is possible to process 10 metric tons (11 tons) of pit and metallic plutonium at H-Canyon/HB-Line, resulting in waste generating approximately 5 additional canisters.

Under the H-Canyon/HB-Line to DWPF Alternative, 6 metric tons (6.6 tons) of surplus plutonium from H-Canyon/HB-Line would be transferred for vitrification with HLW at DWPF. The plutonium mixed with the HLW would not contribute substantially to the DWPF normal release source term, so no incremental normal releases from DWPF are expected from these alternatives (SRNS 2012; WSRC 2008). Therefore, no incremental normal releases from DWPF are expected under any of the alternatives (SRNS 2012; WSRC 2008). **Table C–38** presents the projected incident-free radiological impacts on workers from DWPF operations.

Table C–38 Potential Incremental Radiological Impacts on Workers from Operation of the Defense Waste Processing Facility

Impact Area	Alternative				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Operational Years for DWPF	**N/A**	**10**	**6**	**13**	**N/A**
Total Workforce					
Number of radiation workers [a]	N/A	25	5	8	N/A
Collective dose (person-rem per year)	N/A	5.9	1.2	1.9	N/A
Annual LCFs [b]	N/A	0 (0.004)	0 (0.0007)	0 (0.001)	N/A
Life-of-Project LCFs [b]	N/A	0 (0.04)	0 (0.004)	0 (0.01)	N/A
Average Worker					
Dose (millirem per year) [c]	N/A	240	240	240	N/A
Annual LCF risk	N/A	0.0001	0.0001	0.0001	N/A
Life-of-Project LCF risk	N/A	0.001	0.0009	0.002	N/A

DWPF = Defense Waste Processing Facility; LCF = latent cancer fatality; MOX = mixed oxide; N/A = not applicable; WIPP = Waste Isolation Pilot Plant.

[a] Numbers represent full-time-equivalent workers based on an estimate that no more than 1 to 5 percent of the dose to the 500 badged workers at DWPF would be due to plutonium processing activities (plutonium canister handling, vitrification of additional plutonium-canister material, and handling/staging of plutonium-vitrified material for transport to the Glass Waste Storage Building).

[b] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Note: To convert metric tons to tons, multiply by 1.1023.

Source: DOE 1994: Section 4.1.11.2; SRNS 2012; WSRC 2008.

C.4 Los Alamos National Laboratory

C.4.1 Los Alamos National Laboratory Plutonium Facility

C.4.1.1 Construction

There would be no radiological risk to the public from any potential modification activities (e.g., glovebox installations/modifications/decontamination and decommissioning (D&D) and installation of equipment) at PF-4. Construction worker doses are expected; however, they were estimated not to exceed an annual workforce dose of 18 person-rem per year to 60 workers (about 40 full-time equivalent workers) (LANL 2012), which is equal to an average construction worker dose of 300 millirem per year. This equates to a total potential construction workforce dose of 140 person-rem over the estimated 8 years of facility modifications. This workforce would be monitored (badged).

C.4.1.2 Operations

Under all alternatives analyzed in this *SPD Supplemental EIS*, some level of pit disassembly and conversion processing would occur at PF-4. For all alternatives, under the PDCF Option for pit disassembly and conversion, and for the MOX, H-Canyon/HB-Line, and WIPP Alternatives, under the PDC Option for pit disassembly and conversion, 2 metric tons (2.2 tons) of plutonium would be processed at PF-4. For all action alternatives under the PF-4 and MFFF Option and the PF-4, H-Canyon/HB-Line, and MFFF Option for pit disassembly and conversion, 35 metric tons (38.6 tons) of plutonium would be processed at PF-4. **Tables C–39** and **C–40** present the projected incident-free radiological impacts from PF-4 pit disassembly and conversion operations.

Table C–39 Potential Radiological Impacts on the Public from Pit Disassembly and Conversion Operations at the Los Alamos National Laboratory Plutonium Facility

Impact Area	Alternative: No Action	Immobilization to DWPF	MOX Fuel	H-Canyon/ HB-Line to DWPF	WIPP
Operational Years for Processing at LANL PF-4 (2 MT Case/35 MT Case)	**7**	**7/22**	**7/22**	**7/22**	**7/22**
Population within 50 Miles (80 kilometers)					
Annual dose (person-rem)	0.025	0.025/0.21	0.025/0.21	0.025/0.21	0.025/0.21
Percent of natural background radiation [a]	1.2×10^{-5}	1.2×10^{-5} / 9.8×10^{-5}	1.2×10^{-5} / 9.8×10^{-5}	1.2×10^{-5} / 9.8×10^{-5}	1.2×10^{-5} / 9.8×10^{-5}
Annual LCFs [b]	0 (2×10^{-5})	0 (2×10^{-5} / 1×10^{-4})	0 (2×10^{-5} / 1×10^{-4})	0 (2×10^{-5} / 1×10^{-4})	0 (2×10^{-5} / 1×10^{-4})
Life-of-Project LCFs [b]	0 (1×10^{-4})	0 (1×10^{-4} / 3×10^{-3})	0 (1×10^{-4} / 3×10^{-3})	0 (1×10^{-4} / 3×10^{-3})	0 (1×10^{-4} / 3×10^{-3})
Maximally Exposed Individual					
Annual dose (millirem)	0.0097	0.0097/0.081	0.0097/0.081	0.0097/0.081	0.0097/0.081
Percent of natural background radiation [a]	0.0020	0.0020/0.017	0.0020/0.017	0.0020/0.017	0.0020/0.017
Annual LCF risk	6×10^{-9}	6×10^{-9} / 5×10^{-8}	6×10^{-9} / 5×10^{-8}	6×10^{-9} / 5×10^{-8}	6×10^{-9} / 5×10^{-8}
Life-of-Project LCF risk	4×10^{-8}	4×10^{-8} / 1×10^{-6}	4×10^{-8} / 1×10^{-6}	4×10^{-8} / 1×10^{-6}	4×10^{-8} / 1×10^{-6}
Average Exposed Individual within 50 Miles (80 kilometers) [c]					
Annual dose (millirem)	5.6×10^{-5}	5.6×10^{-5} / 4.7×10^{-4}	5.6×10^{-5} / 4.7×10^{-4}	5.6×10^{-5} / 4.7×10^{-4}	5.6×10^{-5} / 4.7×10^{-4}
Annual LCF risk	3×10^{-11}	3×10^{-11} / 3×10^{-10}	3×10^{-11} / 3×10^{-10}	3×10^{-11} / 3×10^{-10}	3×10^{-11} / 3×10^{-10}
Life-of-Project LCF risk	2×10^{-10}	2×10^{-10} / 6×10^{-9}	2×10^{-10} / 6×10^{-9}	2×10^{-10} / 6×10^{-9}	2×10^{-10} / 6×10^{-9}

DWPF = Defense Waste Processing Facility; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MOX = mixed oxide; MT = metric tons; PF-4 = Plutonium Facility; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] The annual natural background radiation dose at LANL is 480 millirem for the average individual; the population within 50 miles (80 kilometers) in 2020 would receive a dose of about 215,000 person-rem.

[b] Numbers of LCFs in the population are whole numbers; the statistically calculated values are provided in parentheses.

[c] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of LANL PF-4 in 2020 (approximately 448,000).

Note: To convert metric tons to tons, multiply by 1.1023.

Source: LANL 2012.

Table C–40 Potential Radiological Impacts on Workers from Pit Disassembly and Conversion Operations at the Los Alamos National Laboratory Plutonium Facility

Impact Area	Alternative: No Action	Immobilization to DWPF	MOX Fuel	H-Canyon/ HB-Line to DWPF	WIPP
Operational Years for Processing at LANL PF-4 (2 MT Case/35 MT Case)	**7**	**7/22**	**7/22**	**7/22**	**7/22**
Total Workforce					
Number of radiation workers	85	85/253	85/253	85/253	85/253
Collective dose (person-rem per year)	29	29/190	29/190	29/190	29/190
Annual LCFs [a]	0 (0.02)	0 (0.02/0.1)	0 (0.02/0.1)	0 (0.02/0.1)	0 (0.02/0.1)
Life-of-Project LCFs [a]	0 (0.1)	0 (0.1)/3 (2.5)	0 (0.1)/3 (2.5)	0 (0.1)/3 (2.5)	0 (0.1)/3 (2.5)
Average Worker					
Dose (millirem per year) [b]	340	340/760	340/760	340/760	340/760
Annual LCF risk	0.0002	0.0002/0.0005	0.0002/0.0005	0.0002/0.0005	0.0002/0.0005
Life-of-Project LCF risk	0.001	0.001/0.01	0.001/0.01	0.001/0.01	0.001/0.01

DWPF = Defense Waste Processing Facility; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MOX = mixed oxide; MT = metric tons; PF-4 = Plutonium Facility; WIPP = Waste Isolation Pilot Plant.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated value is provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Note: To convert metric tons to tons, multiply by 1.1023.

Source: LANL 2012.

C.5 Combined Impacts under Each Alternative

C.5.1 No Action Alternative

Construction. Construction workers would be monitored (badged), as appropriate. The impacts of construction of PDCF at F-Area would be the same under all alternatives. The only potential dose to workers would be from background radiation levels at SRS (see Section C.3). None of these exposures are expected to result in any additional LCFs to construction workforces.

Because there is no ground surface contamination in F-Area where PDCF would be constructed, there would be no additional radiological releases to the environment or impacts on the general population from ground disturbing construction activities at this location (DOE 1999; NRC 2005:4-7).

Operations. **Tables C–41** and **C–42** summarize the potential radiological impacts on workers and the general public, respectively, under the No Action Alternative. To facilitate comparison of the potential impacts of the alternatives, the estimated annual doses and latent cancer fatality (LCF) risks over the life of each facility are presented. The impacts over each facility's operating time frame were determined by multiplying the annual impacts by each facility's projected operating period.

Waste management activities would be conducted in support of surplus plutonium activities under this alternative at E-Area at SRS and principally at TA-54 at LANL. These activities are expected to result in negligible incremental impacts to both workers and the public from the staging of transuranic (TRU) waste awaiting shipment to WIPP, from potential storage of mixed low-level radioactive waste (MLLW) pending offsite shipment, or from storage or disposal of low-level radioactive waste (LLW).

Table C–41 Radiological Impacts on Workers from Operations Under the No Action Alternative

	SRS					*LANL*
	Support Facilities			*Pit Disassembly and Conversion*	*Disposition*	*Pit Disassembly and Conversion*
Impact Area	*K-Area Storage*	*KIS*	*WSB*	*PDCF*	*MFFF*	*PF-4*
Total Workforce						
Number of radiation workers	24	40	50	383	450	85
Collective dose (person-rem per year)	8.9	25	25	192	51	29
Annual LCFs [a]	0 (0.005)	0 (0.02)	0 (0.02)	0 (0.1)	0 (0.03)	0 (0.02)
Life-of-Project LCFs [a]	0 (0.2)	1 (0.6)	0 (0.3)	1	0 (0.6)	0 (0.1)
Average Worker						
Dose (millirem per year) [b]	370	630	500	500	113	340
Annual LCF risk	0.0002	0.0004	0.0003	0.0003	0.00007	0.0002
Life-of-Project LCF risk	0.009	0.02	0.006	0.003	0.001	0.001

KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WSB = Waste Solidification Building.

[a] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[b] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Table C–42 Radiological Impacts on the Public from Operations Under the No Action Alternative

Impact Area	SRS					LANL
	Principal Support Facilities			Pit Disassembly and Conversion Option	Disposition	Pit Disassembly and Conversion Option
	K-Area Storage [a]	KIS	WSB	PDCF	MFFF	PF-4
Population within 50 Miles (80 kilometers)						
Annual dose (person-rem)	0	4.3×10^{-5}	0.031	0.46	0.045	0.025
Percent of natural background radiation [b]	0	1.7×10^{-8}	1.1×10^{-5}	0.00017	1.7×10^{-5}	1.2×10^{-5}
Annual LCFs	0	0 (3×10^{-8})	0 (2×10^{-5})	0 (0.0003)	0 (3×10^{-5})	0 (2×10^{-5})
Life-of-Project LCFs [c]	0	0 (1×10^{-6})	0 (0.0004)	0 (0.003)	0 (0.0006)	0 (1×10^{-4})
Maximally Exposed Individual						
Annual dose (millirem)	0	8.5×10^{-7}	0.00063	0.0055	0.00050	0.0097
Percent of natural background radiation [b]	0	2.7×10^{-7}	0.00020	0.0018	0.00016	0.0020
Annual LCF risk	0	5×10^{-13}	4×10^{-10}	3×10^{-9}	3×10^{-10}	6×10^{-9}
Life-of-Project LCF risk	0	2×10^{-11}	8×10^{-9}	3×10^{-8}	6×10^{-9}	4×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [d]						
Annual dose (millirem)	0	5.3×10^{-8}	3.6×10^{-5}	0.00053	0.000052	5.6×10^{-5}
Annual LCF risk	0	3×10^{-14}	2×10^{-11}	3×10^{-10}	3×10^{-11}	3×10^{-11}
Life-of-Project LCF risk	0	1×10^{-12}	5×10^{-10}	3×10^{-9}	7×10^{-10}	2×10^{-10}

KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WSB = Waste Solidification Building.

[a] There would be no releases to the atmosphere resulting from storage of plutonium at K-Area and, therefore, no resulting public impacts.

[b] To provide perspective, doses can be compared to the estimated doses these same receptors would receive from natural background radiation (311 millirem per year assumed for SRS and 480 millirem per year at LANL for the average individual).

[c] Total number of LCFs in the population is a whole number; the statistically calculated total values are provided in parentheses.

[d] Obtained by dividing the SRS population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities in 2020 (approximately 809,000 for K-Area, 869,000 for F-Area, and 886,000 for H-Area), as well as by dividing the LANL population dose by the number of people projected to live within 50 miles (80 kilometers) of LANL PF-4 in 2020 (approximately 448,000).

C.5.2 Immobilization to DWPF Alternative

Construction. Construction workers would be monitored (badged) as appropriate. Under the Immobilization to DWPF Alternative, construction of the new immobilization capability at the K-Area Complex and minor modifications to DWPF to accommodate receipt of can-in-canisters from the immobilization capability would be required. The majority of the construction activities would occur in areas with dose rates close to background radiation levels, although there would be existing equipment that would require decontamination and removal. The total construction workforce dose would be 6.6 person-rem over the estimated 2 years during which decontamination and equipment removal would occur (see Section C.3.2.1).

Under the PF-4, H-Canyon/HB-Line, and MFFF Option, construction workforce doses would result from glovebox-related modifications at H-Canyon/HB-Line and glovebox modifications at K-Area. A total construction workforce dose of 0.5 person-rem could occur during the 2 years of modifications at H-Canyon/HB-Line (see Section C.3.3.1) A total construction workforce dose of 4.0 person-rem could occur during the 2 years of decontamination and equipment removal that would be required to support modifications in K-Area (see Section C.3.1.1).

The impacts of construction of PDCF at F-Area would be the same under all alternatives. The only potential dose to workers would be from background radiation levels at SRS (see Section C.3). Under the PF-4 and MFFF Option or the PF-4, H-Canyon/HB-Line, and MFFF Option, construction workers involved in the installation of metal oxidation furnaces at MFFF would likely receive doses only from background radiation levels at SRS.

At LANL PF-4, potential construction activities (e.g., glovebox installations, modifications, D&D, and installation of equipment) would be necessary to allow pit disassembly and conversion of up to 35 metric tons (38.6 tons) of plutonium. This could result in a total construction workforce dose of 140 person-rem over the estimated 8-year construction duration at the facility (see Section C.4.1.1).

None of these exposures is expected to result in any additional LCFs in construction workforces.

Construction of PDCF would not result in radiological impacts on the general population at the site boundary and beyond. Similarly, installation of metal oxidation furnaces in MFFF would not result in radiological impacts on the public. Construction of the immobilization capability at the K-Area Complex would involve decontamination, demolition, construction, and modification activities, including removal of contaminated equipment and piping. No radiological impacts on the public from these activities are expected, however, because all operations involving radioactive materials would occur within the K-Area reactor building and would be subject to strict controls (WSRC 2008). Releases of radioactive materials to the environment caused by modifications to DWPF to accommodate the can-in-canisters are not expected. In addition, no impacts on the public would result from modifications to H-Canyon/HB-Line or modifications to a K-Area glovebox.

Operations. **Tables C–43** and **C–44** summarize the potential radiological impacts on workers and the general public, respectively, under the Immobilization to DWPF Alternative. To facilitate comparison of the potential impacts of the alternatives, the estimated annual doses and LCF risks over the life of each facility are presented. The impacts over each facility's operating timeframe were determined by multiplying the annual impacts by each facility's projected operating period.

Activities at E-Area in support of the Immobilization to DWPF Alternative are expected to result in negligible incremental impacts on both workers and the public from the staging of TRU waste awaiting shipment to WIPP, from potential storage of MLLW pending offsite shipment, and from storage or disposal of LLW. Similarly, at LANL, no incremental impacts on either workers or the public are expected from operations at the waste management facilities.

C.5.3 MOX Fuel Alternative

Construction. Under the PDC Option, construction of PDC at K-Area would entail decontamination and removal of existing equipment. The total workforce dose over the 2 years required for decontamination and equipment removal in support of PDC construction would be 1.0 person-rem (see Section C.3.1.1)

Under the PF-4, H-Canyon/HB-Line, and MFFF Option, construction worker doses would be the same as discussed for the Immobilization to DWPF Alternative. A total construction workforce dose of 0.5 person-rem could occur during the 2 years of modifications at H-Canyon/HB-Line (see Section C.3.3.1) A total construction workforce dose of 4.0 person-rem could occur during the 2 years of decontamination and equipment removal that would be required to support modifications in K-Area (see Section C.3.1.1).

The impacts of construction of PDCF at F-Area would be the same under all alternatives. The only potential dose to workers would be from background radiation levels at SRS (see Section C.3). Under the PF-4 and MFFF Option or the PF-4, H-Canyon/HB-Line, and MFFF Option, construction workers involved in the installation of metal oxidation furnaces at MFFF would likely receive doses only from background radiation levels at SRS.

Table C–43 Radiological Impacts on Workers from Operations Under the Immobilization to DWPF Alternative

	Support Facilities			Pit Disassembly and Conversion Options						Disposition		
					PF-4 at LANL and MFFF [a] at SRS		PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS					
							SRS					
Impact Area	*K-Area Storage*	*KIS*	*WSB*	*PDCF*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/35 MT Case)*	*H-Canyon/ HB-Line/ K-Area Glovebox [b]*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*Immobilization Capability*	*DWPF*	*MFFF*
Total Workforce												
Number of radiation workers	24	40	50	383	35	85 / 253	100 / 50	35	85 / 253	314	25	450
Collective dose (person-rem per year)	8.9	25	25	192	2.3	29 / 190	29 / 38	2.3	29 / 190	314	5.9	51
Annual LCFs [c]	0 (0.005)	0 (0.02)	0 (0.02)	0 (0.1)	0 (0.001)	0 (0.02 / 0.1)	0 (0.02 / 0.02)	0 (0.001)	0 (0.02 / 0.1)	0 (0.2)	0 (0.004)	0 (0.03)
Life-of-Project LCFs [c]	0 (0.1)	0 (0.2)	0 (0.3)	1	0 (0.03)	0 (0.1) / 3	0 (0.3) / 0 (0.3)	0 (0.03)	0 (0.1) / 3	2	0 (0.04)	1 (0.6)
Dose (millirem per year) [d]	370	630	500	500	65	340 / 760	290 / 760	65	340 / 760	1,000	236	113
Annual LCF Risk	0.0002	0.0004	0.0003	0.0003	0.00004	0.0002 / 0.0005	0.0002 / 0.0005	0.00004	0.0002 / 0.0005	0.0006	0.0001	0.00007
Life-of-Project LCF Risk	0.004	0.006	0.007	0.004	0.0008	0.001 / 0.01	0.002 / 0.006	0.0008	0.001 / 0.01	0.006	0.001	0.001

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MT = metric tons; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WSB = Waste Solidification Building;

[a] At SRS, pit conversion would be carried out at MFFF using metal oxidation furnaces and/or at H-Canyon/HB-Line.

[b] At SRS, conversion of plutonium metal in H-Canyon/HB-Line would complement pit disassembly occurring in a K-Area glovebox.

[c] Numbers of LCFs in the worker population are whole numbers; the statistically calculated values are provided in parentheses.

[d] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Note: To convert metric tons to tons, multiply by 1.1023.

Table C–44 Radiological Impacts on the Public from Operations Under the Immobilization to DWPF Alternative

Impact Area	*Support Facilities*			*Pit Disassembly and Conversion Options*						*Disposition*		
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS*					
							SRS					
Impact Area	***K-Area Storage [a]***	***KIS***	***WSB***	***PDCF***	***Metal Oxidation Furnaces at MFFF***	***PF-4 (2 MT Case/ 35 MT Case)***	***H-Canyon/ HB-Line [b]***	***Metal Oxidation Furnaces at MFFF***	***PF-4 (2 MT Case/ 35 MT Case)***	***Immobilization Capability***	***DWPF [c]***	***MFFF***
Population within 50 Miles (80 kilometers)												
Annual dose (person-rem)	0	4.3×10^{-5}	0.031	0.46	0.37	0.025/0.21	0.26	0.37	0.025/0.21	0.00062	0	0.045
Percent of natural background radiation [d]	0	1.7×10^{-8}	1.1×10^{-5}	0.00017	0.00014	1.2×10^{-5} / 9.8×10^{-5}	9.6×10^{-5}	0.00014	1.2×10^{-5} / 9.8×10^{-5}	2.5×10^{-7}	0	1.7×10^{-5}
Annual LCFs [c]	0	0 (3×10^{-8})	0 (2×10^{-5})	0 (0.0003)	0 (0.0002)	0 (2×10^{-5}/1×10^{-4})	0 (0.0002)	0 (0.0002)	0 (2×10^{-5}/ 1×10^{-4})	0 (4×10^{-7})	0	0 (3×10^{-5})
Life-of-Project LCFs [e]	0/0	0 (4×10^{-7})	0 (0.0004)	0 (0.003)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0 (0.002)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0 (4×10^{-6})	0	0 (0.0006)
Maximally Exposed Individual												
Annual dose (millirem)	0	8.5×10^{-7}	0.00063	0.0055	0.0041	0.0097/0.081	0.0024	0.0041	0.0097/0.081	7.5×10^{-6}	0	0.00050
Percent of natural background radiation [d]	0	2.7×10^{-7}	0.00020	0.0018	0.0013	0.0020/0.017	0.00077	0.0013	0.0020/0.017	2.4×10^{-8}	0	0.00016
Annual LCF risk	0	5×10^{-13}	4×10^{-10}	3×10^{-9}	2×10^{-9}	6×10^{-9}/ 5×10^{-8}	1×10^{-9}	2×10^{-9}	6×10^{-9}/ 5×10^{-8}	5×10^{-12}	0	3×10^{-10}
Life-of-Project LCF risk	0/0	8×10^{-12}	9×10^{-9}	4×10^{-8}	5×10^{-8}	4×10^{-8}/ 1×10^{-6}	2×10^{-8}	5×10^{-8}	4×10^{-8}/ 1×10^{-6}	5×10^{-11}	0	6×10^{-9}
Average Exposed Individual within 50 Miles (80 kilometers) [f]												
Annual dose (millirem)	0	5.3×10^{-8}	3.6×10^{-5}	0.00053	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0.00029	0.00043	5.6×10^{-5} / 4.7×10^{-4}	7.7×10^{-7}	0	5.2×10^{-5}
Annual LCF risk	0	3×10^{-14}	2×10^{-11}	3×10^{-10}	3×10^{-10}	3×10^{-11}/ 3×10^{-10}	2×10^{-10}	3×10^{-10}	3×10^{-11}/ 3×10^{-10}	5×10^{-13}	0	3×10^{-11}
Life-of-Project LCF risk	0/0	5×10^{-13}	5×10^{-10}	4×10^{-9}	5×10^{-9}	2×10^{-10}/ 6×10^{-9}	2×10^{-9}	5×10^{-9}	2×10^{-10}/ 6×10^{-9}	5×10^{-12}	0	7×10^{-10}

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MT = metric tons; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WSB= Waste Solidification Building.

[a] There would be no releases to the atmosphere from K-Area storage activities and, therefore, no resulting public impacts.

[b] Potential doses to members of the public from pit disassembly activities in K-Area gloveboxes would be extremely small due to *de minimis* releases from such activities and would be expected to be a fraction of those from the K-Area Interim Surveillance Capability (SRNS 2012).

[c] There would be no additional releases to the atmosphere from DWPF facility operations associated with this alternative and therefore no resulting public impacts.

[d] To provide perspective, doses can be compared to the estimated doses these same receptors would receive from natural background radiation (311 millirem per year assumed for SRS and 480 millirem per year at LANL for the average individual).

[e] The number of LCFs in the population is a whole number; the statistically calculated total values are provided in parentheses.

[f] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities and LANL PF-4 in 2020 (approximately 809,000 for K-Area, 869,000 for F-Area, and 886,000 for H-Area; 448,000 for LANL PF-4).

Note: To convert metric tons to tons, multiply by 1.1023.

At LANL PF-4, construction activities would be the same as discussed under the Immobilization to DWPF Alternative for pit disassembly and conversion of 35 metric tons (38.6 tons) of plutonium. This could result in a total construction workforce dose of 140 person-rem over the estimated 8-year construction duration at the facility (see Section C.4.1.1).

None of these exposures is expected to result in any additional LCFs in construction workforces.

Construction of PDCF would not result in radiological impacts on the general population at the site boundary and beyond. Similarly, potential PDC construction activities would not be expected to result in any radiological impacts on the public. In addition, no impacts on the public would result from modification to H-Canyon/HB-Line or from modifications to a K-Area glovebox. Any other potential construction activities, such as at MFFF (e.g., installation of metal oxidation furnaces), would not result in radiological impacts on the public. Similarly, PF-4 construction activities at LANL would not result in any radiological impacts on the public.

Operations. **Tables C–45** and **C–46** summarize the potential radiological impacts on workers and the general public, respectively, under the MOX Fuel Alternative. To facilitate comparison of the potential impacts of the alternatives, the estimated annual doses and LCF risks over the life of each facility are presented. The impacts over each facility's operating timeframe were determined by multiplying the annual impacts by each facility's projected operating period.

Activities at E-Area, in support of the MOX Fuel Alternative are expected to result in negligible incremental impacts on both workers and the public from the staging of TRU waste awaiting shipment to WIPP or any potential MLLW pending offsite shipment, as well as storage/disposal of LLW. Similarly, at LANL, no incremental impacts on either workers or the public are expected from operations at the waste management support facilities.

C.5.4 H-Canyon/HB-Line to DWPF Alternative

Construction. The impacts of construction activities under the H-Canyon/HB-Line to DWPF Alternative would be the same as those under the MOX Fuel Alternative for all potential facilities and functions at F-, K-, or H-Area at SRS, as well as at PF-4 at LANL.

As an additional note under this alternative, however, there could likely be minor modifications at H-Canyon/HB-Line to prepare non-pit plutonium for DWPF vitrification. Operators may change out or reconfigure some tanks and/or piping to increase plutonium storage capacity. Furthermore, HB-Line may reactivate its scrap recovery south line and change out some unused equipment and add additional equipment to implement vacuum salt distillation and sodium peroxide fusion in the effort to minimize equipment corrosion and increase dissolving-throughput-rates. However, no incremental doses to such construction/modification workers carrying out such functions would be expected.

In all cases, no construction worker exposures are expected to result in additional LCFs to construction workforces.

As is the case in the alternatives discussed above, none of the construction would result in any radiological impacts to the public.

Operations. **Tables C–47** and **C–48** summarize the potential radiological impacts on workers and the general public, respectively, under the H-Canyon/HB-Line to DWPF Alternative. To facilitate comparison of the potential impacts of the alternatives, the estimated annual doses and LCF risks over the life of each facility are presented. The impacts over each facility's operating time frame were determined by multiplying the annual impacts by each facility's projected operating period.

Table C–45 Radiological Impacts On Workers from Operations Under the MOX Fuel Alternative

Impact Area	Support Facilities			Pit Disassembly and Conversion Options						Disposition		
					PF-4 at LANL and MFFF [a] at SRS		PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS					
							SRS					
	K-Area Storage	KIS	WSB	PDCF / PDC	Metal Oxidation Furnaces at MFFF	PF-4 (2 MT Case/ 35 MT Case)	H-Canyon/ HB-Line/ K-Area Glovebox [b]	Metal Oxidation Furnaces at MFFF	PF-4 (2 MT Case/ 35 MT Case)	DWPF	MFFF	H-Canyon/ HB-Line Preparation for WIPP
Total Workforce												
Number of radiation workers	24	40	50	383 / 383	35	85 / 253	100 / 50	35	85 / 253	5	450	130
Collective dose (person-rem per year)	8.9	25	25	192 / 192	2.3	29 / 190	29 / 38	2.3	29 / 190	1.2	51	20
Annual LCFs [c]	0 (0.005)	0 (0.02)	0 (0.02)	0 (0.1 / 0.1)	0 (0.001)	0 (0.02 / 0.1)	0 (0.02 / 0.02)	0 (0.0010)	0 (0.02 / 0.1)	0 (0.0007)	0 (0.03)	0 (0.01)
Life-of-Project LCFs [c]	0 (0.1)	0 (0.1)	0 (0.4)	1 / 1	0 (0.03)	0 (0.1) / 3	0 (0.2) / 0 (0.3)	0 (0.03)	0 (0.1) / 3	0 (0.004)	1 (0.7)	0 (0.1)
Average Worker												
Dose (millirem per year) [d]	370	630	500	500 / 500	65	340 / 760	290 / 760	65	340 / 760	236	113	150
Annual LCF Risk	0.0002	0.0004	0.0003	0.0003 / 0.0003	0.00004	0.0002 / 0.0005	0.0002 / 0.0005	0.00004	0.0002 / 0.0005	0.0001	0.00007	0.00009
Life-of-Project LCF Risk	0.005	0.003	0.007	0.004 / 0.004	0.0008	0.001 / 0.01	0.002 / 0.006	0.0008	0.001 / 0.01	0.0008	0.002	0.0009

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; MT = metric tons; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant; WSB= Waste Solidification Building.

[a] At SRS, pit conversion would be carried out at MFFF using metal oxidation furnaces and/or at H-Canyon/HB-Line.

[b] At SRS, conversion of plutonium metal in H-Canyon/HB-Line would complement pit disassembly occurring in a K-Area glovebox.

[c] The numbers of LCFs in the worker population are whole numbers; statistically calculated values are provided in parentheses.

[d] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Note: To convert metric tons to tons, multiply by 1.1023.

Table C–46 Radiological Impacts on the Public from Operations Under the MOX Fuel Alternative

Impact Area	Support Facilities			Pit Disassembly and Conversion Options						Disposition		
					PF-4 at LANL and MFFF [a] at SRS		PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS					
							SRS					
	K-Area Storage [a]	KIS	WSB	PDCF / PDC	Metal Oxidation Furnaces at MFFF	PF-4 (2 MT Case / 35 MT Case)	H-Canyon/ HB-Line [b]	Metal Oxidation Furnaces at MFFF	PF-4 (2 MT Case/ 35 MT Case)	DWPF [c]	MFFF [d]	H-Canyon/ HB-Line Preparation for WIPP
Population within 50 Miles (80 kilometers)												
Annual dose (person-rem)	0	4.3×10^{-5}	0.031	0.46 / 0.44	0.37	0.025 / 0.21	0.26	0.37	0.025 / 0.21	0	0.052	0.26
Percent of natural background radiation [e]	0	1.7×10^{-8}	1.1×10^{-5}	0.00017 / 0.00018	0.00014	1.2×10^{-5} / 9.8×10^{-5}	9.6×10^{-5}	0.00014	1.2×10^{-5} / 9.8×10^{-5}	0	1.9×10^{-5}	9.6×10^{-5}
Annual LCFs [f]	0	0 (3×10^{-8})	0 (2×10^{-5})	0 (0.0003 / 0.0003)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0 (0.0002)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0	0 (3×10^{-5})	0 (0.0002)
Life-of-Project LCFs [f]	0	0 (2×10^{-7})	0 (0.0005)	0 (0.003) / 0 (0.003)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0 (0.002)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0	0 (0.0007)	0 (0.002)
Maximally Exposed Individual												
Annual dose (millirem)	0	8.5×10^{-7}	0.00063	0.0055 / 0.0061	0.0041	0.0097 / 0.081	0.0024	0.0041	0.0097/0.081	0	0.00058	0.0024
Percent of natural background radiation [e]	0	2.7×10^{-7}	0.00020	0.0018 / 0.0020	0.0013	0.0020 / 0.017	0.00077	0.0013	0.0020/0.017	0	0.00019	0.00077
Annual LCF risk	0	5×10^{-13}	4×10^{-10}	3×10^{-9} / 4×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	1×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	0	4×10^{-10}	1×10^{-9}
Life-of-Project LCF risk	0	4×10^{-12}	9×10^{-9}	4×10^{-8} / 4×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	2×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	0	8×10^{-9}	1×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [g]												
Annual dose (millirem)	0	5.3×10^{-8}	3.6×10^{-5}	0.00053 / 0.00055	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0.00029	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0	6.0×10^{-5}	0.00029
Annual LCF risk	0	3×10^{-14}	2×10^{-11}	3×10^{-10}/ 3×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	2×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	0	4×10^{-11}	2×10^{-10}
Life-of-Project LCF risk	0	2×10^{-13}	5×10^{-10}	4×10^{-9}/ 4×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	2×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	0	9×10^{-10}	2×10^{-9}

Impact Area	Support Facilities			Pit Disassembly and Conversion Options						Disposition		
					PF-4 at LANL and MFFF [a] at SRS		PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS					
							SRS					
	K-Area Storage [a]	KIS	WSB	PDCF / PDC	Metal Oxidation Furnaces at MFFF	PF-4 (2 MT Case / 35 MT Case)	H-Canyon/ HB-Line [b]	Metal Oxidation Furnaces at MFFF	PF-4 (2 MT Case/ 35 MT Case)	DWPF [c]	MFFF [d]	H-Canyon/ HB-Line Preparation for WIPP

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; MT = metric tons; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] There would be no releases to the atmosphere from storage of plutonium at K-Area and, therefore, no public impacts.

[b] Potential doses to members of the public from pit disassembly activities in K-Area gloveboxes would be extremely small due to *de minimis* releases from such activities, and would be expected to be a fraction of those from the K-Area Interim Surveillance Capability (SRNS 2012).

[c] There would be no additional releases to the atmosphere from DWPF facility operations associated with this alternative and, therefore, no resulting public impacts.

[d] At MFFF, 45.1 metric tons of plutonium would be processed over a 24-year period; this would result in an estimated annual throughput rate difference of about 15 percent over the duration of the No Action Alternative (34 metric tons over 21 years).

[e] To provide perspective, doses can be compared to the estimated doses these same receptors would receive from natural background radiation (311 millirem per year at SRS and 480 millirem per year at LANL for the average individual).

[f] The number of LCFs in the population is a whole number; the statistically calculated total values are provided in parentheses.

[g] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities and LANL PF-4 in 2020 (approximately 809,000 for K-Area, 869,000 for F-Area, and 886,000 for H-Area; 448,000 for LANL PF-4).

Note: To convert metric tons to tons, multiply by 1.1023.

Table C–47 Radiological Impacts On Workers from Operations Under the H-Canyon/HB-Line to DWPF Alternative

	Support Facilities			***Pit Disassembly and Conversion Options***						***Disposition***		
					PF-4 at LANL and MFFF [a] at SRS		***PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS***					
							SRS					
Impact Area	***K-Area Storage***	***KIS***	***WSB***	***PDCF / PDC***	***Metal Oxidation Furnaces at MFFF***	***PF-4 (2 MT Case/ 35 MT Case)***	***H-Canyon/ HB-Line/ K-Area Glovebox [b]***	***Metal Oxidation Furnaces at MFFF***	***PF-4 (2 MT Case/ 35 MT Case)***	***DWPF***	***MFFF***	***H-Canyon/ HB-Line (Dissolution to DWPF)***
Total Workforce												
Number of radiation workers	24	40	50	383 / 383	35	85 / 253	100 / 50	35	85 / 253	8	450	14
Collective dose (person-rem per year)	8.9	25	25	192 / 192	2.3	29 / 190	29 / 38	2.3	29 / 190	1.9	51	7.0
Annual LCFs [c]	0 (0.005)	0 (0.02)	0 (0.02)	0 (0.1 / 0.1)	0 (0.001)	0 (0.02 / 0.1)	0 (0.02 / 0.02)	0 (0.001)	0 (0.02 / 0.1)	0 (0.001)	0 (0.03)	0 (0.004)
Life-of-Project LCFs [c]	0 (0.1)	0 (0.2)	0 (0.3)	1 / 1	0 (0.03)	0 (0.1) / 3	0 (0.2) / 0 (0.3)	0 (0.03)	0 (0.1) / 3	0 (0.02)	1 (0.7)	0 (0.06)
Average Worker												
Dose (millirem per year) [d]	370	630	500	500 / 500	65	340 / 760	290 / 760	65	340 / 760	236	113	500
Annual LCF Risk	0.0002	0.0004	0.0003	0.0003 / 0.0003	0.00004	0.0002 / 0.0005	0.0002 / 0.0005	0.00004	0.0002 / 0.0005	0.0001	0.00007	0.0003
Life-of-Project LCF Risk	0.005	0.004	0.007	0.004 / 0.004	0.0008	0.001 / 0.01	0.002 / 0.006	0.0008	0.001 / 0.01	0.002	0.002	0.004

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MT = metric tons; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WSB= Waste Solidification Building.

[a] At SRS, pit conversion would be carried out at MFFF using metal oxidation furnaces and/or at H-Canyon/HB-Line.

[b] At SRS, conversion of plutonium metal in H-Canyon/HB-Line would complement pit disassembly occurring in a K-Area glovebox.

[c] The numbers of LCFs in the worker population are whole numbers; statistically calculated values are provided in parentheses.

[d] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Note: To convert MT to tons, multiply by 1.1023.

Table C–48 Radiological Impacts on the Public from Operations Under the H-Canyon/HB-Line to DWPF Alternative

	Support Facilities			*Pit Disassembly and Conversion Options*						*Disposition*		
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS*					
							SRS					
Impact Area	***K-Area Storage [a]***	***KIS***	***WSB***	***PDCF / PDC***	***Metal Oxidation Furnaces at MFFF)***	***PF-4 (2 MT Case/ 35 MT Case)***	***H-Canyon/ HB-Line [b]***	***Metal Oxidation Furnaces at MFFF)***	***PF-4 (2 MT Case/ 35 MT Case)***	***DWPF [c]***	***MFFF [d]***	***H-Canyon/ HB-Line Dissolution to DWPF***
Population within 50 Miles (80 kilometers)												
Annual dose (person-rem)	0	4.3×10^{-5}	0.031	0.46 / 0.44	0.37	0.025/0.21	0.26	0.37	0.025/0.21	0	0.050	0.0060
Percent of natural background radiation [e]	0	1.7×10^{-8}	1.1×10^{-5}	0.00017 / 0.00018	0.00014	1.2×10^{-5} / 9.8×10^{-5}	9.6×10^{-5}	0.00014	1.2×10^{-5} / 9.8×10^{-5}	0	1.9×10^{-5}	2.2×10^{-6}
Annual LCFs [f]	0	0 (3×10^{-8})	0 (2×10^{-5})	0 (0.0003 / 0.0003)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0 (0.0002)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0	0 (3×10^{-5})	0 (4×10^{-6})
Life-of-Project LCFs [f]	0 / 0	0 (2×10^{-7})	0 (0.0005)	0 (0.003) / 0 (0.003)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0 (0.002)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0	0 (0.0007)	0 (5×10^{-5})
Maximally Exposed Individual												
Annual dose (millirem)	0	8.5×10^{-7}	0.00063	0.0055 / 0.0061	0.0041	0.0097/0.081	0.0024	0.0041	0.0097/0.081	0	0.00055	4.3×10^{-5}
Percent of natural background radiation [e]	0	2.7×10^{-7}	0.00020	0.0018 / 0.0020	0.0013	0.0020/0.017	0.00077	0.0013	0.0020/0.017	0	0.00018	1×10^{-5}
Annual LCF risk	0	5×10^{-13}	4×10^{-10}	3×10^{-9} / 4×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	1×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	0	3×10^{-10}	3×10^{-11}
Life-of-Project LCF risk	0 / 0	4×10^{-12}	9×10^{-9}	4×10^{-8} / 4×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	2×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	0	8×10^{-9}	3×10^{-10}
Average Exposed Individual within 50 Miles (80 kilometers) [g]												
Annual dose (millirem)	0	5.3×10^{-8}	3.6×10^{-5}	0.00053 / 0.00055	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0.00029	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0	5.7×10^{-5}	6.8×10^{-6}
Annual LCF risk	0	3×10^{-14}	2×10^{-11}	3×10^{-10}/ 3×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	2×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	0	3×10^{-11}	4×10^{-12}
Life-of-Project LCF risk	0 / 0	2×10^{-13}	5×10^{-10}	4×10^{-9}/ 4×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	2×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	0	8×10^{-10}	5×10^{-11}

	Support Facilities			***Pit Disassembly and Conversion Options***						***Disposition***		
					PF-4 at LANL and MFFF [a] at SRS		***PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS***					
							SRS					
Impact Area	***K-Area Storage [a]***	***KIS***	***WSB***	***PDCF / PDC***	***Metal Oxidation Furnaces at MFFF)***	***PF-4 (2 MT Case/ 35 MT Case)***	***H-Canyon/ HB-Line [b]***	***Metal Oxidation Furnaces at MFFF)***	***PF-4 (2 MT Case/ 35 MT Case)***	***DWPF [c]***	***MFFF [d]***	***H-Canyon/ HB-Line Dissolution to DWPF***

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MT = metric tons; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WSB= Waste Solidification Building.

[a] There would be no releases to the atmosphere from storage of plutonium at K-Area and, therefore, no resulting public impacts for either of the cases presented.

[b] Potential doses to members of the public from pit disassembly activities in K-Area gloveboxes would be extremely small due to *de minimis* releases from such activities, and would be expected to be a fraction of those from the K-Area Interim Surveillance Capability (SRNS 2012).

[c] There would be no additional releases to the atmosphere from DWPF facility operations associated with this alternative and, therefore, no resulting public impacts.

[d] At MFFF, 41.1 metric tons of plutonium would be processed over a 23-year period; this would result in an estimated annual throughput rate difference of about 10 percent over the duration of the No Action Alternative (34 metric tons over 21 years).

[e] To provide perspective, doses can be compared to the estimated doses these same receptors would receive from natural background radiation (311 millirem per year assumed for SRS and 480 millirem per year at LANL for the average individual).

[f] The number of LCFs in the population is a whole number; the statistically calculated total values are provided in parentheses.

[g] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities and LANL PF-4 in 2020 (approximately 809,000 for K-Area, 869,000 for F-Area, and 886,000 for H-Area; 448,000 for LANL PF-4).

Note: To convert MT to tons, multiply by 1.1023.

Activities at E-Area in support of the H-Canyon/HB-Line to DWPF Alternative are expected to result in negligible incremental impacts to both workers and the public from the staging of TRU waste awaiting shipment to WIPP or any potential MLLW pending offsite shipment, as well as storage/disposal of LLW. Similarly, at LANL, no incremental impacts on either workers or the public are expected from operations at the waste management facilities.

C.5.5 WIPP Alternative

Construction. The impacts of construction discussed under the MOX Fuel Alternative would also apply to the WIPP Alternative. In addition, under the option to dispose of 6 metric tons (6.6 tons) of plutonium to WIPP, modifications would be required at H-Canyon/HB-Line. The total construction workforce dose of 1.2 person-rem would occur over the estimated 2 years required for modifications (see C.3.3.1).

In all cases, no construction worker exposures are expected to result in additional LCFs in construction workforces.

As is the case in the alternatives discussed above, none of the construction would result in any radiological impacts on the public.

Operations. **Tables C–49** and **C–50** summarize the potential radiological impacts on workers and the general public, respectively, under the WIPP Alternative. To facilitate comparison of the potential impacts of the alternatives, the estimated annual doses and LCF risks over the life of each facility are presented. The impacts over each facility's operating timeframe were determined by multiplying the annual impacts by each facility's projected operating period.

Activities at E-Area in support of the WIPP Alternative are expected to result in negligible incremental impacts on both workers and the public from the staging of TRU waste awaiting shipment to WIPP or any potential MLLW pending offsite shipment, as well as storage/disposal of LLW. Similarly, at LANL, no incremental impacts on either workers or the public are expected from operations at the waste management facilities.

Table C–49 Potential Radiological Impacts On Workers from Operations Under the WIPP Alternative

	Support Facilities			*Pit Disassembly and Conversion Options*						*Disposition*	
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS*				
							SRS				
Impact Area	***K-Area Storage***	***KIS***	***WSB***	***PDCF / PDC***	***Metal Oxidation Furnaces at MFFF***	***PF-4 (2 MT Case/ 35 MT Case)***	***H-Canyon/ HB-Line / K-Area Glovebox [b]***	***Metal Oxidation Furnaces at MFFF***	***PF-4 (2 MT Case/ 35 MT Case)***	***MFFF***	***H-Canyon/ HB-Line (Preparation for WIPP)***
Total Workforce											
Number of radiation workers	24	40	50	383 / 383	35	85 / 253	100 / 50	35	85 / 253	450	130
Collective dose (person-rem per year)	8.9	25	25	190 / 190	2.3	29 / 190	29 / 38	2.3	29 / 190	51	60
Annual LCFs [c]	0 (0.005)	0 (0.02)	0 (0.02)	0 (0.1 / 0.1)	0 (0.001)	0 (0.02 / 0.1)	0 (0.02 / 0.02)	0 (0.001)	0 (0.02 / 0.1)	0 (0.03)	0 (0.04)
Life-of-Project LCFs [c]	0 (0.1)	0 (0.1)	0 (0.4)	1 / 1	0 (0.03)	0 (0.1) / 3	0 (0.2) / 0 (0.3)	0 (0.03)	0 (0.1) / 3	1 (0.7)	0 (0.5)
Average Worker											
Dose (millirem per year) [d]	370	630	500	500 / 500	65	340 / 760	290 / 760	65	340 / 760	110	460
Annual LCF Risk	0.0002	0.0004	0.0003	0.0003 / 0.0003	0.00004	0.0002 / 0.0005	0.0002 / 0.0005	0.00004	0.0002 / 0.0005	0.00007	0.0003
Life-of-Project LCF Risk	0.005	0.003	0.007	0.004 / 0.004	0.0008	0.001 / 0.01	0.002 / 0.006	0.0008	0.001 / 0.01	0.002	0.004

KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MT = metric tons; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] At SRS, pit conversion would be carried out at MFFF using metal oxidation furnaces and/or H-Canyon/HB-Line.

[b] At SRS, conversion of plutonium metal in H-Canyon/HB-Line would complement pit disassembly occurring in a K-Area glovebox.

[c] The numbers of LCFs in the worker population are whole numbers; statistically calculated values are provided in parentheses.

[d] Engineering and administrative controls would be implemented to maintain individual worker doses below 2,000 millirem per year and as low as reasonably achievable (DOE 2005a, 2009).

Note: To convert metric tons to tons, multiply by 1.1023.

Table C–50 Radiological Impacts on the Public from Operations Under the WIPP Alternative

Impact Area	*Support Facilities*			*Pit Disassembly and Conversion Options*						*Disposition*		
					PF-4 at LANL and MFFF [a] at SRS		*PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS*					
							SRS					
	K-Area Storage [a]	*KIS*	*WSB*	*PDCF / PDC*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*H-Canyon/ HB-Line [b]*	*Metal Oxidation Furnaces at MFFF*	*PF-4 (2 MT Case/ 35 MT Case)*	*DWPF [c]*	*MFFF [d]*	*H-Canyon/ HB-Line Preparation for WIPP*
Population within 50 Miles (80 kilometers)												
Annual dose (person-rem)	0	4.3×10^{-5}	0.031	0.46 / 0.44	0.37	0.025 / 0.21	0.26	0.37	0.025 / 0.21	0	0.050	0.26
Percent of natural background radiation [e]	0	1.7×10^{-8}	1.1×10^{-5}	0.00017 / 0.00018	0.00014	1.2×10^{-5} / 9.8×10^{-5}	9.6×10^{-5}	0.00014	1.2×10^{-5} / 9.8×10^{-5}	0	1.9×10^{-5}	9.6×10^{-5}
Annual LCFs [f]	0	0 (3×10^{-8})	0 (2×10^{-5})	0 (0.0003 / 0.0003)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0 (0.0002)	0 (0.0002)	0 (2×10^{-5} / 1×10^{-4})	0	0 (3×10^{-5})	0 (0.0002)
Life-of-Project LCFs [f]	0/0	0 (2×10^{-7})	0 (0.0005)	0 (0.003) / 0 (0.003)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0 (0.002)	0 (0.004)	0 (1×10^{-4} / 3×10^{-3})	0	0 (0.0007)	0 (0.002)
Maximally Exposed Individual												
Annual dose (millirem)	0	8.5×10^{-7}	0.00063	0.0055 / 0.0061	0.0041	0.0097/0.081	0.0024	0.0041	0.0097/0.081	0	0.00055	0.0024
Percent of natural background radiation [e]	0	2.7×10^{-7}	0.00020	0.0018 / 0.0020	0.0013	0.0020/0.017	0.00077	0.0013	0.0020/0.017	0	0.00018	0.00077
Annual LCF risk	0	5×10^{-13}	4×10^{-10}	3×10^{-9} / 4×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	1×10^{-9}	2×10^{-9}	6×10^{-9} / 5×10^{-8}	0	3×10^{-10}	1×10^{-9}
Life-of-Project LCF risk	0/0	4×10^{-12}	9×10^{-9}	4×10^{-8} / 4×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	2×10^{-8}	5×10^{-8}	4×10^{-8} / 1×10^{-6}	0	8×10^{-9}	2×10^{-8}
Average Exposed Individual within 50 Miles (80 kilometers) [g]												
Annual dose (millirem)	0	5.3×10^{-8}	3.6×10^{-5}	0.00053 / 0.00055	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0.00029	0.00043	5.6×10^{-5} / 4.7×10^{-4}	0	5.7×10^{-5}	0.00029
Annual LCF risk	0	3×10^{-14}	2×10^{-11}	3×10^{-10}/ 3×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	2×10^{-10}	3×10^{-10}	3×10^{-11} / 3×10^{-10}	0	3×10^{-11}	2×10^{-10}
Life-of-Project LCF risk	0/0	2×10^{-13}	5×10^{-10}	4×10^{-9}/ 4×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	2×10^{-9}	5×10^{-9}	2×10^{-10} / 6×10^{-9}	0	8×10^{-10}	2×10^{-9}

	Support Facilities			***Pit Disassembly and Conversion Options***						***Disposition***		
					PF-4 at LANL and MFFF [a] at SRS		***PF-4 at LANL and H-Canyon/HB-Line and MFFF [a] at SRS***					
							SRS					
Impact Area	***K-Area Storage [a]***	***KIS***	***WSB***	***PDCF / PDC***	***Metal Oxidation Furnaces at MFFF***	***PF-4 (2 MT Case/ 35 MT Case)***	***H-Canyon/ HB-Line [b]***	***Metal Oxidation Furnaces at MFFF***	***PF-4 (2 MT Case/ 35 MT Case)***	***DWPF [c]***	***MFFF [d]***	***H-Canyon/ HB-Line Preparation for WIPP***

DWPF = Defense Waste Processing Facility; KIS = K-Area Interim Surveillance; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; MFFF = Mixed Oxide Fuel Fabrication Facility; MT = metric tons; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; WIPP = Waste Isolation Pilot Plant; WSB= Waste Solidification Building.

[a] There would be no releases to the atmosphere from the K-Area storage and, therefore, no resulting public impacts for either of the cases presented.

[b] Potential doses to members of the public from pit disassembly activities in K-Area gloveboxes would be extremely small due to *de minimis* releases from such activities, and would be expected to be a fraction of those from the K-Area Interim Surveillance Capability (SRNS 2012).

[c] There would be no additional releases to the atmosphere from DWPF facility operations associated with this alternative and, therefore, no resulting public impacts.

[d] At MFFF, 41.1 metric tons of plutonium would be processed over a 23-year period; this would result in an estimated annual throughput rate difference of about 10 percent over the duration of the No Action Alternative (34 metric tons over 21 years).

[e] To provide perspective, doses can be compared to the estimated doses these same receptors would receive from natural background radiation (311 millirem per year assumed for SRS and 480 millirem per year at LANL for the average individual).

[f] The number of LCFs in the population is a whole number; the statistically calculated total values are provided in parentheses.

[g] Obtained by dividing the population dose by the number of people projected to live within 50 miles (80 kilometers) of the SRS facilities and LANL PF-4 in 2020 (approximately 809,000 for K-Area, 869,000 for F-Area, and 886,000 for H-Area; 448,000 for LANL PF-4).

Note: To convert metric tons to tons, multiply by 1.1023.

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