Appendix J
Human Health Risks

This appendix presents detailed information on the potential impacts to humans associated with incident-free (normal) releases of radioactivity from the proposed surplus plutonium disposition facilities. This information supports the human health risk assessments described in Chapter 4. In addition, site-specific input data used in the evaluation of these human health impacts are also provided or referenced where appropriate. The proposed facilities would be at one or more of four candidate U.S. Department of Energy (DOE) sites: the Hanford Site (Hanford), Idaho National Engineering and Environmental Laboratory (INEEL), the Pantex Plant (Pantex), and the Savannah River Site (SRS). Information is also presented on the human health impacts of mixed oxide (MOX) fuel lead assembly fabrication activities at five potential DOE sites: Argonne National Laboratory–West (ANL–W) at INEEL, Hanford, Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), and SRS.

J.1 HANFORD

J.1.1 Assessment Data

To perform the dose assessments for the *Surplus Plutonium Disposition Environmental Impact Statement* (SPD EIS), different types of data were collected and generated. In addition, calculational assumptions were made. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) used for the assessments.

J.1.1.1 Meteorological Data

The meteorological data used for the Hanford dose assessments was in the form of a joint frequency data (JFD) file. A JFD file is a table that lists the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken over a period of several years at a specific location and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operations. Table J–1 presents the JFD used in the dose assessments for Hanford.

J.1.1.2 Population Data

The Hanford population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2010 (about midlife of operations) for areas within 80 km (50 mi) of the locations for the proposed surplus plutonium disposition facilities. The site population in 2010 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at the Fuels and Materials Examination Facility (FMEF) in the 400 Area, the location from which radionuclides are assumed to be released during incident-free operations. Table J–2 presents the population data used for the dose assessments at Hanford.

J.1.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distribution described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each

Table J–1. Hanford 1983–1991 Joint Frequency Distributions at 61-m Height

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**
0.89	A	0.12	0.1	0.08	0.11	0.14	0.15	0.1	0.08	0.14	0.08	0.05	0.06	0.07	0.05	0.05	0.07
	B	0.05	0.05	0.05	0.05	0.06	0.05	0.04	0.03	0.07	0.03	0.02	0.02	0.03	0.02	0.03	0.03
	C	0.06	0.04	0.04	0.04	0.06	0.04	0.07	0.05	0.04	0.04	0.03	0.01	0.05	0.03	0.04	0.04
	D	0.32	0.23	0.2	0.18	0.25	0.26	0.24	0.28	0.36	0.26	0.19	0.15	0.22	0.19	0.22	0.21
	E	0.19	0.14	0.1	0.1	0.13	0.13	0.14	0.19	0.37	0.22	0.18	0.17	0.23	0.19	0.19	0.19
	F	0.22	0.14	0.1	0.09	0.13	0.11	0.15	0.2	0.34	0.2	0.2	0.12	0.2	0.14	0.16	0.16
	G	0.13	0.08	0.06	0.03	0.06	0.07	0.07	0.18	0.22	0.13	0.09	0.07	0.12	0.09	0.12	0.09
2.7	A	0.32	0.28	0.28	0.28	0.39	0.37	0.37	0.34	0.55	0.32	0.16	0.09	0.17	0.13	0.13	0.15
	B	0.12	0.09	0.08	0.06	0.12	0.07	0.1	0.11	0.15	0.12	0.05	0.05	0.05	0.04	0.06	0.07
	C	0.13	0.08	0.08	0.05	0.09	0.08	0.1	0.11	0.16	0.08	0.04	0.03	0.05	0.03	0.06	0.08
	D	0.58	0.41	0.37	0.26	0.38	0.33	0.46	0.59	0.85	0.49	0.25	0.15	0.33	0.36	0.47	0.41
	E	0.32	0.2	0.19	0.12	0.21	0.21	0.25	0.45	0.68	0.46	0.31	0.24	0.37	0.29	0.38	0.33
	F	0.35	0.23	0.15	0.07	0.12	0.09	0.18	0.36	0.64	0.31	0.23	0.16	0.18	0.18	0.23	0.22
	G	0.18	0.12	0.06	0.03	0.04	0.04	0.08	0.2	0.3	0.16	0.1	0.04	0.08	0.1	0.15	0.16
4.7	A	0.39	0.31	0.21	0.1	0.13	0.13	0.15	0.19	0.77	0.51	0.17	0.13	0.19	0.15	0.16	0.17
	B	0.14	0.09	0.06	0.04	0.04	0.04	0.04	0.07	0.2	0.16	0.06	0.04	0.03	0.02	0.06	0.06
	C	0.1	0.1	0.06	0.03	0.03	0.03	0.04	0.06	0.16	0.16	0.04	0.02	0.05	0.04	0.06	0.07
	D	0.59	0.38	0.26	0.14	0.16	0.14	0.32	0.55	0.97	0.75	0.27	0.15	0.34	0.46	0.63	0.55
	E	0.41	0.21	0.15	0.09	0.1	0.11	0.28	0.6	1.02	0.71	0.37	0.27	0.5	0.53	0.6	0.43
	F	0.37	0.22	0.11	0.06	0.07	0.06	0.17	0.48	0.73	0.44	0.21	0.11	0.16	0.2	0.37	0.29
	G	0.19	0.11	0.05	0.02	0.02	0.01	0.04	0.19	0.26	0.14	0.06	0.02	0.04	0.07	0.19	0.13
7.2	A	0.22	0.17	0.08	0.02	0.02	0.01	0.03	0.05	0.32	0.63	0.28	0.17	0.23	0.11	0.19	0.15
	B	0.07	0.05	0.01	0.01	0	0	0.02	0.01	0.1	0.22	0.06	0.05	0.05	0.03	0.07	0.03
	C	0.04	0.05	0.02	0.01	0	0.01	0.02	0.02	0.07	0.18	0.06	0.04	0.03	0.03	0.05	0.04
	D	0.27	0.19	0.09	0.04	0.02	0.04	0.1	0.25	0.65	0.86	0.37	0.2	0.29	0.5	0.75	0.4
	E	0.27	0.18	0.07	0.02	0.02	0.04	0.15	0.43	0.73	0.74	0.34	0.2	0.39	0.73	0.94	0.44
	F	0.21	0.14	0.06	0.02	0.02	0.01	0.09	0.33	0.52	0.39	0.14	0.07	0.09	0.16	0.45	0.26
	G	0.13	0.08	0.04	0.01	0.01	0.01	0.03	0.11	0.19	0.13	0.04	0.02	0.01	0.04	0.14	0.13

Table J–1. Hanford 1983–1991 Joint Frequency Distributions at 61-m Height (Continued)

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
9.8	A	0.05	0.05	0.03	0.01	0	0	0	0.01	0.08	0.29	0.21	0.12	0.12	0.08	0.12	0.04
	B	0.02	0.01	0.01	0	0	0	0	0	0.02	0.08	0.04	0.04	0.04	0.02	0.03	0.02
	C	0.02	0.02	0.01	0	0	0	0	0.01	0.02	0.08	0.06	0.03	0.03	0.03	0.03	0.01
	D	0.09	0.08	0.02	0.01	0	0.01	0.03	0.04	0.24	0.58	0.32	0.16	0.19	0.33	0.57	0.14
	E	0.1	0.12	0.04	0.01	0	0.01	0.06	0.17	0.37	0.51	0.26	0.13	0.17	0.43	0.73	0.22
	F	0.1	0.11	0.03	0.01	0.01	0	0.03	0.14	0.21	0.2	0.07	0.02	0.03	0.08	0.23	0.16
	G	0.05	0.04	0.02	0	0	0	0.01	0.07	0.09	0.05	0.03	0	0	0.02	0.1	0.07
13.0	A	0.01	0.02	0	0	0	0	0	0	0.02	0.09	0.1	0.1	0.08	0.03	0.07	0.01
	B	0	0.01	0	0	0	0	0	0	0.01	0.03	0.04	0.04	0.02	0.01	0.03	0.01
	C	0	0.01	0	0	0	0	0	0	0.01	0.02	0.04	0.02	0.02	0.01	0.02	0.01
	D	0.03	0.03	0.01	0	0	0	0.01	0.02	0.07	0.27	0.24	0.12	0.09	0.19	0.32	0.05
	E	0.04	0.08	0.03	0.01	0	0	0.02	0.05	0.13	0.32	0.25	0.1	0.07	0.2	0.33	0.07
	F	0.04	0.05	0.02	0.01	0	0	0.02	0.06	0.08	0.13	0.05	0.01	0.01	0.02	0.1	0.06
	G	0.01	0.01	0	0	0	0	0	0.02	0.02	0.03	0.01	0	0	0.01	0.05	0.04
16.0	A	0	0.01	0	0	0	0	0	0	0	0.02	0.06	0.03	0.02	0.01	0.01	0
	B	0	0.01	0	0	0	0	0	0	0	0.01	0.02	0.01	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0.01	0.02	0.01	0.01	0	0.01	0
	D	0.02	0.03	0.01	0.01	0	0	0	0.01	0.01	0.11	0.19	0.06	0.03	0.06	0.1	0.01
	E	0.01	0.04	0.03	0	0	0	0.01	0.02	0.05	0.16	0.16	0.04	0.02	0.04	0.09	0.01
	F	0.01	0.03	0	0	0	0	0	0.03	0.04	0.05	0.02	0	0.01	0	0.01	0.02
	G	0	0	0	0	0	0	0	0.02	0.02	0.02	0	0	0	0	0.02	0
19.0	A	0.02	0.03	0	0	0	0	0	0	0	0.01	0.05	0.01	0.01	0	0.01	0
	B	0	0.03	0	0	0	0	0	0	0	0	0.02	0	0	0	0	0
	C	0.01	0.02	0	0	0	0	0	0	0	0	0.03	0	0	0	0	0
	D	0.03	0.09	0	0	0	0	0	0	0	0.09	0.22	0.04	0.03	0.01	0.02	0
	E	0.03	0.1	0.02	0	0	0	0	0.02	0.02	0.1	0.14	0.02	0.01	0.01	0.01	0
	F	0.02	0.04	0.01	0	0	0	0	0.03	0.03	0.04	0.02	0	0	0	0.01	0
	G	0	0.01	0	0	0	0	0	0.02	0.02	0.02	0	0	0	0	0.01	0

Source: Neitzel 1996.

county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the Hanford population from the ingestion pathway. The consumption rates used in the dose assessments were those for the maximally exposed individual (MEI) and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. Hanford food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition Final PEIS* (HNUS 1996).

Table J–2. Projected Hanford Population Surrounding FMEF for Year 2010

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	4,265	44,747	1,141	7,041	19,608	**76,802**
SSW	0	0	0	0	2	1,515	2,758	438	2,976	3,951	**11,640**
SW	0	0	0	0	42	1,388	4,788	316	227	2,047	**8,808**
WSW	0	0	0	0	0	54	2,387	17,154	3,588	325	**23,508**
W	0	0	0	0	0	0	766	6,201	28,142	15,966	**51,075**
WNW	0	0	0	0	0	0	5	879	1,233	9,074	**11,191**
NW	0	0	0	0	0	0	0	645	411	178	**12,34**
NNW	0	0	0	0	0	0	0	1,097	1,437	1,491	**4,025**
N	0	0	0	0	0	0	0	1,153	3,773	2,749	**7,675**
NNE	0	0	0	0	0	18	468	5,523	1,514	25,879	**33,402**
NE	0	0	0	0	0	95	827	7,348	3,019	1,256	**12,545**
ENE	0	0	0	0	0	345	1,544	3,737	423	446	**6,495**
E	0	0	0	0	0	425	948	451	351	327	**2,502**
ESE	0	0	0	0	0	434	655	347	266	326	**2,028**
SE	0	0	0	0	0	419	1,313	1,736	396	1,459	**5,323**
SSE	0	0	0	0	0	6,989	87,249	33,689	608	986	**129,521**
Total	**0**	**0**	**0**	**0**	**44**	**15,947**	**148,455**	**81,855**	**55,405**	**86,068**	**387,774**

Key: FMEF, Fuels and Materials Examination Facility.
Source: DOC 1992.

J.1.1.4 Source Term Data

Estimated incident-free radiological releases associated with the pit conversion, immobilization, and MOX facilities are presented in Tables J–3 through J–5. Stack heights and release locations are provided in the facility data reports (DOE 1999; UC 1998a, 1998b, 1999a, 1999b).

Table J–3. Estimated Incident-Free Annual Radiological Releases From the Pit Conversion Facility at Hanford

Isotope	(μCi/yr)
Plutonium 236	9.3×10^{-11}
Plutonium 238	0.065
Plutonium 239	0.69
Plutonium 240	0.18
Plutonium 241	0.69
Plutonium 242	4.8×10^{-5}
Americium 241	0.37
Hydrogen 3	1.1×10^{9}

Source: UC 1998a.

Table J–4. Estimated Incident-Free Annual Radiological Releases From the Immobilization Facility at Hanford

Isotope	Ceramic (17 t) (μCi/yr)	Ceramic (50 t) (μCi/yr)	Glass (17 t) (μCi/yr)	Glass (50 t) (μCi/yr)
Plutonium 236	–	–	–	–
Plutonium 238	–	0.57	–	0.52
Plutonium 239	3.7	9.5	3.4	8.6
Plutonium 240	1.7	3.1	1.6	2.8
Plutonium 241	110	100	98	93
Plutonium 242	1.3×10^{-3}	1.6×10^{-3}	1.2×10^{-3}	1.5×10^{-3}
Americium 241	2.3	5.4	2.2	5.0
Uranium 234	–	–	–	–
Uranium 235	1.1×10^{-5}	4.5×10^{-5}	2.3×10^{-6}	2.3×10^{-6}
Uranium 238	8.8×10^{-5}	3.5×10^{-4}	1.9×10^{-5}	1.9×10^{-5}

Source: UC 1999a, 1999b.

Table J–5. Estimated Incident-Free Annual Radiological Releases From the MOX Facility at Hanford

Isotope	(μCi/yr)
Plutonium 236	1.3×10^{-8}
Plutonium 238	8.5
Plutonium 239	91
Plutonium 240	23
Plutonium 241	101
Plutonium 242	6.1×10^{-3}
Americium 241	48
Uranium 234	5.1×10^{-3}
Uranium 235	2.1×10^{-4}
Uranium 238	0.012

Source: UC 1998b.

J.1.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operation of the proposed facilities at Hanford, the following additional assumptions and factors were considered, in accordance with the guidelines established in U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109 (NRC 1977).

Ground surfaces were assumed to have no previous deposition of radionuclides for the purposes of modeling the incremental radiological impacts associated with surplus plutonium disposition activities. However, doses associated with true instances of prior deposition are accounted for in the Affected Environment and Cumulative Impacts sections.

The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).

The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).

The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).

The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.

A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.

Reported stack heights were used for atmospheric releases. The resultant doses were conservative as use of the actual stack height instead of the effective stack height negates plume rise.

The calculated doses are 50-year committed doses from 1 year of intake.

J.1.2 Facilities

The following sections present all viable radiological impact scenarios that could be associated with different combinations of incident-free facility operations at Hanford.

J.1.2.1 Pit Conversion Facility

J.1.2.1.1 Construction of Pit Conversion Facility

No radiological risk would be incurred by members of the public from construction and modification of a pit conversion facility at Hanford. According to recent surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.1.2 Operation of Pit Conversion Facility

Tables J–6 and J–7 present the incident-free radiological impacts of the operation of a pit conversion facility at Hanford.

Table J–6. Potential Radiological Impacts on the Public of Operation of Pit Conversion Facility in FMEF at Hanford

Population within 80 km for year 2010	
Dose (person-rem)	6.9
Percent of natural background[a]	5.9×10^{-3}
10-year latent fatal cancers	0.034
Maximally exposed individual	
Annual dose (mrem)	0.017
Percent of natural background[a]	5.7×10^{-3}
10-year latent fatal cancer risk	8.5×10^{-8}
Average exposed individual within 80 km[b]	
Annual dose (mrem)	0.017
10-year latent fatal cancer risk	8.5×10^{-8}

[a] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).
Key: FMEF, Fuels and Materials Examination Facility.
Source: Model results.

Table J–7. Potential Radiological Impacts on Involved Workers of Operation of Pit Conversion Facility in FMEF at Hanford

Number of badged workers	383
Total dose (person-rem/yr)	192
10-year latent fatal cancers	0.77
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

Key: FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

J.1.2.2 Immobilization Facility

J.1.2.2.1 Construction of Immobilization Facility

No radiological risk would be incurred by members of the public from the construction and modification of an immobilization (ceramic or glass) facility at Hanford. According to recent radiation surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.2.2 Operation of Immobilization Facility

Tables J–8 and J–9 present all possible incident-free radiological impact scenarios for the operation of a ceramic or glass immobilization facility at Hanford.

Table J–8. Potential Radiological Impacts on the Public of Operation of Immobilization Facility in FMEF at Hanford

Impact	17 t		50 t	
	Ceramic	Glass	Ceramic	Glass
Population within 80 km for year 2010				
Dose (person-rem)	7.8×10^{-3}	7.1×10^{-3}	0.016	0.015
Percent of natural background[a]	6.7×10^{-6}	6.1×10^{-6}	1.4×10^{-5}	1.3×10^{-5}
10-year latent fatal cancers	3.9×10^{-5}	3.6×10^{-5}	8.0×10^{-5}	7.5×10^{-5}
Maximally exposed individual				
Annual dose (mrem)	1.1×10^{-4}	9.7×10^{-5}	2.2×10^{-4}	2.0×10^{-4}
Percent of natural background[a]	3.7×10^{-5}	3.2×10^{-5}	7.3×10^{-5}	6.7×10^{-5}
10-year latent fatal cancer risk	5.5×10^{-10}	4.9×10^{-10}	1.1×10^{-9}	1.0×10^{-9}
Average exposed individual within 80 km[b]				
Annual dose (mrem)	2.0×10^{-5}	1.8×10^{-5}	4.1×10^{-5}	3.9×10^{-5}
10-year latent fatal cancer risk	1.0×10^{-10}	9.0×10^{-11}	2.1×10^{-10}	2.0×10^{-10}

[a] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).
Key: FMEF, Fuels and Materials Examination Facility.
Source: Model results.

Table J–9. Potential Radiological Impacts on Involved Workers of Operation of Immobilization Facility in FMEF at Hanford[a]

Impact	17 t		50 t	
	Ceramic	Glass	Ceramic	Glass
Number of badged workers	365	365	397	397
Total dose (person-rem/yr)	274	274	298	298
10-year latent fatal cancers	1.1	1.1	1.2	1.2
Average worker dose (mrem/yr)	750	750	750	750
10-year latent fatal cancer risk	3.0×10^{-3}	3.0×10^{-3}	3.0×10^{-3}	3.0×10^{-3}

[a] The presented values are representative of the largest possible number of workers regardless of collocation considerations.
Key: FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1999a, 1999b.

J.1.2.3 MOX Facility

J.1.2.3.1 Construction of MOX Facility

No radiological risk would be incurred by members of the public from the construction and modification of a MOX facility at Hanford. According to recent radiation surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.3.2 Operation of MOX Facility

Tables J–10 and J–11 present the incident-free radiological impacts of the operation of a MOX facility at Hanford. The facility would either be located within the existing FMEF or a new facility would be built adjacent to FMEF.

Table J–10. Potential Radiological Impacts on the Public of Operation of MOX Facility in FMEF or New Construction at Hanford

Impact	FMEF[a]	New[a]
Population dose within 80 km for year 2010		
Dose (person-rem)	0.14	0.29
Percent of natural background[b]	1.2×10^{-4}	2.5×10^{-4}
10-year latent fatal cancers	6.9×10^{-4}	1.5×10^{-3}
Maximally exposed individual		
Annual dose (mrem)	1.8×10^{-3}	4.8×10^{-3}
Percent of natural background[b]	6.1×10^{-4}	1.6×10^{-3}
10-year latent fatal cancer risk	9.3×10^{-9}	2.4×10^{-8}
Average exposed individual within 80 km[c]		
Annual dose (mrem)	3.5×10^{-4}	7.5×10^{-4}
10-year latent fatal cancer risk	1.7×10^{-9}	3.7×10^{-9}

[a] The difference in impacts is attributable to different stack heights. As described in Section 4.26.1.2.2, Water Resources, no component was attributed to liquid pathways because it is not expected that significant contamination could reach these pathways given the site's groundwater and surface-water characteristics.
[b] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).
Key: FMEF, Fuels and Materials Examination Facility.
Source: Model results.

Table J–11. Potential Radiological Impacts on Involved Workers of Operation of MOX Facility in FMEF or New Construction at Hanford

Number of badged workers	331
Total dose (person-rem/yr)	22
10-year latent fatal cancers	0.088
Average worker dose (mrem/yr)	65
10-year latent fatal cancer risk	2.6×10^{-4}

Key: FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1999; UC 1998b.

J.1.2.4 Pit Conversion and Immobilization Facilities

J.1.2.4.1 Construction of Pit Conversion and Immobilization Facilities

No radiological risk would be incurred by members of the public from the construction and modification of pit conversion and immobilization (ceramic or glass) facilities at Hanford. According to recent radiation surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.4.2 Operation of Pit Conversion and Immobilization Facilities

Tables J–12 and J–13 present all possible incident-free radiological impact scenarios for the operation of the pit conversion and immobilization facilities at Hanford.

Table J–12. Potential Radiological Impacts on the Public of Operation of Pit Conversion and Immobilization Facilities in FMEF at Hanford

Impact	Pit Conversion	Immobilization (50 t) Ceramic	Immobilization (50 t) Glass	Total[a]
Population within 80 km for year 2010				
Dose (person-rem)	6.9	0.016	0.015	6.9
Percent of natural background[b]	5.9×10^{-3}	1.4×10^{-5}	1.3×10^{-5}	5.9×10^{-3}
10-year latent fatal cancers	0.034	8.0×10^{-5}	7.5×10^{-5}	0.034
Maximally exposed individual				
Annual dose (mrem)	0.017	2.2×10^{-4}	2.0×10^{-4}	0.017
Percent of natural background[b]	5.7×10^{-3}	7.3×10^{-5}	6.7×10^{-5}	5.8×10^{-3}
10-year latent fatal cancer risk	8.5×10^{-8}	1.1×10^{-9}	1.0×10^{-9}	8.6×10^{-8}
Average exposed individual within 80 km[c]				
Annual dose (mrem)	0.017	4.1×10^{-5}	3.9×10^{-5}	0.017
10-year latent fatal cancer risk	8.5×10^{-8}	2.1×10^{-10}	2.0×10^{-10}	8.5×10^{-8}

[a] Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
[b] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).
Key: FMEF, Fuels and Materials Examination Facility.
Source: Model results.

Table J–13. Potential Radiological Impacts on Involved Workers of Operation of Pit Conversion and Immobilization Facilities in FMEF at Hanford

Impact	Pit Conversion	Immobilization (50 t)[a] Ceramic or Glass	Total
Number of badged workers	383	397	780
Total dose (person-rem/yr)	192	298	490
10-year latent fatal cancers	0.77	1.2	2.0
Average worker dose (mrem/yr)	500	750	628[b]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.5×10^{-3}

[a] The presented values are representative of the largest possible number of workers regardless of collocation considerations.
[b] Represents an average of the doses for both facilities.
Key: FMEF, Fuels and Materials Examination Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998a, 1999a, 1999b.

J.1.2.5 Pit Conversion and MOX Facilities

J.1.2.5.1 Construction of Pit Conversion and MOX Facilities

No radiological risk would be incurred by members of the public from the modification of FMEF for pit disassembly and conversion and MOX fuel fabrication or construction of new MOX facility at Hanford. According to recent radiation surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.5.2 Operation of Pit Conversion and MOX Facilities

Tables J–14 and J–15 present the incident-free radiological impacts of the operation of the pit conversion and MOX facilities at Hanford.

Table J–14. Potential Radiological Impacts on the Public of Operation of Pit Conversion and MOX Facilities in FMEF or New MOX Facility at Hanford

		MOX[a]		
Impact	**Pit Conversion**	**FMEF**	**New**	**Total[b]**
Population within 80 km for year 2010				
Dose (person-rem)	6.9	0.14	0.29	7.2
Percent of natural background[c]	5.9×10^{-3}	1.2×10^{-4}	2.5×10^{-4}	6.2×10^{-3}
10-year latent fatal cancers	0.034	7.0×10^{-4}	1.5×10^{-3}	0.036
Maximally exposed individual				
Annual dose (mrem)	0.017	1.8×10^{-3}	4.8×10^{-3}	0.022
Percent of natural background[c]	5.7×10^{-3}	6.1×10^{-4}	1.6×10^{-3}	7.3×10^{-3}
10-year latent fatal cancer risk	8.5×10^{-8}	9.3×10^{-9}	2.4×10^{-8}	1.1×10^{-7}
Average exposed individual within 80 km[d]				
Annual dose (mrem)	0.017	3.5×10^{-4}	7.5×10^{-4}	0.018
10-year latent fatal cancer risk	8.5×10^{-8}	1.7×10^{-9}	3.7×10^{-9}	8.9×10^{-8}

[a] As described in Section 4.26.1.2.2, Water Resources, no component was attributed to liquid pathways because it is not expected that significant contamination could reach these pathways given the site's groundwater and surface-water characteristics.
[b] Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
[c] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[d] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).
Key: FMEF, Fuels and Materials Examination Facility.
Source: Model results.

Table J–15. Potential Radiological Impacts on Involved Workers of Operation of Pit Conversion and MOX Facilities in FMEF or New MOX Facility at Hanford

Impact	Pit Conversion	MOX (FMEF or New)	Total
Number of badged workers	383	331	714
Total dose (person-rem/yr)	192	22	214
10-year latent fatal cancers	0.77	0.088	0.86
Average worker dose (mrem/yr)	500	65	300[a]
10-year latent fatal cancer risk	2.0×10^{-3}	2.6×10^{-4}	1.2×10^{-3}

[a] Represents an average of the doses for both facilities.

Key: FMEF, Fuels and Materials Examination Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: DOE 1999; UC 1998a, 1998b.

J.1.2.6 Immobilization and MOX Facilities

J.1.2.6.1 Construction of Immobilization and MOX Facilities

No radiological risk would be incurred by members of the public from the modification of FMEF for collocating plutonium conversion and immobilization (ceramic or glass) and MOX fuel fabrication or construction of a new MOX facility at Hanford. According to recent radiation surveys conducted in the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.6.2 Operation of Immobilization and MOX Facilities

Tables J–16 and J–17 present the incident-free radiological impacts of the operation of the immobilization and MOX facilities at Hanford.

Table J–16. Potential Radiological Impacts on the Public of Operation of Collocating Immobilization and MOX Facilities in FMEF or New MOX Facility at Hanford

	Immobilization (17 t)		MOX[a]		
Impact	**Ceramic**	**Glass**	**FMEF**	**New**	**Total[b]**
Population within 80 km for year 2010					
Dose (person-rem)	7.8×10^{-3}	7.1×10^{-3}	0.14	0.29	0.30
Percent of natural background[c]	6.7×10^{-6}	6.1×10^{-6}	1.2×10^{-4}	2.5×10^{-4}	2.6×10^{-4}
10-year latent fatal cancers	3.9×10^{-5}	3.6×10^{-5}	6.9×10^{-4}	1.5×10^{-3}	1.5×10^{-3}
Maximally exposed individual					
Annual dose (mrem)	1.1×10^{-4}	9.7×10^{-5}	1.8×10^{-3}	4.8×10^{-3}	4.9×10^{-3}
Percent of natural background[c]	3.7×10^{-5}	3.2×10^{-5}	6.1×10^{-4}	1.6×10^{-3}	1.6×10^{-3}
10-year latent fatal cancer risk	5.5×10^{-10}	4.9×10^{-10}	9.3×10^{-9}	2.4×10^{-8}	2.5×10^{-8}
Average exposed individual within 80 km[d]					
Annual dose (mrem)	2.0×10^{-5}	1.8×10^{-5}	3.5×10^{-4}	7.5×10^{-4}	7.7×10^{-4}
10-year latent fatal cancer risk	1.0×10^{-10}	9.0×10^{-11}	1.7×10^{-9}	3.7×10^{-9}	3.9×10^{-9}

[a] As described in Section 4.26.1.2.2, Water Resources, no component was attributed to liquid pathways because it is not expected that significant contamination could reach these pathways given the site's groundwater and surface-water characteristics.

[b] Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.

[c] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.

[d] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).

Key: FMEF, Fuels and Materials Examination Facility.

Source: Model results.

Table J–17. Potential Radiological Impacts on Involved Workers of Operation of Collocating Immobilization and MOX Facilities in FMEF or New MOX Facility at Hanford

	Immobilization (17 t)[a]	MOX	
Impact	**Ceramic or Glass**	**(FMEF or New)**	**Total**
Number of badged workers	365	331	696
Total dose (person-rem/yr)	274	22	296
10-year latent fatal cancers	1.1	0.088	1.2
Average worker dose (mrem/yr)	750	65	425[b]
10-year latent fatal cancer risk	3.0×10^{-3}	2.6×10^{-4}	1.7×10^{-3}

[a] The presented values are representative of the largest possible number of workers regardless of collocation considerations.

[b] Represents an average of the doses for both facilities.

Key: FMEF, Fuels and Materials Examination Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: DOE 1999; UC 1998b, 1999a, 1999b.

J.1.2.7 Pit Conversion, Immobilization, and MOX Facilities

J.1.2.7.1 Construction of Pit Conversion, Immobilization, and MOX Facilities

No radiological risk would be incurred by members of the public from the modification of FMEF for pit disassembly and conversion and plutonium conversion and immobilization (ceramic or glass) and construction of a new MOX facility at Hanford. According to recent radiation surveys conducted at the 400 Area, a construction worker would not be expected to receive any additional dose above natural background levels (Antonio 1998). Nonetheless, if deemed necessary, workers may be monitored (badged) as a precautionary measure.

J.1.2.7.2 Operation of Pit Conversion, Immobilization, and MOX Facilities

Tables J–18 and J–19 present all possible incident-free radiological impact scenarios for operating all three facilities at Hanford.

Table J–18. Potential Radiological Impacts on the Public of Operation of Pit Conversion and Immobilization Facilities in FMEF and New MOX Facility at Hanford

Impact	Pit Conversion	Immobilization (17 t)		MOX[a]		Total[b]
		Ceramic	Glass	FMEF	New	
Population within 80 km for year 2010						
Dose (person-rem)	6.9	7.8×10^{-3}	7.1×10^{-3}	0.14	0.29	7.2
Percent of natural background[c]	5.9×10^{-3}	6.7×10^{-6}	6.1×10^{-6}	1.2×10^{-4}	2.5×10^{-4}	6.2×10^{-3}
10-year latent fatal cancers	0.034	3.9×10^{-5}	3.6×10^{-5}	6.9×10^{-4}	1.5×10^{-3}	0.036
Maximally exposed individual						
Annual dose (mrem)	0.017	1.1×10^{-4}	9.7×10^{-5}	1.8×10^{-3}	4.8×10^{-3}	0.022
Percent of natural background[c]	5.7×10^{-3}	3.7×10^{-5}	3.2×10^{-5}	6.1×10^{-4}	1.6×10^{-3}	7.3×10^{-3}
10-year latent fatal cancer risk	8.5×10^{-8}	5.5×10^{-10}	4.9×10^{-10}	9.3×10^{-9}	2.4×10^{-8}	1.1×10^{-7}
Average exposed individual within 80 km[d]						
Annual dose (mrem)	0.017	2.0×10^{-5}	1.8×10^{-5}	3.5×10^{-4}	7.5×10^{-4}	0.018
10-year latent fatal cancer risk	8.5×10^{-8}	1.0×10^{-10}	9.0×10^{-11}	1.7×10^{-9}	3.7×10^{-9}	8.9×10^{-8}

[a] As described in Section 4.26.1.2.2, Water Resources, no component was attributed to liquid pathways because it is not expected that significant contamination could reach these pathways given the site's groundwater and surface-water characteristics.
[b] Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from all three facilities.
[c] The annual natural background radiation level at Hanford is 300 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 116,300 person-rem.
[d] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Hanford in 2010 (387,800).
Key: FMEF, Fuels and Materials Examination Facility.
Source: Model results.

Table J–19. Potential Radiological Impacts on Involved Workers of Operation of Pit Conversion and Immobilization Facilities in FMEF and New MOX Facility at Hanford

Impact	Pit Conversion	Immobilization (17 t)[a] Ceramic or Glass	MOX (FMEF or New)	Total
Number of badged workers	383	365	331	1,079
Total dose (person-rem/yr)	192	274	22	488
10-year latent fatal cancers	0.77	1.1	0.088	2.0
Average worker dose (mrem/yr)	500	750	65	452[b]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.6×10^{-4}	1.8×10^{-3}

[a] The presented values are representative of the largest possible number of workers regardless of collocation considerations.
[b] Represents an average of the doses for all three facilities.

Key: FMEF, Fuels and Materials Examination Facility.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: DOE 1999; UC 1998b, 1999a, 1999b.

J.2 INEEL

J.2.1 Assessment Data

To perform the dose assessments for the SPD EIS, different types of data were collected and generated. In addition, calculational assumptions were made. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) that were used for the assessments.

J.2.1.1 Meteorological Data

The meteorological data used for the INEEL dose assessments was in the form of JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken over a period of several years at a specific location and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operations. Table J–20 presents the JFD used in the dose assessments for INEEL.

J.2.1.2 Population Data

The INEEL population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2010 (about midlife of operations) for areas within 80 km (50 mi) of the locations for the proposed surplus plutonium disposition facilities. The site population in 2010 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at the Idaho Nuclear Technology and Engineering Center (INTEC), the location from which radionuclides are assumed to be released during incident-free operations. Table J–21 presents the population data used for the dose assessments at INEEL.

J.2.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distribution described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII–leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the INEEL population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. INEEL food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition Final PEIS* (HNUS 1996).

Table J–20. INEEL 1987–1991 Joint Frequency Distributions at 61-m Height

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
1.0	A	0.2	0.31	0.28	0.21	0.2	0.19	0.24	0.22	0.17	0.16	0.11	0.11	0.1	0.11	0.09	0.15
	B	0.04	0.06	0.03	0.01	0.01	0.01	0.01	0.02	0.03	0.02	0.01	0.01	0.01	0	0	0.01
	C	0.04	0.07	0.07	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
	D	0.15	0.26	0.15	0.08	0.03	0.05	0.04	0.07	0.07	0.07	0.04	0.05	0.05	0.05	0.05	0.08
	E	0.14	0.17	0.15	0.08	0.07	0.07	0.04	0.06	0.05	0.07	0.06	0.04	0.04	0.05	0.06	0.06
	F	0.4	0.46	0.44	0.3	0.23	0.2	0.16	0.18	0.13	0.16	0.15	0.16	0.17	0.16	0.18	0.27
2.5	A	0.25	0.45	0.58	0.49	0.4	0.34	0.31	0.49	0.63	0.66	0.57	0.32	0.24	0.14	0.18	0.18
	B	0.06	0.18	0.21	0.11	0.03	0.02	0.02	0.05	0.08	0.12	0.08	0.05	0.03	0.01	0.01	0.02
	C	0.15	0.35	0.4	0.09	0.02	0.01	0.02	0.05	0.11	0.1	0.12	0.03	0.04	0.02	0.01	0.03
	D	0.55	1.78	1.05	0.2	0.07	0.04	0.08	0.1	0.17	0.3	0.32	0.2	0.1	0.07	0.08	0.12
	E	0.32	0.75	0.52	0.15	0.07	0.04	0.06	0.09	0.09	0.17	0.15	0.18	0.07	0.06	0.07	0.09
	F	0.77	1.65	1.38	0.67	0.34	0.24	0.21	0.27	0.31	0.51	0.47	0.48	0.35	0.32	0.34	0.38
4.5	A	0.02	0.05	0.05	0.03	0.02	0.01	0.02	0.04	0.08	0.1	0.09	0.08	0.02	0.02	0.02	0.01
	B	0.07	0.12	0.16	0.09	0.04	0.03	0.04	0.12	0.2	0.39	0.4	0.2	0.1	0.05	0.08	0.06
	C	0.07	0.19	0.33	0.13	0.02	0.02	0.02	0.08	0.14	0.33	0.58	0.21	0.07	0.05	0.03	0.06
	D	0.45	2.59	2.36	0.33	0.07	0.05	0.08	0.22	0.36	0.91	1.18	0.7	0.22	0.12	0.12	0.21
	E	0.34	1.26	0.93	0.17	0.04	0.03	0.06	0.11	0.21	0.34	0.49	0.38	0.15	0.08	0.12	0.17
	F	0.35	1.2	1.25	0.37	0.12	0.06	0.04	0.15	0.17	0.33	0.43	0.34	0.18	0.08	0.12	0.16
6.9	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0
	C	0.06	0.07	0.08	0.03	0.02	0.01	0.02	0.07	0.1	0.23	0.46	0.27	0.1	0.04	0.05	0.04
	D	0.67	1.47	1.6	0.35	0.06	0.03	0.08	0.26	0.4	1.28	2.95	1.78	0.44	0.16	0.08	0.4
	E	0.15	0.8	0.8	0.16	0.03	0.01	0.06	0.13	0.13	0.33	0.88	0.69	0.11	0.02	0.01	0.08
	F	0.05	0.2	0.25	0.07	0.01	0.01	0	0.02	0.02	0.01	0.1	0.11	0.01	0.01	0	0.01
9.6	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	0.01	0.01	0.01	0	0	0
	D	0.64	0.61	0.74	0.16	0.02	0.01	0.04	0.16	0.29	1.1	3.53	1.98	0.38	0.12	0.07	0.26
	E	0.03	0.12	0.17	0.07	0	0	0.01	0.03	0.03	0.06	0.37	0.28	0.04	0.01	0	0
	F	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0
13.2	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	0.25	0.25	0.18	0.05	0	0	0.02	0.08	0.16	0.55	2.88	2.13	0.18	0.11	0.01	0.05
	E	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table J–20. INEEL 1987–1991 Joint Frequency Distributions at 61-m Height (Continued)

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
19.0	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	0.01	0.05	0.01	0.01	0	0	0	0	0	0.04	0.47	0.48	0.01	0.01	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25.0	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Sagendorf 1992.

Table J–21. Projected INEEL Population Surrounding INTEC for Year 2010

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	32	204	340	1,222	3,624	**5,422**
SSW	0	0	0	0	0	22	92	182	335	445	**1,076**
SW	0	0	0	0	0	22	87	117	163	304	**693**
WSW	0	0	0	0	0	0	87	136	149	262	**634**
W	0	0	0	0	0	0	87	180	392	280	**939**
WNW	0	0	0	0	0	0	269	519	445	311	**1,544**
NW	0	0	0	0	0	6	384	620	772	720	**2,502**
NNW	0	0	0	0	0	6	96	97	315	173	**687**
N	0	0	0	0	0	0	25	45	77	100	**247**
NNE	0	0	0	0	0	0	25	48	170	161	**404**
NE	0	0	0	0	0	0	0	285	652	342	**1,279**
ENE	0	0	0	0	0	0	0	332	575	1,057	**1,964**
E	0	0	0	0	0	0	0	506	1,203	12,055	**13,764**
ESE	0	0	0	0	0	0	208	947	1,536	103,127	**105,818**
SE	0	0	0	0	0	0	219	374	16,764	11,931	**29,288**
SSE	0	0	0	0	0	20	212	346	7,427	8,500	**16,505**
Total	**0**	**0**	**0**	**0**	**0**	**108**	**1,995**	**5,074**	**32,197**	**143,392**	**182,766**

Key: INTEC, Idaho Nuclear Technology and Engineering Center.
Source: DOC 1992.

J.2.1.4 Source Term Data

Estimated incident-free radiological releases associated with the pit conversion and MOX facilities are presented in Tables J–22 and J–23. Stack heights and release locations are provided in the facility data reports (DOE 1999; UC 1998c, 1998d).

Table J–22. Estimated Incident-Free Annual Radiological Releases From the Pit Conversion Facility at INEEL

Isotope	(μCi/yr)
Plutonium 236	9.3×10^{-11}
Plutonium 238	0.065
Plutonium 239	0.69
Plutonium 240	0.18
Plutonium 241	0.69
Plutonium 242	4.8×10^{-5}
Americium 241	0.37
Hydrogen 3	1.1×10^{9}

Source: UC 1998c.

Table J–23. Estimated Incident-Free Annual Radiological Releases From the MOX Facility at INEEL

Isotope	(μCi/yr)
Plutonium 236	1.3×10^{-8}
Plutonium 238	8.5
Plutonium 239	91
Plutonium 240	23
Plutonium 241	101
Plutonium 242	6.1×10^{-3}
Americium 241	48
Uranium 234	5.1×10^{-3}
Uranium 235	2.1×10^{-4}
Uranium 238	0.012

Source: UC 1998d.

J.2.1.5 Other Calculational Assumptions

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

> Ground surfaces were assumed to have no previous deposition of radionuclides for the purposes of modeling the incremental radiological impacts associated with surplus plutonium disposition activities. However, doses associated with true instances of prior deposition are accounted for in the Affected Environment and Cumulative Impacts sections.
>
> The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).

The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).

The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).

The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.

A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.

Reported stack heights were used for atmospheric releases. The resultant doses were conservative as use of the actual stack height instead of the effective stack height negates plume rise.

The calculated doses are 50-year committed doses from 1 year of intake.

J.2.2 Facilities

The following sections present all viable radiological impact scenarios that could be associated with different combinations of incident-free facility operations at INEEL.

J.2.2.1 Pit Conversion Facility

J.2.2.1.1 Construction of Pit Conversion Facility

No radiological risk would be incurred by members of the public from construction and modification of a pit conversion facility in the Fuel Processing Facility (FPF) at INEEL. According to a recent radiation survey (Mitchell et al. 1997) conducted in the INTEC area, a construction worker could receive about 5 mrem/yr above natural background levels from exposure to radiation deriving from other activities, past or present, at the site. Construction worker exposures would be kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

J.2.2.1.2 Operation of Pit Conversion Facility

Tables J–24 and J–25 present the incident-free radiological impacts of the operation of a pit conversion facility at INEEL.

Table J–24. Potential Radiological Impacts on the Public of Operation of Pit Conversion Facility in FPF at INEEL

Population within 80 km for year 2010	
Dose (person-rem)	2.2
Percent of natural background[a]	3.3×10^{-3}
10-year latent fatal cancers	0.011
Maximally exposed individual	
Annual dose (mrem)	0.015
Percent of natural background[a]	4.2×10^{-3}
10-year latent fatal cancer risk	7.5×10^{-8}
Average exposed individual within 80 km[b]	
Annual dose (mrem)	0.012
10-year latent fatal cancer risk	6.0×10^{-8}

[a] The annual natural background radiation level at INEEL is 361 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 66,000 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of INEEL in 2010 (182,800).
Key: FPF, Fuel Processing Facility.
Source: Model results.

Table J–25. Potential Radiological Impacts on Involved Workers of Operation of Pit Conversion Facility in FPF at INEEL

Number of badged workers	341
Total dose (person-rem/yr)	170
10-year latent fatal cancers	0.68
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

Key: FPF, Fuel Processing Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998c.

J.2.2.2 MOX Facility

J.2.2.2.1 Construction of MOX Facility

No radiological risk would be incurred by members of the public from the construction of a new MOX facility at INEEL. According to a recent radiation survey (Mitchell et al. 1997) conducted in the INTEC area, a construction worker could receive about 5 mrem/yr above natural background levels from exposure to radiation deriving from other activities, past or present, at the site. Construction worker exposures would be kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

J.2.2.2.2 Operation of MOX Facility

Tables J–26 and J–27 present the incident-free radiological impacts of the operation of a new MOX facility at INEEL.

Table J–26. Potential Radiological Impacts on the Public of Operation of New MOX Facility at INEEL[a]

Population within 80 km for year 2010	
Dose (person-rem)	0.037
Percent of natural background[b]	5.6×10^{-5}
10-year latent fatal cancers	1.9×10^{-4}
Maximally exposed individual	
Annual dose (mrem)	3.2×10^{-3}
Percent of natural background[b]	8.8×10^{-4}
10-year latent fatal cancer risk	1.6×10^{-8}
Average exposed individual within 80 km[c]	
Annual dose (mrem)	2.1×10^{-4}
10-year latent fatal cancer risk	1.0×10^{-9}

[a] As described in Section 4.26.2.2.2, Water Resources, no component was attributed to liquid pathways because it is not expected that significant contamination could reach these pathways given the site's groundwater and surface-water characteristics.

[b] The annual natural background radiation level at INEEL is 361 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 66,000 person-rem.

[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of INEEL in 2010 (182,800).

Source: Model results.

Table J–27. Potential Radiological Impacts on Involved Workers of Operation of New MOX Facility at INEEL

Number of badged workers	331
Total dose (person-rem/yr)	22
10-year latent fatal cancers	0.088
Average worker dose (mrem/yr)	65
10-year latent fatal cancer risk	2.6×10^{-4}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: DOE 1999; UC 1998d.

J.2.2.3 Pit Conversion and MOX Facilities

J.2.2.3.1 Construction of Pit Conversion and MOX Facilities

No radiological risk would be incurred by members of the public from the construction and modification of a pit conversion facility in FPF and construction of a new MOX facility at INEEL. According to a recent radiation survey (Mitchell et al. 1997) conducted in the INTEC area, a construction worker could receive about 5 mrem/yr above natural background levels from exposure to radiation deriving from other activities, past or present, at the site. Construction worker exposures would be kept as low as is reasonably achievable, and workers would be monitored (badged) as appropriate.

J.2.2.3.2 Operation of Pit Conversion and MOX Facilities

Tables J–28 and J–29 present the incident-free radiological impacts of operation of pit conversion and MOX facilities at INEEL.

Table J–28. Potential Radiological Impacts on the Public of Operation of Pit Conversion Facility in FPF and New MOX Facility at INEEL

Impact	Pit Conversion	MOX[a]	Total[b]
Population within 80 km for year 2010			
Dose (person-rem)	2.2	0.037	2.2
Percent of natural background[c]	3.3×10^{-3}	5.6×10^{-5}	3.4×10^{-3}
10-year latent fatal cancers	0.011	1.9×10^{-4}	0.011
Maximally exposed individual			
Annual dose (mrem)	0.015	3.2×10^{-3}	0.018
Percent of natural background[c]	4.2×10^{-3}	8.8×10^{-4}	5.1×10^{-3}
10-year latent fatal cancer risk	7.5×10^{-8}	1.6×10^{-8}	9.1×10^{-8}
Average exposed individual within 80 km[d]			
Annual dose (mrem)	0.012	2.1×10^{-4}	0.012
10-year latent fatal cancer risk	6.0×10^{-8}	1.0×10^{-9}	6.1×10^{-8}

[a] As described in Section 4.26.2.2.2, Water Resources, no component was attributed to liquid pathways because it is not expected that significant contamination could reach these pathways given the site's groundwater and surface-water characteristics.
[b] Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
[c] The annual natural background radiation level at INEEL is 361 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 66,000 person-rem.
[d] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of INEEL in 2010 (182,800).
Key: FPF, Fuel Processing Facility.
Source: Model results.

Table J–29. Potential Radiological Impacts on Involved Workers of Operation of Pit Conversion Facility in FPF and New MOX Facility at INEEL

Impact	Pit Conversion	MOX	Total
Number of badged workers	341	331	672
Total dose (person-rem/yr)	170	22	192
10-year latent fatal cancers	0.68	0.088	0.77
Average worker dose (mrem/yr)	500	65	286[a]
10-year latent fatal cancer risk	2.0×10^{-3}	2.6×10^{-4}	1.1×10^{-3}

[a] Represents an average of the doses for both facilities.
Key: FPF, Fuel Processing Facility.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1999; UC 1998c, 1998d.

J.3 PANTEX

J.3.1 Assessment Data

To perform the dose assessments for the SPD EIS, different types of data were collected and generated. In addition, calculational assumptions were made. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) that were used for the assessments.

J.3.1.1 Meteorological Data

The meteorological data used for the Pantex dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken over a period of several years at a specific location and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operations. Table J–30 presents the JFD used in the dose assessments for Pantex.

J.3.1.2 Population Data

The Pantex population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2010 (about midlife of operations) for areas within 80 km (50 mi) of the locations for the proposed plutonium disposition facilities. The site population in 2010 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at Zone 4, the location from which radionuclides are assumed to be released during incident-free operations. Table J–31 presents the population data used for the dose assessments at Pantex.

J.3.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distribution described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the Pantex population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. Pantex food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition Final PEIS* (HNUS 1996).

Table J–30. 1985–1989 Joint Frequency Distributions at 7-m Height for Pantex[a]

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.02	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
	B	0.02	0.01	0.01	0.02	0.03	0.02	0.02	0.02	0.05	0.01	0.03	0.02	0.04	0.02	0.03	0.02
	C	0.02	0	0.01	0.01	0.01	0	0.01	0	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01
	D	0.03	0.01	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.03	0.02	0.02	0.03
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0.12	0.04	0.04	0.05	0.04	0.04	0.07	0.08	0.17	0.11	0.16	0.09	0.13	0.13	0.11	0.08
2.5	A	0.03	0.01	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.02	0.01	0.03	0.02	0.02	0.02	0.01
	B	0.12	0.06	0.08	0.06	0.14	0.06	0.07	0.05	0.13	0.06	0.09	0.05	0.11	0.09	0.11	0.07
	C	0.12	0.05	0.07	0.07	0.06	0.05	0.04	0.05	0.12	0.11	0.09	0.11	0.13	0.13	0.15	0.09
	D	0.22	0.12	0.13	0.14	0.18	0.12	0.12	0.16	0.19	0.16	0.12	0.14	0.18	0.13	0.16	0.16
	E	0.23	0.1	0.09	0.1	0.12	0.14	0.16	0.14	0.31	0.21	0.23	0.18	0.21	0.15	0.19	0.12
	F	0.41	0.16	0.13	0.14	0.18	0.2	0.25	0.23	0.62	0.49	0.64	0.39	0.48	0.49	0.43	0.28
4.5	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0.08	0.04	0.07	0.07	0.07	0.06	0.06	0.09	0.17	0.13	0.13	0.09	0.1	0.08	0.07	0.08
	C	0.45	0.21	0.18	0.2	0.27	0.16	0.22	0.22	0.63	0.45	0.54	0.39	0.47	0.37	0.48	0.32
	D	1.14	0.72	0.64	0.59	0.72	0.66	1.02	1.1	2.19	1.21	1	0.5	0.41	0.32	0.6	0.5
	E	0.72	0.33	0.28	0.27	0.41	0.39	0.79	1.16	2.75	1.85	1.83	0.93	0.55	0.56	0.79	0.38
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.9	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0.13	0.1	0.07	0.05	0.04	0.04	0.05	0.13	0.52	0.5	0.39	0.22	0.16	0.08	0.05	0.04
	D	3.07	1.76	1	0.67	0.9	0.83	1.73	2.59	7.3	4.2	3.32	1.83	1.19	0.57	0.89	0.95
	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
9.6	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0.03	0.02	0.03	0.01	0	0.01	0.01	0.03	0.18	0.19	0.09	0.04	0.03	0.01	0	0.01
	D	1.49	0.82	0.29	0.13	0.11	0.13	0.33	0.48	2.24	1.48	1.01	0.76	0.49	0.12	0.15	0.34
	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
12.1	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	0.01	0.01	0	0	0	0	0	0	0.04	0.01	0.01	0.02	0.01	0	0	0
	D	0.73	0.32	0.05	0.03	0.01	0.02	0.05	0.1	0.41	0.22	0.2	0.25	0.24	0.05	0.09	0.2
	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

[a] Joint frequency distribution data was compiled by the National Weather Service Station at Amarillo Airport; it was assumed that this data satisfactorily represented the atmospheric conditions at the Pantex site.

Source: NWS 1997.

Table J–31. Projected Pantex Population Surrounding Zone 4 for Year 2010

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	4	5	41	100	96	104	268	**618**
SSW	0	0	0	0	5	117	441	1,095	361	1,013	**3,032**
SW	0	0	0	3	3	901	18,330	14,816	13,199	1,137	**48,389**
WSW	0	0	3	2	3	49	88,209	65,959	1,189	528	**15,5942**
W	0	0	2	2	3	25	3,372	683	227	897	**5,211**
WNW	0	0	3	2	3	25	148	360	517	834	**1,892**
NW	0	2	3	3	3	25	98	253	547	542	**1,476**
NNW	0	2	3	4	5	30	88	344	519	16,924	**17,919**
N	0	2	3	4	5	41	151	5,476	176	225	**6,083**
NNE	0	2	3	4	5	41	162	18,764	2,998	233	**22,212**
NE	0	2	3	4	5	41	163	396	295	165	**1,074**
ENE	0	2	3	4	5	41	324	724	22,852	176	**24,131**
E	0	2	3	4	5	961	2,016	884	372	1,085	**5,332**
ESE	0	2	3	4	5	41	273	512	248	401	**1,489**
SE	0	0	3	4	5	41	303	370	115	2,182	**3,023**
SSE	0	0	0	4	5	41	677	311	69	109	**1,216**
Total	**0**	**16**	**35**	**52**	**70**	**2,461**	**114,855**	**111,043**	**43,788**	**26,719**	**299,039**

Source: DOC 1992.

J.3.1.4 Source Term Data

Estimated incident-free radiological releases associated with the new pit conversion and MOX facilities at Pantex are presented in Tables J–32 and J–33. Stack heights and release locations are provided in the facility data reports (DOE 1999; UC 1998e, 1998f).

Table J–32. Estimated Incident-Free Annual Radiological Releases From the New Pit Conversion Facility at Pantex

Isotope	(μCi/yr)
Plutonium 236	9.3×10^{-11}
Plutonium 238	0.065
Plutonium 239	0.69
Plutonium 240	0.18
Plutonium 241	0.69
Plutonium 242	4.8×10^{-5}
Americium 241	0.37
Hydrogen 3	1.1×10^{9}

Source: UC 1998e.

Table J–33. Estimated Incident-Free Annual Radiological Releases From the New MOX Facility at Pantex

Isotope	(μCi/yr)
Plutonium 236	1.3×10^{-8}
Plutonium 238	8.5
Plutonium 239	91
Plutonium 240	23
Plutonium 241	101
Plutonium 242	6.1×10^{-3}
Americium 241	48
Uranium 234	5.1×10^{-3}
Uranium 235	2.1×10^{-4}
Uranium 238	0.012

Source: UC 1998f.

J.3.1.5 Other Calculational Assumptions

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

Ground surfaces were assumed to have no previous deposition of radionuclides for the purposes of modeling the incremental radiological impacts associated with surplus plutonium disposition activities. However, doses associated with true instances of prior deposition are accounted for in the Affected Environment and Cumulative Impacts sections.

The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).

The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).

The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).

The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.

A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases were to the air.

Reported stack heights were used for atmospheric releases. The resultant doses were conservative as use of the actual stack height instead of the effective sack height negates plume rise.

The calculated doses are 50-year committed doses from 1 year of intake.

J.3.2 Facilities

The following sections present all viable radiological impact scenarios that could be associated with different combinations of incident-free facility operations at Pantex.

J.3.2.1 Pit Conversion Facility

J.3.2.1.1 Construction of Pit Conversion Facility

No radiological risk would be incurred by members of the public from the construction of a new pit conversion facility at Pantex. According to a recent radiation survey (DOE 1997) conducted in Zone 4, a construction worker would not be expected to receive any additional radiation exposure above natural background levels in the area. Nonetheless, construction workers may be monitored (badged) as a precautionary measure.

J.3.2.1.2 Operation of Pit Conversion Facility

Tables J–34 and J–35 present the incident-free radiological impacts of the operation of a new pit conversion facility at Pantex.

Table J–34. Potential Radiological Impacts on the Public of Operation of New Pit Conversion Facility at Pantex

Population within 80 km for year 2010	
Dose (person-rem)	0.58
Percent of natural background[a]	5.8×10^{-4}
10-year latent fatal cancers	2.9×10^{-3}
Maximally exposed individual	
Annual dose (mrem)	0.062
Percent of natural background[a]	0.019
10-year latent fatal cancer risk	3.1×10^{-7}
Average exposed individual within 80 km[b]	
Annual dose (mrem)	1.9×10^{-3}
10-year latent fatal cancer risk	9.5×10^{-9}

[a] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex in 2010 (299,000).
Source: Model results.

Table J–35. Potential Radiological Impacts on Involved Workers of Operation of New Pit Conversion Facility at Pantex

Number of badged workers	383
Total dose (person-rem/yr)	192
10-year latent fatal cancers	0.77
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998e.

J.3.2.2 MOX Facility

J.3.2.2.1 Construction of MOX Facility

No radiological risk would be incurred by members of the public from construction of a new MOX facility at Pantex. According to a recent radiation survey (DOE 1997) conducted in Zone 4, a construction worker would not be expected to receive any additional radiation exposure above natural background levels in the area. Nonetheless, construction workers may be monitored (badged) as a precautionary measure.

J.3.2.2.2 Operation of MOX Facility

Tables J–36 and J–37 present the incident-free radiological impacts of the operation of a new MOX facility at Pantex.

Table J–36. Potential Radiological Impacts on the Public of Operation of New MOX Facility at Pantex[a]

Population within 80 km for year 2010	
Dose (person-rem)	0.027
Percent of natural background[b]	2.7×10^{-5}
10-year latent fatal cancers	1.3×10^{-4}
Maximally exposed individual	
Annual dose (mrem)	0.015
Percent of natural background[b]	$4.5\text{x}10^{-3}$
10-year latent fatal cancer risk	7.5×10^{-8}
Average exposed individual within 80 km[c]	
Annual dose (mrem)	8.8×10^{-5}
10-year latent fatal cancer risk	4.5×10^{-10}

[a] As described in Section 4.26.3.2.2, Water Resources, no component was attributed to liquid pathways because it is not expected that significant contamination could reach these pathways given the site's groundwater and surface-water characteristics.
[b] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex in 2010 (299,000).
Source: Model results.

Table J–37. Potential Radiological Impacts on Involved Workers of Operation of New MOX Facility at Pantex

Number of badged workers	331
Total dose (person-rem/yr)	22
10-year latent fatal cancers	0.088
Average worker dose (mrem/yr)	65
10-year latent fatal cancer risk	2.6×10^{-4}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1999; UC 1998f.

J.3.2.3 Pit Conversion and MOX Facilities

J.3.2.3.1 Construction of Pit Conversion and MOX Facilities

No radiological risk would be incurred by members of the public from the construction of new pit conversion and MOX facilities at Pantex. According to a recent radiation survey (DOE 1997) conducted in Zone 4, a construction worker would not be expected to receive any additional radiation exposure above natural background levels in the area. Nonetheless, construction workers may be monitored (badged) as a precautionary measure.

J.3.2.3.2 Operation of Pit Conversion and MOX Facilities

Tables J–38 and J–39 present the incident-free radiological impacts of operation of the new pit conversion and MOX facilities at Pantex.

Table J–38. Potential Radiological Impacts on the Public of Operation of New Pit Conversion and MOX Facilities at Pantex

Impact	Pit Conversion	MOX[a]	Total[b]
Population within 80 km for year 2010			
Dose (person-rem)	0.58	0.027	0.61
Percent of natural background[c]	5.8×10^{-4}	2.7×10^{-5}	6.1×10^{-4}
10-year latent fatal cancers	2.9×10^{-3}	1.3×10^{-4}	3.0×10^{-3}
Maximally exposed individual			
Annual dose (mrem)	0.062	0.015	0.077
Percent of natural background[c]	0.019	4.5×10^{-3}	0.024
10-year latent fatal cancer risk	3.1×10^{-7}	7.5×10^{-8}	3.9×10^{-7}
Average exposed individual within 80 km[d]			
Annual dose (mrem)	1.9×10^{-3}	8.8×10^{-5}	2.0×10^{-3}
10-year latent fatal cancer risk	9.5×10^{-9}	4.4×10^{-10}	9.9×10^{-9}

[a] As described in Section 4.26.3.2.2, Water Resources, no component was attributed to liquid pathways because it is not expected that significant contamination could reach these pathways given the site's groundwater and surface-water characteristics.

[b] Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.

[c] The annual natural background radiation level at Pantex is 332 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive 99,300 person-rem.

[d] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of Pantex in 2010 (299,000).

Source: Model results.

Table J–39. Potential Radiological Impacts on Involved Workers of Operation of New Pit Conversion and MOX Facilities at Pantex

Impact	Pit Conversion	MOX	Total
Number of badged workers	383	331	714
Total dose (person-rem/yr)	192	22	214
10-year latent fatal cancers	0.77	0.088	0.86
Average worker dose (mrem/yr)	500	65	300[a]
10-year latent fatal cancer risk	2.0×10^{-3}	2.6×10^{-4}	$1.2\text{x}10^{-3}$

[a] Represents an average of the doses for both facilities.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: DOE 1999; UC 1998e, 1998f.

J.4 SRS

J.4.1 Assessment Data

To perform the dose assessments for the SPD EIS, different types of data were collected and generated. In addition, calculational assumptions were made. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) that were used for the assessments.

J.4.1.1 Meteorological Data

The meteorological data used for the SRS dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD data file was based on measurements taken over a period of several years at a specific location (F-Area) and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operations. Table J–40 presents the JFD data used in the dose assessments for SRS.

J.4.1.2 Population Data

The SRS population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2010 (about midlife of operations) for areas within 80 km (50 mi) of the locations for the proposed surplus plutonium disposition facilities. The site population in 2010 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grids were centered at the Actinide Packaging and Storage Facility in F-Area, the locations from which radionuclides are assumed to be released during incident-free operations. Tables J–41 and J–42 present the population data used for the dose assessments at SRS.

J.4.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distributions described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII (leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs). Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels are then used in the assessment of doses to the SRS population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. SRS food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition Final PEIS* (HNUS 1996).

Table J–40. SRS 1987–1991 Joint Frequency Distributions at 61-m Height

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
2.0	A	0.27	0.35	0.39	0.42	0.34	0.31	0.28	0.31	0.31	0.3	0.32	0.34	0.5	0.32	0.29	0.26
	B	0.04	0.05	0.06	0.08	0.05	0.05	0.04	0.05	0.05	0.04	0.06	0.07	0.06	0.06	0.06	0.04
	C	0.02	0.03	0.1	0.07	0.02	0.04	0.03	0.06	0.05	0.05	0.07	0.07	0.09	0.06	0.03	0.02
	D	0.01	0.03	0.07	0.02	0.02	0.03	0.05	0.05	0.04	0.04	0.05	0.05	0.03	0.02	0.04	0.03
	E	0	0	0.02	0	0	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.02
	F	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0	0	0
4.0	A	0.64	0.63	0.7	0.77	0.76	0.63	0.54	0.66	0.58	0.64	0.73	1.15	1	0.69	0.52	0.44
	B	0.22	0.3	0.33	0.4	0.33	0.26	0.21	0.22	0.28	0.26	0.51	0.67	0.59	0.3	0.16	0.2
	C	0.08	0.52	0.57	0.77	0.51	0.37	0.33	0.39	0.44	0.45	0.7	0.77	0.69	0.33	0.28	0.15
	D	0.06	0.52	1.49	1.12	0.5	0.51	0.62	0.78	0.77	0.62	0.7	0.75	0.77	0.47	0.31	0.15
	E	0.04	0.2	0.8	0.35	0.18	0.28	0.42	0.55	0.57	0.43	0.51	0.42	0.49	0.33	0.25	0.15
	F	0.02	0.02	0.1	0.05	0.03	0.03	0.07	0.09	0.06	0.07	0.09	0.06	0.06	0.07	0.06	0.04
6.0	A	0.49	0.15	0.1	0.09	0.1	0.09	0.08	0.14	0.11	0.14	0.17	0.17	0.19	0.18	0.1	0.21
	B	0.12	0.22	0.17	0.22	0.19	0.09	0.08	0.15	0.17	0.2	0.3	0.42	0.37	0.28	0.11	0.08
	C	0.08	0.4	0.42	0.63	0.35	0.18	0.19	0.34	0.38	0.43	0.6	0.77	0.64	0.39	0.17	0.11
	D	0.06	0.8	2.28	1.39	0.62	0.44	0.67	1.31	1.21	0.75	0.94	0.87	1.01	0.66	0.29	0.18
	E	0.06	0.51	1.36	1.07	0.56	0.48	0.64	1.25	1.29	0.97	1.08	1.14	1.22	0.77	0.38	0.21
	F	0.02	0.04	0.18	0.28	0.23	0.21	0.2	0.23	0.23	0.26	0.25	0.26	0.21	0.19	0.1	0.08
8.0	A	0.11	0.03	0.01	0.01	0.01	0.01	0	0.02	0.01	0.04	0.02	0.02	0.03	0.03	0.02	0.03
	B	0	0.06	0.02	0.01	0	0	0	0.01	0.03	0.04	0.08	0.06	0.04	0.08	0.03	0.01
	C	0.01	0.11	0.11	0.13	0.06	0.04	0.05	0.07	0.13	0.17	0.27	0.28	0.33	0.29	0.06	0.01
	D	0.04	0.3	0.6	0.41	0.08	0.03	0.1	0.25	0.21	0.15	0.2	0.24	0.63	0.35	0.05	0.02
	E	0.02	0.29	0.25	0.16	0.06	0.02	0.02	0.06	0.08	0.05	0.16	0.12	0.15	0.06	0.02	0.02
	F	0	0.01	0.04	0.06	0.04	0.01	0.02	0.02	0.04	0.05	0.02	0.01	0.01	0	0	0
12.0	A	0.01	0	0	0	0	0	0	0	0	0	0.01	0.01	0	0.01	0	0.01
	B	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0.02	0	0
	C	0	0.01	0	0	0	0	0	0.02	0.03	0.03	0.04	0.06	0.2	0.18	0.01	0
	D	0.01	0.06	0.08	0.08	0.01	0.01	0.01	0.03	0.05	0.03	0.06	0.03	0.39	0.2	0.01	0
	E	0	0.01	0.02	0.01	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
14.1	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	0.01	0	0.01	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Simpkins 1997.

Table J–41. Projected SRS Population Surrounding APSF (Pit Conversion and MOX Facilities) for Year 2010

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	0	600	2,109	3,312	3,447	**9,468**
SSW	0	0	0	0	0	36	935	1,853	4,732	2,501	**10,057**
SW	0	0	0	0	0	73	1,239	8,333	2,023	4,318	**15,986**
WSW	0	0	0	0	0	228	3,762	4,014	3,742	7,194	**18,940**
W	0	0	0	0	0	355	7,786	47,484	21,880	18,192	**95,697**
WNW	0	0	0	0	0	2,439	11,335	205,958	53,232	6,694	**279,658**
NW	0	0	0	0	0	1,455	18,694	38,351	2,884	3,123	**64,507**
NNW	0	0	0	0	0	3,279	40,843	20,468	9,466	5,766	**79,822**
N	0	0	0	0	0	1,012	7,787	6,010	5,928	20,994	**41,731**
NNE	0	0	0	0	0	145	1,934	2,959	6,794	20,775	**32,607**
NE	0	0	0	0	0	0	3,168	3,786	5,985	11,236	**24,175**
ENE	0	0	0	0	0	0	3,077	5,828	7,625	33,477	**50,007**
E	0	0	0	0	0	0	6,188	5,442	7,342	3,952	**22,924**
ESE	0	0	0	0	0	0	996	3,497	4,455	7,253	**16,201**
SE	0	0	0	0	0	0	572	2,555	4,695	7,667	**15,489**
SSE	0	0	0	0	0	0	390	648	4,122	2,975	**8,135**
Total	**0**	**0**	**0**	**0**	**0**	**9,022**	**109,306**	**359,295**	**148,217**	**159,564**	**785,404**

Key: APSF, Actinide Packaging and Storage Facility.
Source: DOC 1992.

Table J–42. Projected SRS Population Surrounding APSF (Immobilization Facility) for Year 2010

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	0	576	2,124	3,368	3,437	**9,505**
SSW	0	0	0	0	0	33	914	1,849	4,750	2,508	**10,054**
SW	0	0	0	0	0	59	1,204	8,412	2,043	4,640	**16,358**
WSW	0	0	0	0	0	241	3,930	4,188	3,771	6,887	**19,017**
W	0	0	0	0	0	543	7,632	51,313	22,422	18,246	**100,156**
WNW	0	0	0	0	0	2,344	11,777	204,567	51,659	6,581	**276,928**
NW	0	0	0	0	0	1,479	19,053	36,367	2,990	3,123	**63,012**
NNW	0	0	0	0	0	3,394	43,236	17,846	9,567	5,783	**79,826**
N	0	0	0	0	0	961	7,818	5,691	6,005	21,037	**41,512**
NNE	0	0	0	0	0	171	1,936	3,000	6,811	21,327	**33,245**
NE	0	0	0	0	0	0	3,137	3,756	6,043	11,279	**24,215**
ENE	0	0	0	0	0	0	3,202	5,735	7,434	34,686	**51,057**
E	0	0	0	0	0	0	6,264	5,509	7,575	3,991	**23,339**
ESE	0	0	0	0	0	0	1,023	2,892	4,016	7,077	**15,008**
SE	0	0	0	0	0	0	569	3,116	5,213	7,848	**16,746**
SSE	0	0	0	0	0	0	380	636	3,953	3,002	**7,971**
Total	**0**	**0**	**0**	**0**	**0**	**9,225**	**112,651**	**357,001**	**147,620**	**161,452**	**787,949**

Key: APSF, Actinide Packaging and Storage Facility.
Source: DOC 1992.

J.4.1.4 Source Term Data

Estimated incident-free radiological releases associated with the new pit conversion, immobilization, and MOX facilities are presented in Tables J–43 through J–45. Stack heights and release locations are provided in the facility data reports (DOE 1999; UC 1998g, 1998h, 1999c, 1999d).

Table J–43. Estimated Incident-Free Annual Radiological Releases From the Pit Conversion Facility at SRS

Isotope	(μCi/yr)
Plutonium 236	9.3×10^{-11}
Plutonium 238	0.065
Plutonium 239	0.69
Plutonium 240	0.18
Plutonium 241	0.69
Plutonium 242	4.8×10^{-5}
Americium 241	0.37
Hydrogen 3	1.1×10^{9}

Source: UC 1998g.

Table J–44. Estimated Incident-Free Annual Radiological Releases From the New Immobilization Facility at SRS

Isotope	Ceramic (17 t) (μCi/yr)	Ceramic (50 t) (μCi/yr)	Glass (17 t) (μCi/yr)	Glass (50 t) (μCi/yr)
Plutonium 236	–	–	–	–
Plutonium 238	–	0.57	–	0.52
Plutonium 239	3.7	9.5	3.4	8.6
Plutonium 240	1.7	3.1	1.6	2.8
Plutonium 241	110	100	98	93
Plutonium 242	1.3×10^{-3}	1.6×10^{-3}	1.2×10^{-3}	1.5×10^{-3}
Americium 241	2.3	5.4	2.2	5.0
Uranium 234	–	–	–	–
Uranium 235	1.1×10^{-5}	4.5×10^{-5}	2.3×10^{-6}	2.3×10^{-6}
Uranium 238	8.8×10^{-5}	3.5×10^{-4}	1.9×10^{-5}	1.9×10^{-5}

Source: UC 1999c, 1999d.

Table J–45. Estimated Incident-Free Annual Radiological Releases From the New MOX Facility at SRS

Isotope	Airborne (μCi/yr)	Liquid (μCi/yr)
Plutonium 236	$1.3.\times10^{-8}$	9.3×10^{-8}
Plutonium 238	8.5	64
Plutonium 239	91	670
Plutonium 240	23	170
Plutonium 241	101	750
Plutonium 242	6.1×10^{-3}	0.046
Americium 241	48	350
Uranium 234	5.1×10^{-3}	0.037
Uranium 235	2.1×10^{-4}	1.6×10^{-3}
Uranium 238	0.012	0.089

Source: UC 1998h.

J.4.1.5 Other Calculational Assumptions

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

Ground surfaces were assumed to have no previous deposition of radionuclides for the purposes of modeling the incremental radiological impacts associated with surplus plutonium disposition activities. However, doses associated with true instances of prior deposition are accounted for in the Affected Environment and Cumulative Impacts sections.

The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).

The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).

The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).

The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.

A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were also examined for the MOX facility because it is the only facility with expected liquid releases at SRS.

Reported stack heights were used for atmospheric releases. The resultant doses were conservative as use of the actual stack height instead of the effective stack height negates plume rise.

The calculated doses are 50-year committed doses from 1 year of intake.

J.4.2 Facilities

The following sections present all viable radiological impact scenarios that could be associated with different combinations of incident-free facility operations at SRS.

J.4.2.1 Pit Conversion Facility

J.4.2.1.1 Construction of Pit Conversion Facility

No radiological risk would be incurred by members of the public from the construction of a new pit conversion facility at SRS. Construction worker exposures to radiation that derives from other activities at the site, past and present, would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–46 for workers at risk.

Table J–46. Potential Radiological Impacts on Construction Workers of New Pit Conversion Facility at SRS

Annual average number of workers	341
Total dose (person-rem/yr)	1.4
Annual latent fatal cancers[a]	5.6×10^{-4}
Average worker dose (mrem/yr)	4
Annual latent fatal cancer risk	1.6×10^{-6}

[a] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.

Note: The radiological limit for a construction worker is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: ICRP 1991; NAS 1990; UC 1998g.

J.4.2.1.2 Operation of Pit Conversion Facility

Tables J–47 and J–48 present the incident-free radiological impacts of the operation of a new pit conversion facility at SRS.

Table J–47. Potential Radiological Impacts on the Public of Operation of New Pit Conversion Facility at SRS

Population within 80 km for year 2010	
Dose (person-rem)	1.6
Percent of natural background[a]	6.9×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}
Maximally exposed individual	
Annual dose (mrem)	3.7×10^{-3}
Percent of natural background[a]	1.3×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}
Average exposed individual within 80 km[b]	
Annual dose (mrem)	2.0×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}

[a] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 232,000 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of SRS in 2010 (about 790,000).
Source: Model results.

Table J–48. Potential Radiological Impacts on Involved Workers of Operation of New Pit Conversion Facility at SRS

Number of badged workers	383
Total dose (person-rem/yr)	192
10-year latent fatal cancers	0.77
Average worker dose (mrem/yr)	500
10-year latent fatal cancer risk	2.0×10^{-3}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998g.

J.4.2.2 Immobilization Facility

J.4.2.2.1 Construction of Immobilization Facility

No radiological risk would be incurred by members of the public from the construction of a new immobilization facility at SRS. Construction worker exposures to radiation that derives from other activities at the site, past or present, would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–49 for workers at risk.

Table J–49. Potential Radiological Impacts on Construction Workers of New Immobilization Facility at SRS[a]

Annual average number of workers	374
Total dose (person-rem/yr)	1.5
Annual latent fatal cancers[b]	6.0×10^{-4}
Average worker dose (mrem/yr)	4
Annual latent fatal cancer risk	1.6×10^{-6}

[a] The values would be the same for immobilization in either ceramic or glass.
[b] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
Note: The radiological limit for a construction worker is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1999c, 1999d.

J.4.2.2.2 Operation of Immobilization Facility

Tables J–50 and J–51 present all possible incident-free radiological impact scenarios of the operation of a new immobilization facility at SRS.

Table J–50. Potential Radiological Impacts on the Public of Operation of New Immobilization Facility at SRS

	17 t		50 t	
Impact	**Ceramic**	**Glass**	**Ceramic**	**Glass**
Population within 80 km for year 2010				
Dose (person-rem)	2.8×10^{-3}	2.6×10^{-3}	5.8×10^{-3}	5.3×10^{-3}
Percent of natural background[a]	1.2×10^{-6}	1.1×10^{-6}	2.5×10^{-6}	2.3×10^{-6}
10-year latent fatal cancers	1.4×10^{-5}	1.3×10^{-5}	2.9×10^{-5}	2.7×10^{-5}
Maximally exposed individual				
Annual dose (mrem)	2.8×10^{-5}	2.6×10^{-5}	5.8×10^{-5}	5.3×10^{-5}
Percent of natural background[a]	9.5×10^{-6}	8.8×10^{-6}	2.0×10^{-5}	1.8×10^{-5}
10-year latent fatal cancer risk	1.4×10^{-10}	1.3×10^{-10}	2.9×10^{-10}	2.7×10^{-10}
Average exposed individual within 80 km[b]				
Annual dose (mrem)	3.6×10^{-6}	3.3×10^{-6}	7.4×10^{-6}	6.7×10^{-6}
10-year latent fatal cancer risk	1.8×10^{-11}	1.6×10^{-11}	3.7×10^{-11}	3.4×10^{-11}

[Text deleted.]
[a] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 232,000 person-rem.
[b] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the SRS facilities in 2010 (about 790,000).
Source: Model results.

Table J–51. Potential Radiological Impacts on Involved Workers of Operation of New Immobilization Facility at SRS[a]

Impact	17 t	50 t
Number of badged workers	323	339
Total dose (person-rem/yr)	242	254
10-year latent fatal cancers	0.97	1.0
Average worker dose (mrem/yr)	750	750
10-year latent fatal cancer risk	3.0×10^{-3}	3.0×10^{-3}

[a] The values would be the same for immobilization in either ceramic or glass.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: UC 1999c, 1999d.

J.4.2.3 MOX Facility

J.4.2.3.1 Construction of MOX Facility

No radiological risk would be incurred by members of the public from the construction of a new MOX facility at SRS. Construction worker exposures to radiation that derives from other activities at the site, past or present, would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–52 for workers at risk.

Table J–52. Potential Radiological Impacts on Construction Workers of New MOX Facility at SRS

Annual average number of workers	292
Total dose (person-rem/yr)	1.2
Annual latent fatal cancers[a]	4.8×10^{-4}
Average worker dose (mrem/yr)	4
Annual latent fatal cancer risk	1.6×10^{-6}

[a] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.

Note: The radiological limit for a construction worker is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: ICRP 1991; NAS 1990; UC 1998h.

J.4.2.3.2 Operation of MOX Facility

Tables J–53 and J–54 present the incident-free radiological impacts of the operation of a new MOX facility at SRS.

Table J–53. Potential Radiological Impacts on the Public of Operation of New MOX Facility at SRS[a]

Population within 80 km for year 2010	
Dose (person-rem)	0.18
Percent of natural background[b]	7.8×10^{-5}
10-year latent fatal cancers	9.1×10^{-4}
Maximally exposed individual	
Annual dose (mrem)	3.7×10^{-3}
Percent of natural background[b]	1.3×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}
Average exposed individual within 80 km[c]	
Annual dose (mrem)	2.3×10^{-4}
10-year latent fatal cancer risk	1.2×10^{-9}

[a] Includes a dose component from liquid pathways because it is possible that liquid releases could reach these pathways at SRS.
[b] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 232,000 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of SRS in 2010 (about 790,000).
Source: Model results.

Table J–54. Potential Radiological Impacts on Involved Workers of Operation of New MOX Facility at SRS

Number of badged workers	331
Total dose (person-rem/yr)	22
10-year latent fatal cancers	0.088
Average worker dose (mrem/yr)	65
10-year latent fatal cancer risk	2.6×10^{-4}

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1999; UC 1998h.

J.4.2.4 Pit Conversion and Immobilization Facilities

J.4.2.4.1 Construction of Pit Conversion and Immobilization Facilities

No radiological risk would be incurred by members of the public from construction of new pit conversion and immobilization facilities at SRS. Construction worker exposures to radiation that derives from other activities at the site, past or present, would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–55 for workers at risk.

Table J–55. Potential Radiological Impacts on Construction Workers of New Pit Conversion and Immobilization Facilities at SRS

Impact	Pit Conversion	Immobilization[a]	Total
Annual average number of workers	316	374	690
Total dose (person-rem/yr)	1.3	1.5	2.8
Annual latent fatal cancers[b]	5.2×10^{-4}	6.0×10^{-4}	1.1×10^{-3}
Average worker dose (mrem/yr)	4	4	4[c]
Annual latent fatal cancer risk	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}

[a] The values would be the same for immobilization in either ceramic or glass.
[b] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[c] Represents an average of the doses for both facilities.
Note: The radiological limit for a construction worker is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1998g, 1999c, 1999d.

J.4.2.4.2 Operation of Pit Conversion and Immobilization Facilities

Tables J–56 and J–57 present all possible incident-free radiological impact scenarios of operation of the new pit conversion and immobilization facilities at SRS.

Table J–56. Potential Radiological Impacts on the Public of Operation of New Pit Conversion and Immobilization Facilities at SRS

Impact	Pit Conversion	Immobilization (50 t)		Total[a]
		Ceramic	Glass	
Population within 80 km for year 2010				
Dose (person-rem)	1.6	5.8×10^{-3}	5.3×10^{-3}	1.6
Percent of natural background[b]	6.9×10^{-4}	2.5×10^{-6}	2.3×10^{-6}	6.9×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}	2.9×10^{-5}	2.7×10^{-5}	8.0×10^{-3}
Maximally exposed individual				
Annual dose (mrem)	3.7×10^{-3}	5.8×10^{-5}	5.3×10^{-5}	3.8×10^{-3}
Percent of natural background[b]	1.3×10^{-3}	2.0×10^{-5}	1.8×10^{-5}	1.3×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}	2.9×10^{-10}	2.7×10^{-10}	1.9×10^{-8}
Average exposed individual within 80 km[c]				
Annual dose (mrem)	2.0×10^{-3}	7.4×10^{-6}	6.7×10^{-6}	2.0×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}	3.7×10^{-11}	3.4×10^{-11}	1.0×10^{-8}

[Text deleted.]
[a] Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
[b] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 232,000 person-rem.
[c] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the SRS facilities in 2010 (about 790,000).
Source: Model results.

Table J–57. Radiological Impacts on Involved Workers of Operation of New Pit Conversion and Immobilization Facilities at SRS

Impact	Pit Conversion	Immobilization (50 t)[a]	Total
Number of badged workers	383	339	772
Total dose (person-rem/yr)	192	254	446
10-year latent fatal cancers	0.77	1.0	1.8
Average worker dose (mrem/yr)	500	750	618[b]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.5×10^{-3}

[a] The values would be the same for immobilization in either ceramic or glass.
[b] Represents an average of the doses for both facilities.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved with operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: UC 1998g, 1999c, 1999d.

J.4.2.5 Pit Conversion and MOX Facilities

J.4.2.5.1 Construction of Pit Conversion and MOX Facilities

No radiological risk would be incurred by members of the public from the construction of new pit conversion and MOX facilities at SRS. Construction worker exposures to radiation that derives from other activities at the site, past or present, would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–58 for workers at risk.

Table J–58. Potential Radiological Impacts on Construction Workers of New Pit Conversion and MOX Facilities at SRS

Impact	Pit Conversion	MOX	Total
Annual average number of workers	341	292	633
Total dose (person-rem/yr)	1.4	1.2	2.6
Annual latent fatal cancers[a]	5.6×10^{-4}	4.8×10^{-4}	1.0×10^{-3}
Average worker dose (mrem/yr)	4	4	4[b]
Annual latent fatal cancer risk	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}

[a] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[b] Represents an average of the doses for both facilities.
Note: The radiological limit for a construction worker is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1998g, 1998h.

J.4.2.5.2 Operation of Pit Conversion and MOX Facilities

Tables J–59 and J–60 present the incident-free radiological impacts of operation of the new pit conversion and MOX facilities at SRS.

Table J–59. Potential Radiological Impacts on the Public of Operation of New Pit Conversion and MOX Facilities at SRS

Impact	Pit Conversion	MOX[a]	Total[b]
Population within 80 km for year 2010			
Dose (person-rem)	1.6	0.18	1.8
Percent of natural background[c]	6.9×10^{-4}	7.8×10^{-5}	7.7×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}	9.1×10^{-4}	8.9×10^{-3}
Maximally exposed individual			
Annual dose (mrem)	3.7×10^{-3}	3.7×10^{-3}	7.4×10^{-3}
Percent of natural background[c]	1.3×10^{-3}	1.3×10^{-3}	2.5×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}	1.9×10^{-8}	3.7×10^{-8}
Average exposed individual within 80 km[d]			
Annual dose (mrem)	2.0×10^{-3}	2.3×10^{-4}	2.2×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}	1.2×10^{-9}	1.1×10^{-8}

[a] Includes a dose component from liquid pathways because it is possible that liquid releases could reach these pathways at SRS.
[b] Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
[c] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 232,000 person-rem.
[d] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of SRS in 2010 (about 790,000).
Source: Model results.

Table J–60. Potential Radiological Impacts on Involved Workers of Operation of New Pit Conversion and MOX Facilities at SRS

Impact	Pit Conversion	MOX	Total
Number of badged workers	383	331	714
Total dose (person-rem/yr)	192	22	214
10-year latent fatal cancers	0.77	0.088	0.86
Average worker dose (mrem/yr)	500	65	300[a]
10-year latent fatal cancer risk	2.0×10^{-3}	2.6×10^{-4}	1.2×10^{-3}

[a] Represents an average of the doses for both facilities.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1999; UC 1998g, 1998h.

J.4.2.6 Immobilization and MOX Facilities

J.4.2.6.1 Construction of Immobilization and MOX Facilities

No radiological risk would be incurred by members of the public from the construction of new immobilization and MOX facilities at SRS. Construction worker exposures to radiation deriving from other activities, past or present, at the site would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–61 for workers at risk.

Table J–61. Potential Radiological Impacts on Construction Workers of New Immobilization and MOX Facilities at SRS

Impact	Immobilization[a]	MOX	Total
Annual average number of workers	374	292	666
Total dose (person-rem/yr)	1.5	1.2	2.7
Annual latent fatal cancers[b]	6.0×10^{-4}	4.8×10^{-4}	1.1×10^{-3}
Average worker dose (mrem/yr)	4	4	4[c]
Annual latent fatal cancer risk	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}

[a] The values would be the same for immobilization in either ceramic or glass.
[b] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[c] Represents an average of the doses for both facilities.
Note: The radiological limit for a construction worker is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1998h, 1999c, 1999d.

J.4.2.6.2 Operation of Immobilization and MOX Facilities

Tables J–62 and J–63 present the incident-free radiological impacts of operation of the new immobilization and MOX facilities at SRS.

Table J–62. Potential Radiological Impacts on the Public of Operation of New Immobilization and MOX Facilities at SRS

	Immobilization (17 t)			
Impact	Ceramic	Glass	MOX[a]	Total[b]
Population within 80 km for year 2010				
Dose (person-rem)	2.8×10^{-3}	2.6×10^{-3}	0.18	0.18
Percent of natural background[c]	1.2×10^{-6}	1.1×10^{-6}	7.8×10^{-5}	7.9×10^{-5}
10-year latent fatal cancers	1.4×10^{-5}	1.3×10^{-5}	9.1×10^{-4}	9.2×10^{-4}
Maximally exposed individual				
Annual dose (mrem)	2.8×10^{-5}	2.6×10^{-5}	3.7×10^{-3}	3.7×10^{-3}
Percent of natural background[c]	9.5×10^{-6}	8.8×10^{-6}	1.3×10^{-3}	1.3×10^{-3}
10-year latent fatal cancer risk	1.4×10^{-10}	1.3×10^{-10}	1.9×10^{-8}	1.9×10^{-8}
Average exposed individual within 80 km[d]				
Annual dose (mrem)	3.6×10^{-6}	3.3×10^{-6}	2.3×10^{-4}	2.3×10^{-4}
10-year latent fatal cancer risk	1.8×10^{-11}	1.6×10^{-11}	1.2×10^{-9}	1.2×10^{-9}

[Text deleted.]
[a] Includes a dose component from liquid pathways because it is possible that liquid releases could reach these pathways at SRS.
[b] Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from both facilities.
[c] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in 2010 would receive about 232,000 person-rem.
[d] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the SRS facilities in 2010 (about 790,000).
Source: Model results.

Table J–63. Potential Radiological Impacts on Involved Workers of Operation of New Immobilization and MOX Facilities at SRS

Impact	Immobilization (17 t)[a]	MOX	Total
Number of badged workers	323	331	654
Total dose (person-rem/yr)	242	22	264
10-year latent fatal cancers	0.97	0.088	1.1
Average worker dose (mrem/yr)	750	65	404[b]
10-year latent fatal cancer risk	3.0×10^{-3}	2.6×10^{-4}	1.6×10^{-3}

[a] The values would be the same for immobilization in either ceramic or glass.
[b] Represents an average of the doses for both facilities.
Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: DOE 1999; UC 1998h, 1999c, 1999d.

J.4.2.7 Pit Conversion, Immobilization, and MOX Facilities

J.4.2.7.1 Construction of Pit Conversion, Immobilization, and MOX Facilities

No radiological risk would be incurred by members of the public from the construction of new pit conversion, immobilization, and MOX facilities at SRS. Construction worker exposures to radiation that derives from other activities at the site, past or present, would also be kept as low as is reasonably achievable. Construction workers would be monitored (badged) as appropriate. Summaries of radiological impacts of these activities are presented in Table J–64 for workers at risk.

Table J–64. Potential Radiological Impacts on Construction Workers of New Pit Conversion, Immobilization, and MOX Facilities at SRS

Impact	Pit Conversion	Immobilization[a]	MOX	Total
Annual average number of workers	341	374	292	1,007
Total dose (person-rem/yr)	1.4	1.5	1.2	4.1
Annual latent fatal cancers[b]	5.6×10^{-4}	6.0×10^{-4}	4.8×10^{-4}	1.6×10^{-3}
Average worker dose (mrem/yr)	4	4	4	4[c]
Annual latent fatal cancer risk	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}

[a] The values would be the same for immobilization in either ceramic or glass.
[b] Values are based on a risk factor of 400 latent fatal cancers per million person-rem set by the National Research Council's Committee on the Biological Effects of Ionizing Radiations.
[c] Represents an average of the doses for all three facilities.
Note: The radiological limit for construction workers is 100 mrem/yr because they are categorized as members of the public (DOE 1993). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.
Source: ICRP 1991; NAS 1990; UC 1998g, 1998h, 1999c, 1999d.

J.4.2.7.2 Operation of Pit Conversion, Immobilization, and MOX Facilities

Tables J–65 and J–66 present all possible incident-free radiological impact scenarios of operation of all three new facilities at SRS.

Table J–65. Potential Radiological Impacts on the Public of Operation of New Pit Conversion, Immobilization, and MOX Facilities at SRS

Impact	Pit Conversion	Immobilization (17 t)		MOX[a]	Total[b]
		Ceramic	Glass		
Population within 80 km for year 2010					
Dose (person-rem)	1.6	2.8×10^{-3}	2.6×10^{-3}	0.18	1.8
Percent of natural background[c]	6.9×10^{-4}	1.2×10^{-6}	1.1×10^{-6}	7.8×10^{-5}	7.8×10^{-4}
10-year latent fatal cancers	8.0×10^{-3}	1.4×10^{-5}	1.3×10^{-5}	9.1×10^{-4}	9.0×10^{-3}
Maximally exposed individual					
Annual dose (mrem)	3.7×10^{-3}	2.8×10^{-5}	2.6×10^{-5}	3.7×10^{-3}	7.4×10^{-3}
Percent of natural background[c]	1.3×10^{-3}	9.5×10^{-6}	8.8×10^{-6}	1.3×10^{-3}	2.5×10^{-3}
10-year latent fatal cancer risk	1.9×10^{-8}	1.4×10^{-10}	1.3×10^{-10}	1.9×10^{-8}	3.7×10^{-8}
Average exposed individual within 80 km[d]					
Annual dose (mrem)	2.0×10^{-3}	3.6×10^{-6}	3.3×10^{-6}	2.3×10^{-4}	2.2×10^{-3}
10-year latent fatal cancer risk	1.0×10^{-8}	1.8×10^{-11}	1.6×10^{-11}	1.2×10^{-9}	1.1×10^{-8}

[Text deleted.]

[a] Includes a dose component from liquid pathways because it is possible that liquid releases could reach these pathways at SRS.

[b] Totals represent the largest possible sums for each public category. Totals are additive in all cases because the same groups or individuals would receive doses from all three facilities.

[c] The annual natural background radiation level at SRS is 295 mrem for the average individual; the population within 80 km (50 mi) in the year 2010 receives about 232,000 person-rem.

[d] Obtained by dividing the population dose by the number of people projected to live within 80 km (50 mi) of the SRS facilities in 2010 (about 790,000).

Source: Model results.

Table J–66. Potential Radiological Impacts on Involved Workers of Operation of New Pit Conversion, Immobilization, and MOX Facilities at SRS

Impact	Pit Conversion	Immobilization (17 t)[a]	MOX	Total
Number of badged workers	383	323	331	1,037
Total dose (person-rem/yr)	192	242	22	456
10-year latent fatal cancers	0.77	0.97	0.088	1.8
Average worker dose (mrem/yr)	500	750	65	440[b]
10-year latent fatal cancer risk	2.0×10^{-3}	3.0×10^{-3}	2.6×10^{-4}	1.8×10^{-3}

[a] The values would be the same for immobilization in either ceramic or glass.

[b] Represents an average of the doses for all three facilities.

Note: The radiological limit for an individual worker is 5,000 mrem/yr (DOE 1995). However, the maximum dose to a worker involved in operations would be kept below the DOE administrative control level of 2,000 mrem/yr (DOE 1994). An effective ALARA program would ensure that doses are reduced to levels that are as low as is reasonably achievable.

Source: DOE 1999; UC 1998g, 1998h, 1999c, 1999d.

J.5 LEAD ASSEMBLY FABRICATION

J.5.1 ANL–W

J.5.1.1 Assessment Data

This section presents applicable data and assumptions used in the assessment of lead assembly human health risks at ANL–W at INEEL. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) used for the assessment.

J.5.1.1.1 Meteorological Data

The meteorological data used for the ANL–W dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken over a period of several years at a specific location and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operations. Table J–20 presents the JFD used in the dose assessments for ANL–W.

J.5.1.1.2 Population Data

The INEEL population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2005 for areas within 80 km (50 mi) of the proposed facility location. The site population in 2005 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at ANL–W, the location from which radionuclides are assumed to be released during incident-free operations. Table J–67 presents the population data used for the lead assembly dose assessments at ANL–W.

J.5.1.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distributions described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. ANL–W food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition Final PEIS* (HNUS 1996).

J.5.1.1.4 Source Term Data

Estimated incident-free radiological releases associated with the MOX fuel lead assembly facility are presented in Table J–68. Stack height and release location are provided in the Oak Ridge National Laboratory (ORNL) *ANL-W MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement* (O'Connor et al. 1998a).

Table J–67. Projected INEEL Population Surrounding ANL–W for Year 2005

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	0	277	2,086	6,173	30,883	**39,419**
SSW	0	0	0	0	0	0	273	323	906	3,267	**4,769**
SW	0	0	0	0	0	0	246	247	224	334	**1,051**
WSW	0	0	0	0	0	0	0	238	177	181	**596**
W	0	0	0	0	0	0	0	179	224	528	**931**
WNW	0	0	0	0	0	0	35	474	824	467	**1,800**
NW	0	0	0	0	0	0	36	57	280	929	**1,302**
NNW	0	0	0	0	0	0	0	81	76	76	**233**
N	0	0	0	0	0	0	0	254	140	146	**540**
NNE	0	0	0	0	0	0	252	450	266	158	**1,126**
NE	0	0	0	0	0	0	252	443	515	98	**1,308**
ENE	0	0	0	0	0	0	253	706	1,411	5,196	**7,566**
E	0	0	0	0	0	0	367	1,405	18,570	32,506	**52,848**
ESE	0	0	0	0	0	103	509	4,197	90,875	756	**96,440**
SE	0	0	0	0	17	80	589	3,523	11,502	411	**16,122**
SSE	0	0	0	0	17	52	279	4,816	19,230	1,068	**25,462**
Total	**0**	**0**	**0**	**0**	**34**	**235**	**3,368**	**19,479**	**151,393**	**77,004**	**251,513**

Key: ANL–W, Argonne National Laboratory–West.
Source: DOC 1992.

Table J–68. Estimated Incident-Free Annual Radiological Releases From the MOX Lead Assembly Facility at ANL–W

Isotope	(μCi/yr)
Plutonium 236	–
Plutonium 238	0.85
Plutonium 239	23
Plutonium 240	5.3
Plutonium 241	58
Plutonium 242	9.3×10^{-4}
Americium 241	2.0
Uranium 234	1.3×10^{-3}
Uranium 235	5.4×10^{-5}
Uranium 238	3.1×10^{-3}

Source: O'Connor et al. 1998a.

J.5.1.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operation of the lead assembly facility at ANL–W, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977).

Ground surfaces were assumed to have no previous deposition of radionuclides for the purposes of modeling the incremental radiological impacts associated with surplus plutonium disposition activities.

However, doses associated with true instances of prior deposition are accounted for in the Affected Environment and Cumulative Impacts sections.

The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).

The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).

The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).

The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.

A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.

Reported stack heights were used for atmospheric releases and were assumed to be the effective stack height. The resultant doses were conservative because use of the actual stack height negates plume rise.

The calculated doses are 50-year committed doses from 1 year of intake.

J.5.1.2 Human Health Impacts

Potential radiological impacts on the public and workers resulting from normal lead assembly operations are presented in Section 4.27.1.4. Potential impacts on postirradiation examination facility workers are presented in Section 4.27.6.2.

J.5.2 Hanford

J.5.2.1 Assessment Data

This section presents applicable data and assumptions used in the assessment of lead assembly human health risks at Hanford. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) used for the assessment.

J.5.2.1.1 Meteorological Data

The meteorological data used for the Hanford dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken over a period of several years at a specific location and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operations. Table J–1 presents the JFD used in the dose assessments for Hanford.

J.5.2.1.2 Population Data

The Hanford population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2005 for areas within 80 km (50 mi) of the proposed facility location. The site population in 2005 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at FMEF in the 400 Area, the location from which radionuclides are assumed to be released during incident-free operations. Table J–69 presents the population data used for lead assembly dose assessments at Hanford.

Table J–69. Projected Hanford Population Surrounding FMEF for Year 2005

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	3,886	40,763	1,039	7,050	19,641	**72,379**
SSW	0	0	0	0	2	1,380	2,513	399	2,888	3,828	**11,010**
SW	0	0	0	0	38	1,265	4,361	288	207	1,923	**8,082**
WSW	0	0	0	0	0	50	2,175	15,734	3,338	300	**21,597**
W	0	0	0	0	0	0	698	5,764	26,190	14,858	**47,510**
WNW	0	0	0	0	0	0	5	813	1,147	8,446	**10,411**
NW	0	0	0	0	0	0	0	592	377	163	**1,132**
NNW	0	0	0	0	0	0	0	1,034	1,317	1,362	**3,713**
N	0	0	0	0	0	0	0	1,224	3,458	2,520	**7,202**
NNE	0	0	0	0	0	16	425	5,074	1,388	23,720	**30,623**
NE	0	0	0	0	0	86	751	6,743	2,769	1,153	**11,502**
ENE	0	0	0	0	0	313	1,401	3,391	385	410	**5,900**
E	0	0	0	0	0	386	861	410	319	300	**2,276**
ESE	0	0	0	0	0	393	595	315	245	302	**1,850**
SE	0	0	0	0	0	381	1,191	1,604	366	1,364	**4,906**
SSE	0	0	0	0	0	6,366	79,333	30,715	565	979	**117,958**
Total	**0**	**0**	**0**	**0**	**40**	**14,522**	**135,072**	**75,139**	**52,009**	**81,269**	**358,051**

Key: FMEF, Fuels and Materials Examination Facility.
Source: DOC 1992.

J.5.2.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distributions described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. Hanford food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition Final PEIS* (HNUS 1996).

J.5.2.1.4 Source Term Data

Estimated incident-free radiological releases associated with the MOX fuel lead assembly facility are presented in Table J–70. Stack height and release location are reported in the ORNL *Hanford MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement* (O'Connor et al. 1998b).

Table J–70. Estimated Incident-Free Annual Radiological Releases From the MOX Lead Assembly Facility at Hanford

Isotope	(μCi/yr)
Plutonium 236	–
Plutonium 238	0.85
Plutonium 239	23
Plutonium 240	5.3
Plutonium 241	58
Plutonium 242	9.3×10^{-4}
Americium 241	2.0
Uranium 234	1.3×10^{-3}
Uranium 235	5.4×10^{-5}
Uranium 238	3.1×10^{-3}

Source: O'Connor et al. 1998b.

J.5.2.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operation of the lead assembly facility at Hanford, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977).

Ground surfaces were assumed to have no previous deposition of radionuclides for the purposes of modeling the incremental radiological impacts associated with surplus plutonium disposition activities. However, doses associated with true instances of prior deposition are accounted for in the Affected Environment and Cumulative Impacts sections.

The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).

The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).

The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).

The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.

A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.

Reported stack heights were used for atmospheric releases and were assumed to be the effective stack height. The resultant doses were conservative because use of the actual stack height negates plume rise.

The calculated doses are 50-year committed doses from 1 year of intake.

J.5.2.2 Human Health Impacts

Potential radiological impacts on the public and workers resulting from normal lead assembly operations are presented in Section 4.27.2.4.

J.5.3 LLNL

J.5.3.1 Assessment Data

This section presents applicable data and assumptions used in the assessment of lead assembly human health risks at LLNL. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) used for the assessment.

J.5.3.1.1 Meteorological Data

The meteorological data used for the LLNL dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken at a specific location and height. Annual meteorological conditions were used for normal operations. Table J–71 presents the JFD used in the dose assessments for LLNL.

J.5.3.1.2 Population Data

The LLNL population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2005 for areas within 80 km (50 mi) of the proposed facility location. The site population in 2005 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at Building 332, the location from which radionuclides are assumed to be released during incident-free operations. Table J–72 presents the population data that were used for lead assembly dose assessments at LLNL.

J.5.3.1.3 Agricultural Data

The 1992 Census of Agriculture (DOC 1992) was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distributions described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. LLNL food production and consumption data used for the dose assessments in the SPD EIS were obtained from the 1992 census data for LLNL (DOC 1992).

Table J–71. LLNL 1993 Joint Frequency Distributions at 10-m Height

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.89	A	0.45	0.41	0.4	0.33	0.27	0.17	0.14	0.11	0.13	0.34	0.62	1.14	1.53	0.78	0.57	0.45
	B	0.22	0.11	0.1	0.11	0.1	0.03	0.03	0.01	0.07	0.05	0.27	0.41	0.17	0.17	0.14	0.09
	C	0.13	0.09	0.15	0.03	0.02	0.01	0	0.03	0.08	0.14	0.16	0.22	0.16	0.09	0.08	0.07
	D	0.17	0.33	0.45	0.53	0.65	0.67	0.23	0.34	1.05	1.86	1.21	0.7	0.27	0.13	0.05	0.03
	E	0.18	0.33	0.86	0.99	1.01	1.13	0.39	0.48	1.07	1.7	0.74	0.41	0.25	0.06	0.09	0.03
	F	0.11	0.16	0.61	0.93	0.8	0.63	0.55	0.31	0.35	0.38	0.39	0.14	0.1	0.08	0.11	0.07
	G	0.62	0.74	1.06	1.64	1.97	1.78	1.53	0.97	0.73	0.75	0.49	0.48	0.34	0.27	0.35	0.37
2.86	A	0.3	0.37	0.24	0.18	0.03	0.02	0.02	0.01	0	0.02	0.26	0.81	0.89	0.31	0.21	0.16
	B	0.4	0.39	0.77	0.16	0	0.03	0.02	0.01	0.02	0.08	0.39	1.26	1.15	0.22	0.07	0.21
	C	0.07	0.59	1.21	0	0	0	0	0.01	0.02	0.09	0.7	1.28	1.17	0.23	0.01	0.03
	D	0.03	0.82	1.04	0.03	0	0	0.03	0.09	0.25	1.14	4.88	2.71	1.81	0.21	0.02	0
	E	0.07	0.13	0.27	0.07	0	0	0.05	0.06	0.63	1.91	0.93	0.16	0.03	0	0	0.02
	F	0.03	0.03	0.16	0.1	0.01	0.02	0.01	0.02	0.03	0.02	0.06	0.02	0.01	0.02	0.01	0.01
	G	0.01	0.05	0.07	0.06	0.05	0.02	0.03	0.02	0.05	0.03	0.06	0	0	0	0.01	0.01
4.71	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	0.34	0.71	0.23	0.02	0	0.02	0	0.05	0.01	0.03	0.3	1.22	1.62	0.16	0.01	0
	D	0.08	0.72	0.56	0	0	0	0	0.06	0.09	0.61	3.64	1.51	2.04	0.11	0.01	0.02
	E	0	0.02	0	0	0	0	0	0	0	0.15	0.17	0.01	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.69	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	0.15	0.24	0.02	0	0	0	0	0	0.03	0.45	1.25	0.32	0.13	0.03	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.68	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	0.07	0.08	0	0	0	0	0	0	0.02	0.07	0.02	0	0.01	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table J–71. LLNL 1993 Joint Frequency Distributions at 10-m Height (Continued)

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
10.5	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Key: LLNL, Lawrence Livermore National Laboratory.
Source: Gouveia 1997.

Table J–72. Projected LLNL Population Surrounding Building 332 for Year 2005

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	5	14	6	8	10	84	178	157	15,286	56,124	**71,872**
SSW	5	15	13	8	10	47	1,080	301,887	190,271	27,874	**521,210**
SW	31	538	25	18	16	91	42,723	589,979	350,562	52,017	**1,036,000**
WSW	228	1,283	660	982	1,885	644	146,903	239,224	184,580	4,845	**581,234**
W	302	1,316	3,338	6,379	9,931	24,309	112,488	123,480	333,290	64,111	**678,944**
WNW	311	1,316	4,567	6,337	8,349	20,051	92,859	476,610	570,787	545,627	**1,726,814**
NW	272	1,316	1,770	2,274	212	677	78,366	170,569	454,881	135,688	**846,025**
NNW	109	1,423	2,850	2,109	53	404	8,150	275,850	117,234	154,923	**563,105**
N	5	49	1,094	324	39	367	4,555	139,309	1,444	230,332	**377,518**
NNE	5	15	25	35	45	283	13,831	24,535	7,317	5,523	**51,614**
NE	5	15	16	25	21	127	8,403	12,091	128,594	36,124	**185,421**
ENE	5	11	6	8	10	111	2,218	130,249	211,561	11,360	**355,539**
E	5	14	8	8	10	249	54,523	86,577	30,047	47,622	**219,063**
ESE	5	15	17	8	10	103	1,898	7,484	230,939	242,714	**483,193**
SE	5	15	10	8	10	91	512	902	18,290	23,344	**43,187**
SSE	5	12	6	8	10	85	314	83	26	1,063	**1,612**
Total	**1,303**	**7,367**	**14,411**	**18,539**	**20,621**	**47,723**	**569,001**	**2,578,986**	**2,845,109**	**1,639,291**	**7,742,351**

Key: LLNL, Lawrence Livermore National Laboratory.
Source: DOC 1992.

J.5.3.1.4 Source Term Data

Estimated incident-free radiological releases associated with the MOX fuel lead assembly facility are presented in Table J–73. Stack height and release location are provided in the ORNL *LLNL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement* (O'Connor et al. 1998c).

Table J–73. Estimated Incident-Free Annual Radiological Releases From the MOX Lead Assembly Facility at LLNL

Isotope	(μCi/yr)
Plutonium 236	–
Plutonium 238	0.85
Plutonium 239	23
Plutonium 240	5.3
Plutonium 241	58
Plutonium 242	9.3×10^{-4}
Americium 241	2.0
Uranium 234	1.3×10^{-3}
Uranium 235	5.4×10^{-5}
Uranium 238	3.1×10^{-3}

Source: O'Connor et al. 1998c.

J.5.3.1.5 Other Calculational Assumptions

To estimate radiological impacts of incident-free operation of the lead assembly facility at LLNL, the following additional assumptions and factors were considered, in accordance with the guidelines established in NRC Regulatory Guide 1.109 (NRC 1977).

Ground surfaces were assumed to have no previous deposition of radionuclides for the purposes of modeling the incremental radiological impacts associated with surplus plutonium disposition activities. However, doses associated with true instances of prior deposition are accounted for in the Affected Environment and Cumulative Impacts sections.

The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).

The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).

The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).

The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.

A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.

Reported stack heights were used for atmospheric releases and were assumed to be the effective stack height. The resultant doses were conservative because use of the actual stack height negates plume rise.

The calculated doses are 50-year committed doses from 1 year of intake.

J.5.3.2 Human Health Impacts

Potential radiological impacts on the public and workers resulting from normal lead assembly operations are presented in Section 4.27.3.4.

J.5.4 LANL

J.5.4.1 Assessment Data

This section presents applicable data and assumptions used in the assessment of lead assembly human health risks at LANL. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) used for the assessment.

J.5.4.1.1 Meteorological Data

The meteorological data used for the LANL dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken at a specific location and height. Annual meteorological conditions were used for normal operations. Table J–74 presents the JFD used in the dose assessments for LANL.

J.5.4.1.2 Population Data

The LANL population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2005 for areas within 80 km (50 mi) of the proposed facility location. The site population in 2005 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered at Technical Area 55 (TA–55), the location from which radionuclides are assumed to be released during incident-free operations. Table J–75 presents the population data used for lead assembly dose assessments at LANL.

J.5.4.1.3 Agricultural Data

The 1992 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distributions described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-m (50-mi) assessment area were assumed to consume only food grown in that area. LANL food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Final Environmental Impact Statement on Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site* (DOE 1998).

Table J–74. LANL 1993–1996 Joint Frequency Distributions at 11-m Height

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
0.78	A	0.12	0.26	0.5	0.84	0.74	0.54	0.45	0.32	0.18	0.11	0.08	0.05	0.06	0.06	0.07	0.07
	B	0.03	0.05	0.12	0.19	0.16	0.09	0.08	0.07	0.04	0.01	0.02	0.01	0.02	0.02	0.01	0.02
	C	0.05	0.09	0.14	0.2	0.16	0.09	0.09	0.09	0.07	0.04	0.03	0.03	0.02	0.03	0.02	0.03
	D	0.86	0.69	0.57	0.45	0.47	0.34	0.33	0.33	0.38	0.35	0.33	0.31	0.35	0.4	0.57	0.72
	E	0.59	0.45	0.33	0.23	0.22	0.15	0.13	0.13	0.17	0.24	0.32	0.28	0.29	0.4	0.51	0.62
	F	0.26	0.28	0.27	0.19	0.18	0.17	0.2	0.25	0.3	0.32	0.22	0.17	0.15	0.2	0.24	0.25
2.5	A	0.03	0.07	0.17	0.45	0.56	0.43	0.33	0.22	0.18	0.08	0.06	0.05	0.04	0.03	0.03	0.03
	B	0.02	0.05	0.2	0.39	0.42	0.31	0.27	0.22	0.16	0.1	0.06	0.05	0.05	0.04	0.03	0.02
	C	0.05	0.15	0.46	0.68	0.65	0.45	0.46	0.59	0.59	0.26	0.16	0.12	0.16	0.12	0.07	0.05
	D	0.95	1.09	0.94	0.72	0.56	0.34	0.47	1.3	2.12	1.89	1.93	0.95	1.08	0.81	0.56	0.63
	E	0.87	0.59	0.34	0.19	0.11	0.1	0.13	0.24	0.67	1.82	2.41	1.72	1.84	1.41	0.8	0.8
	F	0.09	0.07	0.05	0.03	0.01	0.01	0.05	0.1	0.25	0.33	0.11	0.36	0.39	0.39	0.12	0.07
4.5	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	0.01	0.01	0.01	0.02	0.01	0
	C	0.02	0.04	0.07	0.04	0.02	0.01	0.01	0.03	0.15	0.09	0.11	0.19	0.31	0.19	0.09	0.02
	D	0.81	0.8	0.42	0.16	0.07	0.04	0.11	0.99	3.24	3.52	2.59	1.61	1.86	1.05	0.54	0.44
	E	0.21	0.2	0.08	0.01	0	0	0.01	0.07	0.32	1.74	1.08	1.32	1.31	0.32	0.23	0.22
	F	0	0.01	0	0	0	0	0	0	0.02	0.04	0	0.05	0.05	0.01	0.01	0
6.9	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0.01	0	0
	D	0.19	0.2	0.05	0	0	0	0.01	0.31	0.96	1.42	0.87	0.93	0.62	0.48	0.31	0.15
	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
9.6	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	0.01	0.01	0	0	0	0	0	0.05	0.03	0.08	0.09	0.19	0.08	0.05	0.04	0.02
	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
105	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	0.01	0	0	0.01	0.01	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Key: LANL, Los Alamos National Laboratory.
Source: LANL 1997.

Table J–75. Projected LANL Population Surrounding TA–55 for Year 2005

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	25	26	44	221	701	1,606	1,125	2,962	**6,710**
SSW	0	0	26	20	56	21	1,373	4,464	4,949	43,596	**54,505**
SW	0	0	26	22	80	29	155	1,767	817	30,893	**33,789**
WSW	0	0	26	21	56	302	159	1,187	2,500	61	**4,312**
W	0	0	27	20	26	457	190	1,084	135	350	**2,289**
WNW	0	12	39	135	90	532	73	138	1,755	1,306	**4,080**
NW	0	152	1,287	2,379	1,500	720	102	195	248	274	**6,857**
NNW	0	427	844	224	126	421	169	211	174	220	**2,816**
N	500	585	264	107	137	560	609	688	659	289	**4,398**
NNE	0	480	61	57	56	463	958	919	658	143	**3,795**
NE	0	101	12	17	22	378	12,856	2,950	1,954	3,236	**21,526**
ENE	0	10	12	17	22	618	13,270	3,439	2,869	1,938	**22,195**
E	0	10	12	17	22	684	3,598	590	719	1,161	**6,813**
ESE	0	10	12	17	33	220	1,602	3,608	316	834	**6,652**
SE	0	0	0	0	4,488	952	6,143	76,455	4,503	742	**93,283**
SSE	0	0	0	117	85	224	5,021	10,633	2,091	483	**18,654**
Total	**500**	**1,787**	**2,673**	**3,196**	**6,843**	**6,802**	**46,979**	**109,934**	**25,472**	**88,488**	**292,674**

Key: LANL, Los Alamos National Laboratory; TA–55, Technical Area 55.
Source: DOC 1992.

J.5.4.1.4 Source Term Data

Estimated incident-free radiological releases associated with the MOX fuel lead assembly facility are presented in Table J–76. Stack height and release location are provided in the ORNL *LANL MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement* (O'Connor et al. 1998d).

Table J–76. Estimated Incident-Free Annual Radiological Releases From the MOX Lead Assembly Facility at LANL

Isotope	(μCi/yr)
Plutonium 236	–
Plutonium 238	0.85
Plutonium 239	23
Plutonium 240	5.3
Plutonium 241	58
Plutonium 242	9.3×10^{-4}
Americium 241	2.0
Uranium 234	1.3×10^{-3}
Uranium 235	5.4×10^{-5}
Uranium 238	3.1×10^{-3}

Source: O'Connor et al. 1998d.

J.5.4.1.5 Other Calculational Assumptions

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

Ground surfaces were assumed to have no previous deposition of radionuclides for the purposes of modeling the incremental radiological impacts associated with surplus plutonium disposition activities. However, doses associated with true instances of prior deposition are accounted for in the Affected Environment and Cumulative Impacts sections.

The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).

The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).

The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).

The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.

A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.

Reported stack heights were used for atmospheric releases and were assumed to be the effective stack height. The resultant doses were conservative, because use of the actual stack height negates plume rise.

The calculated doses are 50-year committed doses from 1 year of intake.

J.5.4.2 Human Health Impacts

Potential radiological impacts on the public and workers resulting from normal lead assembly operations are presented in Section 4.27.4.4.

J.5.5 SRS

J.5.5.1 Assessment Data

This section presents applicable data and assumptions used in the assessment of lead assembly human health risks at SRS. Appendix F.10 provides a summary of the methods and tools (e.g., the GENII computer code) used for the assessment.

J.5.5.1.1 Meteorological Data

The meteorological data used for the SRS dose assessments was in the form of a JFD file. A JFD file is a table listing the percentages of time the wind blows in a certain direction, at a certain speed, and within a certain stability class. The JFD file was based on measurements taken over a period of several years at a specific location (H-Area) and height. Average annual meteorological conditions, averaged over the measurement period, were used for normal operations. Table J–77 presents the JFD used in the dose assessments for SRS.

J.5.5.1.2 Population Data

The SRS population distribution was based on the *1990 Census of Population and Housing Data* (DOC 1992). Projections were determined for the year 2005 for areas within 80 km (50 mi) of the proposed facility location. The site population in 2005 was assumed to be representative of the population over the operational period evaluated. The population was spatially distributed on a circular grid with 16 directions and 10 radial distances out to an 80-km (50-mi) distance. The grid was centered within H-Area, the location from which radionuclides are assumed to be released during incident-free operations. Table J–78 presents the population data used for the lead assembly dose assessments at SRS.

J.5.5.1.3 Agricultural Data

The 1987 Census of Agriculture was the source used to generate site-specific data for food production. Food production was spatially distributed on a circular grid similar to that used for the population distributions described previously. This food grid (or wheel) was generated by combining the fraction of a county in each segment (e.g., south, southwest, north-northeast) and the county production of the eight food categories analyzed by GENII—leafy vegetables, root vegetables, fruits, grains, beef, poultry, milk, and eggs. Each county's food production was assumed to be distributed uniformly over the given county's land area. These categorized food wheels were then used in the assessment of doses to the population from the ingestion pathway. The consumption rates used in the dose assessments were those for the MEI and average exposed individual. People living within the 80-km (50-mi) assessment area were assumed to consume only food grown in that area. SRS food production and consumption data used for the dose assessments in the SPD EIS were obtained from the *Health Risk Data for Storage and Disposition of Final PEIS* (HNUS 1996).

Table J–77. SRS 1987–1991 Joint Frequency Distributions at 61-m Height

Wind Speed (m/s)	Stability Class	Wind Blows Toward															
		S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE
2.0	A	0.37	0.41	0.37	0.42	0.4	0.37	0.4	0.36	0.36	0.35	0.45	0.39	0.45	0.43	0.37	0.41
	B	0.08	0.08	0.09	0.1	0.05	0.06	0.06	0.05	0.08	0.07	0.05	0.05	0.05	0.08	0.05	0.07
	C	0.03	0.06	0.09	0.07	0.06	0.05	0.06	0.05	0.07	0.05	0.06	0.05	0.08	0.05	0.05	0.05
	D	0.02	0.05	0.06	0.04	0.06	0.03	0.06	0.07	0.06	0.03	0.07	0.05	0.04	0.03	0.05	0.04
	E	0.01	0.02	0.04	0.01	0.01	0.03	0.03	0.03	0.02	0.02	0.01	0.01	0.02	0.01	0.02	0.02
	F	0	0.01	0.01	0.01	0.01	0.01	0	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01
4.0	A	0.87	0.74	0.88	1	0.94	0.94	0.65	0.62	0.74	0.72	1	1.28	1.29	0.94	0.53	0.6
	B	0.27	0.41	0.58	0.62	0.43	0.34	0.24	0.22	0.32	0.33	0.48	0.67	0.56	0.37	0.25	0.21
	C	0.17	0.57	1.13	1.03	0.6	0.41	0.41	0.37	0.48	0.52	0.59	0.79	0.53	0.45	0.3	0.24
	D	0.1	0.44	1.07	0.89	0.55	0.5	0.71	0.69	0.92	0.91	0.8	0.81	0.72	0.57	0.43	0.27
	E	0.06	0.27	0.69	0.48	0.3	0.33	0.46	0.7	0.67	0.57	0.54	0.47	0.43	0.43	0.33	0.3
	F	0.02	0.05	0.09	0.04	0.02	0.08	0.09	0.09	0.11	0.08	0.12	0.09	0.03	0.05	0.05	0.07
6.0	A	0.57	0.26	0.16	0.19	0.15	0.07	0.07	0.09	0.14	0.14	0.21	0.24	0.27	0.24	0.14	0.24
	B	0.14	0.39	0.38	0.31	0.16	0.11	0.07	0.08	0.19	0.21	0.32	0.51	0.51	0.36	0.13	0.09
	C	0.12	0.54	1.3	0.74	0.35	0.19	0.22	0.25	0.47	0.46	0.56	0.69	0.64	0.56	0.21	0.12
	D	0.12	0.43	0.85	0.58	0.4	0.44	0.65	1.16	1.45	0.78	0.9	0.77	0.78	0.65	0.32	0.09
	E	0.07	0.53	0.69	0.71	0.6	0.45	0.65	1.01	1.18	0.94	0.91	0.89	0.48	0.4	0.19	0.14
	F	0.01	0.26	0.21	0.14	0.14	0.19	0.13	0.16	0.22	0.21	0.24	0.23	0.07	0.04	0.02	0.04
8.0	A	0.09	0.05	0.01	0.01	0.01	0	0.01	0.01	0.02	0.02	0.02	0.04	0.03	0.02	0.01	0.06
	B	0.01	0.08	0.03	0.01	0.01	0.01	0	0.01	0.05	0.04	0.05	0.1	0.17	0.21	0.06	0.01
	C	0.01	0.1	0.2	0.08	0.02	0.03	0.03	0.06	0.16	0.16	0.21	0.26	0.45	0.43	0.1	0.02
	D	0.01	0.05	0.1	0.02	0.01	0.01	0.05	0.18	0.22	0.15	0.1	0.09	0.03	0.05	0.03	0
	E	0	0.05	0.03	0.04	0.01	0.01	0	0.03	0.04	0.02	0.04	0.01	0.01	0	0	0
	F	0	0.03	0.02	0.02	0	0.01	0	0.01	0.02	0.01	0.02	0.01	0	0	0	0
12.0	A	0.01	0	0	0	0	0	0	0	0	0.01	0.01	0.01	0	0.01	0	0.01
	B	0	0.01	0	0	0	0	0	0	0	0	0.01	0.01	0.06	0.06	0.01	0
	C	0	0.01	0	0	0	0.01	0	0.03	0.04	0.04	0.05	0.06	0.16	0.17	0.02	0.01
	D	0	0.02	0.02	0	0	0	0	0.01	0.02	0.04	0	0	0.01	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14.1	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Simpkins 1997.

Table J–78. Projected SRS Population Surrounding H-Area for Year 2005

Direction	Distance (mi)										Total
	0–1	1–2	2–3	3–4	4–5	5–10	10–20	20–30	30–40	40–50	
S	0	0	0	0	0	0	485	1,807	5,207	3,545	**11,044**
SSW	0	0	0	0	0	0	629	1,906	5,070	2,361	**9,966**
SW	0	0	0	0	0	25	895	7,586	1,939	2,953	**13,398**
WSW	0	0	0	0	0	71	2,428	4,529	3,330	8,327	**18,685**
W	0	0	0	0	0	683	4,586	54,394	22,338	13,086	**95,087**
WNW	0	0	0	0	0	1,384	7,849	172,996	76,767	6,917	**265,913**
NW	0	0	0	0	0	1,026	14,508	34,759	4,044	3,629	**57,966**
NNW	0	0	0	0	0	2,691	30,598	23,544	8,243	6,184	**71,260**
N	0	0	0	0	0	363	4,049	3,790	4,887	20,832	**33,921**
NNE	0	0	0	0	0	89	1,790	3,016	6,535	21,457	**32,887**
NE	0	0	0	0	0	15	3,754	3,684	6,147	9,896	**23,496**
ENE	0	0	0	0	0	9	3,723	6,246	6,956	43,139	**60,073**
E	0	0	0	0	0	113	7,647	3,844	6,830	4,084	**22,518**
ESE	0	0	0	0	0	3	1,329	2,551	3,551	5,933	**13,367**
SE	0	0	0	0	0	0	552	4,950	4,962	8,342	**18,806**
SSE	0	0	0	0	0	0	374	597	1,940	2,703	**5,614**
Total	**0**	**0**	**0**	**0**	**0**	**6,472**	**85,196**	**330,199**	**168,746**	**163,388**	**754,001**

Source: DOC 1992.

J.5.5.1.4 Source Term Data

Estimated incident-free radiological releases associated with the MOX fuel lead assembly facility are presented in Table J–79. Stack height and release location are provided in the ORNL *SRS MOX Fuel Lead Assemblies Data Report for the Surplus Plutonium Disposition Environmental Impact Statement* (O'Connor et al. 1998e).

Table J–79. Estimated Incident-Free Annual Radiological Releases From the MOX Lead Assembly Facility at SRS

Isotope	(μCi/yr)
Plutonium 236	–
Plutonium 238	0.85
Plutonium 239	23
Plutonium 240	5.3
Plutonium 241	58
Plutonium 242	9.3×10^{-4}
Americium 241	2.0
Uranium 234	1.3×10^{-3}
Uranium 235	5.4×10^{-5}
Uranium 238	3.1×10^{-3}

Source: O'Connor et al. 1998e.

J.5.5.1.5 Other Calculational Assumptions

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

Ground surfaces were assumed to have no previous deposition of radionuclides for the purposes of modeling the incremental radiological impacts associated with surplus plutonium disposition activities. However, doses associated with true instances of prior deposition are accounted for in the Affected Environment and Cumulative Impacts sections.

The annual external exposure time to the plume and to soil contamination was 0.7 year for the MEI (NRC 1977).

The annual external exposure time to the plume and to soil contamination was 0.5 year for the population (NRC 1977).

The annual inhalation exposure time to the plume was 1 year for the MEI and general population (NRC 1977).

The exposed individual or population was assumed to have the characteristics and habits (e.g., inhalation and ingestion rates) of the adult human.

A semi-infinite/finite plume model was used for air immersion doses. Other pathways evaluated were ground exposure, inhalation, ingestion of food crops, and ingestion of contaminated animal products. Drinking water, aquatic food ingestion, and any other pathway that may involve liquid exposure were not examined because all releases are to the air.

Reported stack heights were used for atmospheric releases and were assumed to be the effective stack height. The resultant doses were conservative because use of the actual stack height negates plume rise.

The calculated doses are 50-year committed doses from 1 year of intake.

J.5.5.2 Human Health Impacts

Potential radiological impacts on the public and workers resulting from normal lead assembly operations are presented in Section 4.27.5.4.

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