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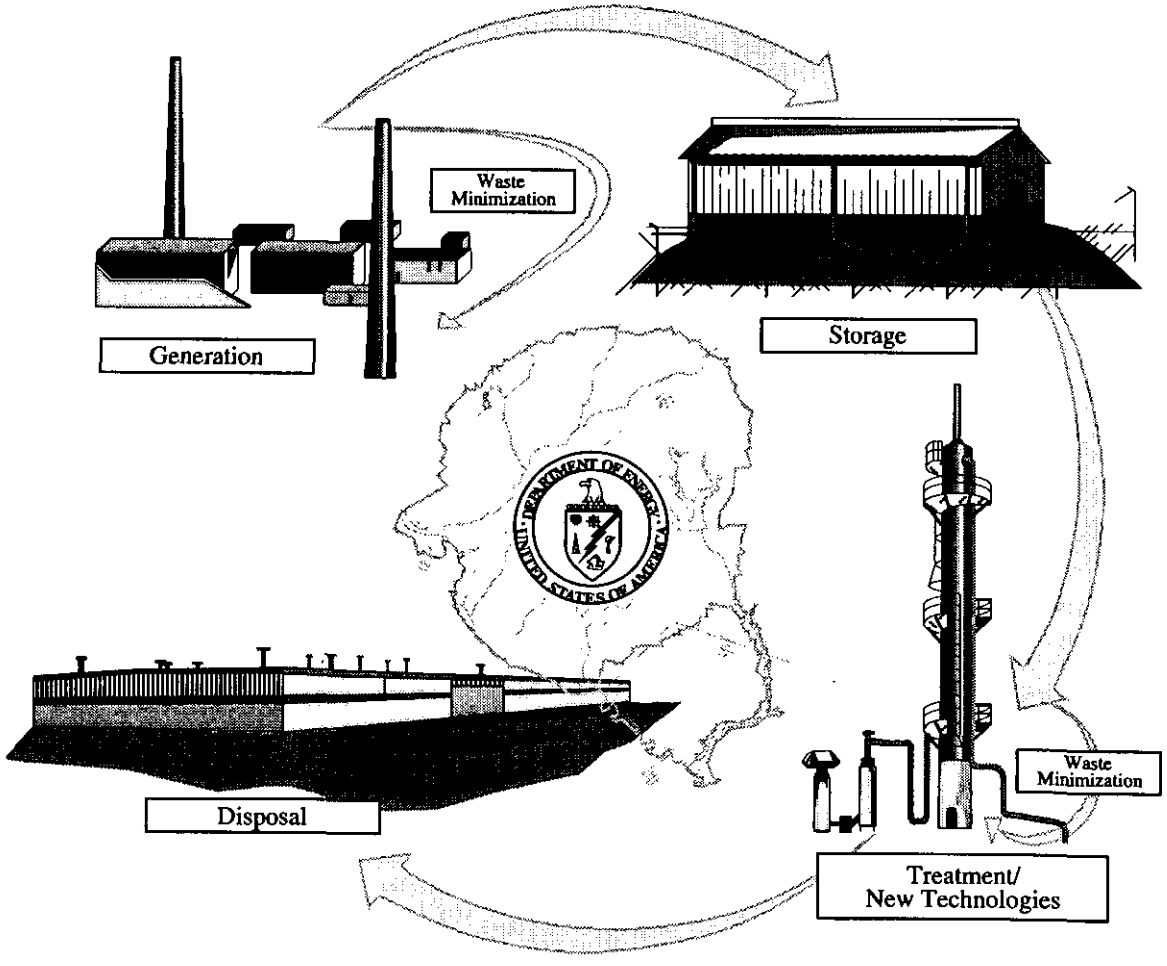
Savannah River Site

Waste Management

Final
Environmental Impact Statement
Volume II



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Department of Energy • Savannah River Operations Office • Aiken, South Carolina

VOLUME II

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APPENDIX A

WASTE FORECASTS

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Table A-1 provides a summary of the three 30-year waste forecasts (expected, minimum, and maximum) for SRS by waste and year. The table supports the discussion of the waste forecasts in Section 2.1. The table was compiled from the *Thirty-Year Solid Waste Generation Forecast for Facilities at SRS* (U) (WSRC 1994a), the *Thirty-Year Solid Waste Generation Maximum and Minimum Forecast for SRS* (WSRC 1994b). Changes in mixed waste volumes between the draft EIS and this document as a result of changes between the draft and proposed site treatment plan are presented in Table A-2, and are reflected in the mixed waste totals in this table.

The waste to be managed includes the forecasted generation identified in this appendix plus existing waste volumes in storage; existing waste in storage is included in Section 2.1, Waste Forecasts. To convert volumes to cubic feet, multiply by 35.31.

Table A-1. Thirty-year waste forecast by waste type (volume in cubic meters).

Year		Liquid high-level waste	Low-level waste	Hazardous waste	Mixed waste	Transuranic waste
1995	Expected	2,598	17,916	2,418	2,501	650
	Minimum	705	17,906	1,398	1,622	650
	Maximum	2,598	20,028	3,268	3,810	650
1996	Expected	4,317	17,821	1,478	2,539	1,201
	Minimum	1,317	17,816	757	2,074	1,201
	Maximum	4,358	19,136	1,965	4,296	1,754
1997	Expected	3,752	16,574	8,938	1,426	780
	Minimum	1,158	16,448	4,013	938	780
	Maximum	4,358	24,395	10,631	2,535	780
1998	Expected	2,432	15,458	40,052	1,682	757
	Minimum	1,240	13,206	32,471	971	487
	Maximum	4,321	31,032	40,242	2,734	808
1999	Expected	1,788	15,081	33,375	2,479	720
	Minimum	326	12,970	29,941	935	450
	Maximum	2,611	30,481	34,272	3,512	733
2000	Expected	2,175	20,568	6,121	6,302	983
	Minimum	387	12,258	3,400	3,751	135
	Maximum	2,174	39,980	7,334	74,249	87,355[a]
2001	Expected	2,175	20,354	74,672	5,066	1,064
	Minimum	387	11,553	59,577	2,186	60
	Maximum	2,174	39,884	75,885	73,037	87,355
2002	Expected	857	20,039	8,007	5,111	1,064
	Minimum	387	11,287	1,075	2,136	59
	Maximum	850	39,726	9,220	73,087	87,355
2003	Expected	228	17,509	7,510	29,273	716
	Minimum	387	11,254	1,390	2,351	59
	Maximum	227	47,536	8,723	97,096	87,486
2004	Expected	126	16,856	16,416	9,379	412
	Minimum	387	13,964	18,938	9,082	241
	Maximum	227	51,057	28,550	81,567	87,630

TC

Table A-1. (continued).

Year		Liquid high-level waste	Low-level waste	Hazardous waste	Mixed waste	Transuranic waste
2005	Expected	126	16,387	16,324	9,023	338
	Minimum	387	12,379	18,050	5,587	114
	Maximum	227	56,663	28,425	80,801	87,450
2006	Expected	126	15,319	16,367	9,177	213
	Minimum	387	12,419	12,555	5,541	114
	Maximum	227	56,193	27,981	16,897	1,139
2007	Expected	126	15,319	16,449	9,189	213
	Minimum	387	12,742	12,634	5,817	118
	Maximum	227	56,193	28,154	16,914	1,139
2008	Expected	126	15,319	16,393	9,232	213
	Minimum	387	12,625	7,087	5,732	185
	Maximum	227	56,193	28,017	16,965	1,139
2009	Expected	126	15,319	16,410	9,245	213
	Minimum	387	11,098	734	2,240	59
	Maximum	227	56,193	24,742	16,982	1,139
2010	Expected	126	15,606	16,401	9,557	285
	Minimum	387	11,098	751	2,279	59
	Maximum	227	56,767	21,359	17,534	1,283
2011	Expected	126	14,996	13,118	9,015	210
	Minimum	387	11,018	720	2,180	58
	Maximum	227	55,548	21,408	16,477	1,132
2012	Expected	126	15,400	9,892	9,418	215
TC	Minimum	387	11,425	752	2,561	131
	Maximum	227	56,516	21,530	17,387	1,143
2013	Expected	126	15,319	9,943	9,358	214
	Minimum	387	11,098	762	2,264	59
	Maximum	227	56,193	21,557	17,118	1,139
2014	Expected	126	15,299	9,946	9,402	213
	Minimum	387	11,320	784	2,501	61
	Maximum	227	51,052	21,641	17,164	421
2015	Expected	126	15,586	9,973	9,530	284
	Minimum	387	11,078	747	2,141	58
	Maximum	227	51,626	21,623	17,533	532
2016	Expected	126	15,299	9,998	9,307	213
	Minimum	387	11,365	812	2,397	130
	Maximum	227	50,262	21,118	15,106	388
2017	Expected	126	14,976	9,933	9,032	209
	Minimum	387	10,995	741	2,058	57
	Maximum	227	49,617	21,021	14,550	381
2018	Expected	126	13,719	9,015	5,412	147
	Minimum	387	11,076	764	2,151	58
	Maximum	228	50,262	21,123	15,174	388
2019	Expected		13,799	9,029	5,497	148
	Minimum		11,116	768	2,178	58
	Maximum		50,584	21,161	15,478	392

Table A-1. (continued).

Year		Liquid high-level waste	Low-level waste	Hazardous waste	Mixed waste	Transuranic waste
2020	Expected		13,719	8,925	5,486	147
	Minimum		11,282	791	2,361	129
	Maximum		50,262	20,925	15,242	388
2021	Expected		14,005	9,139	5,733	219
	Minimum		11,398	828	2,441	61
	Maximum		50,835	21,363	15,761	532
2022	Expected		13,719	9,072	5,526	147
	Minimum		11,076	771	2,176	58
	Maximum		50,262	21,180	15,310	388
2023	Expected		13,396	9,054	5,255	143
	Minimum		10,995	763	2,094	57
	Maximum		49,617	21,129	14,754	381
2024	Expected		13,755	9,135	5,609	233
	Minimum		10,959	738	2,085	48
	Maximum		50,447	21,274	15,557	530
Totals	Expected	22,212	474,432	433,503	224,761	12,564
	Minimum	12,099	367,224	215,512	84,830	5,794
	Maximum	27,077	1,404,540	676,821	804,627	543,330

TC

a. The large volumes of transuranic waste are a result of digging up the burial ground.

Table A-2 summarizes the revisions to the mixed waste forecasts that were incorporated in the final EIS. These changes were made to align the EIS waste forecasts with the 5-year projections for mixed waste generation included in the *SRS Proposed Site Treatment Plan* (WSRC 1995). Table A-2 presents the changes in volume for the various mixed waste classes that have been incorporated in the forecasts. Negative values represent reductions in the current waste forecast from that used in the draft EIS analyses. The net effect of these changes (including revised estimates of the amount of mixed waste currently stored at SRS) is an increase in the amount of mixed waste to be managed over the 30-year period of 8,795 cubic meters for the expected and minimum forecasts and 1,554 cubic meters for the maximum forecast (Hess 1995).

Table A-2. Revisions to thirty-year mixed waste generation forecasts by waste classes (volume in cubic meters).

		Waste classes								
Year		Inorganic debris	Aqueous liquids	Organic liquids	Organic sludge	Lead	Composite filters	LDR[a]	Organic debris	Mercury
1995	Expected	+5.4	+13	-3	+1.8	+3	-2.4	+213	+320.6	+0.1
	Minimum	+5.4	NC[b]	-3	+1.8	+3	-2.4	+213	+320.6	+0.1
	Maximum	NC	NC	-2.5	NC	NC	NC	NC	NC	NC
1996	Expected	+5.4	NC	-116	+1.8	+1	-3.4	+227	+313	NC
	Minimum	+5.4	NC	-116	+1.8	+1	-3.4	+227	+313	NC
	Maximum	NC	NC	-115	NC	NC	NC	NC	NC	NC
1997	Expected	+5.4	NC	-25	+0.8	+1	-0.4	+227	+313	+0.3
	Minimum	+5.4	NC	-25	+0.8	+1	-0.4	+227	+313	+0.3
TC	Maximum	NC	NC	-24	NC	NC	NC	NC	NC	NC
1998	Expected	+5.4	NC	-40	+0.8	+5	-0.4	+227	+314	+0.4
	Minimum	+5.4	NC	-40	+0.8	+5	-0.4	+227	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
1999	Expected	+5.4	NC	-40	+0.8	+5	-0.4	+227	+314	+0.5
	Minimum	+5.4	NC	-40	+0.8	+5	-0.4	+227	+314	+0.5
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2000	Expected	+5.4	NC	-40	+0.7	+4	-0.4	+30.3	+314	+0.5
	Minimum	+5.4	NC	-40	+0.7	+4	-0.4	+30.3	+314	+0.5
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2001	Expected	+5.4	NC	-40	+0.7	+4	-0.4	+14	+314	+0.5
	Minimum	+5.4	NC	-40	+0.7	+4	-0.4	+14	+314	+0.5
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2002	Expected	+5.4	NC	-40	+0.7	+4	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-40	+0.7	+4	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2003	Expected	+5.4	NC	+112	+0.9	+5	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	+112	+0.9	+5	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2004	Expected	+5.4	NC	-39	+0.9	+6	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-39	+0.9	+6	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2005	Expected	+5.4	NC	+48	+0.9	+6	-0.4	+30.3	+314	+0.4
	Minimum	+5.4	NC	+48	+0.9	+6	-0.4	+30.3	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2006	Expected	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC

Table A-2. (continued).

Year		Waste classes								
		Inorganic debris	Aqueous liquids	Organic liquids	Organic sludge	Lead	Composite filters	LDR[a]	Organic debris	Mercury
2007	Expected	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2008	Expected	+5.4	NC	-39	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2009	Expected	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2010	Expected	+5.4	NC	-38	+1	+7	-0.4	+30.3	+314	+0.4
	Minimum	+5.4	NC	-38	+1	+7	-0.4	+30.3	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2011	Expected	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2012	Expected	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2013	Expected	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2014	Expected	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-38	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-39	NC	NC	NC	NC	NC	NC
2015	Expected	+5.4	NC	-190	+1	+7	-0.4	+30.3	+314	+0.4
	Minimum	+5.4	NC	-190	+1	+7	-0.4	+30.3	+314	+0.4
	Maximum	NC	NC	-190	NC	NC	NC	NC	NC	NC
2016	Expected	+5.4	NC	-190	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-190	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-190	NC	NC	NC	NC	NC	NC
2017	Expected	+5.4	NC	-190	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-190	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-190	NC	NC	NC	NC	NC	NC
2018	Expected	+5.4	NC	-190	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	-190	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	-190	NC	NC	NC	NC	NC	NC
2019	Expected	+5.4	NC	+1	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	+1	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	NC	NC	NC	NC	NC	NC	NC
2020	Expected	+5.4	NC	+1	+1	+7	-0.4	+30.3	+314	+0.4
	Minimum	+5.4	NC	+1	+1	+7	-0.4	+30.3	+314	+0.4
	Maximum	NC	NC	NC	NC	NC	NC	NC	NC	NC
2021	Expected	+5.4	NC	+1	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	+1	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	NC	NC	NC	NC	NC	NC	NC

TC

Table A-2. (continued).

Year		Waste classes: Inorganic debris	Aqueous liquids	Organic liquids	Organic sludge	Lead	Composite filters	LDR[a]	Organic debris	Mercury
2022	Expected	+5.4	NC	+1	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	+1	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	NC	NC	NC	NC	NC	NC	NC
2023	Expected	+5.4	NC	+1	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	+1	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	NC	NC	NC	NC	NC	NC	NC
2024	Expected	+5.4	NC	+1	+1	+7	-0.4	+14	+314	+0.4
	Minimum	+5.4	NC	+1	+1	+7	-0.4	+14	+314	+0.4
	Maximum	NC	NC	NC	NC	NC	NC	NC	NC	NC

a. LDR = Land Disposal Restriction.
b. NC = No change.

Tables A-3 through A-6 provide a summary of the three 30-year waste forecasts (expected, minimum, and maximum) for SRS by waste type (except high-level waste), treatability group, and year. The table supports the discussion of the waste forecast in Section 2.1. The table was compiled from the *Thirty-Year Solid Waste Generation Forecast by Treatability Group* (U) (WSRC 1994c) and the *Thirty-Year Solid Waste Generation Maximum and Minimum Forecast for SRS.* TE

Table A-3. Thirty-year low-level waste forecast by waste classes (volume in cubic meters). TE

Year		Low-level waste classes				
		Long-lived[a]	Tritiated[b]	Bulk[c]	Soils[d]	Job-control waste[e]
1995	Expected	63	106	234	988	16,526
	Minimum	63	106	234	978	16,526
	Maximum	63	106	234	3,100	16,526
1996	Expected	40	67	157	878	16,679
	Minimum	40	67	157	873	16,679
	Maximum	40	67	157	2,193	16,679
1997	Expected	1	3	29	630	15,911
	Minimum	1	3	29	625	15,790
	Maximum	1	3	29	8,451	15,911
1998	Expected	7	13	50	328	15,060
	Minimum	7	13	50	322	12,814
	Maximum	7	13	50	16,131	14,831
1999	Expected	2	5	32	294	14,748
	Minimum	2	5	32	288	12,643
	Maximum	2	5	32	15,923	14,519
2000	Expected	120	211	511	1,054	18,673
	Minimum	49	106	403	532	11,169
	Maximum	163	274	570	20,801	18,172
2001	Expected	120	211	511	1,054	18,459
	Minimum	30	75	342	410	10,695
	Maximum	163	274	570	20,801	18,076
2002	Expected	120	211	511	1,054	18,144
	Minimum	29	72	322	383	10,481
	Maximum	163	274	570	20,801	17,918
2003	Expected	120	211	511	1,058	15,610
	Minimum	30	75	342	369	10,437
	Maximum	163	274	570	28,711	17,818
2004	Expected	144	304	540	2,542	13,326
	Minimum	65	222	371	2,806	10,501
	Maximum	204	446	599	31,906	17,902
2005	Expected	127	277	499	2,418	13,067
	Minimum	43	140	332	1,560	10,304
	Maximum	195	6,872	570	31,240	17,786
2006	Expected	136	290	511	2,482	11,900
	Minimum	44	141	342	1,560	10,332
	Maximum	187	6,832	570	30,849	17,755
2007	Expected	136	290	511	2,482	11,900
	Minimum	53	157	374	1,624	10,532
	Maximum	187	6,832	570	30,849	17,755
2008	Expected	136	290	511	2,482	11,900
	Minimum	51	152	351	1,617	10,453
	Maximum	187	6,832	570	30,849	17,755

Table A-3. (continued).

Year		Low-level waste classes				
		Long-lived	Tritiated	Bulk	Soils	Job-control waste
2009	Expected	136	290	511	2,482	11,900
	Minimum	30	75	342	371	10,279
	Maximum	187	6,832	570	30,849	17,755
2010	Expected	144	304	540	2,540	12,078
	Minimum	30	75	342	371	10,279
	Maximum	196	6,847	599	31,193	17,932
2011	Expected	126	274	479	2,418	11,700
	Minimum	30	72	322	371	10,223
	Maximum	177	6,816	538	30,462	17,555
2012	Expected	137	293	531	2,482	11,957
	Minimum	39	91	381	429	10,485
	Maximum	197	6,848	602	30,914	17,955
2013	Expected	136	290	511	2,482	11,900
	Minimum	30	75	342	371	10,279
	Maximum	187	6,832	570	30,849	17,755
2014	Expected	136	290	511	2,482	11,880
	Minimum	39	88	354	436	10,403
	Maximum	187	6,832	570	30,849	12,614
2015	Expected	144	304	540	2,540	12,058
	Minimum	30	75	342	371	10,259
	Maximum	196	6,847	599	31,193	12,791
2016	Expected	136	290	511	2,482	11,880
	Minimum	39	89	371	429	10,437
	Maximum	179	6,793	570	30,138	12,582
2017	Expected	126	274	479	2,418	11,680
	Minimum	29	72	322	369	10,203
	Maximum	170	6,777	538	29,751	12,382
2018	Expected	120	211	511	1,060	11,817
	Minimum	30	75	342	369	10,259
	Maximum	179	6,793	570	31,038	12,582
2019	Expected	121	214	531	1,060	11,873
	Minimum	31	77	352	369	10,287
	Maximum	189	6,809	602	30,203	12,782
2020	Expected	120	211	511	1,060	11,817
	Minimum	38	86	351	426	10,381
	Maximum	179	6,793	570	30,138	12,582
2021	Expected	129	225	540	1,118	11,995
	Minimum	40	91	374	434	10,459
	Maximum	188	6,807	599	30,482	12,759
2022	Expected	120	211	511	1,060	11,817
	Minimum	30	75	342	369	10,259
	Maximum	179	6,793	570	30,138	12,582
2023	Expected	110	195	479	996	11,617
	Minimum	29	72	322	369	10,203
	Maximum	170	6,777	538	29,751	12,382
2024	Expected	120	212	525	1,053	11,845
	Minimum	29	70	313	369	10,178
	Maximum	187	6,805	595	30,152	12,737

a. Includes long-lived spent deionizer resins and other long-lived low-level waste.
b. Includes tritiated job-control waste, tritiated equipment and tritiated soils.
c. Includes naval hardware and low-activity equipment.
d. Includes suspect soils and low-activity soils.
e. Includes offsite job-control, low-activity job-control, and intermediate activity job-control.

Table A-4. Thirty-year hazardous waste forecast by waste classes (volume in cubic meters).

Year		Hazardous waste classes																
		PCB	Metal debris	Soil	Inorganic debris	Heterogeneous debris	Aqueous liquid	Organic liquid	Glass debris	Aqueous/ organic liquid[a]	Bulk	Organic sludge	Lead	Inorganic sludge	Composite filters	Paint waste	Sand/ gravel/ rock	Organic debris
1995	Expected	105	97	272	150	264	20	20	20	1,174	96	29	59	29	20	10	53	1
	Minimum	105	97	203	150	265	20	20	20	222	96	29	59	29	20	10	53	1
	Maximum	5	97	1,128	150	264	20	20	20	1,174	96	29	59	29	20	10	148	1
1996	Expected	24	51	168	83	152	10	10	10	810	51	15	37	15	10	5	25	1
	Minimum	24	51	99	83	153	10	10	10	158	51	15	37	15	10	5	25	1
	Maximum	5	51	623	83	152	10	10	10	810	51	15	37	15	10	5	76	1
1997	Expected	5	359	5,075	325	508	97	97	160	806	232	114	153	114	97	80	715	1
	Minimum	5	233	1,864	283	465	55	55	76	141	191	72	112	72	55	38	296	1
	Maximum	5	359	6,600	325	508	97	97	160	806	232	114	153	114	97	80	885	1
1998	Expected	32	1,184	29,250	421	456	392	392	781	868	407	394	404	394	392	390	3,893	1
	Minimum	32	980	24,074	353	387	324	324	644	165	339	326	335	326	324	322	3,212	1
	Maximum	32	1,184	29,421	421	456	392	392	781	868	407	394	404	394	392	390	3,912	1
1999	Expected	43	1,036	23,807	459	568	333	333	647	841	408	342	367	342	333	324	3,190	1
	Minimum	43	956	21,735	432	541	306	306	594	146	381	316	340	316	306	297	2,923	1
	Maximum	5	1,036	24,648	459	568	333	333	647	841	408	342	367	342	333	324	3,284	1
2000	Expected	88	233	3,269	198	312	61	61	104	844	143	71	94	71	62	55	453	1
	Minimum	95	151	2,044	102	161	37	37	70	136	74	40	52	40	38	41	281	1
	Maximum	88	252	4,161	241	383	67	67	107	844	171	80	108	80	67	54	563	1
2001	Expected	88	2,288	54,635	883	997	746	746	1,474	907	828	756	779	756	747	639	7,302	1
	Minimum	88	1,831	44,202	654	706	598	598	1,193	163	630	600	611	600	599	602	5,900	1
	Maximum	88	2,307	55,527	926	1,068	752	752	1,477	907	856	765	793	765	752	638	7,412	1
2002	Expected	88	289	4,656	217	330	80	80	141	880	161	89	112	89	80	73	638	1
	Minimum	85	75	349	69	120	13	13	23	144	44	15	26	15	14	17	53	1
	Maximum	88	308	5,549	260	402	85	85	144	880	190	98	126	93	85	72	748	1
2003	Expected	88	273	4,269	212	325	75	75	131	899	156	84	107	84	75	68	587	1
	Minimum	88	86	574	73	125	16	16	29	147	48	18	29	18	18	21	83	1
	Maximum	88	292	5,162	255	397	80	80	134	899	185	93	121	93	80	67	697	1
2004	Expected	92	541	10,878	305	422	164	164	308	961	248	173	197	173	164	156	1,469	1
	Minimum	92	614	13,691	253	309	192	192	380	174	226	194	206	194	193	196	1,833	1
	Maximum	92	887	19,967	457	602	278	278	528	961	385	291	320	291	278	264	2,671	1
2005	Expected	88	536	10,867	296	407	162	162	307	934	242	171	194	171	163	156	1,466	1
	Minimum	88	584	13,066	239	290	183	183	362	155	214	185	196	185	184	187	1,749	1
	Maximum	88	883	19,900	451	593	277	277	528	943	382	290	318	290	277	264	2,662	1
2006	Expected	88	537	10,872	300	413	163	163	307	953	244	172	195	172	163	156	1,467	1
	Minimum	88	420	8,939	184	236	128	128	252	159	159	130	141	130	129	132	1,199	1
	Maximum	88	868	19,558	446	588	272	272	518	962	377	285	313	285	272	259	2,616	1
2007	Expected	92	543	10,864	304	420	163	163	308	1,015	247	173	196	173	164	157	1,467	1
	Minimum	95	426	8,944	191	248	129	129	254	185	164	131	143	131	130	133	1,201	1
	Maximum	92	879	19,574	463	615	274	274	520	1,024	387	288	319	288	274	260	2,622	1
2008	Expected	88	537	10,864	300	413	163	163	307	989	244	172	195	172	163	156	1,466	1
	Minimum	88	257	4,817	133	188	73	73	143	166	107	75	87	75	75	77	650	1
	Maximum	88	868	19,558	446	588	272	272	518	998	377	285	313	285	272	269	2,616	1
2009	Expected	88	537	10,864	300	413	163	163	307	1,008	244	172	195	172	163	156	1,466	1
	Minimum	88	65	65	66	118	10	10	16	170	41	11	23	11	11	14	15	1
	Maximum	88	769	17,089	414	556	239	239	452	1,016	344	252	280	252	239	226	2,287	1

Table A-4. (continued).

Year		Hazardous waste classes																
		PCB	Metal debris	Soil	Inorganic debris	Heterogeneous debris	Aqueous liquid	Organic liquid	Glass debris	Aqueous/ organic liquid[a]	Bulk	Organic sludge	Lead	Inorganic sludge	Composite filters	Paint waste	Sand/ gravel/ rock	Organic debris
2010	Expected	88	530	10,854	289	395	161	161	305	1,069	237	170	191	170	162	155	1,462	1
	Minimum	88	65	58	66	118	9	9	15	196	41	11	23	11	11	14	14	1
	Maximum	88	663	14,537	370	505	205	205	384	1,078	304	217	244	217	205	192	1,946	1
2011	Expected	85	435	8,390	262	372	129	129	240	1,042	208	138	160	138	130	123	1,135	1
	Minimum	85	63	58	65	116	9	9	15	177	40	11	22	11	10	13	14	1
	Maximum	85	667	14,578	376	514	205	205	385	1,051	307	218	246	218	205	193	1,952	1
2012	Expected	92	341	5,926	235	349	97	97	176	1,060	179	106	130	106	98	90	808	1
	Minimum	92	64	63	68	121	10	10	15	181	42	12	23	12	11	13	16	1
	Maximum	92	674	14,617	385	631	207	207	387	1,069	314	220	249	220	207	193	1,953	1
2013	Expected	88	340	5,926	234	347	97	97	175	1,123	178	106	129	106	97	90	808	1
	Minimum	88	65	58	66	118	9	9	15	207	41	11	23	11	11	14	14	1
	Maximum	88	670	14,612	381	523	206	206	386	1,132	311	219	247	219	206	193	1,957	1
2014	Expected	92	345	5,926	238	354	98	98	177	1,096	181	107	130	107	98	91	808	1
	Minimum	92	69	62	71	127	10	10	16	188	45	12	24	12	11	14	16	1
	Maximum	92	681	14,628	397	549	208	208	388	1,105	321	222	253	222	208	194	1,962	1
2015	Expected	92	343	5,932	239	356	98	98	176	1,114	182	107	131	107	98	90	809	1
	Minimum	88	65	58	66	118	9	9	15	192	41	11	23	11	11	14	14	1
	Maximum	92	674	14,650	386	531	207	207	387	1,123	314	220	249	220	207	193	1,962	1
2016	Expected	88	340	5,926	234	347	97	97	175	1,178	178	106	129	106	97	90	808	1
	Minimum	92	68	63	71	127	10	10	16	218	45	12	24	12	11	14	16	1
	Maximum	88	656	14,242	376	517	201	201	376	1,187	306	214	242	214	201	188	1,907	1
2017	Expected	85	336	5,921	229	339	96	96	175	1,150	175	105	127	105	97	90	808	1
	Minimum	85	63	56	65	116	9	9	15	200	40	11	22	11	10	13	14	1
	Maximum	85	652	14,208	371	509	200	200	375	1,159	303	213	241	213	200	188	1,903	1
2018	Expected	88	310	5,185	224	337	87	87	155	1,183	168	96	119	96	87	80	709	1
	Minimum	88	65	56	66	118	9	9	15	211	41	11	23	11	11	14	14	1
	Maximum	88	656	14,242	376	517	201	201	376	1,192	306	214	242	214	201	188	1,907	1
2019	Expected	92	312	5,185	225	339	87	87	156	1,186	169	96	120	96	88	80	709	1
	Minimum	92	66	56	66	119	10	10	16	207	41	11	23	11	11	14	14	1
	Maximum	92	659	14,247	380	525	202	202	377	1,195	309	215	244	215	202	188	1,909	1
2020	Expected	85	299	5,169	208	311	85	85	153	1,204	158	93	114	93	95	79	704	1
	Minimum	88	67	62	70	125	10	10	16	211	44	12	24	12	11	14	16	1
	Maximum	85	646	14,129	359	491	199	199	374	1,213	295	211	237	211	199	187	1,891	1
2021	Expected	95	319	5,191	233	353	88	88	157	1,237	175	98	122	93	89	82	711	1
	Minimum	95	71	61	73	129	10	10	17	222	46	12	25	12	12	15	16	1
	Maximum	95	670	14,296	397	553	204	204	379	1,246	320	218	249	218	204	189	1,918	1
2022	Expected	88	310	5,185	224	337	87	87	155	1,240	168	96	119	96	87	80	709	1
	Minimum	88	65	56	66	118	9	9	15	218	41	11	23	11	11	14	14	1
	Maximum	88	656	14,242	376	517	201	201	376	1,249	306	214	242	214	201	188	1,907	1
2023	Expected	85	307	5,181	219	329	86	86	155	1,258	165	95	118	95	87	80	707	1
	Minimum	85	63	56	65	116	9	9	15	222	40	11	22	11	10	13	14	1
	Maximum	85	652	14,208	371	509	200	200	375	1,267	303	213	241	213	200	188	1,903	1
2024	Expected	92	312	5,186	226	340	87	87	156	1,288	170	97	120	97	88	81	709	1
	Minimum	81	57	56	60	108	8	8	13	232	37	10	21	10	9	12	14	1
	Maximum	92	659	14,251	382	527	202	202	377	1,297	310	215	244	215	202	188	1,910	1

a. Recategorized as aqueous liquids or organic liquids in the in-depth options analysis discussed in Section 2.3.

Table A-5. Thirty-year mixed waste generation forecast by waste classes (volume in cubic meters). Changes in the volumes of mixed waste classes between the draft EIS and this document as a result of changes between the draft and proposed site treatment plan are presented in Table A-2 and reflected in the volumes in this table.

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		Mixed waste classes																
Year		PCB	Metal debris	Soil	Inorganic debris	Heterogeneous debris	Aqueous liquid	Organic liquid	Glass debris	Bulk	Organic sludge	Lead	Inorganic sludge	Composite filters	Paint waste	Sand/ gravel/ rock	LDR[a]	Organic debris	Burial ground complex[b]
1995	Expected	2	76	156	119	195	701	79	15	76	25	47	23	16	8	38	403	324	0
	Minimum	2	76	124	119	194	72	79	15	76	25	47	23	16	8	38	403	324	0
	Maximum	2	76	1,027	114	195	894	207	15	76	25	43	23	15	8	113	190	815	0
1996	Expected	1	65	140	104	170	620	94	13	65	23	42	20	14	7	33	807	322	0
	Minimum	1	65	108	104	170	187	94	13	65	23	42	20	17	7	33	807	322	0
	Maximum	1	65	918	99	170	1,118	229	13	65	22	41	20	17	7	98	580	835	0
1997	Expected	1	0	42	6	9	636	171	0	0	2	9	0	1	0	0	227	322	0
	Minimum	1	0	11	6	8	180	171	0	0	2	9	0	1	0	0	227	322	0
	Maximum	1	0	234	1	8	1,138	305	0	0	2	8	0	1	0	0	0	835	0
1998	Expected	1	9	196	12	19	667	159	3	5	5	12	3	4	2	21	243	322	0
	Minimum	1	3	14	10	14	187	157	1	3	3	10	1	2	0	1	243	322	0
	Maximum	1	9	411	7	18	11,755	280	3	5	5	7	3	4	2	24	16	765	0
1999	Expected	1	30	801	16	29	702	166	10	10	12	19	10	11	10	101	227	322	0
	Minimum	1	0	11	6	8	192	156	0	0	2	9	0	1	0	0	227	322	0
	Maximum	1	30	992	11	28	1,217	288	10	10	12	14	10	11	10	101	0	765	0
2000	Expected	2	447	1,476	581	972	809	245	98	388	126	209	123	92	64	300	47	322	0
	Minimum	2	318	927	315	525	252	210	76	209	67	116	65	60	65	173	47	322	0
	Maximum	2	517	4,941	734	1,233	1,349	386	108	493	158	257	156	109	60	704	17	765	62,260
2001	Expected	2	410	553	569	948	825	233	86	375	113	197	111	80	52	177	14	322	0
	Minimum	2	234	97	224	371	237	190	56	146	41	79	39	39	50	46	14	322	0
	Maximum	2	480	4,019	721	1,209	1,370	373	96	480	146	244	144	97	48	581	0	765	62,260
2002	Expected	2	410	553	569	948	854	233	86	375	113	197	111	80	52	177	30	322	0
	Minimum	2	220	97	214	353	241	188	52	138	40	75	37	37	46	45	30	322	0
	Maximum	2	480	4,019	721	1,209	1,404	373	96	480	146	244	144	97	48	581	16	765	62,260
2003	Expected	2	1,130	18,553	909	1,427	1,122	624	326	615	353	437	351	320	292	2,577	14	322	0
	Minimum	2	234	97	224	371	249	341	56	146	41	81	39	39	50	46	14	322	0
	Maximum	2	1,200	22,019	961	1,689	1,678	612	336	720	386	484	384	337	288	2,980	0	759	62,260
2004	Expected	2	554	3,563	646	1,088	954	277	130	440	160	249	158	124	94	586	30	322	0
	Minimum	2	457	5,092	328	565	326	261	127	237	115	159	113	110	118	720	30	322	0
	Maximum	2	743	10,222	838	1,430	1,557	456	180	585	233	336	231	181	130	1,410	16	759	62,260
2005	Expected	2	515	3,478	576	971	973	355	123	394	146	226	144	118	92	560	30	322	0
	Minimum	2	326	2,577	252	428	293	309	87	175	74	112	71	71	81	376	30	322	0
	Maximum	2	718	9,700	801	1,367	1,586	455	175	559	225	323	223	176	127	1,344	0	759	62,260
2006	Expected	2	529	3,521	609	1,024	1,006	271	125	415	153	236	150	119	91	573	30	322	0
	Minimum	2	333	2,577	257	437	299	222	89	179	74	115	72	72	83	377	30	322	0
	Maximum	2	658	8,472	781	1,327	1,600	436	155	540	205	304	203	156	107	1,174	16	759	0
2007	Expected	2	529	3,521	609	1,024	1,034	271	125	415	153	236	150	119	91	573	14	322	0
	Minimum	2	362	2,620	301	508	311	227	94	207	83	129	81	78	86	391	14	322	0
	Maximum	2	658	8,472	781	1,327	1,634	436	155	540	205	304	203	156	107	1,174	0	759	0
2008	Expected	2	529	3,521	609	1,024	1,062	270	125	415	153	236	150	119	91	573	30	322	0
	Minimum	2	344	2,615	284	481	315	225	90	197	80	124	78	75	82	388	30	322	0
	Maximum	2	658	8,472	781	1,327	1,668	436	155	540	205	304	203	156	107	1,174	16	759	0
2009	Expected	2	529	3,521	609	1,024	1,090	271	125	415	153	236	150	119	91	573	14	322	0
	Minimum	2	234	101	224	371	284	189	56	146	41	82	39	39	50	47	14	322	0
	Maximum	2	658	8,472	781	1,327	1,702	436	155	540	205	304	203	156	107	1,174	0	759	0

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Table A-5. (continued).

Year		Mixed waste classes																	
		PCB	Metal debris	Soil	Inorganic debris	Heterogeneous debris	Aqueous liquid	Organic liquid	Glass debris	Bulk	Organic sludge	Lead	Inorganic sludge	Composite filters	Paint waste	Sand/ gravel/ rock	LDR[a]	Organic debris	Burial ground complex[b]
2010	Expected	2	554	3,558	646	1,087	1,123	276	130	440	160	249	158	124	94	585	46	322	0
	Minimum	2	234	101	224	371	290	189	56	146	41	82	39	39	50	47	46	322	0
	Maximum	2	684	8,736	818	1,390	1,741	441	160	565	213	316	211	162	110	1,212	16	759	0
2011	Expected	2	500	3,478	566	953	1,142	266	119	386	144	222	142	113	88	559	14	322	0
	Minimum	2	220	101	214	353	294	187	52	138	40	78	38	37	46	45	14	322	0
	Maximum	2	630	8,171	738	1,256	1,764	430	150	511	197	289	195	151	105	1,131	0	759	0
2012	Expected	2	543	3,521	619	1,042	1,177	273	129	422	154	240	152	121	95	574	30	322	0
	Minimum	2	266	139	267	442	308	195	62	174	50	96	96	45	54	60	30	322	0
	Maximum	2	687	8,515	824	1,399	1,809	441	161	568	214	318	212	182	110	1,189	16	759	0
2013	Expected	2	529	3,521	609	1,024	1,203	271	125	415	153	236	150	116	91	573	14	322	0
	Minimum	2	234	101	224	371	308	189	56	146	41	82	39	39	50	47	14	322	0
	Maximum	2	656	8,472	781	1,327	1,836	436	155	540	205	304	203	156	107	1,174	0	759	0
2014	Expected	2	529	3,521	609	1,024	1,231	271	125	415	153	236	150	119	91	573	30	322	0
	Minimum	2	248	144	257	424	317	193	58	167	48	93	46	43	49	60	30	322	0
	Maximum	2	658	8,472	781	1,326	1,872	436	155	540	205	302	203	156	107	1,174	16	758	0
2015	Expected	2	554	3,558	646	1,087	1,264	124	130	440	160	249	153	124	94	585	30	322	0
	Minimum	2	234	101	224	371	319	37	56	146	41	82	39	39	50	47	30	322	0
	Maximum	2	684	6,736	818	1,389	1,911	290	160	565	213	314	211	182	110	1,212	0	758	0
2016	Expected	2	529	3,521	609	1,024	1,286	119	125	415	153	236	150	119	91	573	30	322	0
	Minimum	2	259	139	262	438	330	42	61	171	49	94	47	44	52	59	30	322	0
	Maximum	2	599	6,991	781	1,287	1,920	265	136	520	186	282	184	137	88	977	16	758	0
2017	Expected	2	500	3,478	566	953	1,311	114	119	386	144	222	142	113	88	559	14	322	0
	Minimum	2	220	97	214	353	329	35	52	138	40	78	37	37	46	45	14	322	0
	Maximum	2	570	6,690	718	1,215	1,948	259	130	491	177	268	175	131	85	934	0	758	0
2018	Expected	2	411	558	569	945	1,305	80	86	376	113	197	111	80	52	178	30	322	0
	Minimum	2	234	97	224	370	337	37	56	146	41	82	39	39	50	46	30	322	0
	Maximum	2	599	6,991	761	1,287	1,988	265	136	520	186	282	184	137	88	977	16	758	0
2019	Expected	2	425	558	580	963	1,335	83	89	383	115	200	113	82	55	179	14	322	0
	Minimum	2	241	97	230	379	344	38	57	149	42	84	40	40	52	47	14	322	0
	Maximum	2	628	7,034	804	1,358	2,028	271	141	549	194	296	192	142	91	991	0	758	0
2020	Expected	2	411	558	569	945	1,361	81	86	376	113	197	111	80	52	178	46	322	0
	Minimum	2	245	134	251	415	352	41	57	164	47	91	45	42	49	57	46	322	0
	Maximum	2	599	6,991	761	1,287	2,056	265	138	520	186	282	184	137	88	977	16	758	0
2021	Expected	2	436	595	607	1,008	1,395	86	91	401	121	209	118	85	54	190	14	322	0
	Minimum	2	263	140	267	442	360	43	61	174	50	96	48	45	53	61	14	322	0
	Maximum	2	624	7,254	799	1,349	2,095	270	141	545	193	295	191	142	90	1,015	0	758	0
2022	Expected	2	411	558	569	945	1,418	81	86	376	113	197	111	80	52	178	30	322	0
	Minimum	2	234	97	224	370	360	38	56	146	41	82	39	39	50	46	30	322	0
	Maximum	2	599	6,991	781	1,287	2,124	265	136	520	186	282	184	137	88	977	16	758	0
2023	Expected	2	382	515	526	874	1,443	75	80	347	104	182	102	74	49	164	14	322	0
	Minimum	2	220	97	214	353	365	36	52	138	40	78	37	37	46	45	14	322	0
	Maximum	2	570	6,690	718	1,215	2,152	259	130	491	177	268	175	131	85	934	0	758	0
2024	Expected	2	420	552	573	952	1,475	82	88	376	113	198	111	81	54	177	30	322	0
	Minimum	2	213	97	209	345	370	35	50	135	39	77	37	36	45	44	30	322	0
	Maximum	2	621	6,991	793	1,340	2,196	269	140	541	192	293	190	141	90	984	16	758	0

a. Denotes waste that complies with land disposal restriction treatment standards including gold traps, In-Tank Precipitation filters, and safety/control rods.

b. Burial ground complex waste is 5 percent bulk; 45 percent soil; 10 percent sand, rock, and gravel; 10 percent metal debris; 1 percent each inorganic debris, glass debris, and organic debris; 25 percent heterogeneous debris; and 2 percent lead.

Table A-6. Thirty-year transuranic and alpha waste forecast by waste classes (volume in cubic meters). | TC

Year		Transuranic and alpha waste classes			
		Low-activity with processing[a]	High-activity[b]	Low-activity without processing[c]	Burial ground complex[d]
1995	Expected	133	439	78	0
	Minimum	133	439	78	0
	Maximum	133	439	78	0
1996	Expected	203	882	116	0
	Minimum	203	882	116	0
	Maximum	286	1,297	171	0
1997	Expected	124	595	61	0
	Minimum	124	595	61	0
	Maximum	124	595	61	0
1998	Expected	141	545	72	0
	Minimum	90	351	47	0
	Maximum	149	584	74	0
1999	Expected	135	517	68	0
	Minimum	84	323	43	0
	Maximum	138	528	67	0
2000	Expected	179	710	93	0
	Minimum	21	100	14	0
	Maximum	184	759	98	86,314
2001	Expected	195	768	101	0
	Minimum	10	44	6	0
	Maximum	184	759	98	86,314
2002	Expected	195	768	101	0
	Minimum	9	43	6	0
	Maximum	184	759	98	86,314
2003	Expected	129	518	68	0
	Minimum	9	44	6	0
	Maximum	204	857	111	86,314
2004	Expected	67	305	40	0
	Minimum	37	180	24	0
	Maximum	226	965	125	86,314
2005	Expected	56	249	33	0
	Minimum	18	85	11	0
	Maximum	199	830	107	86,314
2006	Expected	33	160	21	0
	Minimum	18	85	11	0
	Maximum	199	832	108	0
2007	Expected	33	160	21	0
	Minimum	18	88	12	0
	Maximum	199	832	108	0
2008	Expected	33	160	21	0
	Minimum	28	138	18	0
	Maximum	199	832	108	0
2009	Expected	33	160	21	0
	Minimum	9	44	6	0
	Maximum	199	832	108	0
2010	Expected	43	213	28	0
	Minimum	9	44	6	0
	Maximum	221	940	122	0

Table A-6. (continued).

Year		Transuranic and alpha waste classes			
		Low-activity with processing[a]	High-activity[b]	Low-activity without processing[c]	Burial ground complex[d]
2011	Expected	32	157	21	0
	Minimum	9	43	6	0
	Maximum	198	827	107	0
2012	Expected	33	160	21	0
	Minimum	20	98	13	0
	Maximum	200	835	108	0
2013	Expected	33	160	21	0
	Minimum	9	44	6	0
	Maximum	199	832	108	0
2014	Expected	32	159	21	0
	Minimum	10	45	6	0
	Maximum	64	315	42	0
2015	Expected	43	213	28	0
	Minimum	9	43	6	0
	Maximum	80	398	53	0
2016	Expected	32	159	21	0
	Minimum	20	97	13	0
	Maximum	59	291	39	0
2017	Expected	32	156	21	0
	Minimum	9	42	6	0
	Maximum	58	285	38	0
2018	Expected	23	110	15	0
	Minimum	9	43	6	0
	Maximum	59	291	39	0
2019	Expected	23	110	15	0
	Minimum	9	43	6	0
	Maximum	59	293	39	0
2020	Expected	23	110	15	0
	Minimum	20	96	13	0
	Maximum	59	291	39	0
2021	Expected	33	163	22	0
	Minimum	10	46	6	0
	Maximum	80	398	53	0
2022	Expected	23	110	15	0
	Minimum	9	43	6	0
	Maximum	59	291	39	0
2023	Expected	22	107	14	0
	Minimum	9	42	6	0
	Maximum	58	285	38	0
2024	Expected	35	174	23	0
	Minimum	8	36	5	0
	Maximum	80	397	53	0

a. Includes mixed alpha job-control waste, mixed transuranic job-control waste, and transuranic job-control waste with less than 0.5 curies per drum.
b. Includes mixed transuranic equipment, transuranic equipment, mixed transuranic job-control waste with more than 0.5 curies per drum, transuranic job-control waste with more than 0.5 curies per drum, and remote handled transuranic and mixed transuranic wastes.
c. Includes alpha job-control waste.
d. Includes 50 percent mixed alpha job-control waste; 40 percent mixed transuranic job-control waste less than 0.5 curies per drum; and 10 percent mixed transuranic job-control waste greater than 0.5 curie per drum.

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Hess, M. L., 1995, Westinghouse Savannah River Company, Aiken, South Carolina, Interoffice memorandum to H. L. Pope, U.S. Department of Energy, Savannah River Operations Office, Aiken, South Carolina, "WSRC Data Transmittal - Summary of Changes Between Draft and Final WMEIS Forecasts and Alternatives (U)," ESH-NEP-95-0084, May 15.

WSRC (Westinghouse Savannah River Company), 1994a, *Thirty-Year Solid Waste Generation for Facilities at SRS (U)*, WSRC-RP-94-532, Aiken, South Carolina, May 9.

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WSRC (Westinghouse Savannah River Company), 1994c, *Thirty-Year Solid Waste Generation Forecast By Treatability Group (U)*, WSRC-RP-94-584, Revision 1, Aiken, South Carolina, June 14.

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APPENDIX B

FACILITY DESCRIPTIONS

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B.1 ALPHA VITRIFICATION FACILITY

OBJECTIVE:

The alpha vitrification facility[1] would provide treatment of nonmixed and mixed alpha waste (10 to 100 nanocuries of transuranics per gram of waste) and nonmixed and mixed transuranic waste (greater than 100 nanocuries of transuranics per gram of waste). The facility would have the ability to open drums of waste, perform size reduction, produce a glass waste form suitable for disposal, and treat secondary wastes.

DESCRIPTION:

An alpha vitrification facility would treat nonmixed and mixed alpha waste and transuranic waste. The facility would have three main activities: preparation of waste for treatment, primary waste treatment, and secondary waste treatment.

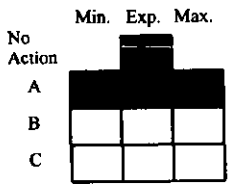
The alpha vitrification facility would be located in E-Area. The facility would accept drummed waste that has first been processed through the transuranic waste characterization/certification facility. In most cases the solid waste would be removed from the drum, sorted by size, and shredded as needed to meet the vitrification unit requirements. This would be accomplished using shredding shears and/or bandsaws. If the radioactivity levels of the waste were too high to maintain worker radiation levels as low as reasonably achievable, the intact drum would be shredded without removing the waste. Wastes would be combined with frit and additives and sent to the thermal pretreatment unit. Under alternative C, the facility would crush concrete culverts and sort concrete rubble to separate alpha-contaminated rubble from reusable non-contaminated rubble. Culverts that are not contaminated could be reused or disposed of. A small amount of contaminated soil (mixed waste soils) could be used as a frit substitute in the vitrification process in an effort to recycle waste materials. The decision to use mixed waste soils as frit would be based on the requirements for the final glass waste form.

The facility would include a thermal pretreatment unit to reduce the carbon content of the waste in order to increase the quality of glass produced during vitrification, prevent glass melt burping, and ensure Resource Conservation and Recovery Act (RCRA) thermal treatment requirements are met. The waste residue, or ash, would be vitrified (i.e., fused into a solid waste matrix) in a high temperature melter. Gases produced during the vitrification process would be sent through an afterburner and an offgas

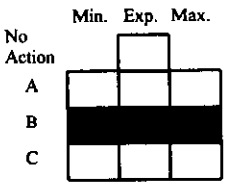
[1]Facilities that exist, are planned, or have been funded are capitalized. Other facilities are not capitalized.

treatment system. The afterburner would destroy remaining organic compounds to meet RCRA standards prior to treatment in an offgas system. The offgas system would filter the gases to minimize the release of the remaining hazardous constituents or particulates to the atmosphere. Liquids generated by the offgas system would be evaporated and recondensed. The condensed evaporator overheads would be sent to a dedicated wastewater treatment unit for the treatment of mercury, trace radionuclides, and other remaining hazardous materials. The closed-loop system would ensure that water would be returned to the offgas system for reuse. The concentrate remaining after the liquid was evaporated would be treated using stabilization techniques (Hess 1994a).

PROJECT-SPECIFIC ACTIONS:

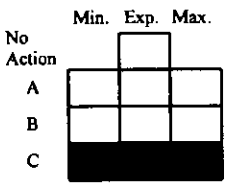


Under the no-action alternative and alternative A, the alpha vitrification facility would not be constructed.

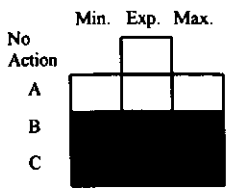


Under alternative B, only nonmetallic mixed-alpha waste, plutonium-238 waste and high-activity plutonium-239 waste would be vitrified in the facility. Where possible, metals would be separated from the plutonium-238 waste to remove the potential for gas generation problems. In order to keep radiation exposure to workers as low as reasonably achievable, it may not always be possible to sort the wastes. Therefore, some drums may be shredded unopened, resulting in metals in the melter. The output would be packages of transuranic waste that would be sent offsite for disposal at the Waste Isolation Pilot Plant.

TC



Under alternative C, prior to the operation of the alpha vitrification facility, alpha waste would be direct disposed or treated in the Consolidated Incineration Facility. Once operating, the remaining alpha and transuranic waste volume would be vitrified. A minor portion of the output (less than 10 percent) would be packages of alpha waste that would be sent to shallow land disposal or to RCRA-permitted disposal onsite. Most of the output would be packages of transuranic waste that would be disposed offsite at the Waste Isolation Pilot Plant.



In both alternatives B and C, the vitrified and stabilized waste forms would be sent back to the transuranic waste characterization/certification facility for final certification before disposal.

The vitrification of solid waste would achieve an average volume reduction ratio of 15 to 1. Liquid waste would achieve an average volume reduction of 75 to 1. For alternative C, the solid waste feed stream would contain appreciable quantities of metal, yet it is assumed that vitrification would still achieve an average volume reduction ratio of 15 to 1. This is because shredding bulky material would eliminate voids and secondary liquid waste generated in the offgas system when thermally treating metals would be much lower than that generated when combustible material is processed (Hess 1994a).

The amounts and types of waste that would be treated in the alpha vitrification facility for each alternative and forecast is presented in Table B.1-1.

Table B.1-1. The amounts and types of waste that would be treated in the alpha vitrification facility for each alternative (cubic meters).[a,b]

	Min.	Exp.	Max.	
		NA		
A	NA	NA	NA	TC
B	5,127 m^3 total 416 m^3/yr	7,052 m^3 total 559 m^3/yr	233,770 m^3 total 19,388 m^3/yr	
	<——— Primarily nonmetallic alpha waste and plutonium-238 waste[c] ———>			
C	10,528 m^3 total 853 m^3/yr	14,847 m^3 total 1,177 m^3/yr	385,741 m^3 total 34,901 m^3/yr	
	<——— All alpha and transuranic wastes ———>			

a. Source: Hess (1995a).
b. To convert to cubic feet, multiply by 35.31.
c. Metals would be removed when possible. The waste stream containing metals would be, for the most part, entirely metal, but other waste streams would not be free of metals because drums often cannot be opened and sorted due to high radiation levels.

B.2 AQUEOUS AND ORGANIC WASTE STORAGE TANKS

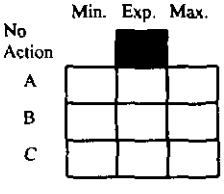
OBJECTIVE:

The aqueous and organic waste storage tanks would provide storage capacity for liquid mixed wastes.

DESCRIPTION:

DOE would need to construct two series of 114-cubic meter (30,000-gallon) tanks in E-Area. One tank series would store mixed aqueous wastes, while the second tank series would store mixed organic wastes. The aqueous waste tanks would be similar in design and construction to the 114-cubic meter (30,000-gallon) solvent tanks planned in H-Area but would be installed above grade. The organic waste tanks would be single-walled tanks constructed in below-grade vaults. Each tank would be provided with a leak-detection system, secondary containment, leak-collection sump, overfill protection, waste agitation pumps, vent filtration system, and inspection ports. Each tank would be secured to a concrete pad or to anchors that would serve as a supporting foundation.

PROJECT-SPECIFIC ACTIONS:



Under the no-action alternative, DOE would need to store large volumes of mixed aqueous and organic wastes. DOE would add new tanks as needed to accommodate expected aqueous and organic liquid waste generation over the next 30 years (Table B.2-1).

Based on DOE's 30-year expected waste forecast, approximately 4,850 cubic meters (1.28×10^6 gallons) of mixed aqueous waste would be generated over the 30-year period. The initial tank would reach capacity in 1995. To accommodate mixed aqueous waste generation, DOE would need to build an additional one or two tanks (depending on waste generation rates) every year for the entire 30-year period. Accordingly, a total of forty-three 114-cubic meter (30,000-gallon) tanks would need to be constructed (Hess 1994b).

Based on DOE's 30-year expected waste forecast, approximately 2,900 cubic meters (7.68×10^5 gallons) of mixed organic waste would be generated over the 30-year period. The initial tank would reach capacity in 2000, and the second tank would reach capacity in the year 2001. Four additional tanks

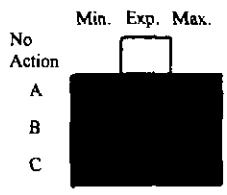
Table B.2-1. New tanks needed to accommodate estimated aqueous and organic liquid waste forecast.[a,b]

	Min.	Exp.	Max.
		4,850 m^3 aqueous waste 43 tanks 2,900 m^3 organic waste 25 tanks	
A	Aqueous and organic waste storage tanks would not be required.	Aqueous and organic waste storage tanks would not be required.	Aqueous and organic waste storage tanks would not be required.
B	Aqueous and organic waste storage tanks would not be required.	Aqueous and organic waste storage tanks would not be required.	Aqueous and organic waste storage tanks would not be required.
C	Aqueous and organic waste storage tanks would not be required.	Aqueous and organic waste storage tanks would not be required.	Aqueous and organic waste storage tanks would not be required.

a. Source: Hess (1994b).
b. To convert to gallons, multiply by 264.2.

would need to be constructed by the year 2003, and a new tank would need to be constructed every year until 2018.

From 2018 until 2024, a new tank would need to be constructed every 1 or 2 years. A total of twenty-six 114-cubic meter (30,000-gallon) tanks would need to be constructed over the entire 30-year period (Hess 1994b).



For each of the other alternatives, adequate treatment capacity would be available for the mixed aqueous and organic liquid waste volumes in all waste forecasts. No additional tanks would be required.

B.3 BURIAL GROUND SOLVENT TANKS

OBJECTIVE:

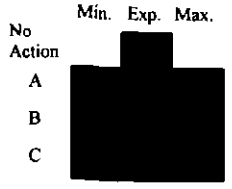
Burial Ground Solvent Tanks S23 through S30 store spent solvent waste generated by the plutonium-uranium extraction (PUREX) process that takes place in Savannah River Site (SRS) separations facilities. Liquid waste solvent tanks S33 through S36 would be constructed in H-Area to provide replacement storage capacity for these wastes in October 1996, by which time the existing solvent tanks must be removed from service.

DESCRIPTION:

There are eight interim-status storage tanks in E-Area, of which two, S29 and S30, are currently used to store mixed solvent wastes. Each tank is constructed of steel and can hold 95 cubic meters (25,000 gallons) of waste. Each tank rests on four steel saddles on top of a concrete slab. The slab slopes to a sump that collects liquid that could escape from the tank. These tanks are used to store spent solvent (predominately tributyl phosphate and n-paraffin) from the PUREX process (enriched uranium recovery process). This radioactive solvent may also contain varying concentrations of lead, mercury, silver, benzene, trichloroethylene, other organics, and an inorganic layer. Future PUREX solvent waste generated from the separations facilities would be radioactive but would not contain metal or organic contaminants in sufficient concentrations to classify the solvent as a mixed waste under RCRA. Mixed and low-level radioactive PUREX solvent wastes would be managed in the same manner (WSRC 1990a).

Tanks S29 and S30 reach the end of their allowable service life in October 1996. At that time, replacement tanks would be required to extend storage capacity. DOE plans to construct four 114-cubic meter (30,000-gallon) tanks in H-Area to replace Tanks S29 and S30. The replacement tanks would be buried, double-walled, and constructed of cathodically protected carbon steel. Each tank would have a leak-detection system, leak-collection sump, overfill protection, waste agitation pumps, common vent filtration system, and inspection ports. Each tank would be secured to a concrete anchor or pad that would serve as a supporting foundation and protect against flotation. Each tank's vent would be piped into a common stack or filter to capture volatile organic compounds and radionuclides (WSRC 1993a). The RCRA interim status storage capacity would be transferred from the existing solvent tanks to the four new tanks (WSRC 1994a).

PROJECT-SPECIFIC ACTIONS:



Under each of the alternatives, the contents of the E-Area solvent tanks would be transferred to the four H-Area 114-cubic meter (30,000 gallon) tanks for storage [total capacity is 450 cubic meters (1.2×10^5 gallons)]. Table B.3-1 presents the volume of waste that would be stored. The tanks currently store 120 cubic meters (31,700 gallons) of waste, and it is projected that an additional 307 cubic meters (81,200 gallons) of solvent waste would be generated over the next 30 years, as follows: 54.5 cubic meters (14,400 gallons) in 1995 from the closure of tanks S23-S28, 15 cubic meters (4,000 gallons) in 1997 from the closure of tanks S29 and S30; 151 cubic meters (40,000 gallons) in 2003 and 87 cubic meters (23,000 gallons) in 2005 from deinventory of the SRS separations facilities (Hess 1994c).

Table B.3-1. Estimated volume of waste stored in Burial Ground Solvent Tanks (cubic meters).[a,b]

	Min.	Exp.	Max.
		427 m^3 (max storage)	
A	327 m^3 (max storage) 137 m^3 (storage in 2024)	327 m^3 (max storage) 137 m^3 (storage in 2024)	327 m^3 (max storage) 137 m^3 (storage in 2024)
B	327 m^3 (max storage) 137 m^3 (storage in 2024)	327 m^3 (max storage) 137 m^3 (storage in 2024)	327 m^3 (max storage) 137 m^3 (storage in 2024)
C	327 m^3 (max storage) 137 m^3 (storage in 2024)	327 m^3 (max storage) 137 m^3 (storage in 2024)	327 m^3 (max storage) 137 m^3 (storage in 2024)

a. Source: Hess (1994b).
b. To convert to gallons, multiply by 264.2.

B.4 COMPACTORS

OBJECTIVE:

Compactors provide a method to reduce the volume of low-level waste, thereby increasing disposal capacity.

DESCRIPTION:

TE Low-activity waste is compacted in low-level waste compactors in either H-Area, M-Area or L-Area (WSRC 1993b, c). The H-Area compactor receives job-control waste from separations facilities, Waste Management, Facilities and Services, Reactors, Tritium, the Defense Waste Processing Facility and Laboratories (WSRC 1994b). The M-Area compactor processes primarily uranium-contaminated job-control waste from M-Area facilities (WSRC 1993b). The L-Area compactor compacts tritiated waste generated in reactor facilities (K-, L-, P-, R-, C-, and 400-D-Areas).

The H-Area compactor and the M-Area compactor are enclosed steel-box-container compactors with vented high efficiency particulate air filter systems. Both compactors receive 90 cubic feet steel containers of low-level waste. The steel container is placed into an enclosed compactor unit and its contents compacted. Cardboard boxes containing low-level waste are manually added to the steel container and the contents recompacted. This process is repeated until the compactor compression efficiency limit is reached. The box compactor compression efficiency ratio is 4 to 1 (Hess 1994a).

The L-Area compactor is a Container Products model that includes the compactor, exhaust pre-filters, and high efficiency particulate air filters. The compactor exhaust moves through a duct into the main building exhaust and discharges from a permitted stack. The compactor reduces the volume of bagged waste into 21-inch cardboard boxes that are then placed into steel box containers for disposal. The L-Area compactor compression efficiency ratio is 4 to 1.

Under the no-action alternative and alternative A, DOE would operate the existing compactors at their maximum capacities from the years 1995 until 2024 to compact low-activity job-control waste. Under alternative B, it is assumed that DOE would operate the compactor only in 1995. DOE would ship low-
TC activity job-control waste offsite for treatment by a commercial vendor beginning in fiscal year 1996. Under alternative C, DOE would operate the compactors in 1995 at their maximum capacities. In 1996, assuming the Consolidated Incineration Facility begins operation, DOE would treat incinerable job-
TE control waste at that facility. DOE would continue to compact waste that does not meet the Consolidated

Incineration Facility waste acceptance criteria; this material is assumed to be 10 percent of the low-activity job-control waste in a given year. Under alternative C, the existing compactors would cease operation in the year 2005. DOE would then vitrify low-activity job-control waste at the non-alpha vitrification facility which would begin operation in 2006. TE TC

PROJECT-SPECIFIC ACTIONS:

Low-level waste management activities for the existing compactors are shown in Table B.4-1.

Table B.4-1. Estimated volumes of waste compacted for each alternative (cubic meters).[a,b]

	Min.	Exp.	Max.
		119,490 m^3 total 3,983m^3/yr	
A	119,490 m^3 total 3,983 m^3/yr	119,490 m^3 total 3,983 m^3/yr	119,490 m^3 total 3,983 m^3/yr
B	3,983 m^3 total	3,983 m^3 total	3,983 m^3 total
C	15,260 m^3 total 950 to 3,983 m^3/yr	18,438 m^3 total 1,199 to 3,983 m^3/yr	19,079 m^3 total 1,281 to 3,983 m^3/yr

a. Source: Hess (1994b).
b. To convert to cubic feet, multiply by 35.31.

B.5 CONSOLIDATED INCINERATION FACILITY

OBJECTIVE:

The Consolidated Incineration Facility would provide incineration capability for a wide range of combustible hazardous, mixed, and low-level wastes. This facility represents the consolidation of several separate SRS incineration initiatives:

- a hazardous waste incinerator that would have provided incineration capability for SRS solid and liquid hazardous wastes

- a Defense Waste Processing Facility benzene incinerator that would have provided dedicated incineration capability for the benzene generated by the high-level waste processing activities at the Defense Waste Processing Facility

- a hazardous waste incinerator upgrade that would accept SRS solid and liquid mixed wastes as well as solid and liquid nonhazardous, radioactive wastes

Further discussion of these initiatives and the basis for development of the Consolidated Incineration Facility can be found in the *Savannah River Site Consolidated Incineration Facility Mission Need and Design Capacity Review* (WSRC 1993c).

The U.S. Department of Energy (DOE) agreed to continue its "fresh look" at operating the Consolidated Incineration Facility in this environmental impact statement (EIS). Emissions and doses to workers and the public from various waste-burning scenarios are presented independently in this appendix chapter. These Consolidated Incineration Facility emissions have been included in the analyses of each alternative and waste forecast in the EIS.

DESCRIPTION:

Incineration was selected because it was the Resource Conservation and Recovery Act (RCRA)-specified technology or the best demonstrated available technology for many SRS hazardous and mixed wastes, and it would provide cost-effective volume reduction for low-level radioactive wastes. The Consolidated Incineration Facility would include processes to stabilize the incinerator solid waste residues (ash) and offgas-scrubber-blowdown liquid with cement into a form known as ashcrete for onsite disposal in accordance with applicable regulations. A permit application to include stabilization of the incinerator

offgas-scrubber-blowdown liquid in the ashcrete process has been submitted to applicable regulatory agencies.

Under the Federal Facility Compliance Act, DOE is required to develop site-specific plans to treat mixed wastes to the standards established under RCRA. Incineration is required by the U.S. Environmental Protection Agency (EPA) Land Disposal Restrictions regulations for the treatment of certain SRS mixed wastes. The *SRS Proposed Site Treatment Plan* (WSRC 1995) identified five SRS mixed waste streams for which treatment by the Consolidated Incineration Facility was determined to be the preferred option: TC

- Radiologically-contaminated solvents
- Solvent-contaminated debris
- Incinerable toxic characteristic material
- Defense Waste Processing Facility benzene
- Mixed waste oil - sitewide

TC

These wastes were included in the Consolidated Incineration Facility design basis waste groups (WSRC 1990b). The proposed site treatment plan identified nine additional mixed waste streams that were not included in the design basis waste groups but for which the Consolidated Incineration Facility was the preferred option: TE

- Filter paper take-up rolls
- Mark 15 filter paper
- Paints and thinners
- Job-control waste containing solvent-contaminated wipes
- Tributyl phosphate and n-paraffin
- Spent filter cartridges and carbon filter media
- Mixed waste from laboratory samples
- Wastewater from transuranic drum dewatering
- Plastic/lead/cadmium raschig rings

TC

DOE's site treatment plan options analyses also identified incineration at SRS as the preferred treatment option for limited quantities of mixed waste generated by Naval Reactors Program sites (approximately 18 cubic meters over a 5-year forecast period). Incineration of these wastes has been included in the analyses of this EIS.

Final decisions regarding the treatment of these wastes will be made in conjunction with ongoing negotiations with the State of South Carolina pursuant to the Federal Facility Compliance Act.

TC | Incineration at the Consolidated Incineration Facility for the design basis waste groups was considered in an Environmental Assessment (DOE 1992) and Finding of No Significant Impact (57 FR 61402) that established the NEPA basis for construction of the Consolidated Incineration Facility.

The Consolidated Incineration Facility main process building (Building 261-H) would include areas for solid waste receipt; solid waste handling; a rotary kiln incineration system, including incinerator ash removal and treatment, and offgas cleaning; and the necessary control room and support service facilities. A system to solidify incinerator ash and offgas-scrubber-blowdown would also be installed before operation.

The Consolidated Incineration Facility would process both liquid and solid wastes. Solid waste would be delivered in cardboard boxes manually loaded onto a conveyor. The boxes would pass through a portal monitor to determine if the radiation rate of the box contents was below the maximum Consolidated Incineration Facility waste acceptance criteria of 10 millirem per hour at 3 inches. The boxes would be x-rayed to ensure that materials unacceptable to the incineration process were not present. Waste boxes would be assayed to ensure that their curie content was in agreement with the waste manifest. Boxes would be stored on the conveyor system before being fed to the incinerator.

Liquid waste would be transported to the Consolidated Incineration Facility by various methods. Radioactive organic waste (benzene) would be piped directly from the Defense Waste Processing Facility for incineration. Other liquid wastes would be transported in carboys, drums, or tanker trucks to the Consolidated Incineration Facility tank farm which consists of five tanks: a 25-cubic meter (6,500-gallon) aqueous waste tank, two 16-cubic meter (4,200-gallon) blend tanks, a 25-cubic meter (6,500-gallon) spare tank, and a 48-cubic meter (12,600-gallon) fuel oil tank. Dikes (secondary containment) to contain accidental spills would be provided around the waste tanks, fuel oil tank, and the truck unloading pads. Liquids collected in sumps in the diked areas would be analyzed for contamination. If contamination was found, the liquid would be pumped into the aqueous waste tank for processing in the incinerator. Liquid wastes from the tank farm would be blended to provide a solution with a heating value, viscosity, and an ash and chlorine content that would achieve stable combustion in the rotary kiln. Aqueous waste may be blended with other liquids for incineration or be evaporated in the

TE | incinerator, depending on the heating value of the liquid and free water content. Additional Consolidated Incineration Facility-related components would include a propane storage tank and two standby diesel generators.

The incinerator system consists of a rotary kiln primary incineration chamber and a secondary combustion chamber. The system is designed to ensure a 99.99 percent destruction and removal efficiency for each principle organic hazardous constituent in accordance with RCRA regulations.

The secondary combustion chamber offgas (exhaust) would be treated by a wet scrubbing system for acid gas control and particulate removal to meet environmental regulations. The offgas system consists of a quench system for temperature reduction; a free-jet scrubber; a cyclone separator; a mist eliminator; a reheater; high efficiency particulate air filters; induced draft fans; and an exhaust stack. The offgas wet scrubber liquid chemistry would be controlled to maintain suspended solids and chlorine concentration limits. Concentration limits would be maintained by emptying and refilling the offgas wet scrubber storage tank. The scrubber liquid blowdown would be solidified in cement, in the same manner as the incinerator ash, at the ashcrete stabilization unit.

High efficiency particulate air filters are provided for the container handling kiln feed, ashout areas exhaust vents, and the kiln seal shroud exhaust. Stack monitoring equipment is installed to monitor the discharge of chemical and radiological materials.

The Consolidated Incineration Facility is expected to achieve a net volume reduction of 11 to 1 for low-level job-control waste, 8 to 1 for other types of solid waste, and 40 to 1 for liquid waste, even considering the increase in volume due to secondary waste stabilization. DOE would operate the Consolidated Incineration Facility within design and permit mechanical and thermal utilization limits. The mechanical design utilization is based on a combination of waste throughput, waste forms, and material handling requirements to physically accommodate waste material feed. The thermal utilization is based on the amount of heat that can be safely and effectively dissipated from the incinerator.

Mechanical utilization limit is the hourly throughput rating. The annual operating capacity of the Consolidated Incineration Facility for liquid waste would be approximately 4,630 cubic meters (1.63×10^5 cubic feet) per year at 70 percent attainment and for solid waste, approximately 17,830 cubic meters (6.3×10^5 cubic feet) per year at 50 percent attainment (WSRC 1993c). The incinerator liquid-waste-feed-system design is based on a high heating value (i.e., organics) liquid waste flow rate of 687 pounds per hour and low heating value (i.e., aqueous) liquid waste flow rate of 950 pounds per hour. The incinerator is designed to incinerate an annual average of 720 pounds per hour of solid waste, based on the total heating value and ash content of the solid waste (WSRC 1993d). Modifications to the TC

Consolidated Incineration Facility's waste handling systems are assumed to increase the solids handling capacity to the following:

- 961 pounds per hour for alternative B - minimum waste forecast
- 2,285 pounds per hour for alternative A - expected waste forecast
- 11,251 pounds per hour for alternative A - maximum waste forecast

The ashout and ash stabilization systems would also be modified for alternative A (all waste forecasts) and alternative B – minimum waste forecast to handle the larger throughputs associated with soils incineration (Blankenhorn 1995).

TC

Thermal utilization limits are expressed in terms of British thermal units (amount of energy required to raise the temperature of one pound of water from 58.5 degrees Fahrenheit to 59.5 degrees Fahrenheit) per hour. The maximum feed rate is determined by the combined heat release of the waste forms and auxiliary fuel oil. The maximum thermal release rating for the Consolidated Incineration Facility rotary kiln system is limited to about 13 million British thermal units per hour. The maximum thermal release rating for the secondary combustion chamber is about 5 million British thermal units per hour. The Consolidated Incineration Facility is limited to an approximate thermal capacity of 18 million British thermal units per hour.

DOE has submitted a permit application to operate the Consolidated Incineration Facility to segregate and incinerate listed hazardous and mixed wastes separately from characteristic-only hazardous wastes and nonhazardous wastes. It is assumed that treating hazardous, mixed, and mixed alpha waste in the Consolidated Incineration Facility would result in 70 percent secondary waste disposal in RCRA-permitted disposal vaults and 30 percent secondary waste disposal in shallow land disposal. It is also assumed that low-level and non-mixed alpha waste treatment would result in 100 percent secondary waste disposal in shallow land disposal.

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PROJECT-SPECIFIC ACTIONS:

The volumes of waste that would be treated by the Consolidated Incineration Facility for each alternative and waste forecast are shown in Table B.5-1. The table also identifies the percentage of the Consolidated Incineration Facility's mechanical or thermal operating limits (whichever is most critical) represented by the waste feeds evaluated for each alternative and forecast.

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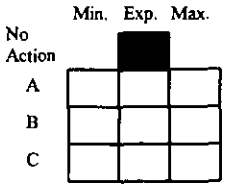
Table B.5-1. Average annual and total estimated volumes of waste incinerated for each alternative. The Consolidated Incineration Facility would operate for the 30-year period of analysis in alternatives A and B, and cease operation in 2005 in alternative C.[a]

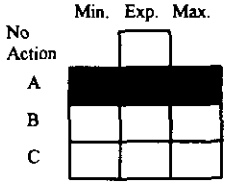
	Min.	*Exp.*	Max.
		The Consolidated Incineration Facility would not operate under the no-action alternative.	
A	Solids (337 m^3 per year) 5,214 m^3 mixed 4, 561 m^3 hazardous Liquids (1,188 m^3 per year) 29,480 m^3 mixed 4,967 m^3 hazardous Soils (754 m^3 per year) 14,324 m^3 mixed 74% of solids handling capacity[b] 23% of aqueous liquids capacity[c] 40% of organic liquids capacity[d]	Solids (654 m^3 per year) 10,633 m^3 mixed 8,346 m^3 hazardous Liquids (2,008 m^3 per year) 49,436 m^3 mixed 8,809 m^3 hazardous Soils (2,790 m^3 per year) 52,999 m^3 mixed 85% of solids handling capacity[b] 37% of aqueous liquids capacity[c] 77% of organic liquids capacity[d]	Solids (964 m^3 per year) (3%) 15,346 m^3 mixed 12,617 m^3 hazardous Liquids (1,234 m^2 per year) 22,793 m^3 mixed 12,990 m^3 hazardous Soils (13,897 m^2 per year) 264,036 m^3 mixed 85% of solids handling capacity[b] 15% of aqueous liquids capacity[c] 61% of organic liquids capacity[d]
B	Solids (7,317 m^3 per year) 178,329 m^3 low-level 19,743 m^3 mixed 14,121 m^3 hazardous Liquids (937 m^3 per year) 22,210 m^3 mixed 4,967 m^3 hazardous Soils (780 m^3 per year) 14,324 m^3 mixed 84% of solids handling capacity[b] 18% of aqueous liquids capacity[c] 29% of organic liquids capacity[d]	Solids (9,456 m^3 per year) 213,536 m^3 low-level 33,594 m^3 mixed 27,090 m^3 hazardous Liquids (1,572 m^3 per year) 36,784 m^3 mixed 8,809 m^3 hazardous 78% of CIF thermal capacity[e]	Solids (15,412 m^3 per year) 307,468 m^3 low-level 99,901 m^3 mixed 39,589 m^3 hazardous Liquids (1,179 m^3 per year) 21,201 m^3 mixed 12,990 m^3 hazardous 98% of CIF thermal capacity[e]
C	Solids (6,746 m^3 per year) 56,605 m^3 low-level 7,042 m^3 mixed 3,497 m^3 hazardous 318 m^3 alpha Liquids (708 m^3 per year) 3,379 m^3 mixed 3,703 m^3 hazardous 41% of CIF thermal capacity[e]	Solids (8,961 m^3 per year) 72,718 m^3 low-level 11,999 m^3 mixed 4,199 m^3 hazardous 694 m^3 alpha Liquids (861 m^3 per year) 4,100 m^3 mixed 4,507 m^3 hazardous 56% of CIF thermal capacity[e]	Solids (15,064 m^3 per year) 79,311 m^3 low-level 65,993 m^3 mixed 4,658 m^3 hazardous 680 m^3 alpha Liquids (1,095 m^3 per year) 6,167 m^3 mixed 4,779 m^3 hazardous 89% of CIF thermal capacity[e]

TC

a. Source: Hess (1995a,b); Blankenhorn (1995).
b. Percent of Consolidated Incineration Facility annual mechanical operating capacity for solids (including soils).
c. Percent of Consolidated Incineration Facility annual mechanical operating capacity for aqueous liquids.
d. Percent of Consolidated Incineration Facility annual mechanical operating capacity for organic liquids.
e. Percent of Consolidated Incineration Facility annual thermal operating capacity.



Under the no-action alternative, the Consolidated Incineration Facility would not operate.

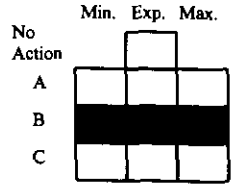


Alternative A - For all three waste forecasts, hazardous and mixed wastes would be treated at the Consolidated Incineration Facility. Mixed wastes would include mixed waste requiring size reduction, Defense Waste Processing Facility benzene, organic liquid, radioactive oil, PUREX solvent, paint wastes, composite filters, aqueous liquids, organic and inorganic sludges, contaminated soils, and spent decontamination solution from the containment building. Hazardous waste would include composite filters, paint waste, organic liquids, and aqueous liquids.

The Consolidated Incineration Facility capacity for treating soils is limited by the feed, ash-out, and ash stabilization system. The rotary kiln and offgas system are capable of treating large volumes of soil because the thermal energy requirements and offgas flow rates for soil are much less than for combustible solids and liquids. Under alternative A, DOE would modify the Consolidated Incineration Facility by the year 2006 to process large volumes of mixed waste soil by installing new feed, material handling, ash-out, and ash stabilization systems to treat approximately 750 cubic meters (26,500 cubic feet) to 13,900 cubic meters (4.9×10^5 cubic feet) of soils per year (Hess 1995a). The Consolidated Incineration Facility is expected to achieve a net volume increase of 1 to 3 for soils due to the increase in volume resulting from secondary waste stabilization.

TC

Under the maximum waste forecast, spent decontamination solutions from the containment building would not go directly to the Consolidated Incineration Facility because volumes would be too large and would require treatment by a wastewater treatment facility. Solid (1 percent) and liquid (5 percent) residuals from the wastewater treatment process would be incinerated.

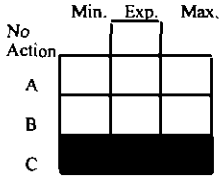


Alternative B - For all three waste forecasts, hazardous, mixed, and low-level wastes would be treated at the Consolidated Incineration Facility. Mixed wastes would include mixed waste requiring size reduction, Defense Waste Processing Facility benzene, organic liquid, radioactive oil, PUREX solvent, paint wastes, composite filters, aqueous liquids, and spent decontamination solution from the containment building. Hazardous waste would

include composite filters, paint waste, organic liquids, and aqueous liquids. Low-level waste would include low-activity and tritiated job-control wastes.

Under the minimum waste forecast, mixed waste soils and sludges would be incinerated because there is insufficient volume of these wastes to warrant construction of other facilities. DOE would modify the Consolidated Incineration Facility by 2006 to process large volumes of soil by installing new feed, material handling, ash-out, and ash stabilization systems to treat approximately 750 cubic meters (26,500 cubic feet) per year of soils (Hess 1995a). TC

Under the maximum waste forecast, spent decontamination solutions from the containment building would not go directly to the Consolidated Incineration Facility because volumes would be too large and would require treatment by a wastewater treatment facility. Solid (1 percent) and liquid (5 percent) residuals from the wastewater treatment process would be incinerated.



Alternative C - Hazardous, mixed, alpha, and low-level wastes would be treated at the Consolidated Incineration Facility. Mixed wastes would include mixed waste requiring size reduction, Defense Waste Processing Facility benzene, organic liquid, radioactive oil, PUREX solvent, paint wastes, composite filters, and aqueous liquids. Hazardous waste would include composite filters, paint waste, organic liquids, and aqueous liquids. Alpha waste would include mixed and nonmixed wastes. Low-level waste would include low-activity and tritiated job-control wastes. The Consolidated Incineration Facility would cease operating in 2005 in this alternative.

SUMMARY OF IMPACTS:

The consequences of the incineration of hazardous, mixed, and low-level radioactive wastes at the Consolidated Incineration Facility under alternative B are described in Table B.5-2. Alternative B provides bounding impacts with respect to operations of the Consolidated Incineration Facility because the facility would operate throughout the 30-year analysis period (compared to alternative C in which the facility would be replaced by the non-alpha vitrification facility in 2006) and would burn low-level, hazardous, and mixed wastes (compared to only hazardous and mixed wastes under alternative A). The impacts resulting from the incineration of hazardous and mixed wastes have been identified separately from those associated with incineration of low-level wastes.

Table B.5-2. Summary of impacts from the operation of the Consolidated Incineration Facility (CIF) under alternative B.[a]

Minimum Waste Forecast	Expected Waste Forecast	Maximum Waste Forecast
Stabilized ash and blowdown disposal volumes		
MW/HW[b,c]	MW/HW	MW/HW
33,518 m^3 to RCRA-permitted disposal	6,108 m^3 to RCRA-permitted disposal	12,803 m^3 to RCRA-permitted disposal
14,366 m^3 to shallow land disposal	2,618 m^3 to shallow land disposal	5,488 m^3 to shallow land disposal
LLW[d]	LLW	LLW
16,212 m^3 to shallow land disposal	19,412 m^3 to shallow land disposal	27,952 m^3 to shallow land disposal
Auxiliary fuel oil consumption[e]		
TC MW/HW	MW/HW	MW/HW
134×10^6 pounds	111×10^6 pounds	85×10^6 pounds
LLW	LLW	LLW
13.2×10^6 pounds	15.8×10^6 pounds	22.8×10^6 pounds
Non-radiological air emissions[f]		
Annual average probability of excess latent cancers to offsite residents due to CIF operations		
1.7×10^{-10}	2.7×10^{-10}	2.0×10^{-10}
Calculated maximum 8-hour average air pollutant concentrations at 100 meters (328 feet) and 640 meters (2,100 feet)		
Well below Occupational Safety and Health Administration permissible exposure levels		
Radiological air emissions		
Average annual radiological dose and resulting health effects to the public[g]		
Offsite maximally exposed individual		
TE MW/HW	MW/HW	MW/HW
0.00352 millirem	0.00452 millirem	0.00783 millirem
1.76×10^{-9} probability of an excess fatal cancer	2.26×10^{-9} probability of an excess fatal cancer	3.91×10^{-9} probability of an excess fatal cancer
LLW	LLW	LLW
0.00528 millirem	0.00641 millirem	0.0159 millirem
2.64×10^{-9} probability of an excess fatal cancer	3.21×10^{-9} probability of an excess fatal cancer	7.97×10^{-9} probability of an excess fatal cancer
Total	Total	Total
0.00880 millirem	0.0109 millirem	0.0237 millirem
4.40×10^{-9} probability of an excess fatal cancer	5.47×10^{-9} probability of an excess fatal cancer	1.19×10^{-8} probability of an excess fatal cancer
Offsite Population		
MW/HW	MW/HW	MW/HW
TC 0.207 person-rem	0.268 person-rem	0.466 person-rem
1.03×10^{-4} number of additional fatal cancers	1.34×10^{-4} number of additional fatal cancers	2.33×10^{-4} number of additional fatal cancers
LLW	LLW	LLW
0.313 person-rem	0.379 person-rem	0.783 person-rem
1.57×10^{-4} number of additional fatal cancers	1.90×10^{-4} number of additional fatal cancers	3.91×10^{-4} number of additional fatal cancers
Total	Total	Total
0.520 person-rem	0.647 person-rem	1.25 person-rem
2.60×10^{-4} number of additional fatal cancers	3.24×10^{-4} number of additional fatal cancers	6.24×10^{-4} number of additional fatal cancers

Table B.5-2. (continued).

Minimum Waste Forecast	Expected Waste Forecast	Maximum Waste Forecast
Radiological air emissions		
Average annual radiological dose and resulting health effects to uninvolved workers		
640 meter uninvolved worker		
MW/HW	MW/HW	MW/HW
0.0693 millirem	0.0900 millirem	0.157 millirem
3.47×10^{-8} probability of an excess fatal cancer	4.50×10^{-8} probability of an excess fatal cancer	7.84×10^{-8} probability of an excess fatal cancer
LLW	LLW	LLW
0.106 millirem	0.127 millirem	0.179 millirem
5.28×10^{-8} probability of an excess fatal cancer	6.33×10^{-8} probability of an excess fatal cancer	8.97×10^{-8} probability of an excess fatal cancer
Total	Total	Total
0.0175 millirem	0.217 millirem	0.336 millirem
8.75×10^{-8} probability of an excess fatal cancer	1.08×10^{-7} probability of an excess fatal cancer	1.68×10^{-7} probability of an excess fatal cancer
100 meter uninvolved worker		
MW/HW	MW/HW	MW/HW
0.200 person-rem	0.260 person-rem	0.452 person-rem
1.00×10^{-7} number of additional fatal cancers	1.30×10^{-7} number of additional fatal cancers	2.26×10^{-7} number of additional fatal cancers
LLW	LLW	LLW
0.302 person-rem	0.366 person-rem	0.666 person-rem
1.51×10^{-7} number of additional fatal cancers	1.83×10^{-7} number of additional fatal cancers	3.33×10^{-7} number of additional fatal cancers
Total	Total	Total
0.502 person-rem	0.626 person-rem	1.12 person-rem
2.51×10^{-7} number of additional fatal cancers	3.13×10^{-7} number of additional fatal cancers	5.59×10^{-7} number of additional fatal cancers
Direct exposure[h]		
Average annual radiological dose and resulting health effects to involved workers		
Maximally exposed individual		
MW/HW	MW/HW	MW/HW
112 millirem	146 millirem	256 millirem
4.48×10^{-5} probability of an excess fatal cancer	5.84×10^{-5} probability of an excess fatal cancer	1.02×10^{-4} probability of an excess fatal cancer
LLW	LLW	LLW
169 millirem	205 millirem	234 millirem
6.77×10^{-5} probability of an excess fatal cancer	8.19×10^{-5} probability of an excess fatal cancer	9.37×10^{-5} probability of an excess fatal cancer
Total	Total	Total
281 millirem	351 millirem	490 millirem
1.13×10^{-4} probability of an excess fatal cancer	1.40×10^{-4} probability of an excess fatal cancer	1.96×10^{-4} probability of an excess fatal cancer

TC

Table B.5-2. (continued).

Minimum Waste Forecast	Expected Waste Forecast	Maximum Waste Forecast
	Average annual involved worker population dose[i]	
MW/HW	MW/HW	MW/HW
2.91 person-rem	3.80 person-rem	6.66 person-rem
0.00117 number of additional fatal cancers	0.00152 number of additional fatal cancers	0.00266 number of additional fatal cancers
LLW	LLW	LLW
4.40 person-rem	5.32 person-rem	6.09 person-rem
0.00176 number of additional fatal cancers	0.00213 number of additional fatal cancers	0.00244 number of additional fatal cancers
Total	Total	Total
7.31 person-rem	9.12 person-rem	12.8 person-rem
0.00293 number of additional fatal cancers	0.00365 number of additional fatal cancers	0.00510 number of additional fatal cancers

TC

a. Source: Hess (1995b). Waste disposal volumes and fuel consumption are for the entire 30-year analysis period.
b. MW/HW = mixed waste/hazardous waste.
c. Stabilized ash and blowdown volumes assume that 70 percent of hazardous/mixed waste residues require RCRA-permitted disposal, 30 percent can be sent to shallow land disposal.
d. LLW = low-level waste.
e. Auxiliary fuel oil consumption based on categorization of each waste type by soils, solids, and high and low Btu-content liquids. Fuel oil consumption is calculated based on each waste category being incinerated separately.
f. Includes emissions of dioxins (Mullholland et al. 1994) and products of incomplete combustion from the Consolidated Incineration Facility.
g. Average annual dose and probability of fatal cancer obtained by dividing the 30-year dose and associated probability by 29.
h. Direct exposure scaled to cesium-137. Direct exposure is normalized to the expected case average exposure provided by Hess (1994d).
i. Number of additional fatal cancers are per year of Consolidated Incineration Facility operation.

B.6 CONTAINMENT BUILDING (HAZARDOUS WASTE/MIXED WASTE TREATMENT BUILDING)

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OBJECTIVE:

At one time, the Hazardous Waste/Mixed Waste Treatment Building project was to provide a RCRA-permitted facility for the treatment of hazardous and mixed wastes that could not be treated to meet land disposal restrictions standards in other existing or planned facilities at SRS. The Hazardous Waste/Mixed Waste Treatment Building would have provided a facility in which wastes were processed into waste forms suitable for disposal. The facility would have also repackaged some waste streams for shipment to other SRS treatment facilities such as the Consolidated Incineration Facility. Changes in the applicable regulatory requirements and to the mission of SRS have prompted DOE to re-evaluate the current scope and design of the Hazardous Waste/Mixed Waste Treatment Building. This facility has not yet been constructed.

Many treatment processes originally planned for the treatment building could be performed in existing SRS facilities in accordance with RCRA containment building regulations. Design features of a containment building include:

- walls, floor, and roof to prevent exposure to the elements
- primary barrier, such as the floor of a process area, or process tankage that is resistant to the hazardous materials contained therein
- secondary containment system, in addition to the primary barrier, for hazardous liquid materials (the containment building itself may act as secondary containment to the tanks within)
- leak detection system between the primary barrier and secondary containment system
- liquid collection and removal system

A containment building (as defined by RCRA) must be constructed and operated to:

- ensure that the containment building is maintained free of cracks, corrosion, or other defects that could allow hazardous materials to escape

- control the inventory of hazardous material within the containment walls so that the height of the containment wall is not exceeded

- provide a decontamination area for personnel and equipment to prevent spreading hazardous materials outside the containment building

- control fugitive emissions

- promptly repair conditions that could result in a release of hazardous waste

DESCRIPTION:

The *SRS Proposed Site Treatment Plan* identified several preferred treatment options that could be carried out in existing SRS facilities in accordance with RCRA containment building standards. These treatment options include:

- two 90-day generator treatments at the Savannah River Technology Center that would discharge treatment residuals to the Mixed Waste Storage Tanks

TE
- macroencapsulation (in a welded stainless steel box) of silver saddles at a separations canyon building

TC
- macroencapsulation (by polymer coating) of mixed waste lead and contaminated debris by an onsite vendor at an unspecified location

- macroencapsulation (in a welded stainless steel box) at the tritium facilities of mercury-contaminated equipment and a mercury-contaminated recorder

- size reduction of filter paper take-up rolls in preparation for treatment at the Consolidated Incineration Facility

- decontamination and macroencapsulation (in a welded stainless steel box) of high-level waste sludge and supernatant-contaminated debris at the Building 299-H decontamination facility that would discharge spent decontamination solutions to the high-level waste tank farms.

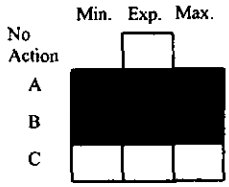
Low volume and/or one-time generation wastes would be treated at existing SRS facilities as indicated in the SRS draft site treatment plan. Approximately 1,703 cubic meters (4.49×10^5 gallons) of mixed waste would be treated at these facilities, 63 percent of which would be high-level waste sludge and supernatant-contaminated debris that requires decontamination or macroencapsulation. The 30-year waste forecast for this EIS identified larger quantities of mixed waste lead than those anticipated in the 5-year waste forecast used to develop the SRS proposed site treatment plan. As a result of the increased volume, a dedicated waste management facility has been proposed to treat mixed waste lead.

DOE proposes in this EIS to construct a containment building as a self-contained facility to accommodate waste quantities too large to be managed within existing SRS facilities or for which an existing facility that conforms to RCRA containment building standards cannot be identified. The EIS has identified several additional treatments that could be performed in such a containment building. These include:

- physical and chemical decontamination of debris, equipment, and nonradioactive lead wastes
- macroencapsulation (in a welded stainless steel box) of debris
- macroencapsulation (by polymer coating) of radioactive lead
- wet chemical oxidation of reactive metals
- roasting and retorting of mercury-contaminated equipment and amalgamation of the elemental mercury

TE

DOE proposes to construct a containment building for the decontamination and treatment of hazardous and/or mixed wastes. This building would begin operation in 2006. The activities to be conducted in the containment building are identical under alternatives A and B. Under alternative C, the containment building would operate differently.



Alternatives A and B

Under alternatives A and B, the containment building would be designed with five separate processing bays. The activities to be conducted in each of the bays are as follows: (1) container opening/content sorting, (2) size reduction, (3) decontamination, (4) macroencapsulation, and (5) repackaging/waste characterization. Each bay would contain the necessary equipment to conduct the respective activities. Waste would be processed through each bay as was necessary to properly handle each individual waste type. If processing associated with a particular bay is not required for a specific waste, the bay would be bypassed.

The container opening/content sorting bay would contain equipment to help facilitate the opening of mixed waste containers. Once the container was opened, the contents would be removed and hand sorted by size. Materials that need to be further reduced in size for treatment/decontamination would be separated from those that are already small enough for treatment/decontamination. Mixed wastes would be sorted using gloveboxes. Wastes requiring size reduction would be sent to the size reduction bay. This bay would contain equipment such as shredder shears and bandsaws that would be used to reduce the size of waste for subsequent processing.

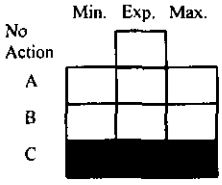
Mixed waste such as bulk equipment and debris would be decontaminated in the decontamination bay using technologies such as degreasing, water washing, and/or carbon dioxide blasting. This bay would contain the necessary equipment to implement the selected decontamination technologies. Spent decontamination solutions would be collected in a tank truck for treatment onsite. Mixed wastes that are decontaminated (i.e., the hazardous component of the waste has been removed) would be reclassified as low-activity equipment waste and would be managed in accordance with the proposed alternatives for that treatability group. Wastes that are not decontaminated would continue on to the macroencapsulation bay for further processing.

Two types of macroencapsulation would be conducted in the macroencapsulation bay. The first macroencapsulation process would be for debris and bulk equipment that could not be successfully decontaminated. The debris and bulk equipment would be macroencapsulated by packaging it in stainless steel boxes that would then be welded shut. The second macroencapsulation process would be
TC | for mixed waste lead, debris, and bulk equipment. The lead would not have been sent to the decontamination bay in the previous step, but, rather would be sent directly from the container

opening/content sorting bay or the size reduction bay to the macroencapsulation bay. The lead, debris and bulk equipment would be macroencapsulated by coating the surface with a polymer. Mixed waste that is macroencapsulated would be able to be disposed in RCRA-permitted disposal vaults because it would meet the applicable land disposal restriction treatment standards under the debris rule. TC

The fifth bay would be the packaging bay. This bay would house equipment to facilitate the packaging of waste into a waste container. Wastes would either be packaged for onsite disposal as a mixed waste (i.e., if macroencapsulated) or packaged for transportation to the applicable low-level waste facility for further processing if successfully decontaminated (Hess 1994a).

For alternatives A and B, it is estimated that approximately 80 percent of the incoming debris and bulk equipment waste would be successfully decontaminated and that 20 percent would need to be macroencapsulated prior to disposal. Additionally, it is estimated that the quantity of spent decontamination solutions generated during decontamination procedures would be equal to 50 percent of the influent waste volume (Hess 1994b).



Alternative C

The major differences between the containment building proposed under alternative C and that proposed under alternatives A and B are the inclusion of:

- roasting, retorting, and amalgamation (see glossary) of mercury and mercury-contaminated wastes
- wet chemical oxidation of reactive metals
- debris and equipment that could not be decontaminated would be transferred to the non-alpha vitrification facility instead of treated by macroencapsulation
- nonradioactive materials would be separated into lead and non-lead components by a combination of physical and chemical separation techniques
- radioactive lead would be treated at the non-alpha vitrification facility instead of macroencapsulated by polymer coating at the containment building

The containment building would process both hazardous and mixed wastes under alternative C.

Under alternative C, the containment building would be designed with six separate processing bays as follows: (1) container opening/content sorting, (2) size reduction/physical separation, (3) roasting/retorting and amalgamation, (4) wet chemical oxidation, (5) decontamination, and (6) repackaging/waste characterization. As discussed for alternatives A and B, waste would be processed through each bay as necessary to properly handle each individual type of waste. If processing associated with a particular bay is not required for a specific waste, the bay would be bypassed. Each bay would contain the necessary equipment to conduct the respective activities.

The container opening/content sorting bay and the size reduction/physical separation bay would have the same function as discussed above. Hazardous and mixed waste containers would be opened and their contents sorted by size. Hazardous wastes would be sorted on tables, while mixed wastes would be sorted using glove boxes. Wastes requiring size reduction would be sent to the size reduction/physical separation bay. Additionally, hazardous waste that contains lead would be separated into lead and non-lead components by cutting or disassembling the lead-containing waste items (e.g., removing lead components such as solder or washers from a piece of equipment). After sorting, dismantling, and/or size reduction, hazardous waste lead would not be further processed in the containment building; instead, it would be sent directly to the last bay for repackaging (Hess 1994a).

Approximately 48 cubic meters (1,700 cubic feet) of pumps that contain mercury would be sent to the third bay for roasting and retorting. The mercury that is captured during the process and additional elemental mercury wastes would be amalgamated to meet the land disposal restrictions treatment standards. The amalgamated mercury would be approximately 1 cubic meter (264 gallons) in volume and would be able to be disposed of at the RCRA-permitted disposal vaults. The metal pumps would be reclassified as a low-level waste and would need no further treatment (Hess 1994b).

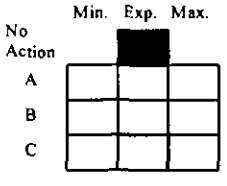
Approximately 5 cubic meters (170 cubic feet) of the hazardous and mixed waste metal debris that would be sent to the containment building contains reactive metals. This waste would be treated in the fourth bay by wet chemical oxidation to eliminate the reactivity in accordance with the land disposal restrictions treatment standards. Liquid residuals that are generated during the wet chemical oxidation process, approximately 15 cubic meters (530 cubic feet), would be collected in a tank truck for treatment at the non-alpha vitrification facility (Hess 1994b).

Bulk equipment and debris would be decontaminated in the fifth bay using technologies such as degreasing, water washing, and/or carbon dioxide blasting. No hazardous lead wastes would be sent to the decontamination bay. Decontamination solutions would be collected in a tank truck for treatment at the non-alpha vitrification facility. Mixed wastes that are successfully decontaminated (i.e., the hazardous component of the waste has been removed) would be reclassified as low-activity equipment waste and managed in accordance with the proposed alternatives for that treatability group. Hazardous wastes that are successfully decontaminated would be recycled. Wastes that are not successfully decontaminated would require further onsite processing.

Wastes would be packaged in the sixth bay. This bay would have equipment to facilitate the packaging of waste from the various bays into a waste container. Mixed wastes that are successfully treated and/or decontaminated (i.e., the hazardous component of the waste has been removed) and the pumps that were roasted/retorted would be reclassified as low-level waste and would be packaged for transport to an onsite low-level waste disposal facility. Amalgamated mercury would be packaged for disposal at RCRA-permitted disposal vaults. Mixed wastes that are not treated and/or decontaminated (i.e., the hazardous component of the waste still remains), hazardous wastes that are not decontaminated, and the dismantled lead hazardous wastes would be repackaged for further processing onsite. Hazardous waste metals that are decontaminated would be reused onsite as a substitute for a new product or would be sold as scrap (Hess 1994a).

Under alternative C, it is estimated that approximately 80 percent of the hazardous and mixed waste would be able to be decontaminated. It is estimated that the quantity of spent decontamination solutions generated during decontamination procedures for both hazardous and mixed wastes would be equal to 50 percent of the influent waste volume to the decontamination unit (Hess 1994b).

PROJECT-SPECIFIC ACTIONS:



Under the no-action alternative, the containment building would not be constructed.

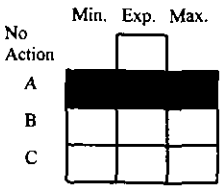
For each alternative, Table B.6-1 presents the volume of wastes to be decontaminated and macroencapsulated.

Table B.6-1. Waste that would be treated between the years 2006 and 2024 in the containment building under each alternative (cubic meters).[a,b]

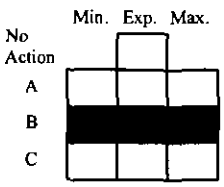
	Min.	Exp.	Max.
		the containment building would not be constructed	
A	40,601 m^3 decontaminated (2,136 m^3 annually) 9,439 m^3 macroencapsulated (497 m^3 annually) mixed waste only	76,983 m^3 decontaminated (4,052 m^3 annually) 18,419 m^3 macroencapsulated (969 m^3 annually) mixed waste only	275,684 m^3 decontaminated (14,510 m^3 annually) 62,803 m^3 macroencapsulated (3,305 m^3 annually) mixed waste only 137,842 m^3 decontamination solution 6,892 m^3 liquid residual[c] 1,378 m^3 solid residual[c] 129,572 m^3 discharged to outfall
B	26,062 m^3 decontaminated (1,372 m^3 annually) 6,531 m^3 macroencapsulated (344 m^3 annually) mixed waste only	51,680 m^3 decontaminated (2,720 m^3 annually) 13,358 m^3 macroencapsulated (703 m^3 annually) mixed waste only	185,468 m^3 decontaminated (11,000 m^3 annually) 39,896 m^3 macroencapsulated (2,350 m^3 annually) mixed waste only 92,734 m^3 decontamination solution 4,637 m^3 liquid residual[c] 927 m^3 solid residual[c] 87,170 m^3 discharged to outfall
C	11,120 m^3 MW decontaminated[d] (586 m^3 annually) 3,977 m^3 HW decontaminated[d] (209 m^3 annually)	23,409 m^3 MW decontaminated[d] (1,233 m^3 annually) 13,743 m^3 HW decontaminated[d] (723 m^3 annually)	86,088 m^3 MW decontaminated[d] (4,700 m^3 annually) 24,325 m^3 HW decontaminated[d] (1,280 m^3 annually)

TC

a. Source: Hess (1995a).
b. To convert to gallons, multiply by 264.2.
c. Treated in the Consolidated Incineration Facility.
d. Waste volumes MW = mixed waste; HW = hazardous waste.

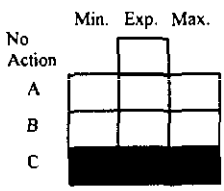


Alternative A - For each forecast, only mixed waste would be treated in the containment building. The following mixed waste treatability groups would be processed: glass debris, metal debris, equipment, lead, heterogeneous debris, inorganic debris, organic debris, and composite filters.



Alternative B - Only mixed waste would be treated in the containment building. The following mixed waste treatability groups would be processed: glass debris, metal debris, bulk equipment, lead, heterogeneous debris, inorganic debris, and organic debris.

In the maximum forecasts of alternatives A and B, the volume of spent decontamination solution would exceed the available treatment capacity for this waste at the Consolidated Incineration Facility. The containment building would be modified to include a wastewater treatment unit to treat the spent decontamination solutions. The wastewater treatment process would result in a liquid residual, a solid residual, and the remainder which would be discharged to a National Pollutant Discharge Elimination System permitted outfall. The liquid and solid residuals from the wastewater treatment unit would be treated at the Consolidated Incineration Facility.



Alternative C - Both hazardous waste and mixed waste would be processed in the containment building. Hazardous waste treatability groups to be decontaminated and/or treated include metal debris (some of which is reactive), bulk equipment, and lead. Mixed waste treatability groups to be decontaminated and/or treated include metal debris (some of which is reactive), bulk equipment, elemental mercury and mercury-contaminated process equipment.

B.7 DEFENSE WASTE PROCESSING FACILITY

OBJECTIVE:

The Defense Waste Processing Facility is a system for treatment of high-level radioactive waste at SRS. Defense Waste Processing Facility refers to high-level waste pre-treatment processes, the Vitrification Facility, Saltstone Manufacturing and Disposal, radioactive glass waste storage facilities, and associated support facilities. The process used to recover uranium and plutonium from production reactor fuel and target assemblies in the chemical separations areas at SRS resulted in liquid high-level radioactive waste. This waste, which now amounts to approximately 131 million liters (3.46×10^7 gallons), is stored in underground tanks in the F- and H-Areas near the center of SRS. After its introduction into the tanks, the high-level waste settles, separating into a sludge layer at the bottom of the tanks and an upper layer of soluble salts dissolved in water (supernatant). The evaporation of the supernatant creates a third waste form, crystallized saltcake, in the tanks. See the *Final Supplemental Environmental Impact Statement Defense Waste Processing Facility* (DOE 1994a) for details.

The Defense Waste Processing Facility is designed to incorporate the highly radioactive waste constituents into borosilicate glass in a process called vitrification and seal the radioactive glass in stainless steel canisters for eventual disposal at a permanent Federal repository located deep within a stable geologic (e.g., rock) formation.

DESCRIPTION:

The Defense Waste Processing Facility system includes processes and associated facilities and structures
TE | located in H-, S-, and Z-Areas near the center of SRS. The major parts of the Defense Waste Processing Facility system are listed below:

Pre-treatment (H-Area) - Pre-treatment processes and associated facilities to prepare high-level waste for incorporation into glass at the Vitrification Facility, including:

- Extended Sludge Processing - a washing process, carried out in selected H-Area high-level waste tanks, to remove aluminum hydroxide and soluble salts from the high-level waste sludge. The facility is built, and the process is presently being tested.

- In-Tank Precipitation - a process in H-Area to remove cesium through precipitation with sodium tetraphenylborate and strontium and plutonium through sorption onto the sodium titanate solids

from the highly radioactive salt solution. The precipitate would be treated by the late wash process; the low radioactivity salt solution that remains would be sent to the Saltstone Manufacturing and Disposal Facility. The In-Tank Precipitation facility is constructed, and testing is nearly complete.

- Late Wash - a process to wash the highly radioactive precipitate resulting from In-Tank Precipitation to remove a chemical (sodium nitrite) that could potentially interfere with operations in the Vitrification Facility. This H-Area facility is presently being designed and constructed.

Vitrification Facility and associated support facilities and structures (S-Area) - These facilities include:

- Vitrification Facility - a large building that contains processing equipment to immobilize the highly radioactive sludge and precipitate portions of the high-level waste in borosilicate glass. The sludge and precipitate are treated chemically, mixed with frit (finely ground glass), melted, and poured into stainless steel canisters that are then welded shut. The facility is presently constructed and undergoing startup testing.

- Glass Waste Storage Buildings - buildings for interim storage of the radioactive glass waste canisters in highly shielded concrete vaults located below ground level. One building is completed; one building is in the planning stage.

- Chemical Waste Treatment Facility - an industrial waste treatment facility that neutralizes nonradioactive wastewater from bulk chemical storage areas and nonradioactive process areas of the Vitrification Facility. This facility is constructed and in operation.

- Failed Equipment Storage Vaults - shielded concrete vaults that would be used for interim storage of failed melters and possibly other process equipment that are too radioactive to allow disposal at existing onsite disposal facilities. These vaults would be used until permanent disposal facilities can be developed. Two vaults are nearly constructed; four more vaults are planned for the near future. DOE estimates that a total of approximately 14 vaults would be needed to accommodate wastes generated during the 24-year operating period covered under the Defense Waste Processing Facility Supplemental EIS.

- Organic Waste Storage Tank - A 568,000-liter (150,000-gallon) capacity aboveground tank that stores liquid organic waste consisting mostly of benzene. During radioactive operations, the tank would store hazardous and low-level radioactive waste that would be a byproduct of the vitrification process as a result of processing high-level radioactive precipitate from the In-Tank Precipitation process. The tank is constructed and stores nonradioactive liquid organic waste generated during startup testing of the Vitrification Facility.

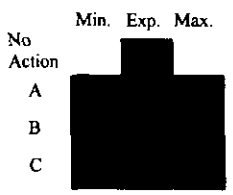
Saltstone Manufacturing and Disposal (Z-Area) - Facilities to treat and dispose of the low radioactivity salt solution resulting from the In-Tank Precipitation pre-treatment process, including:

- Saltstone Manufacturing Plant - a processing plant that blends the low radioactivity salt solution with cement, slag, and flyash to create a mixture that hardens into a concrete-like material called saltstone. The plant is constructed and in operation to treat liquid waste residuals from the F/H-Area Effluent Treatment Facility, an existing wastewater treatment facility that serves the tank farms. The plant is ready for treatment of the low radioactivity salt solution produced by In-Tank Precipitation.

- Saltstone Disposal Vaults - large concrete disposal vaults into which the mixture of salt solution, flyash, slag, and cement that is prepared at the Saltstone Manufacturing Plant is pumped. After cells in the vault are filled, they are sealed with concrete. Eventually, the vaults will be covered with soil, and an engineered cap constructed of clay and other materials will be installed over the vaults to reduce infiltration by rainwater and leaching of contaminants into the groundwater. Two vaults have been constructed. DOE estimates that 13 more vaults would be constructed over the life of the facility (DOE 1994a).

Note that the treatment, storage, and disposal facilities described as part of Defense Waste Processing Facility are not considered in this EIS.

PROJECT-SPECIFIC ACTIONS:



Under each alternative, the Defense Waste Processing Facility would operate until 2018 to process high-level waste stored at SRS.

B.8 E-AREA VAULTS

OBJECTIVE:

The E-Area vaults would provide disposal and storage for solid, low-level, nonhazardous wastes to support continuing SRS operations. As presently planned, the facility would include three types of structures for four designated waste categories: low-activity waste vaults would receive one type of waste; the long-lived waste storage buildings would accept wastes containing isotopes with half-lives that exceed the performance criteria for disposal; a third type of structure divided in two parts, intermediate-level nontritium vaults and intermediate-level tritium vaults, would receive two categories of waste.

DOE Order 5820.2A, "Radioactive Waste Management," establishes performance criteria for the disposal of low-level wastes. A radiological performance assessment is required to ensure that the waste inventory and the proposed disposal method provide reasonable assurance that the performance objectives would be met. The radiological performance assessment projects the migration of radionuclides from the disposed waste to the environment and estimates the resulting dose to people. DOE has completed the radiological performance assessment for the E-Area vaults and has incorporated the results into the waste acceptance criteria to define maximum radionuclide inventory limits that are acceptable for disposal. DOE would construct additional vaults of the current designs or alternate designs that can be demonstrated to achieve the performance objectives.

For purposes of analysis in this EIS, low-level wastes that are not stabilized prior to disposal (except for suspect soils and naval hardware) would be certified to meet the waste acceptance criteria for disposal in the low-level waste vaults. The analyses do not distinguish between the waste forms that are sent to vault disposal. It was assumed that the impacts were a function only of the volume of waste disposal (the number of low-activity waste and intermediate-level waste vaults) for each alternative.

DESCRIPTION:

The *Waste Management Activities for Groundwater Protection Final Environmental Impact Statement* (DOE 1987) and its Record of Decision (53 FR 7557) identified vaults as one of several project-specific technologies considered for new disposal/storage facilities for low-level radioactive waste. One of the actions was construction of a new "vault design" low-level radioactive waste facility in E-Area adjacent to the existing Low-Level Radioactive Waste Disposal Facility. TE

The E-Area vaults are centrally located between the two chemical separation areas (F-Area and H-Area) near the center of SRS and consist of three types of facilities. Below-grade concrete vaults (referred to as intermediate-level waste vaults) would be used for disposal of containerized intermediate-activity tritiated and nontritiated waste. Above-grade concrete vaults (referred to as low-activity waste vaults) would be used for disposal of containerized low-activity waste. On-grade buildings (referred to as long-lived waste storage buildings) would be used for storage of containerized spent deionizer resins and other long-lived wastes.

Intermediate-Level Waste Vaults

An intermediate-level nontritium vault is a concrete structure approximately 58 meters (189 feet) long, 15 meters (48 feet) wide, and 9 meters (29 feet) deep with a seven-cell configuration. Exterior walls are 0.76 meters (2-1/2 feet) thick; and interior walls forming the cells are 0.46 meter (1-1/2 feet) thick. Walls are structurally mated to a base slab which is approximately 0.76 meter (2-1/2 feet) thick and extends past the outside of the exterior walls approximately 0.6 meter (2 feet) (WSRC 1994c). An
TC | intermediate-level nontritium vault has approximately 4,400 cubic meters (1.55×10^5 cubic feet) of usable waste disposal capacity (Hess 1995b).

An intermediate-level tritium vault is structurally identical to the intermediate-level nontritium vault except for length and depth. The intermediate-level tritium vault is 2 feet deeper and approximately 57 feet long with a two-cell configuration. The intermediate-level tritium vault has approximately
TC | 400 cubic meters (14,000 cubic feet) of usable waste disposal capacity (Hess 1995b). One of the intermediate-level tritium vault cells has been fitted with a silo storage system designed to house tritium crucibles.

Shielding blocks and raincovers are provided during cell loading operations. Reinforced concrete blocks are positioned across the width of a cell to provide personnel shielding from the radioactive materials within the cell. The raincover is a roof-truss-type of steel structure that fits around the cells' walls to completely cover the cell opening. Raincovers are installed on a cell until interim closure is accomplished.

Waste containers placed in an intermediate-level vault cell would be encapsulated in grout. Successive grout layers are cured before installing additional waste containers. A permanent roof slab of reinforced concrete that completely covers the vault cells would be installed after the cells in a vault have been filled. Final closure would be performed after vaults were filled by placing an earthen cover with an engineered clay cap over the entire vault area (WSRC 1994c).

At this time, one intermediate-level nontritium vault and one intermediate-level tritium vault have each been constructed. It is assumed that future intermediate-level vaults would be constructed in a combined single vault configuration of nine cells housing both tritiated and non-tritiated intermediate-activity waste (Hess 1994e). The vault construction would be identical to the intermediate-activity nontritium vaults except that the structure would be approximately 75 meters (246 feet) long. No silos would be provided for tritium crucibles. The usable disposal capacity of each vault would be approximately 5,300 cubic meters (1.87×10^5 cubic feet). TE TC

Low-Activity Waste Vaults

The low-activity waste vaults are concrete structures approximately 200 meters (643 feet) long by 44 meters (145 feet) wide by 8 meters (27 feet) deep. Each vault contains 12 cells with approximately 30,500 cubic meters (1.07×10^6 cubic feet) of usable waste disposal capacity. At this time, one low-activity waste vault has been constructed. End, side, and interior walls of each module are 0.61 meter (2 feet) thick. The low-activity waste vault walls are structurally mated to the footers, and the floor slabs are poured between and on top of the footers. TC TE

Low-activity waste vaults have a permanent 41-centimeter (16-inch) thick, poured-in-place concrete roof to prevent the infiltration of rainwater and are constructed on poured-in-place concrete pads with sidewalls. When the vaults are filled to capacity, a closure cap would be used to cover the concrete roof to further reduce the infiltration of water. Each cell within the vault has a means of collecting and removing water that enters the vault.

Low-activity waste to be disposed of would be containerized and stacked using an extendible boom forklift. Low-activity waste would be packaged in various approved containers such as steel boxes and Department of Transportation-approved drums. Packaging and stacking would be similar to the engineered low-level trench operation for low-activity waste (see Appendix B.27). TC

Each low-activity waste vault would be closed in stages. Individual cells would be closed, then the entire vault area would be closed. Low-activity waste vault final closure consists of placing an earthen cover with an engineered clay cap over the entire vault area (WSRC 1994c).

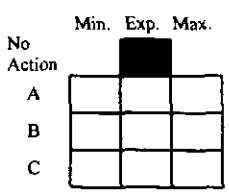
Long-Lived Waste Storage Buildings

The long-lived waste storage buildings would be built on-grade and consist of a poured-in-place concrete slab covered by a steel, pre-engineered, single-span building. The floor slab would be 15 meters (50 feet) square, and the building would be approximately 18 meters (60 feet) square and 6.1 meters (20 feet) high. The floor slab would be 0.3 meter (1 foot) thick with integral deep footings and surface containment curbs around each side. The building would extend past the concrete floor slab on each side. This area would be covered with compacted, crushed stone on three sides, and the fourth side would be covered with a poured-in-place, reinforced concrete pad. This pad would provide an access ramp for vehicle travel into the long-lived waste storage building.

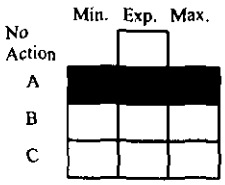
Process water deionizers from Reactors would be stored in the long-lived waste storage building that has been constructed in the E-Area. These deionizers contain carbon-14 which has a half-life of 5,600 years (WSRC 1994b). The building would be able to store a total of 140 cubic meters (4,839 cubic feet) of waste. Wastes would be placed using a forklift and would be containerized and provided with adequate shielding. DOE plans to build additional storage buildings as needed (WSRC 1993b).

After long-lived waste storage buildings are filled with waste containers, the equipment and personnel access doors would be closed and locked. Long-lived waste storage buildings would not be permanent disposal facilities (WSRC 1994c). The disposition of the long-lived waste has not been determined and would be subject to a subsequent National Environmental Policy Act (NEPA) evaluation. Long-lived wastes would continue to be stored for the duration of the 30-year analysis period for each alternative
TC | and forecast considered in this EIS.

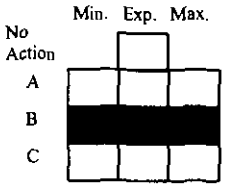
PROJECT-SPECIFIC ACTIONS:



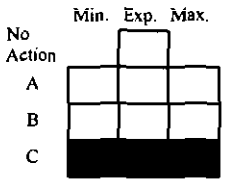
TE | Under the no-action alternative, the E-Area vaults would be used for disposal of low-activity and intermediate-activity wastes. Low-activity wastes planned for disposal in the E-Area vaults include low-activity job-control waste, offsite
TC | job-control waste, low-activity equipment waste, and low-activity soils. Nonmixed alpha waste would also be segregated for disposal in low-activity waste vaults. Intermediate-activity wastes planned for disposal in vaults include tritiated job-control waste, tritiated soils, tritiated equipment wastes, and intermediate-activity job-control waste. Long-lived waste would be stored in the long-lived waste storage building.



Under alternative A, the E-Area vaults would be used for disposal of the same low-level waste identified under the no-action alternative. TC



Under alternative B, the E-Area vaults would be used for disposal of low-activity job-control waste, offsite job-control waste, low-activity soils, low-activity equipment, intermediate-activity job-control waste, tritiated job-control waste, intermediate-activity equipment, tritiated equipment, tritiated soils, and compacted low-level waste. Nonmixed alpha waste would also be segregated for disposal in low-activity waste vaults. Low-activity job-control and equipment waste treated by offsite commercial vendors would also be returned to SRS for disposal in the low-activity waste vaults. TC



Under alternative C, the E-Area vaults would be used for disposal of the same waste as indicated under alternative B, except for off-site commercial vendor-treated low-activity job-control and equipment waste, from the year 1995 to 2005. After 2006, when the non-alpha vitrification facility begins operation, all low-level waste would be disposed of by shallow land disposal. TC

Estimated volumes for long-lived waste storage and low-level waste vault disposal for each alternative are presented in Tables B.8-1 and B.8-2.

Table B.8-1. Estimated volumes and number of additional buildings required for storing long-lived waste under each alternative.[a]

	Min.	Exp.	Max.
		3,333 m^3 24 buildings	
A	1,033 m^3 7 buildings	3,333 m^3 24 buildings	4,672 m^3 34 buildings
B	1,033 m^3 7 buildings	3,333 m^3 24 buildings	4,672 m^3 34 buildings
C	1,033 m^3 7 buildings	3,333 m^3 24 buildings	4,672 m^3 34 buildings

a. Source: Hess (1994b).

Table B.8-2. Estimated volumes of low-level waste and number of additional vaults required for each alternative (cubic meters).[a]

	Min.	Exp.	Max.
		351,099 m^3 10 low-activity waste vaults 28,912 m^3 5 intermediate-level waste vaults	
A	254,254 m^3 9 low-activity waste vaults 15,045 m^3 2 intermediate-level waste vaults	356,767 m^3 12 low-activity waste vaults 28,912 m^3 5 intermediate-level waste vaults	933,637 m^3 31 low-activity waste vaults 166,201 m^3 31 intermediate-level waste vaults
B	45,546 m^3 1 low-activity waste vaults 13,878 m^3 2 intermediate-level waste vaults	61,471 m^3 1 low-activity waste vaults 27,013 m^3 5 intermediate-level waste vaults	250,595 m^3 8 low-activity waste vaults 48,730 m^3 9 intermediate-level waste vaults
C	70,672 m^3 2 low-activity waste vaults 5,831 m^3 1 intermediate-level waste vaults	86,170 m^3 2 low-activity waste vaults 10,953 m^3 2 intermediate-level waste vaults	168,499 m^3 5 low-activity waste vaults 16,032 m^3 3 intermediate-level waste vaults

a. Source: Hess (1995b).

B.9 EXPERIMENTAL TRANSURANIC WASTE ASSAY FACILITY/ WASTE CERTIFICATION FACILITY

TE

OBJECTIVE:

The Experimental Transuranic Waste Assay Facility, which is not currently operating, is designed to weigh, assay, and x-ray drums of alpha waste to ensure they are properly packaged to meet the waste acceptance criteria of the transuranic waste storage pads, low-activity waste vaults, or RCRA-permitted disposal vaults. The Waste Certification Facility provides certification capabilities for disposal of nonmixed and mixed alpha waste (10 to 100 nanocuries of transuranic activity per gram). The Experimental Transuranic Waste Assay Facility/Waste Certification Facility is designed to accept only vented 55-gallon drums of waste.

TC

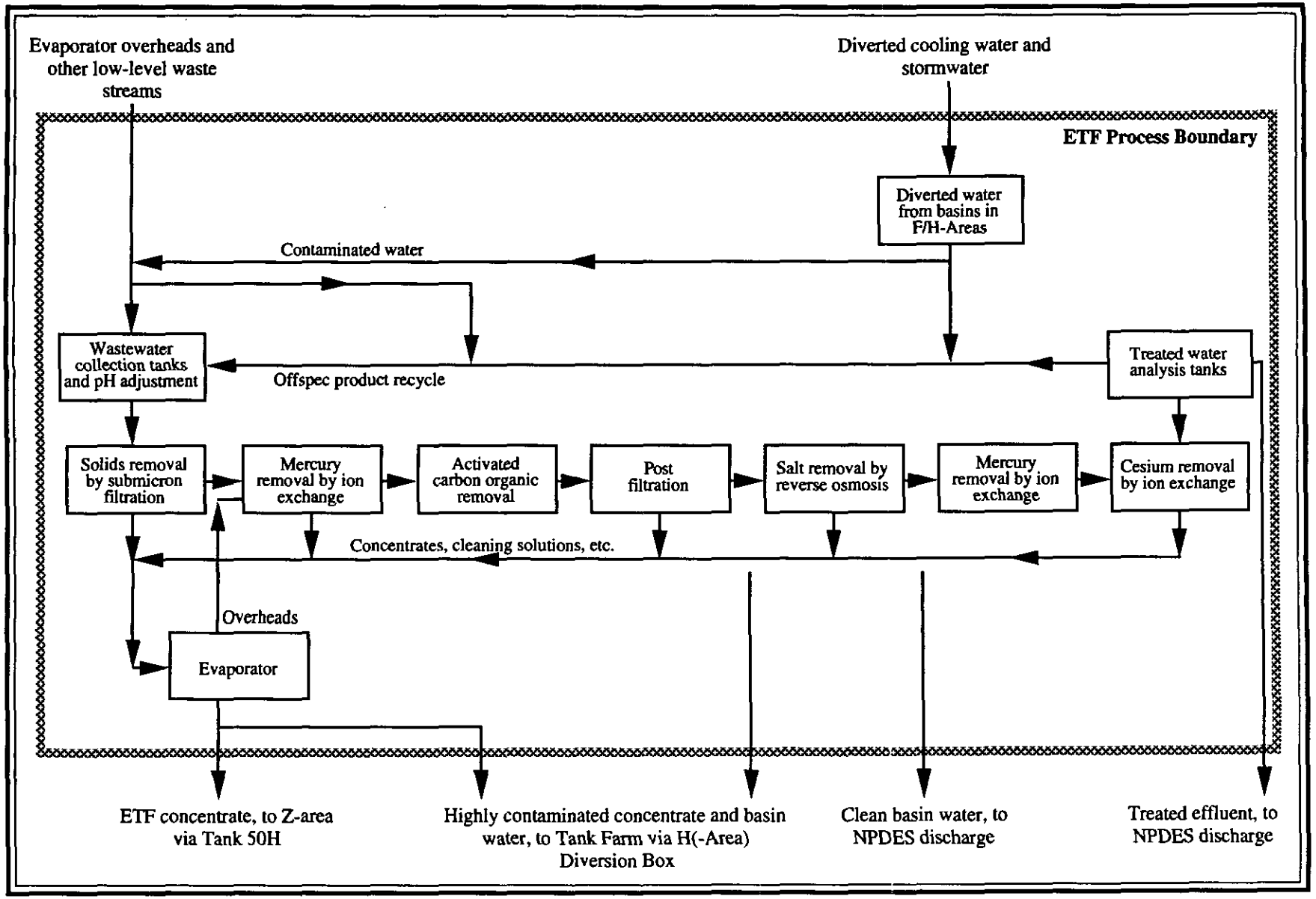
TC

DESCRIPTION:

The Experimental Transuranic Waste Assay Facility/Waste Certification Facility would ensure that SRS transuranic waste meet the acceptance criteria established by the Waste Isolation Pilot Plant. The criteria identify the numerous requirements that must be met to allow transuranic waste to be disposed at the Waste Isolation Pilot Plant, including but not limited to packaging, waste characterization, and radiological content.

The overall facility is housed in a metal building in E-Area. The facility was constructed in two parts. The Experimental Transuranic Waste Assay Facility portion is 15 meters (50 feet) wide by 9.1 meters (30 feet) long and 4.3 meters (14 feet) high. The assay bay has the capacity to temporarily hold a 100-drum backlog of waste while operating. The facility handles one drum at a time. Each drum is x-rayed to see if proper waste forms have been packaged and weighed to assist assay calculation. The drum is assayed for alpha radioactivity measured in nanocuries per gram of waste. The weight of the container is subtracted from the weight of the container plus contents to ensure that the assay calculation is done on the waste only (WSRC 1992a).

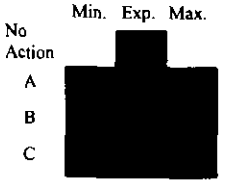
The Waste Certification Facility portion has a packaging bay measuring 10 meters (33 feet) wide, 16 meters (53 feet) long, and 9 meters (30 feet) high and side offices that are 4.6 meters (15 feet) wide, 5.2 meters (17 feet) long, and 4.3 meters (14 feet) high. The facility was originally designed to certify and band drums in 7-drum arrays and load them for shipment to the Waste Isolation Pilot Plant. The packaging bay is equipped with an 18-metric-ton (20-ton) bridge crane for the loading operations. The packaging bay has the capacity to temporarily hold a 56-drum backlog while operating (WSRC 1992a).



TE **Figure B.10-1.** F/H-Area Effluent Treatment Facility (ETF).

The F/H-Area Effluent Treatment Facility decontaminates wastewater through a series of steps consisting of pH adjustment, sub-micron filtration, heavy-metal and organic adsorption, reverse osmosis, and ion exchange. The treatment steps concentrate the contaminants into a smaller volume of secondary waste, which is then further concentrated by evaporation. The waste concentrate is eventually disposed of in the Z-Area Saltstone Manufacturing and Disposal Facility. The treated effluent is analyzed to ensure that it has been properly decontaminated and discharged to Upper Three Runs through permitted outfall H-016 (DOE 1986b) if it meets the National Pollutant Discharge Elimination System discharge criteria. The effluent's chemical content is regulated by the F/H-Area Effluent Treatment Facility Wastewater Permit, and the discharge radionuclide limits are set by DOE Order 5400.5, "Radiation Protection of the Public and the Environment."

PROJECT-SPECIFIC ACTIONS:



Under each alternative, the F/H-Area Effluent Treatment Facility would continue to treat low-level radioactively contaminated wastewater. The expected forecast wastewater flow into the F/H-Area Effluent Treatment Facility from current F- and H-Area operations (based on historical data) is approximately 62,000 cubic meters per year, or 1.8×10^6 cubic meters over the 30-year analysis period. The volume of F- and H-Area wastewater to be treated at the Effluent Treatment Facility is approximately 14.7×10^6 cubic meters over 30 years for the maximum forecast and 9.3×10^5 cubic meters over 30 years for the minimum forecast (Todaro 1994). An increased volume of waste is expected due to the projected increase in environmental restoration activities and operation of the Defense Waste Processing Facility over a 30-year period. Investigation-derived wastes from environmental restoration activities (aqueous liquids from groundwater monitoring wells), which would be treated at the F/H-Area Effluent Treatment Facility, are currently projected at approximately 27,838 cubic meters (7.35×10^6 gallons) over the 30-year period (Hess 1995a) for the expected waste forecast. For the maximum waste forecast, the volume of investigation-derived wastes to be treated at the F/H-Area Effluent Treatment Facility is estimated to be approximately 44,800 cubic meters (1.18×10^7 gallons) over the 30-year period. For the minimum waste forecast, the volume of investigation-derived wastes to be treated at the F/H-Area Effluent Treatment Facility is estimated to be approximately 3,964 cubic meters (1.05×10^6 gallons) over the 30-year period. The Defense Waste Processing Facility is expected to generate approximately 37.8 cubic meters (10,000 gallons) per day of recycle wastewater (at 75 percent attainment) or 22.7 cubic meters (6,000 gallons) per day at 45 percent attainment after radioactive operations have begun. The Defense Waste Processing Facility wastewater would be processed by the tank farm evaporators and the overheads treated at the F/H-Area Effluent Treatment Facility. During nonradioactive startup testing, the Defense Waste Processing Facility is

TE

expected to generate approximately 18.9 cubic meters (5,000 gallons) per day of wastewater to be treated directly at the F/H-Area Effluent Treatment Facility. Table B.10-2 presents additional volumes of wastewater to be treated at the F/H-Area Effluent Treatment Facility as a result of Defense Waste Processing Facility recycle and investigation-derived wastes from groundwater monitoring well operations.

Table B.10-2. Additional volume of wastewater to be treated at the F/H-Area Effluent Treatment Facility over the 30-year analysis period (cubic meters).[a,b]

	Min.	Exp.	Max.
		358,966 m^3	
A	335,092 m^3	358,966 m^3	375,883 m^3
B	335,092 m^3	358,966 m^3	375,883 m^3
C	335,092 m^3	358,966 m^3	375,883 m^3

a. Source: Todaro (1994); Hess (1995a).
b. To convert to gallons, multiply by 264.2.

B.11 HAZARDOUS WASTE/MIXED WASTE DISPOSAL VAULTS

OBJECTIVE:

DOE Order 5820.2A establishes performance objectives for the disposal of low-level wastes, including mixed low-level wastes. A radiological performance assessment is required to ensure that the waste inventory and the proposed disposal method provide reasonable assurance that the performance objectives of DOE Order 5820.2A will be met. The radiological performance assessment projects the migration of radionuclides from the disposed waste to the environment and estimates the resulting dose to man. DOE has submitted a RCRA permit application to the South Carolina Department of Health and Environmental Control (SCDHEC) requesting permission to construct 10 Hazardous Waste/Mixed Waste Disposal Vaults. A radiological performance assessment will be prepared at a later date to determine the performance of the Hazardous Waste/Mixed Waste Disposal Vault design and establish waste acceptance criteria defining the maximum radionuclide inventory limits that are acceptable for disposal. Based on results from the radiological performance assessment, DOE could determine that alternative disposal methods meeting RCRA design specifications would also achieve the performance objectives of DOE Order 5820.2A for certain SRS mixed wastes. For purposes of analysis in this EIS, RCRA disposal capacity has been based on the current Hazardous Waste/Mixed Waste Disposal Vault's design, which conforms to the joint design guidance for mixed waste land disposal facilities issued by EPA and the Nuclear Regulatory Commission in 1987.

DESCRIPTION:

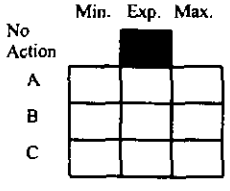
RCRA-permitted disposal vaults were addressed in the *Waste Management Activities for Groundwater Protection Final EIS*, and DOE decided to construct and operate these vaults (53 FR 7557; March 2, 1988). Since then, DOE has submitted a RCRA permit application to SCDHEC to construct 10 Hazardous Waste/Mixed Waste Disposal Vaults in the central portion of SRS about 0.80 kilometer (0.5 mile) northeast of F-Area. Once the permit application is approved by SCDHEC, the vaults would be constructed and operated. They would be above-grade reinforced concrete vaults designed for the permanent disposal of hazardous and mixed waste generated at various locations throughout SRS. The disposal vaults would be permitted as landfills in accordance with 40 CFR 264, Subpart N, and designated as Buildings 645-1G through 645-10G. TE

The approximate outside dimensions of each vault would be 62 meters (205 feet) long by 14 meters (46.5 feet) wide by 7.8 meters (25.7 feet) high. Each vault would contain four individual waste cells which could each contain 300 concrete disposal containers or 2,250 55-gallon drums. This is equivalent

to a capacity of 2.3 acre-feet or a usable capacity of approximately 2,300 cubic meters (81,200 cubic feet) (Hess 1994e). Wastes would meet land disposal restriction standards prior to placement in the Hazardous Waste/Mixed Waste Disposal Vaults. Liquid wastes would not be disposed in these vaults. Each vault would contain a leachate collection system, leak-detection system, and primary and secondary containment high-density polyethylene liners. The waste would be placed in the cells using a crane and a closed circuit camera/monitoring system. The waste would generally be transported to the vaults in either concrete containers or 55-gallon drums. During the time that waste is being placed in the vault, each individual waste cell would be covered with temporary steel covers. Once each individual vault was filled, a permanent reinforced concrete cap would be added to the structure. After the last vault is sealed, the area surrounding the vaults would be backfilled with soil to the top of the roofs. A cover of low permeability material would be constructed over the top of the soil backfill and the vaults.

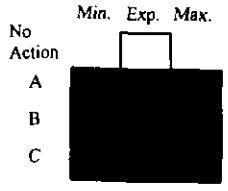
Wastes planned for disposal in the Hazardous Waste/Mixed Waste Disposal Vaults would include vitrified mixed wastes from the M-Area Vendor Treatment Facility; stabilized ash and blowdown wastes from the Consolidated Incineration Facility; macroencapsulated wastes from the containment building; gold traps, safety/control rods, In-Tank Precipitation filters, Defense Waste Processing Facility late wash filters, and mercury-contaminated process equipment; and vitrified wastes from the alpha and non-alpha vitrification facilities.

PROJECT-SPECIFIC ACTIONS:

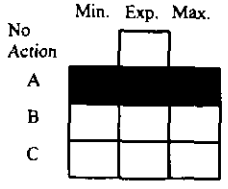


Under the no-action alternative, RCRA-permitted disposal would only be used for the disposal of mixed waste. Mixed waste planned for disposal includes vitrified wastes from the M-Area Vendor Treatment Facility, gold traps, safety/control rods, In-Tank Precipitation filters, and Defense Waste Processing Facility late wash filters. In-Tank Precipitation and Defense Waste Processing Facility late wash filters would not be disposed of immediately because they must be stored for a period of time prior to disposal to allow for offgassing.

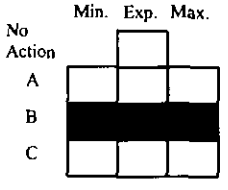
Due to the limited amount of treatment under the no-action alternative, only 2,182 cubic meters (77,000 cubic feet) of mixed waste would be suitable for placement in RCRA-permitted disposal over the 30-year analysis period. Because each vault has a usable capacity of 2,300 cubic meters (81,200 cubic feet), a single vault would be sufficient to meet onsite disposal capacity requirements under the no-action alternative. This vault would begin accepting waste in 2002.



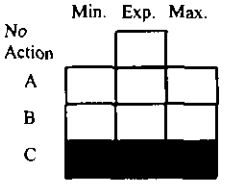
Under each of the action alternatives, DOE plans to treat both hazardous and mixed waste (including alpha waste containing 10 to 100 nanocuries per gram transuranics) onsite and send residuals to onsite RCRA-permitted disposal. DOE would build additional vaults as needed to provide for RCRA-permitted disposal capacity needs. The additional vaults would be identical in construction to the initial vault.



Wastes that would be placed in the vaults under alternative A include vitrified wastes from the M-Area Vendor Treatment Facility; stabilized ash and blowdown wastes from the Consolidated Incineration Facility; macroencapsulated mixed wastes treated in the containment building; gold traps, safety/control rods, In-Tank Precipitation and Defense Waste Processing Facility late wash filters, and mercury-contaminated process equipment; and macroencapsulated mixed alpha wastes.



Wastes planned for RCRA-permitted disposal under alternative B include vitrified wastes from the M-Area Vendor Treatment Facility; stabilized ash and blowdown wastes from the Consolidated Incineration Facility; macroencapsulated mixed wastes treated in the containment building; gold traps, safety/control rods, In-Tank Precipitation and Defense Waste Processing Facility late wash filters, and mercury-contaminated process equipment; vitrified soils and sludges from the non-alpha vitrification facility; and macroencapsulated mixed alpha wastes.



Wastes planned for RCRA-permitted disposal under alternative C include vitrified wastes from the M-Area Vendor Treatment Facility; stabilized ash and blowdown wastes from the Consolidated Incineration Facility; gold traps, safety/control rods, and In-Tank Precipitation and Defense Waste Processing Facility late wash filters; amalgamated radioactive mercury; vitrified hazardous and mixed wastes from the non-alpha vitrification facility; macroencapsulated mixed alpha wastes; and vitrified mixed wastes containing 10 to 100 nanocuries per gram transuranics from the alpha vitrification facility.

Table B.11-1 presents the different volumes of waste that would be disposed and the number of vaults required for each alternative.

Table B.11-1. Estimated volumes of hazardous and mixed wastes and the number of vaults required for each alternative (cubic meters).[a,b]

TC

	Min.	Exp.	Max.
		2,182 m^3 1 vault	
A	46,260 m^3 21 vaults	140,025 m^3 61 vaults	797,796 m^3 347 vaults
B	44,734 m^3 20 vaults	47,570 m^3 21 vaults	220,513 m^3 96 vaults
C	21,803 m^3 10 vaults	90,223 m^3 40 vaults	254,698 m^3 111 vaults

a. Source: Hess (1995a).
b. To convert to gallons, multiply by 264.2.

B.12 HAZARDOUS WASTE STORAGE FACILITIES

OBJECTIVE:

The hazardous waste storage facilities would provide storage capacity for SRS containerized hazardous wastes in accordance with RCRA requirements.

DESCRIPTION:

Hazardous wastes generated at various locations throughout SRS are stored in three RCRA-permitted hazardous waste storage buildings and on three interim status storage pads in B- and N-Areas. These locations are collectively referred to as the Hazardous Waste Storage Facility. For RCRA permitting purposes Building 645-2N is included in the Hazardous Waste Storage Facility permit. However, since Building 645-2N is used for the storage of mixed waste, it is discussed under mixed waste storage in Appendix B.16. TE

The three RCRA-permitted hazardous waste storage buildings are Buildings 710-B, 645-N, and 645-4N. Buildings 710-B and 645-4N are completely enclosed structures with metal roofs and sides. Building 645-N is a partially enclosed metal building; two sides of the building are sheet metal while the remaining two sides are enclosed by a chain-link fence with gates. Usable storage capacities of each of the hazardous waste storage buildings are as follows: Building 710-B, 146 cubic meters (5,200 cubic feet); Building 645-N, 171 cubic meters (6,000 cubic feet); and Building 645-4N, 426 cubic meters (15,000 cubic feet) (WSRC 1993e). The three buildings rest on impervious concrete slabs. Building 645-N and Building 710-B are divided into waste storage cells that have concrete curb containment systems. Building 645-4N has a single bay with a concrete curb containment system. In Buildings 645-N and 645-4N, the floor of each storage cell (or, for Building 645-4N, the floor in general) slopes toward an individual sump for the collection of released liquids. Hazardous waste is stored primarily in 55-gallon Department of Transportation-approved drums. However, metal storage boxes may be used to store solid wastes. Containers are stored on wooden pallets, and the boxes have metal risers to elevate them off the floor. Once DOE has accumulated enough containers, they are transported to an offsite RCRA treatment and disposal facility.

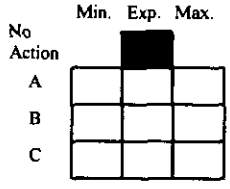
The Solid Waste Storage Pads are open storage areas located on the asphalt pads within the fenced area of N-Area. Waste Pad 1 is located between Building 645-2N and Building 645-4N; Waste Pad 2 is located between Building 645-4N and 645-N; and Waste Pad 3 is located east of Building 645-N. Hazardous waste is stored in 55-gallon Department of Transportation-approved drums or in metal boxes.

Only solid wastes are stored on the Solid Waste Storage Pads. The combined usable storage capacity of the Solid Waste Storage Pads is 1,758 cubic meters (62,000 cubic feet) (WSRC 1993e). The asphalt pads are sloped to drain rainwater; the containers are placed on pallets and the metal boxes have risers to prevent rainwater from coming into contact with them. Once DOE has accumulated enough containers, they are transported to an offsite RCRA treatment and disposal facility.

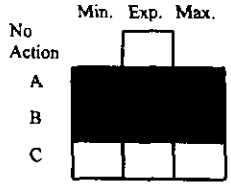
Hazardous wastes are also stored in the interim status storage building, Building 316-M. The building is essentially an above-grade concrete pad with a pavilion-like structure surrounded by a chain-link fence. The pad is curbed on three sides; the fourth side is built to a sufficient elevation to ensure drainage to static sumps within the pad. Hazardous waste is containerized in 55-gallon drums. The building measures 37 meters (120 feet) by 15 meters (50 feet) with an actual storage area of 30 meters (100 feet) by 12 meters (40 feet). The building has maximum usable capacity of 117 cubic meters (4,100 cubic feet).

Hazardous wastes stored in the Hazardous Waste Storage Facility and Building 316-M include, but, are not limited to the following: lead; organic, inorganic, heterogeneous, glass, and metal debris; equipment; composite filters; paint wastes; organic sludges and liquids; soils; inorganic sludges; still bottoms from onsite solvent distillation; and melt waste from the onsite lead melter.

PROJECT-SPECIFIC ACTIONS:



Under the no-action alternative, hazardous wastes would continue to be sent offsite for treatment and disposal. Therefore, additional hazardous waste storage would not be required.



Alternatives A and B - All hazardous wastes would be sent offsite for treatment and disposal or would be incinerated onsite. Accordingly, additional hazardous waste storage would not be required.

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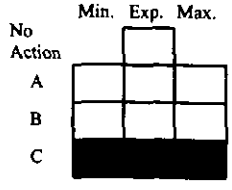


Alternative C - All hazardous wastes would be sent offsite for treatment and disposal or treated onsite at the containment building, Consolidated Incineration Facility, or non-alpha vitrification facility. Accordingly, additional hazardous waste storage would not be required.

B.13 HIGH-LEVEL WASTE TANK FARMS

OBJECTIVE:

In F- and H-Areas there are a total of 50 active waste tanks designed to store liquid high-level waste. These tanks and associated equipment are known as the F- and H-Area tank farms. The primary purpose of the tank farms is to receive and store liquid high-level waste until the waste can be treated into a form suitable for final disposal. Liquid high-level waste is an aqueous slurry that contains soluble salts and insoluble sludges, each of which has high levels of radionuclides. Tables B.13-1 and B.13-2 present the chemical and radionuclide composition of the high-level radioactive waste. The potential environmental impacts of storing high-level waste in the tank farms were evaluated in the *Double-Shell Tanks for Defense High-Level Radioactive Waste Storage, Environmental Impact Statement* (DOE 1980).

Table B.13-1. Typical chemical composition of SRS liquid high-level waste.

Component	Sludge[a,b], percent by weight	Supernatant[c], percent by weight
Sodium nitrate	2.83	48.8
Sodium nitrite	–	12.2
Sodium hydroxide	3.28	13.3
Sodium carbonate	–	5.21
Sodium tetrahydroxo aluminum ion	–	11.1
Sodium sulfate, anhydrous	–	5.99
Sodium fluoride	–	0.18
Sodium chloride	–	0.37
Sodium metasilicate	–	0.14
Sodium chromate	–	0.16
Nickel (II) hydroxide	1.94	–
Mercury (II) oxide	1.6	–
Uranyl hydroxide	3.4	–
Iron oxide	30.1	–
Aluminum oxide	32.9	–
Manganese oxide	0.51	–
Silicon oxide	5.9	–
Zeolite	3.7	–

a. Source: WSRC (1992b).
b. Analysis of insoluble solids (dry basis).
c. Analysis of soluble solids (dry basis).

Table B.13-2. Typical radionuclide content of combined supernatant, salt, and sludge in tanks in the F- and H-Area tank farms (curies per liter).[a]

Radionuclide	F-Area tanks			H-Area tanks		
	Composite	Sample highest value	Sample lowest value	Composite	Sample highest value	Sample lowest value
Tritium	—	—	—	0.00108	—	—
Strontium-89	0.0232	0.291	—	0.0248	5.02	—
Strontium-90	0.951	47.6	0.00145	1.54	9.25	2.91×10^{-4}
Yttrium-90	0.951	47.6	0.00145	1.53	9.25	2.91×10^{-4}
Yttrium-91	0.0396	0.502	—	0.0449	0.925	—
Zirconium-95	0.0608	0.766	—	0.0766	1.51	—
Niobium-95	0.135	1.66	—	0.166	3.17	—
Ruthenium-106	0.0254	0.206	2.51×10^{-6}	0.0925	1.35	—
Rhodium-106	0.0254	0.206	2.51×10^{-6}	0.0925	1.35	—
Cesium-137	1.03	3.43	0.0661	1.51	3.43	0.0114
Barium-237	0.951	3.17	0.0608	1.40	3.17	0.0103
Cerium-144	0.370	2.91	—	1.14	1.93	—
Praeseodymium-144	0.370	2.91	—	1.14	1.93	—
Promethium-147	0.262	1.72	4.76×10^{-4}	0.978	10.30	2.40×10^{-5}
Uranium-235	2.22×10^{-8}	1.61×10^{-7}	1.48×10^{-9}	8.72×10^{-9}	9.78×10^{-8}	1.19×10^{-10}
Uranium-238	8.72×10^{-7}	7.66×10^{-6}	1.66×10^{-8}	5.55×10^{-8}	1.03×10^{-6}	1.85×10^{-11}
TE | Plutonium-238	4.49×10^{-5}	6.08×10^{-4}	—	0.0243	0.106	—
Plutonium-239	2.59×10^{-4}	0.00203	4.23×10^{-6}	2.32×10^{-4}	7.66×10^{-4}	2.59×10^{-8}
TE | Plutonium-240	7.93×10^{-5}	5.55×10^{-4}	8.98×10^{-7}	—	—	—
Plutonium-241	—	—	—	0.0251	—	—
Americium-241	—	—	—	3.17×10^{-6}	—	—
Curium-244	0.00225	0.00248	—	2.22×10^{-5}	2.54×10^{-4}	—

a. Source: WSRC (1992b).

Approximately 130,600 cubic meters (3.45×10^{7} gallons) of liquid high-level waste are currently
TE | contained in the 50 waste tanks (WSRC 1994f). Collectively, the tanks are at greater than 90 percent of usable capacity. During the next 30 years, DOE's primary objective for its high-level waste program is to remove the waste from the tanks without adequate secondary containment and prepare it for
TE | vitrification at the Defense Waste Processing Facility (WSRC 1994g). The potential environmental impacts of operating the Defense Waste Processing Facility and associated high-level waste facilities as

they are presently designed were examined in the *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility* (DOE 1994a).

Additionally, DOE is obligated under the Federal Facility Agreement executed by DOE, EPA, and SCDHEC in 1993 to remove from service those tanks that do not meet secondary containment standards, that leak, or that have leaked. Of the 50 tanks in service at SRS, 23 do not meet criteria specified in the Federal Facility Agreement for leak detection and secondary containment; these tanks have been scheduled for waste removal (WSRC 1993f). TC

DESCRIPTION:

The high-level waste tank farms include 51 large underground storage tanks, 4 evaporators (only 2 are operational), transfer pipelines, 14 diversion boxes, 13 pump pits, and associated tanks, pumps, and piping for transferring the waste (WSRC 1991). Tank 16 is empty and will remain so. Tank 16 closure will be addressed under the SRS RCRA Facility Investigation program. The tank farm equipment and processes are permitted by SCDHEC as an industrial wastewater facility under permit number 17,424-IW. Tank 50 is permitted separately under an industrial wastewater treatment permit. Twenty-two of the active tanks are located in F-Area, and 28 are in H-Area (WSRC 1991). Figure B.13-1 lists the status and contents of each individual high-level waste tank.

Figure B.13-2 is a general description of tank farm processes. The tank farms receive waste from a number of sources, primarily in F- and H-Areas. The wastes were produced as the result of the separation of useful products from spent aluminum-clad nuclear fuel and targets. SRS currently generates small amounts of high-level waste as a result of limited production activities. The separations facilities generate two waste streams which are sent to the tank farms: (1) high-heat waste, which contains most of the radionuclides and must be aged in a high-heat waste tank before evaporation, and (2) low-heat waste, which contains a lower concentration of radionuclides and can be sent directly to an evaporator feed tank. A smaller percentage of the total influent to the tank farms is generated from other SRS facilities, including:

- Receiving Basin for Offsite Fuel/Resin Regeneration Facility
- Savannah River Technology Center
- H-Area Maintenance Facility
- Reactor areas (filter backwash)
- F/H-Area Effluent Treatment Facility
- Recycle wastewater from the Defense Waste Processing Facility, when it becomes operational

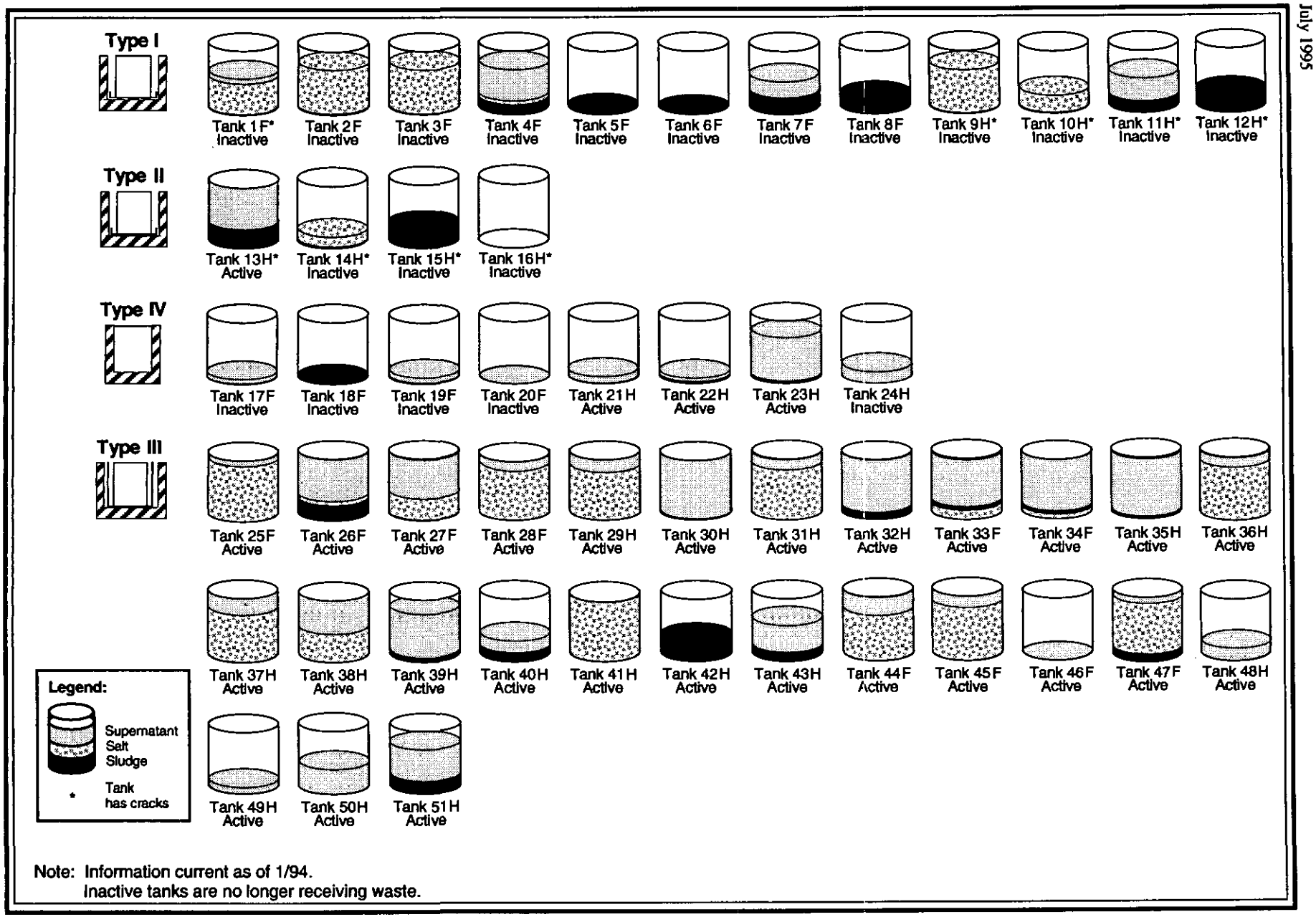


Figure B.13-1. High-level waste tank status and contents.

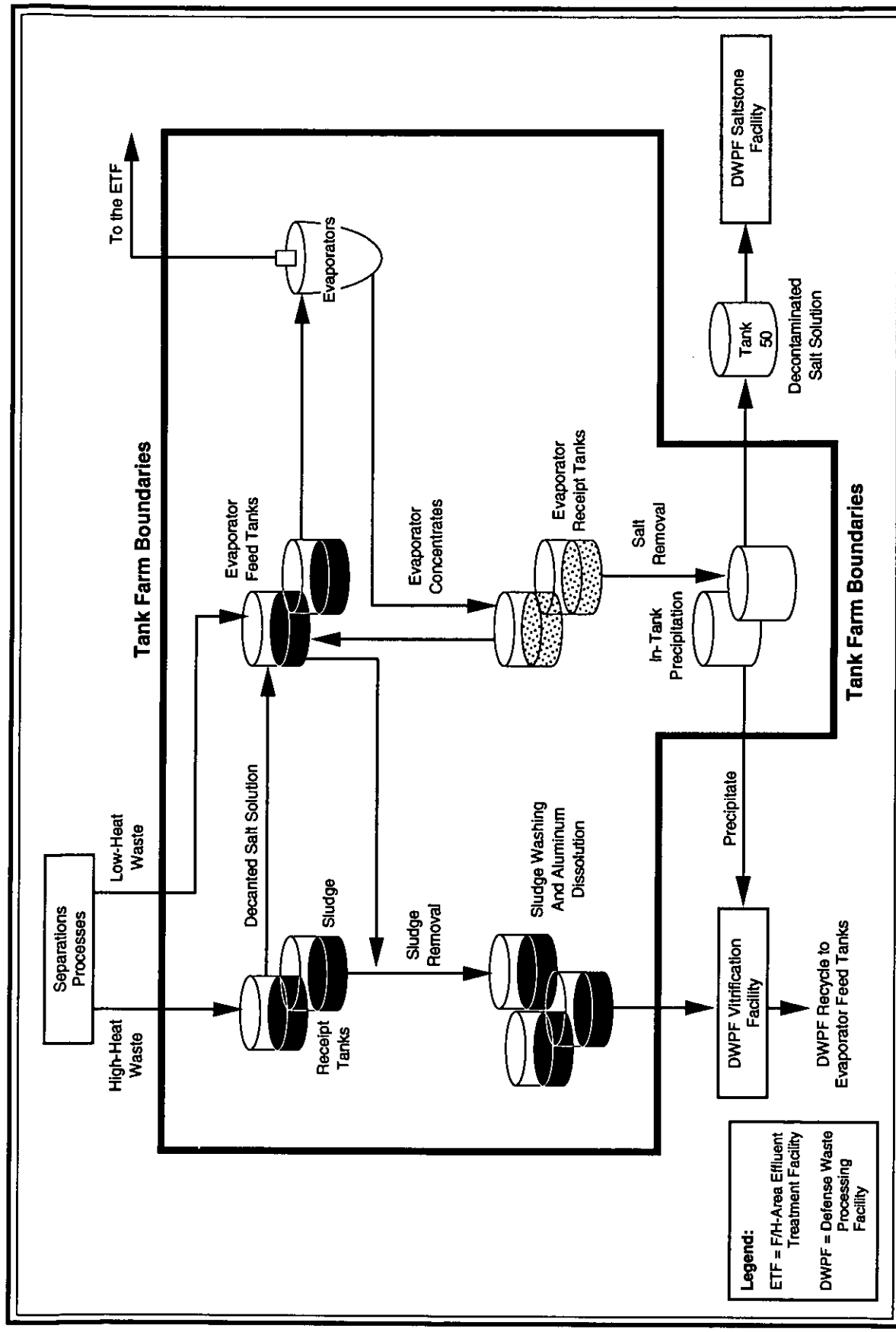


Figure B.13-2. High-level waste tank farm processes.

The waste is transferred by underground transfer lines (or trucked in from reactor areas and the Savannah River Technology Center) from point of generation to the F- or H-Area tank farm. To prevent corrosion
TE | of the carbon steel tanks, the waste is neutralized with sodium hydroxide (pH 10-13) (WSRC 1994d, e). After the waste is put into the tanks, it settles, separating into a sludge layer and an upper water layer (called the supernatant). The sludge consists primarily of oxides and hydroxides of heavy metals (aluminum, iron, manganese, and mercury). The sludge contains more than 60 percent of the radionuclides (WSRC 1992b). When DOE begins processing the waste, the sludge would first be slurried using hydraulic slurrying techniques and sent to Extended Sludge Processing. Most of the sludge that would be processed during the next 30 years already resides in the tank farms, having been
TE | deposited during more than 40 years of SRS operation (WSRC 1994e). Refer to the *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility* for a detailed discussion of Extended Sludge Processing. The spent washwater from Extended Sludge Processing would be returned to the waste tanks for temporary storage and later evaporation.

The supernatant contains mostly sodium salts and soluble metal compounds (mercury, chromium, lead, silver, and barium) with the main radioactive constituent being an isotope of cesium and strontium (WSRC 1992b). To save tank space, supernatant is processed through large evaporators to remove the
TE | water, which reduces the liquid volume by approximately 75 percent (WSRC 1994e). The purpose of evaporating the supernatant is to concentrate and immobilize the waste as crystallized salt. Within the evaporator, the supernatant is heated to the boiling point of its aqueous component which induces a vapor phase (called evaporator overheads). The evaporator overheads are condensed and monitored to ensure that they do not contain excessive amounts of radionuclides. If necessary, the overheads pass through a cesium removal column to remove radioactive cesium. Following condensing and monitoring, the evaporator overheads are sent to the F/H-Area Effluent Treatment Facility for final treatment and discharge (WSRC 1991). The concentrated waste remaining after evaporation is transferred to another tank, where it forms into a saltcake. The salt would be processed by In-Tank Precipitation when it becomes operational, where the soluble radioactive metal ions (cesium, strontium, uranium, and plutonium) would be precipitated using sodium tetraphenylborate or adsorbed on monosodium titanate to form insoluble solids. The resulting slurry would be filtered and the solids concentrated. The concentrated precipitate would be sent to the Defense Waste Processing Facility for vitrification, and the filtrate would be transferred to the Saltstone Manufacturing and Disposal Facility for disposition in grout
TE | (WSRC 1994d). Refer to the *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility* for a detailed discussion of In-Tank Precipitation.

Each tank farm has two single-stage, bent-tube evaporators that concentrate wastes. Of these four evaporators, only two (2H and 2F) are currently operating. The other two (1H and 1F) will no longer be

operated due to equipment failures and estimated amounts of waste that would come from the separations facilities. The Replacement High-Level Waste Evaporator is currently scheduled for startup in May 1999. Without the Replacement High-Level Waste Evaporator, the tank farm would run out of required tank space, which would force the Defense Waste Processing Facility to stop vitrifying high-level waste. A project description of the Replacement High-Level Waste Evaporator included in this appendix provides a detailed discussion of this facility.

The primary role of the 2H Evaporator is to evaporate the 221-H separations facility's low-heat waste stream, the Receiving Basin for Offsite Fuel waste, the planned Defense Waste Processing Facility recycle stream, and Extended Sludge Processing washwater. The Defense Waste Processing Facility recycle [projected at 5,700 to 13,600 cubic meters (1.5 to 3.6×10^6 gallons) per year] and Extended Sludge Processing washwater would add large volumes of waste to the tank farms and evaporators.

Further, the Defense Waste Processing Facility recycle stream cannot be "turned off" in the event of evaporator problems. Therefore, at least 11,400 cubic meters (3.0×10^6 gallons) of available tank space must be available prior to the startup of the Defense Waste Processing Facility, in addition to the 4,900 cubic meters (1.3×10^6 gallons) of emergency spare tank capacity required should a waste tank fail. Current projections indicate that approximately 12,500 cubic meters (3.3×10^6 gallons) of tank space would be available at the startup of the Defense Waste Processing Facility operations, and available tank space would remain between 9,000 and 16,000 cubic meters (2.4 and 4.2×10^6 gallons) during the Defense Waste Processing Facility's operative years (WSRC 1994e). | TE

The primary role of the 2F Evaporator is to evaporate the 221-F separations facility's low-heat waste, high-heat waste, and the 8,000-cubic meter (2.1×10^6 gallon) backlog of F-Area high-heat waste in Tanks 33 and 34. Once the backlog is evaporated, the 2F evaporator will become the primary high-heat waste evaporator for F- and H-Area and assist the H-Area evaporator with the Defense Waste Processing Facility recycle and Extended Sludge Processing washwater streams (WSRC 1994e). | TE

The 2H and 2F evaporators are each 2.4 meters (8 feet) in diameter and approximately 4.6 to 5 meters (15 to 16.5 feet) tall with an operating capacity of 6.8 cubic meters (1,800 gallons) (WSRC 1991). Each stainless-steel evaporator contains a heater tube bundle; two steam lifts, which remove the waste concentrate from the evaporator; a de-entrainer, which removes water droplets; a warming coil, which helps prevent salt crystallization within the evaporator; and two steam lances, which also inhibit salt crystallization (WSRC 1991). The evaporator systems also consist of a mercury collection tank, a cesium removal pumptank and column, a supernatant collection and diverting tank (2F only), and a waste concentrate transfer system.

In approximately 10 years of operation (1982 through 1993), the maximum amount of evaporator supernatant generated annually from the 2F and 2H evaporators combined was approximately 27,300 cubic meters (7.2×10^6 gallons) (Campbell 1994a). The rate at which the evaporator overheads are generated depends on the heat transfer rate of the evaporator system, the dissolved solids content of the wastewater feed, and the dissolved solids content maintained within the evaporator pot. Waste forecasts were calculated assuming scheduled downtime of the evaporators.

Several tanks are used for purposes other than waste storage: Tanks 22, 48, and 49 are used for In-Tank Precipitation; Tanks 40, 42, and 51 are used for Extended Sludge Processing; and Tank 50 is used as the feed tank for the Z-Area Saltstone Manufacturing and Disposal Facility.

The high-level waste tanks are built of carbon steel and reinforced concrete using one of four designs. DOE plans to remove the high-level waste from the old tanks and transfer it to newer tanks (Type III) with secondary containment. Of the 50 tanks currently in use, 23 (Types I, II, and IV designs) do not meet criteria for leak detection and secondary containment, and 27 tanks (Type III design) do meet these
TE | criteria (WSRC 1994g). Table B.13-3 describes each type of tank by the following features: construction dates, capacity, key design features, and the percentage of total waste volume and radioactivity. The *Double-Shell Tanks for Defense High-Level Radioactive Waste Storage Environmental Impact Statement* contains a detailed discussion of tank designs.

Ventilation systems for the waste storage tanks vary; some have no active ventilation, while others maintain negative pressure (approximately -0.5 inches of water) on the structure to ensure that the direction of unfiltered air flow is into the potentially contaminated structure. For most tank systems, the exhaust air is treated to remove moisture, heated to prevent condensation at the filters, filtered by high efficiency particulate air filters, and monitored for radioactive particulates prior to release into the atmosphere. Exhaust ventilation systems for other waste-handling operations in the tank farms use an air-mover system, high efficiency particulate air filtration, and monitoring for radioactive particulates
TE | prior to release into the atmosphere (WSRC 1994h).

Table B.13-3. F- and H-Area high-level waste tank features.[a]

Tank type	Construction date	Capacity of each tank	Key design features	Percent of total waste stored in this tank type	Percent of total radioactive content stored in this tank type
I	1951-1953	2.8×10^6 liters (7.4×10^5 gallons)	1.5 meter (5-foot) high secondary containment pans Active waste cooling systems	12	27
II	1955-1956	4×10^6 liters (1.06×10^6 gallons)	1.5 meter (5-foot) high secondary containment pans Active waste cooling systems	4	8
III	1967-1981	4.9×10^6 liters (1.3×10^6 gallons)	Full height secondary containment Active waste cooling system	77	64
IV	1958-1963	4.9×10^6 liters (1.3×10^6 gallons)	Single steel tank, no secondary containment No active waste cooling systems	7	<1

a. Sources: Main (1991); Wells (1994). TE

The 50 waste tanks currently in use at SRS have a limited service life. The tanks are susceptible to general corrosion, nitrate-induced stress corrosion cracking, and pitting and corrosion. The concentrations and volumes of incoming wastes are controlled to prevent corrosion of the carbon steel tanks. Requirements for accepting waste into the tank farms for storage and evaporation are determined by a number of safety and regulatory factors. These are specified in a document which discusses tank farm waste acceptance criteria, and specifies limits for incoming waste (WSRC 1994i). TE

In the history of the tank farms, nine of the tanks have leaked detectable quantities of waste from the primary tank to secondary containment with no release to the environment. A tenth tank, Tank 20, has known cracks above the level of the stored liquid; however, no waste has been identified leaking through these cracks (WSRC 1994d). A history of tank leakage and spills is presented in Table B.13-4. TC

Table B.13-4. High-level waste tank leakage and spill history.

Tank Number	Tank Type	Date	Occurrence
1-9	I	—	Leakage from primary tank to secondary containment with no release to the environment[a]
8	I	1961	Fill-line encasement leaked approximately 5,700 liters (1,500 gallons), causing soil contamination and potential groundwater contamination[a]
16	II	1972	Leakage of approximately a few tens of gallons from secondary containment to the environment[b]
13	II	1983	Spill of approximately 380 liters (100 gallons)[c]
37	III	1989	Transfer line leaked approximately 225 kilograms (500 pounds) of concentrated (after volume reduction in evaporator) waste[d]

a. Source: Odum (1976).
b. Source: Poe (1974).
c. Source: Boore et al. (1986).
d. Source: WSRC (1992c).
Note: These leak sites have been cleaned up or stabilized to prevent the further spread of contamination and are monitored by groundwater monitoring wells established under SRS's extensive groundwater monitoring program. Remediation and environmental restoration of contaminated sites at the F- and H-Area Tank Farms will be undertaken when waste removal plans for the tanks are completed and surplus facility deactivation and decommissioning plans are developed.

Twenty-three out of the 50 tanks currently in use (Tanks 1 through 24 except for Tank 16) and their ancillary equipment do not meet secondary containment requirements (WSRC 1993f).

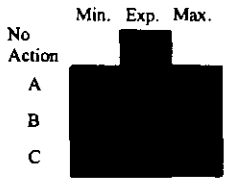
According to the Federal Facility Agreement executed by DOE, EPA, and SCDHEC, liquid high-level waste tanks that do not meet the standards set forth in the Agreement may be used for continued storage of their current waste inventories. However, these waste tanks are required to be placed on a schedule for removal from service (WSRC 1993f).

According to the waste removal plan, salt would be removed from the Type III tanks first, and these tanks would be reused to support tank farm evaporator operations and to process Defense Waste Processing Facility recycle wastewater. The first sludge tanks to be emptied would be old-design tanks,

which would then be removed from service. The waste removal program includes removing salt and sludge by mechanical agitators, cleaning the tank interior by spray washing the floor and walls, and steam/water cleaning the tank annulus if necessary (WSRC 1994g). Waste removal equipment consists of slurry pump support structures above the tank top; slurry pumps (typically three for salt tanks and four for sludge tanks); water and electrical service to the slurry pumps; motor and instrument controls; tank sampling equipment; and interior tank washwater piping and spray nozzles (WSRC 1994g). TC

Each tank is currently being fitted with waste removal equipment, including slurry pumps and transfer jets. According to current operating plans and projected funding, by 2018 DOE expects that the high-level wastes at SRS would have been processed into borosilicate glass, and the tanks would be empty (DOE 1994a). This schedule is based on successful completion of several key activities that must be accomplished before waste removal can begin. These include operation of the in-service evaporators, restart and operation of Extended Sludge Processing, startup and operation of In-Tank Precipitation, and startup and operation of the Defense Waste Processing Facility (WSRC 1993f). TC

PROJECT-SPECIFIC ACTIONS:



Under each alternative, the tank farms would continue to receive waste (including Defense Waste Processing Facility recycle wastewater), in Type III tanks, operate the evaporators to reduce the volume of waste, construct and begin operation of the Replacement High-Level Waste Evaporator, proceed with waste removal operations as required by the Federal Facility Agreement, and build no new tanks. Table B.13-5 presents volumes of waste to be stored and treated for each alternative.

Table B.13-5. Volumes of waste to be stored and treated at the F- and H-Area high-level waste tank farms (cubic meters).[a,b,c,d]

TE

	Min.	Exp.	Max.
		130,581 m^3 existing inventory 22,212 m^3 new waste	
A	130,581 m^3 existing inventory 12,099 m^3 new waste	130,581 m^3 existing inventory 22,212 m^3 new waste	130,581 m^3 existing inventory 27,077 m^3 new waste[e]
B	130,581 m^3 existing inventory 12,099 m^3 new waste	130,581 m^3 existing inventory 22,212 m^3 new waste	130,581 m^3 existing inventory 27,077 m^3 new waste
C	130,581 m^3 existing inventory 12,099 m^3 new waste	130,581 m^3 existing inventory 22,212 m^3 new waste	130,581 m^3 existing inventory 27,077 m^3 new waste

TE

a. Source: Hess (1994f, g); WSRC (1994f).
b. To convert to gallons, multiply by 264.2.
c. Waste volumes are not additive because newly generated waste volume would be reduced by approximately 75 percent via evaporation.
d. Under all alternatives, the Replacement High-Level Waste Evaporator would begin operation in May 1999.
e. The 30-year maximum waste forecast indicates that, in order to empty the tanks as planned by the year 2018, the existing evaporators would have to be operated at higher rates.

B.14 M-AREA AIR STRIPPER

TE

OBJECTIVE:

The M-Area Air Stripper treats the M-Area groundwater plume that is contaminated with organic solvents as part of environmental restoration.

DESCRIPTION:

The M-Area Air Stripper (also called the M-1 Air Stripper), located at Building 323-M, is part of the pump-and-treat remedial action system designed to remove organic solvents from a groundwater contaminant plume beneath M-Area. Volatile organic compounds of concern include trichloroethylene and tetrachloroethylene. The system consists of an air stripper, 11 recovery wells, an air blower, an effluent-discharge pump, an instrument air system, a control building, and associated piping, instrumentation, and controls. The average water feed rate to the air stripper is approximately 1.9 cubic meters (500 gallons) per minute. The National Pollutant Discharge Elimination System permit requires the treated effluent to have a concentration of not more than 5 parts per billion each of trichloroethylene and tetrachloroethylene. Concentrations of volatile organic compounds in the treated effluent have consistently been less than the detection limit of 1 part per billion. A 20-inch line transports treated effluent from the air stripper to Outfall M-005 in accordance with National Pollutant Discharge Elimination System permit criteria.

During construction of groundwater monitoring wells, DOE generates well development water; during routine sampling of SRS groundwater monitoring wells, DOE generates well purge water. DOE collects the development and purge water (investigation-derived waste) in a tank truck and transports it to the M-Area Air Stripper for treatment.

PROJECT-SPECIFIC ACTIONS:

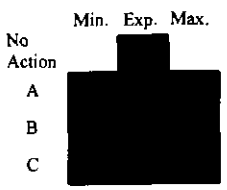


Table B.14-1 presents volumes of hazardous investigation-derived waste from groundwater monitoring wells to be treated in the M-Area Air Stripper under each alternative. These volumes represent a very small portion of the throughput of the M-Area Air Stripper; between 5,000 and 32,000 cubic meters (1.32×10^6 and 8.45×10^6 gallons) over 30 years versus approximately 13,000 cubic meters (3.43×10^6 gallons) per minute of groundwater.

TE

TE **Table B.14-1.** Volumes of investigation-derived waste from groundwater monitoring wells to be treated in the M-Area Air Stripper (cubic meters).[a,b]

	Min.	Exp.	Max.
		31,233 m^3[c]	
A	5,369 m^3[d]	31,233 m^3	31,495 m^3[e]
B	5,369 m^3	31,233 m^3	31,495 m^3
C	5,369 m^3	31,233 m^3	31,495 m^3

TC

a. Source: Hess (1995a).
b. To convert to gallons, multiply by 264.2.
c. The initial annual amount would be 800 cubic meters (2.11×10^5 gallons). Due to the increase in groundwater monitoring well activities under environmental restoration, the annual quantity would increase to 1,286 cubic meters (3.4×10^5 gallons).
d. The annual amount would vary from 124 cubic meters (32,800 gallons) to 528 cubic meters (139,000 gallons) and would average 179 cubic meters (47,300 gallons).
e. The annual amount would vary from 806 cubic meters (2.13×10^5 gallons) to 1,297 cubic meters (3.43×10^5 gallons) and would average 1,050 cubic meters (277×10^5 gallons) per year.

TC

B.15 M-AREA VENDOR TREATMENT FACILITY | TE

OBJECTIVE:

The M-Area Vendor Treatment Facility would provide a vitrification process to treat M-Area electroplating wastes to meet the land disposal restrictions criteria. The wastes to be treated include the following six waste streams which were the basis of the initial treatability studies and procurement of the vitrification subcontractor:

- M-Area plating-line sludge from supernatant treatment
- M-Area high-nickel plating-line sludge
- M-Area sludge treatability samples
- Mark 15 filtercake
- Plating-line sump material
- Nickel plating-line solution

The potential impacts of treating these six waste streams were considered in an Environmental Assessment (DOE 1994b) and a Finding of No Significant Impact issued in August 1994. These six mixed waste streams constitute approximately 2,471 cubic meters (87,300 cubic feet) of mixed waste (Hess 1995a). | TE | TC

Under the Federal Facility Compliance Act, DOE must develop site-specific plans for the treatment of mixed wastes to the standards established by RCRA. The *SRS Proposed Site Treatment Plan* identified two additional types of mixed waste for which treatment by the M-Area Vendor Treatment Facility was determined to be the preferred option:

- uranium/chromium solution
- soils from spill remediation | TC

These mixed wastes streams [approximately 18 cubic meters (635 cubic feet)] would be introduced directly to the vitrification unit. The treatment of these two additional wastes would not appreciably alter the processes or timeframe for operation of the M-Area Vendor Treatment Facility. Final decisions regarding the treatment of these wastes would be made in conjunction with ongoing negotiations with the State of South Carolina pursuant to the Federal Facility Compliance Act.

DESCRIPTION:

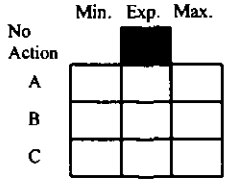
The M-Area Vendor Treatment Facility would be a temporary vitrification facility; it has not yet been constructed. Its operation would be linked to the existing M-Area Liquid Effluent Treatment Facility to treat the electroplating sludges stored in the Process Waste Interim Treatment/Storage Facility tanks, waste flushes from the tanks, and drummed wastewater sludge stored in the M-Area mixed waste storage building. The wastes would be blended in existing M-Area tanks. Stabilizing chemicals and glass-forming materials would be added to the mixture, which would then be fed to the vitrification unit.

The offgas scrubber liquid from the vitrification unit would be treated by the M-Area Liquid Effluent Treatment Facility, which discharges to Outfall M-004 in accordance with National Pollutant Discharge Elimination System permit limits. M-Area Liquid Effluent Treatment Facility filtercake and filter media generated from the treatment of the offgas scrubber liquid effluent would be returned to the Process Waste Interim Treatment/Storage Facility tanks for blending with other waste feed to the vitrification unit.

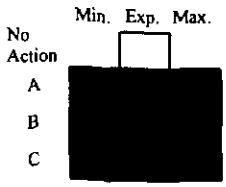
Molten glass from the vitrification unit would be discharged either directly to 71-gallon drums or to a gem-making machine. The gem-making machine consists of a gob cutter that cuts the glass stream into small balls of glass that drop onto a steel cooling disk where they harden to form glass gems with a flattened marble appearance. The gems are then dropped from the cooling disk into a hopper or 71-gallon drum.

The vitrification unit is sized to treat the entire volume of design-basis wastes in one year. It is anticipated that the 3.03×10^6 kilograms (6.26×10^5 pounds) of M-Area wastes would be reduced to 1.12×10^6 kilograms (5.09×10^5 pounds) of glass. A total waste volume reduction of approximately
TE | 83 percent would be expected (WSRC 1994j).

PROJECT-SPECIFIC ACTIONS:



Under the no-action alternative, the facility would treat the original six waste streams.



Under each alternative except the no-action alternative, the M-Area Vendor Treatment Facility would treat the six original waste streams and two additional waste streams as described in the Objective section (WSRC 1995). TC

TE

B.16 MIXED WASTE STORAGE FACILITIES

OBJECTIVE:

The mixed waste storage facilities would provide storage capacity for SRS containerized mixed wastes in accordance with RCRA and DOE Order 5820.2A requirements.

DESCRIPTION:

DOE would store containerized mixed waste in Building 645-2N, Building 643-29E, Building 643-43E, Building 316-M, and on the 315-4M storage pad and Waste Storage Pads 20 through 22. Each of these mixed waste container storage facilities is discussed below.

Three buildings are used to store mixed waste at SRS. Building 645-2N is a RCRA-permitted facility and is located in the Hazardous Waste Storage Facility in N-Area. Building 645-2N is a steel-framed building with sheet metal siding and an impervious concrete floor. The building is divided into four waste storage cells, and each cell has a concrete dike containment system. The floor of each storage cell slopes toward an individual sump for the collection of released liquids. The actual storage area for the four cells combined is approximately 60 meters (196 feet) by 14 meters (46 feet). The building has

TE

usable storage capacity of approximately 558 cubic meters (19,700 cubic feet) (WSRC 1994k). Mixed waste is primarily containerized in 55-gallon drums or steel boxes. The 55-gallon drums are used to store both liquid and solid wastes; metal storage boxes are used to store only solid wastes. Containers are stored on wooden pallets, and the boxes have metal risers which elevate the bottoms of the containers off the floor.

Two of the mixed waste storage buildings, Building 643-29E and Building 643-43E, have interim status and are located in E-Area. Building 643-43E was constructed under the approved "General Plant Project" Categorical Exclusion (CX 9004020, Project S-2842, October 5, 1990). The buildings are similar in design and construction; only the dimensions are different. The buildings are metal structures with I-beam frames, sheet metal roofing, partial sheet metal siding, and concrete pad floors. The outside walls of each building consist of chain-link fencing from the ground to a height of about 1.5 meters (5 feet). The concrete pads are surrounded by reinforced concrete dikes to provide secondary containment. In Building 643-29E, the floor slopes towards a sump to collect released liquids or other liquids that enter the storage area. The floor in Building 643-43E is level. Mixed waste is stored in 55-gallon drums and metal storage boxes; if necessary, concrete culverts are used for shielding. Waste containers are elevated off the floor to prevent the container bottoms from contacting accumulated

liquids on the floor. Drums are placed on pallets and the metal boxes are constructed with metal risers. Other containers such as culverts are also elevated using devices such as pallets, risers, or wooden or metal blocks. Building 643-29E is 18 meters (60 feet) by 18 meters (60 feet) in size with an actual storage area of 15 meters (50 feet) by 15 meters (50 feet). The maximum usable storage capacity is 62 cubic meters (2,200 cubic feet) (Hess 1995a). Building 643-43E measures 49 meters (160 feet) by 18 meters (60 feet) in size with an actual storage area of 46 meters (150 feet) by 15 meters (50 feet) and a maximum usable storage capacity of 619 cubic meters (21,900 cubic feet) (WSRC 1994k). | TE

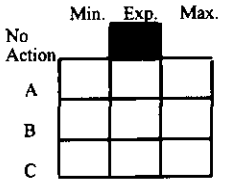
Mixed waste is also stored in an interim status storage building (Building 316-M) in M-Area. The building is essentially an above-grade concrete pad with a pavilion-like structure surrounded by a chain-link fence. The pad is curbed on three sides with the fourth side built to a sufficient elevation to ensure drainage to static sumps within the pad. Mixed waste management practices in the M-Area building are similar to management practices in the N- and E-Area storage buildings. Mixed waste is primarily containerized in 55-gallon drums or steel boxes. The building measures 37 meters (120 feet) by 15 meters (50 feet) with an actual storage area of 30 meters (100 feet) by 12 meters (40 feet) and a maximum usable capacity of 117 cubic meters (4,100 cubic feet) (WSRC 1994k). | TE

Three above-grade concrete pads in E-Area would be used to store mixed waste. DOE has submitted (in May 1992) a permit application for Waste Storage Pads 20, 21, and 22. Each waste storage pad consists of a concrete pad enclosed by a chain link fence but exposed to the elements. To contain leaks and direct rainwater, the waste storage pads have curbs and sloped foundations that drain to sumps. Mixed waste would be stored in 55-gallon drums and carbon steel boxes; concrete culverts and casks are used for shielding. Only solid waste forms would be stored on the waste storage pads. The pad dimensions are: Pad 20 [46 meters by 18 inches (150 feet by 60 feet)], Pad 21 [46 meters by 16 meters (150 feet by 54 feet)], and Pad 22 [52 meters by 16 meters (170 feet by 54 feet)]. The pads have a combined usable storage capacity of 2,056 cubic meters (72,600 cubic feet) (Hess 1995a). | TC

DOE has submitted a RCRA permit application requesting interim status for a storage pad in M-Area, Pad 315-4M, that would be used to store containerized vitrified mixed wastes from the M-Area Vendor Treatment Facility and stabilized ash and blowdown wastes from the Consolidated Incineration Facility. Pad 315-4M is a concrete pad that is completely fenced and exposed to the elements. The combination of curbing and a sloped foundation prevents run-on and directs rainwater to a stormwater drain that empties to Outfall M-001 in accordance with National Pollutant Discharge Elimination System permit limits. Mixed wastes are stored in 55-gallon drums, carbon steel boxes, and 71-gallon square steel drums. The pad measures 41 meters (135 feet) by 61 meters (200 feet) with an actual storage area of

41 meters (134 feet) by 61 meters (199 feet) and a maximum usable capacity of 2,271 cubic meters
TE | (80,000 cubic feet) (WSRC 1994k).

PROJECT-SPECIFIC ACTIONS:



Under the no-action alternative, mixed non-alpha waste that is currently stored on the transuranic waste storage pads (i.e., waste with less than 10 nanocuries per gram of transuranics) would be transferred to Waste Storage Pads 20, 21, and 22. Due to DOE's limited capacity to treat mixed waste, the majority of mixed wastes would continue to be stored under the no-action alternative. RCRA-permitted disposal capacity would not be available until the year 2002. Accordingly, mixed waste that ultimately would be disposed in the RCRA-permitted disposal vault would continue to be stored in the mixed waste storage buildings and pads until the vault is ready to receive waste.

TE | The expected waste generation forecast indicates that approximately 1.84×10^5 cubic meters (6.49×10^6 cubic feet) of containerized mixed waste would be placed in RCRA storage over the next 30 years. The mixed waste storage buildings and pads (645-2N, 643-29E, 643-43E, 316-M, 315-4M and Pads 20 through 22) would reach capacity by the year 1998. In order to accommodate future mixed waste storage needs, DOE plans to build additional mixed waste storage buildings as needed. Building 643-43E would serve as the prototype for future buildings. Each building would have a usable storage capacity of 619 cubic meters (22,000 cubic feet). Approximately 291 additional mixed waste storage buildings would be needed over the next 30 years (Hess 1995a).

Under the no-action alternative, Pad 315-4M would be used to store containerized vitrified mixed wastes from the M-Area Vendor Treatment Facility. These wastes would be stored on the Pad until RCRA-permitted disposal became available in the year 2002.

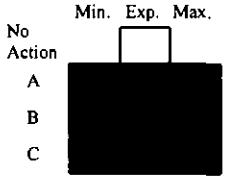
In order to accommodate future mixed waste storage needs prior to the availability of treatment and
TE | disposal capacity, DOE would build additional mixed waste storage buildings as needed. Table B.16-1 presents the maximum storage requirements, and the year they would be needed.

Table B.16-1. Mixed waste storage requirements for each alternative.[a] TE

	Min.	Exp.	Max.
		291 additional buildings (limited treatment)	
A	45 additional buildings in 2008	79 additional buildings in 2005	757 additional buildings in 2005
B	39 additional buildings in 2008	79 additional buildings in 2005	652 additional buildings in 2005
C	39 additional buildings in 2008	79 additional buildings in 2005	652 additional buildings in 2005

TC

a. Source: Hess (1995a).



Under alternatives A, B, and C, Pad 315-4M would be used to store containerized vitrified mixed wastes from the M-Area Vendor Treatment Facility and stabilized ash and blowdown wastes from the Consolidated Incineration Facility. These wastes would be stored on the Pad until RCRA-permitted disposal became available in the year 2002. Storage capacity on Pad 315-4M is sufficient to accommodate these wastes until disposal capacity becomes available. The maximum volume stored would be reached in the year 2001 for each alternative. Table B.16-2 presents maximum storage volumes. TE

Table B.16-2. Estimated amount of mixed waste that would be stored on Pad 315-4M (cubic meters).[a,b] TE

	Min.	Exp.	Max.
		2,271 m^3	
A	679 m^3	733 m^3	2,271 m^3
B	938 m^3	1,102 m^3	2,271 m^3
C	938 m^3	1,102 m^3	2,271 m^3

TC

a. Source: Hess (1995a).
b. To convert to cubic feet, multiply by 35.31.

TE

B.17 NEW WASTE TRANSFER FACILITY

OBJECTIVE:

The New Waste Transfer Facility is designed to be a highly reliable and flexible receipt and distribution point for the Defense Waste Processing Facility recycle and inter-tank farm waste streams (WSRC
TE 1994e). No processing would occur in the New Waste Transfer Facility (WSRC 1993f).

The New Waste Transfer Facility (also referred to as H-Diversion Box-8) was built to replace the operation of H-Diversion Box-2 and would allow H-Diversion Box-2 to serve only assigned tanks involved in waste removal operations. The New Waste Transfer Facility is currently scheduled to be connected to the Defense Waste Processing Facility and the tank farm in mid-1995 and begin operation in late 1995.

The New Waste Transfer Facility was constructed as a categorical exclusion under then-current NEPA
TE guidelines (52 FR 47662). The startup date is scheduled for November 1995 (WSRC 1994e).

DESCRIPTION:

The New Waste Transfer Facility consists of five adjacent cells: four each contain one pump tank and serve as pump pits; the fifth cell is a large diversion box. The pump pits and diversion box would be housed in one section of the building, and a second section would contain the local instrumentation and operations equipment and controls. The facility would be equipped with an enclosed overhead crane/camera system for remote maintenance (WSRC 1992d). The facility would handle transfers between the Defense Waste Processing Facility and the H-Area tank farm, between the F-Area tank farm and H-Area tank farm, between the F/H-Area Effluent Treatment Facility and H-Area tank farm, and intra-tank transfers within the H-Area tank farm (WSRC 1993g).

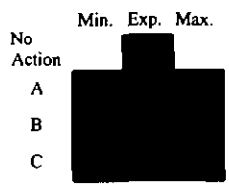
The New Waste Transfer Facility is expected to handle the following waste streams:

- High-heat waste (i.e., liquid high-level waste that contains a major portion of radioactivity)
- Low-heat waste (i.e., liquid high-level waste that contains a reduced concentration of radionuclides)
- High-heat and low-heat supernatant

- Aged high-heat and low-heat waste sludge slurries
- Reconstituted salt (re-dissolved salt)
- In-Tank Precipitation washwater
- Extended Sludge Processing washwater
- Defense Waste Processing Facility late wash process washwater
- Defense Waste Processing Facility aqueous recycle waste from the vitrification facility
- Receiving Basin for Offsite Fuel wastewater (WSRC 1993g)

The ventilation system for pump tanks and pump tank cells includes a discharged high efficiency particulate air filter that removes airborne radionuclides from the air passing over the pump pits and through the pump tanks and diversion box. The filter equipment is housed in a separate concrete-shielded building. An emergency diesel generator would serve as backup if the main power supply were interrupted (WSRC 1993g).

PROJECT-SPECIFIC ACTIONS:



Under each alternative, the New Waste Transfer Facility would begin operation according to the planned schedule to facilitate liquid high-level waste transfers between the Defense Waste Processing Facility and the F- and H-Area tank farms.

TE

B.18 NON-ALPHA VITRIFICATION FACILITY

OBJECTIVE:

The non-alpha vitrification facility would provide treatment for liquid, soil, and sludge wastes, primarily resulting from environmental restoration and/or decontamination and decommissioning activities, for which treatment capacity is not otherwise available at SRS.

DESCRIPTION:

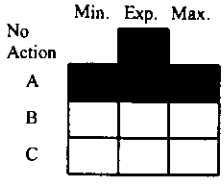
DOE would construct a non-alpha vitrification facility for the treatment of mixed, hazardous, and low-level wastes under alternative C and the expected and maximum forecasts of alternative B. It would not be built under the no-action alternative, alternative A, or the minimum forecast of alternative B. The facility is targeted to begin operating in the year 2006. Activities that would be conducted in the non-alpha vitrification facility can generally be broken down into three steps: preparation of wastes for treatment; vitrification; and treatment of byproducts generated during the vitrification process. Each of these steps is discussed in more detail below.

In the first step, waste containers would be opened and the soils and concrete would be sorted. In alternative B, the containerized waste would consist solely of sludges. In alternative C, solid and liquid wastes would also be treated. Therefore, an additional process in alternative C would be to shred the solid wastes to approximately 1/8 inch in size using shredder shears and/or bandsaws. Soils and concrete would be processed through a sorting operation to separate contaminated and uncontaminated materials. Concrete waste forms would be ball-milled and then sorted. Soils and concrete that were uncontaminated would be reused onsite as backfill, and the contaminated soils and concrete would be vitrified. It is expected that 60 percent of the mixed waste and low-activity waste soils and concrete would be vitrified, and the remaining 40 percent would be used as backfill. For suspect soils, it is expected that 40 percent would be vitrified, and the remaining 60 percent would be used as backfill. Frit and additives would be added to the waste, and the mixture would be sent to the thermal pretreatment unit (Hess 1994a).

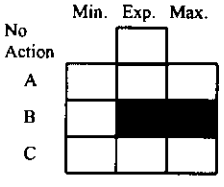
The first phase of vitrification is thermal pretreatment. During thermal pretreatment, the carbon content of the waste would be reduced in order to produce a higher-quality glass matrix. Then the waste would be vitrified (i.e., fused into a solid waste matrix) in a high temperature melter. Gases produced during the vitrification process would be sent through an afterburner and an offgas treatment system. The afterburner would destroy remaining hazardous organic compounds prior to treatment in the offgas

system. The offgas system would scrub the gases to minimize the release of remaining hazardous constituents or particulates to the atmosphere. Liquids generated by the offgas system would be evaporated and recondensed. The condensed overheads would be sent to a dedicated wastewater treatment unit for the treatment of mercury, trace radionuclides, and other materials. The closed-loop wastewater treatment system would ensure that once treated, the wastewater would be returned to the offgas system for reuse. Vitrified wastes would be sent either to RCRA-permitted disposal vaults or to shallow land disposal. It is assumed that 50 percent of the treated mixed and hazardous wastes would require RCRA-permitted disposal, and the remaining 50 percent could be disposed of as low-level waste (Hess 1994a).

PROJECT-SPECIFIC ACTIONS:



Under the no-action alternative and each waste forecast of alternative A, the facility would not be constructed.

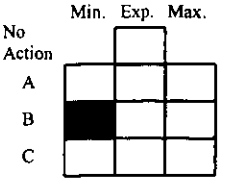


For the expected and maximum waste forecasts of alternative B, only mixed wastes would be treated in the non-alpha vitrification facility. The mixed waste treatability groups to be processed include soils, organic sludge, and inorganic sludge. Table B.18-1 presents the volumes that would be treated. | TE

For the expected waste forecast of alternative B, the feed rate to the non-alpha vitrification facility would be approximately 302 cubic meters (10,700 cubic feet) per year of sludges and approximately 2,790 cubic meters (98,500 cubic feet) per year of soils.

| TE

For the maximum waste forecast of alternative B, the feed rate to the non-alpha vitrification facility would be approximately 400 cubic meters (14,100 cubic feet) per year of sludges and approximately 15,000 cubic meters (5.30×10^5 cubic feet) per year of soils.



For the minimum waste forecast of alternative B, the non-alpha vitrification facility would not be built. Insufficient waste volumes were forecasted for the minimum case to warrant construction of the non-alpha vitrification facility. Mixed waste

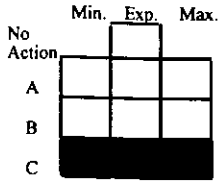
TE | **Table B.18-1.** Volumes of waste that would be treated in the non-alpha vitrification facility (cubic meters).[a,b]

	Min.	Exp.	Max.
		Not constructed	
A	Not constructed	Not constructed	Not constructed
B	Not constructed	88,331 m^3 soil/concrete sorted 5,174 m^3 sludge vitrified (302 m^3 annually) 52,999 m^3 soil vitrified (2,790 m^3 annually) mixed wastes only	440,060 m^3 soil/concrete sorted 7,451 m^3 sludge vitrified (400 m^3 annually) 264,036 m^3 soil vitrified (15,000 m^3 annually) mixed wastes only
C	34,897 m^3 soil/concrete sorted (23,873 m^3 mixed; 11,024 m^3 low-level) Vitrified[c]: 59,654 m^3 mixed 37,860 m^3 hazardous 213,566 m^3 low-level	125,510 m^3 soil/concrete sorted (88,331 m^3 mixed; 37,179 m^3 low-level) Vitrified[d]: 141,020 m^3 mixed 211,271 m^3 hazardous 268,639 m^3 low-level	1,019,845 m^3 soil/concrete sorted (440,098 m^3 mixed; 579,747 m^3 low-level) Vitrified[e]: 457,405 m^3 mixed 395,795 m^3 hazardous 742,319 m^3 low-level

TC

a. Source: Hess (1995a).
b. To convert to gallons multiply by 264.2; to convert to cubic feet multiply by 35.31.
c. Mixed would include 14,324 m^3 of soil; 33,970 m^3 of solids; 11,360 m^3 of liquids.
Hazardous would include 26,932 m^3 of soil; 6,933 m^3 of solids; 3,995 m^3 of liquids.
Low-level would include 5,292 m^3 of soil, 208,274 m^3 of solids; no liquids.
d. Mixed would include 52,999 m^3 of soil; 69,472 m^3 of solids; 18,549 m^3 of liquids.
Hazardous would include 152,815 m^3 of soil; 22,417 m^3 of solids; 36,039 m^3 of liquids.
Low-level would include 19,001 m^3 of soil, 249,638 m^3 of solids; no liquids.
e. Mixed would include 264,059 m^3 of soil; 132,453 m^3 of solids; 60,893 m^3 of liquids.
Hazardous would include 330,501 m^3 of soil; 38,167 m^3 of solids; 27,127 m^3 of liquids.
Low-level would include 278,397 m^3 of soil, 463,922 m^3 of solids; no liquids.

soils and sludges would be incinerated at the Consolidated Incineration Facility after modifications to accommodate the treatment of such materials.



For each waste forecast of alternative C, hazardous, mixed, and low-level wastes would be treated in the non-alpha vitrification facility. Hazardous wastes to be treated include metal debris, equipment, and lead wastes that were not successfully decontaminated in the containment building; soils; inorganic, organic, heterogeneous, and glass debris; organic and inorganic sludges; and organic and inorganic liquids. Mixed wastes to be treated include metal debris and equipment wastes that were not successfully decontaminated in the containment building; spent decontamination solutions and wet chemical oxidation residuals from the containment building; glass, heterogeneous, inorganic, and organic debris; lead; benzene waste from the Defense Waste Processing Facility; aqueous and organic liquids; radioactive oil; PUREX solvent; paint wastes; composite filters; soils; organic and inorganic sludge; and mercury-contaminated material. Low-level wastes to be treated include low-activity soils, suspect soils, low-activity job-control waste; job-control waste from offsite generators; tritiated soils; tritiated job-control waste; tritiated equipment; intermediate-activity job-control waste; and low-activity equipment (Hess 1994a).

For the expected waste forecast of alternative C, the combined feed rate to the non-alpha vitrification facility would average approximately 11,832 cubic meters (4.18×10^5 cubic feet) per year of soils, 17,975 cubic meters (6.35×10^5 cubic feet) per year of solids, and 2,873 cubic meters (1.01×10^5 cubic feet) per year of liquids (Hess 1995a). TC

For the minimum waste forecast, the combined feed rate to the non-alpha vitrification facility would be approximately 2,450 cubic meters (86,500 cubic feet) per year of soils, 13,115 cubic meters (4.63×10^5 cubic feet) per year of solids, and 808 cubic meters (28,500 cubic feet) per year of liquids (Hess 1995a). TC

For the maximum waste forecast, the combined feed rate to the non-alpha vitrification facility would be approximately 45,945 cubic meters (1.62×10^6 cubic feet) per year of soils, 33,397 cubic meters (1.18×10^6) per year of solids, and 4,633 cubic meters (1.64×10^5) per year of liquids (Hess 1995a). TC

B.19 LOW-LEVEL WASTE SMELTER

OBJECTIVE:

In this EIS the decontamination of low-activity equipment waste would be done by offsite commercial facilities because such facilities are currently available to perform the treatment required.

DESCRIPTION:

DOE would ship low-activity equipment waste to an offsite facility which uses a standard smelter process for decontamination. The equipment waste would be smelted to separate the pure metallic fraction from the slag that would contain impurities, including the majority of the radionuclides. It is assumed that 90 percent of the low-activity equipment waste volume would be recovered as metal suitable for reuse, and 10 percent of the incoming waste volume would be slag. The slag would be formed into blocks and packaged for shipment back to SRS for disposal. Because slag is a stable waste form, and the radionuclides would be fixed in the waste matrix, the slag residues could be sent to shallow land disposal.

DOE would ship offsite low-activity equipment waste (including low-activity equipment waste resulting from the decontamination of mixed wastes at the containment building) for decontamination in alternatives B and C. Less waste volume would be available for decontamination under alternative C due
TE | to the diminished role of the containment building in that alternative (Hess 1994a, h).

For purposes of assessment, the offsite decontamination facility was assumed to be located in Oak Ridge,
TC | Tennessee. In terms of transportation and surrounding population, this location is representative of the range of possible locations.

PROJECT-SPECIFIC ACTIONS:

The volumes of low-activity equipment waste sent offsite for decontamination by smelting for each
TE | alternative and waste forecast are shown in Table B.19-1.

Table B.19-1. Estimated volumes of low-level waste smelted for each alternative.[a,b] TE

	Min.	Exp.	Max.
		None	
A	None	None	None
B	9,838 m^3	17,965 m^3	53,792 m^3
C	5,894 m^3	10,501 m^3	27,556 m^3

TC

a. Source: Hess (1995a).
b. To convert to cubic feet, multiply by 35.31.

B.20 OFFSITE LOW-LEVEL WASTE VOLUME REDUCTION

OBJECTIVE:

Offsite commercial vendor facilities have been designated for the treatment and repackaging of SRS low-activity wastes because such facilities are currently available. This commercial volume reduction capability could be used to more efficiently utilize low-level waste disposal capacity before a facility that provided the same treatment capability could be constructed and commence operations at SRS.

DESCRIPTION:

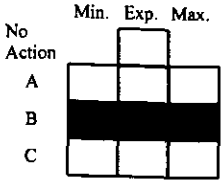
DOE would ship low-activity job-control and equipment waste to an offsite facility for volume reduction. The low-level waste would be treated or repackaged to make more efficient use of low-level waste disposal capacity or to meet the waste acceptance criteria for treatment at the Consolidated Incineration Facility at SRS. It is assumed that 50 percent of the low-activity job control waste generated each year would be transferred to a commercial vendor who would perform the following:

TC

- 60 percent supercompacted (an average of volume reduction 8 to 1; varies from 12 to 1 for job-control waste to 4 to 1 for bulk equipment)
- 20 percent reduced in size and repackaged for treatment at the Consolidated Incineration Facility (30 percent volume reduction from repackaging; 8 to 1 volume reduction for the Consolidated Incineration Facility)
- 10 percent incinerated at the vendor facility followed by supercompaction of the ash (100 to 1 volume reduction)
- 5 percent reduced in size and repackaged for disposal (30 percent volume reduction)
- 5 percent undergoing metal melt followed by supercompaction (20 to 1 volume reduction)

DOE would also ship 50 percent of the low-activity equipment waste generated each year to a commercial vendor for supercompaction (8 to 1 volume reduction). The treated wastes would be returned to SRS for disposal in the low-activity waste vaults with the exception of the metal melt waste which would be sent to shallow land disposal.

PROJECT-SPECIFIC ACTIONS:



DOE would utilize commercial vendors for volume reduction of low-level waste under alternative B only. Assuming that contracts are executed based on the responses to the request for proposal, DOE would begin offsite shipments of low-activity waste in fiscal year 1996 at which time it is assumed that the existing SRS compactors would cease operation. Uncompacted wastes placed in the low-activity waste vault prior to October 1995 would be stored for retrieval and processing by the commercial vendor. TE

For purposes of assessment, the offsite volume reduction facility was assumed to be located in Oak Ridge, Tennessee. In terms of transportation and surrounding population, this location is representative of the range of possible locations.

The volumes of low-activity waste sent offsite for treatment and repackaging for each alternative and waste forecast are shown in Table B.20-1.

SUMMARY OF IMPACTS: TC

The consequences of the offsite treatment of low-level radioactive wastes are expected to be small. Treatment of SRS low-activity waste is not expected to result in exceedance of the vendor's permitted emissions limits. DOE would only ship wastes that conform to the vendor's waste acceptance criteria. SRS wastes are not expected to contain radionuclides that are not already being processed in the waste feed currently being treated by the vendor. Compliance with the vendor's waste acceptance criteria will ensure that the SRS radionuclide distributions are adequately considered in the vendor's permits and licenses.

The request for proposal specifies that the vendor must have existing contracts for volume reduction of low-level waste and that the SRS waste cannot exceed 50 percent of the vendor's treatment capacity. It is expected that the SRS wastes will comprise approximately 25 percent of the vendor's total operating capacity. The request for proposal also stipulates that the vendor must start treating SRS waste within three months of contract award. As such, it is expected that the vendor will utilize idle capacity since three months would not be sufficient time to develop new capacity to support treatment of SRS waste (Hess 1995c).

Table B.20-1. Volumes of low-activity waste that would be treated offsite (cubic meters).[a,b]

	Min.	Exp.	Max.
		None	
A	None	None	None
B	158,350 m^3 job control waste 95,010 m^3 supercompacted 31,670 m^3 repackaged for CIF[c] 15,835 m^3 incinerated 7,918 m^3 repackaged for disposal 7,918 m^3 metal melt/ supercompacted 14,906 m^3 equipment waste supercompacted 5,970 m^3/year average	186,671 m^3 job control waste 112,002 m^3 supercompacted 37,334 m^3 repackaged for CIF[c] 18,667 m^3 incinerated 9,334 m^3 repackaged for disposal 9,334 m^3 metal melt/ supercompacted 27,220 m^3 equipment waste supercompacted 7,380 m^3/year average	210,269 m^3 job control waste 126,161 m^3 supercompacted 42,054 m^3 repackaged for CIF[c] 21,027 m^3 incinerated 10,513 m^3 repackaged for disposal 10,513 m^3 metal melt/ supercompacted 81,503 m^3 equipment waste supercompacted 10,060 m^3/year average
C	None	None	None

TC

a. Source: Hess (1995a).
b. To convert to gallons multiply by 264.2; to convert to cubic feet multiply by 35.31.
c. Consolidated Incineration Facility.

Operational impacts associated with these offsite facilities are presented in the Traffic and Transportation and Occupational and Public Health Section of Chapter 4 (4.4.11 and 4.4.12) and Appendix E (Sections 3.0 and 4.0).

B.21 OFFSITE MIXED WASTE TREATMENTS

OBJECTIVE:

Offsite commercial or DOE-operated treatment facilities have been designated for treatment of mixed wastes generated at SRS when an offsite facility currently exists that could perform the treatment required or when a planned offsite treatment facility would be available before a facility that provided the same treatment capability could be constructed and commence operations at SRS.

DESCRIPTION:

The *SRS Proposed Site Treatment Plan* evaluated existing commercial and existing or proposed DOE-operated treatment facilities (both onsite and offsite) in its options analysis to arrive at a preferred option for each mixed waste. Offsite commercial and DOE-operated facilities were identified as the preferred options for several SRS mixed wastes.

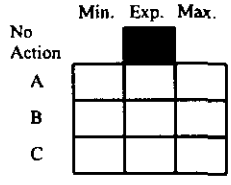
The Waste Engineering Development Facility at the Idaho National Engineering Laboratory was identified as the preferred option for treating SRS mercury and mercury-contaminated mixed waste. A small quantity of elemental liquid mercury [less than 1 cubic meter (35 cubic feet)] would be shipped to the Waste Engineering Development Facility's amalgamation unit. The mercury waste would be treated by amalgamation (the combination of liquid elemental mercury with inorganic reagents such as copper, zinc, nickel, gold or sulfur that results in a semi-solid amalgam and thereby reduces potential emissions of mercury vapor into the air). Amalgamation is the treatment standard specified for such radioactive mercury waste. DOE would also ship a small quantity [less than 2 cubic meters (71 cubic feet)] of mercury-contaminated waste (rocks, dirt, sand, concrete, and glass) generated from cleaning Tank E-3-1 in H-Area. This waste would be treated at the Waste Engineering Development Facility's stabilization unit by immobilizing the mercury in a grout matrix. Both the amalgamated mercury and the stabilized mercury-contaminated waste would be returned to SRS for disposal. The amalgamated mercury would be sent to RCRA-permitted disposal, and the stabilized mercury-contaminated waste would be sent to shallow land disposal.

DOE has generated a small amount [0.8 cubic meter (28 cubic feet)] of calcium metal waste. This waste would be shipped to the Los Alamos National Laboratory for treatment using the Reactive Metals Skid, a mobile treatment unit. The treatment would involve controlled wet oxidation to eliminate the reactivity of the calcium in metallic form. Treatment residuals would be returned to SRS for disposal.

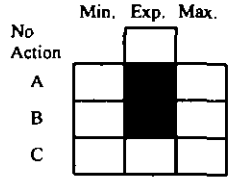
DOE anticipates generating a limited quantity [less than 60 cubic meters (2,100 cubic feet)] of radioactively contaminated PCB wastes over the 30-year analysis period of this EIS. These wastes would be shipped to a commercial facility for treatment to destroy the PCB fraction. The radioactively contaminated residuals from the treatment process would be returned to SRS for shallow land disposal.

The *SRS Proposed Site Treatment Plan* assumed that half of the existing inventory and forecast waste generation of mixed waste lead would consist of lead that could be decontaminated and reused. DOE identified a commercial facility that could perform the required decontamination procedures. The commercial facility would decontaminate the lead using an acid bath. It is assumed that this process would be able to successfully decontaminate 80 percent of the lead. The decontaminated lead would be sold for reuse. Lead that could not be decontaminated would be stabilized and returned to SRS for disposal. The spent acid solutions from the decontamination process would be neutralized, volume reduced, stabilized, and then returned to SRS for disposal.

PROJECT-SPECIFIC ACTIONS:



No-Action - Offsite mixed waste treatment facilities would not be used under the no-action alternative.



Alternatives A and B - The offsite mixed waste treatment would be identical for alternatives A and B expected waste forecasts.

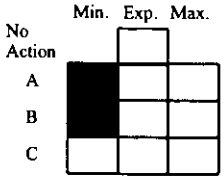
DOE would ship radioactively contaminated PCB wastes to a commercial facility for treatment of the PCB fraction. The waste shipments would total approximately 2 cubic meters (71 cubic feet) per year for a total of 56 cubic meters (2,000 cubic feet) over the 30-year period. Residuals from the treatment
TE | process [approximately 7 cubic meters (250 cubic feet) over the 30-year period] would be returned to SRS for shallow land disposal.

TC | DOE would ship 3,010 cubic meters (1.06×10^5 cubic feet) of mixed waste lead to the commercial facility for decontamination. The waste shipments would total approximately 119 cubic meters (4,200 cubic feet) per year. Lead that could not be decontaminated and spent decontamination solutions [a total of

602 cubic meters (21,000 cubic feet) over the 30-year period] would be stabilized and returned to SRS for RCRA-permitted disposal.

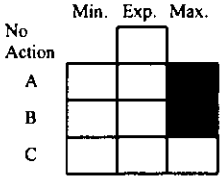
Small quantities [approximately 2 cubic meters (70.6 cubic feet)] of mercury and mercury-contaminated waste would be shipped to the Waste Engineering Development Facility at the Idaho National Engineering Laboratory. Residuals from the treatment processes would be returned to SRS for disposal. TC

A small amount [0.8 cubic meter (28 cubic feet)] of calcium metal waste would be shipped to the Los Alamos National Laboratory. Residuals from treatment using the Reactive Metals Skid would be returned to SRS for disposal (Hess 1995a).



For the minimum waste forecast, PCB wastes, mercury wastes, and calcium metal wastes would be the same as described in the expected waste forecast.

Under alternatives A and B, DOE would ship 1,316 cubic meters (46,500 cubic feet) of mixed waste lead to the commercial facility for decontamination. The waste shipments would total approximately 41 cubic meters (1,450 cubic feet) per year. Lead that could not be decontaminated and spent decontamination solutions [a total of 263 cubic meters (9,300 cubic feet) over the 30-year period] would be stabilized and returned to SRS for disposal (Hess 1995a). TC

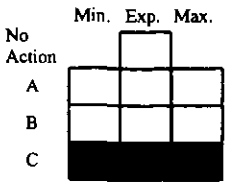


For the maximum waste forecast, mercury wastes and calcium metal wastes would be managed as described in the expected waste forecast.

DOE would ship radioactively contaminated PCB wastes to a commercial facility for treatment of the PCB fraction. The waste shipments would total approximately 2 cubic meters (71 cubic feet) per year for a total of 55 cubic meters (1,900 cubic feet) over the 30-year period. Residuals from the treatment process [approximately 7 cubic meters (250 cubic feet) over the 30-year period] would be returned to SRS for shallow land disposal.

DOE would ship 7,675 cubic meters (2.71×10^5 feet) of mixed waste lead to the commercial facility for decontamination. The waste shipments would total approximately 780 cubic meters (27,500 cubic feet) per year from the years 2000 to 2005 and approximately 152 cubic meters (5,400 cubic feet) per year

from the years 2006 to 2024. Lead that could not be decontaminated and spent decontamination solutions [a total of 1,535 cubic meters (54,200 cubic feet) over the 30-year period] would be stabilized and returned to SRS for disposal.



Alternative C - For each waste forecast of alternative C, offsite mixed waste treatment facilities would be utilized as described for alternatives A and B except that no wastes would be shipped offsite to the Waste Engineering Development Facility at the Idaho National Engineering Laboratory. Mercury-contaminated waste would be vitrified at the non-alpha vitrification facility, and mercury waste would be amalgamated at the containment building under alternative C.

B.22 ORGANIC WASTE STORAGE TANK

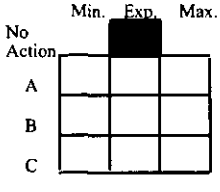
OBJECTIVE:

The Organic Waste Storage Tank provides RCRA storage for organic waste generated from high-level waste processing at the Defense Waste Processing Facility.

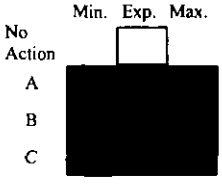
DESCRIPTION:

Beginning in 1996, a 570-cubic meter (150,000-gallon) stainless steel tank would be used for the storage of mixed organic waste generated from the Defense Waste Processing Facility. This tank is referred to as the Organic Waste Storage Tank and is located in the 200-S Area. The tank has a double-seal internal floating roof in addition to a fixed dome roof. The tank vapor space would be filled with nitrogen gas, an inert gas, to prevent ignition. A full-height carbon steel outer vessel would serve as secondary containment for the tank. Waste would be transferred to the tank from the Defense Waste Processing Facility via a welded steel overhead line. Mixed organic waste to be stored in the tank would consist mostly of benzene (80 to 90 percent) and other aromatic compounds, with small amounts of mercury (WSRC 1993h). TE

PROJECT-SPECIFIC ACTIONS:



No Action - Based on DOE's 30-year expected waste forecast, approximately 151 cubic meters (5,300 cubic feet) of organic waste would be generated every year from 1996 to 2,014 for a total of 2,793 cubic meters (98,600 cubic feet). Under the no-action alternative, DOE plans to continue to store this organic waste. Therefore, the storage capacity of the existing 570-cubic meter (150,000-gallon) tank would be sufficient for approximately 4 years. To accommodate mixed organic waste generation, DOE would build additional organic waste storage tanks identical to the existing tank. Accordingly, 4 additional 570-cubic meter (150,000-gallon) organic waste storage tanks would need to be constructed in S-Area over the 30-year period (Hess 1995a). TC



Alternatives A, B, and C - The amount of mixed organic waste generated would be the same for each waste forecast and is the same as described under the no-action alternative. Under alternatives A, B, and C, DOE would treat the mixed organic

waste; therefore, the existing 570-cubic meter (150,000-gallon) tank would provide sufficient storage capacity over the next 30 years. No additional tanks would need to be constructed.

B.23 PROCESS WASTE INTERIM TREATMENT/STORAGE FACILITY

OBJECTIVE:

The Process Waste Interim Treatment/Storage Facility was built to store the wastewater slurry generated by the M-Area Liquid Effluent Treatment Facility process until a concentrated wastewater treatment process was developed. This vitrification treatment process is to be provided by a commercial vendor, the M-Area Vendor Treatment Facility (Appendix B.15). The treatment facility is currently being permitted, and when it has been constructed and placed in operation, it would treat the wastes currently stored in the Process Waste Interim Treatment/Storage Facility tanks. TE

DESCRIPTION:

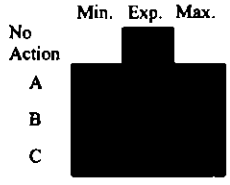
The M-Area Liquid Effluent Treatment Facility was built to treat M-Area waste acids, caustics, and rinse waters. The M-Area Liquid Effluent Treatment Facility is an industrial wastewater treatment facility that includes three linked treatment facilities: the Dilute Effluent Treatment Facility; the Chemical Transfer Facility; and the Process Waste Interim Treatment/Storage Facility. The Dilute Effluent Treatment Facility (Building 341-M) consists of wastewater equalization, physical/chemical precipitation, flocculation, and pressure filtration process equipment. The filtercake resulting from the precipitation and filtration processes is transported to the Chemical Transfer Facility in dedicated 55-gallon drums. The Chemical Transfer Facility originally treated concentrated process wastewater and plating-line solutions prior to transfer to the Process Waste Interim Treatment/Storage Facility tanks, but presently it only slurries the Dilute Effluent Treatment Facility filtercake for pipeline transfer to the tanks.

The M-Area Process Waste Interim Treatment/Storage Facility tanks are used for storing concentrated mixed wastes (i.e., electroplating sludge) from the M-Area Liquid Effluent Treatment Facility. These tanks have been granted interim status under RCRA. The Process Waste Interim Treatment/Storage Facility consists of six 132-cubic meter (35,000-gallon) tanks and four 1,900-cubic meter (500,000-gallon) tanks (WSRC 1992e).

The 132-cubic meter (35,000-gallon) tanks are single-shelled, welded-steel tanks and are located inside Building 341-1M. Building 341-1M consists of a single reinforced concrete pad with steel walls and a roof. To contain leaks and gather accumulated liquids, the concrete pad is diked and slopes towards a sump. The tanks are mounted horizontally on steel saddle support structures to prevent them from coming into contact with accumulated liquids.

The 1,900-cubic meter (500,000-gallon) tanks are double-walled welded-steel tanks that have been field constructed on individual reinforced concrete pads. These tanks are outside. The double-walled construction would contain releases due to tank failure. Additionally, each tank is designed to overflow to one of the other tanks (WSRC 1992e).

PROJECT-SPECIFIC ACTIONS:



Under the no-action alternative and for all waste forecasts of alternatives A, B, and C, the M-Area Process Waste Interim Treatment/Storage Facility tanks would continue to store concentrated mixed wastes from the M-Area Liquid Effluent Treatment Facility. The Process Waste Interim Treatment/Storage Facility tanks would be used to prepare the waste feed to the M-Area Vendor Treatment Facility and to store offgas-scrubber-blowdown liquid from the vitrification unit prior to treatment at the M-Area Liquid Effluent Treatment Facility.

TE | The existing tanks would provide sufficient storage capacity under all alternatives.

B.24 RECYCLING UNITS

RECYCLING UNIT: Silver Recovery

OBJECTIVE:

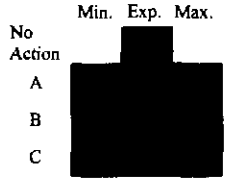
The silver recovery system is located in Building 725-N and extracts silver from waste photographic fixative solutions used to develop X-rays films and silk screens. The silver is extracted using ion exchange technology (Nelson 1993).

DESCRIPTION:

Waste solutions flow by gravity from a 18.93-liter (5-gallon) storage vessel into the first of two ion exchange cartridges connected in series to ensure that silver solutions are not accidentally discharged. Each ion exchange cartridge contains a core of iron powder or steel wool which acts as an ion exchange media when the silver-containing solutions are passed through. The waste solutions drain through the first cartridge into the second one. The first (primary) ion exchange cartridge is removed from the process line when it is saturated with silver. The second ion exchange cartridge is then moved to the primary cartridge location, and its original place filled with a fresh ion exchange cartridge (WSRC No date). | TE

The treated fixative solution is discharged to the N-Area sanitary sewer at an average rate of 0.022 liters (0.01 gallons) per minute with a peak discharge of 0.131 liters (0.03 gallons) per minute. Rinse water is also generated when spent ion exchange cartridge cores are flushed. Periodically, the rinse water discharges through the spent ion exchange cartridge and into the silver recovery unit at 0.379 liters (0.1 gallons) per minute (Stewart 1992). After the spent cores are rinsed, dried, packaged, they are shipped offsite for recovery of precious metals (WSRC No date). | TE

PROJECT-SPECIFIC ACTIONS:



Under each alternative, the facility would operate as described.

RECYCLING UNIT: Lead Melter

OBJECTIVE:

The lead melter melts and recycles scrap lead that is not radioactively contaminated (WSRC 1992f).

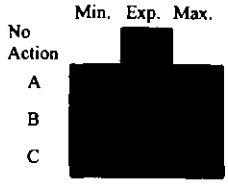
DESCRIPTION:

The lead melter is located in Building 711-4N.

The furnace consists of two pots which hold 4,082.4 kilograms (9,000 pounds) and 3,175.2 kilograms (7,000 pounds) of scrap lead, respectively. The furnace operates at least weekly for batch processing of scrap lead. It uses Number 2 Fuel Oil (Dukes 1994). The molten lead is reconfigured for new uses and/or stored. The recycled lead can be used as radiation shielding, counterweights, or for other
TE | purposes (WSRC 1993i).

Particulates and vapors generated during lead melting, from both the lead and the fuel combustion exhaust, are contained within the furnace and discharged through a high efficiency particulate air pre-filter and filter to the atmosphere. Lead and particulate emissions are estimated to be between 2.43×10^{-8} and 4.86×10^{-8} metric tons per year (2.68×10^{-8} and 5.36×10^{-8} tons per year). Fugitive lead emissions (those not discharged out a stack but escaping through doors, windows, etc.) from melting and pouring are estimated at between 3.25×10^{-5} and 6.43×10^{-5} metric tons per year (3.58×10^{-5} and 7.14×10^{-5} tons per year) (Dukes 1994). Residue from melting operations is regulated as hazardous waste and is managed in a satellite accumulation area prior to onsite permitted storage. Approximately 0.21 cubic meter (7 cubic feet) of residue are generated per month.

PROJECT-SPECIFIC ACTIONS:



Under each alternative, the facility would operate as described.

RECYCLING UNIT: Solvent Reclamation

OBJECTIVE:

Solvent reclamation units distill waste solvents and condense the reclaimed solvents for future use.

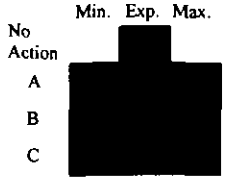
DESCRIPTION:

Five solvent reclamation units exist at SRS. Two are located in building 725-2N, while three are portable and are transported to various locations throughout SRS (WSRC 1992g). Each solvent reclamation unit is composed of a 28.39-liter (7.5 gallon) electrically powered still. The still is filled with waste solvent and heated to the boiling temperature of the solvent to be reclaimed. Solvent vapors are captured within a unit-contained condenser and cooled with a recycled antifreeze and water mixture. The condensed solvent flows into a clean solvent drum. The duration of distillation for each 28.39-liter (7.5 gallon) batch is approximately 4 hours (WSRC 1993i). TE

Each solvent distillation vessel is sealed to prevent vapor releases to the atmosphere. Vapor effluent from the reclaimed solvent container is treated with air-phased activated carbon units which are periodically inspected for solvent saturation. Discharges of volatile organic compounds to the atmosphere are estimate at 0.005 kilograms (0.01 pounds) per hour of operation per unit (WSRC 1992g).

Waste solvent residue is cleaned from the stills, containerized, and managed in a satellite accumulation area prior to onsite permitted storage. Coolant solution is collected in a holding tank and reused (WSRC 1993i).

PROJECT-SPECIFIC ACTIONS:



Under each alternative, the facility would operate as described.

RECYCLING UNIT: Refrigerant Gas Recovery and Recycling

OBJECTIVE:

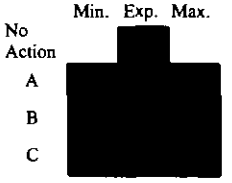
These closed-loop systems recover and reuse chlorofluorocarbons and hydrochlorofluorocarbons without venting to the atmosphere (WSRC 1993i). Equipment that uses refrigerant gases is recharged with one of these units. Gases are also reclaimed from decommissioned cooling equipment prior to disposal (Hess 1994i).

DESCRIPTION:

There are 71 refrigerant gas recovery and recycling units at SRS (Hess 1994j). These portable units are based in Buildings 711-5N and 716-N; however, they are used throughout SRS. The process of reclaiming the refrigerants involves attaching a refrigerant gas recovery unit to the equipment being recharged. The refrigerant gas is released into the unit's sealed recovery system. The warm gas is forced at high velocity into a oil/acid separator where oils, acids, and particulates (e.g., copper chips) drop to the bottom of the separator. The separated, cleaned vapors then pass through a compressor and condenser to form a liquid refrigerant. The liquid is then cooled to between 1.7 and 4.4 °C. The cooling promotes drying of the liquid and air separation. The reclaimed refrigerant is stored within the unit (Hess 1994j). Storage capacity is 13.61 kilograms (30 pounds) or 40.82 kilograms (90 pounds), depending on the unit. Recycled refrigerant, stored within the unit, is used to recharge the cooling equipment (Hess 1994i).

Refrigerant recycling units are closed loop-systems; therefore, no refrigerant gas emissions are released (Hess 1994i). Oil, acid, and particulates separated from waste gas are removed from the separating unit and managed as waste oil (a nonhazardous waste), which is burned for energy recovery in an SRS powerhouse boiler (Harvey 1994).

PROJECT-SPECIFIC ACTIONS:



Under each alternative, the facility would operate as described.

RECYCLING UNIT: Vacuum Stripping Facility

OBJECTIVE:

This portable stripping device is used to abrade contaminated surface coatings from materials (Miller 1994a).

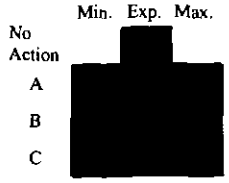
DESCRIPTION:

The vacuum stripping facility is located in Building 728-N. Vacuum stripping pneumatically propels aluminum oxide grit at the surface to be decontaminated. The surface is abraded by the impact of the grit. The grit and dislodged material are vacuumed from the surface immediately. The unit separates contaminated material and shattered grit from the intact grit and reuses the intact grit in the decontamination process (Miller 1994a).

Particulates generated during decontamination are captured in a dust filter. The waste captured in the dust filter is stabilized with an agent such as concrete if the waste is finely powdered and managed as low-level waste. A secondary high efficiency particulate air filter is installed on the stripper to prevent releases to the atmosphere (Hess 1994k). The building is also equipped with high efficiency particulate air filters to further ensure contaminants are not released to the atmosphere. | TE

The rate at which high efficiency particulate air filters are used and the volume of waste from the dust filter depends on the size and level of contamination of the equipment being decontaminated. The volume of job-control waste depends on the number of jobs at the facility. Based on the equipment to be decontaminated during the first quarter of Fiscal Year 1995, the waste estimate is 0.01 cubic meters (0.35 cubic feet) of removed contamination and unusable grit (excludes stabilizing agent volume) and 0.453 cubic meters (16 cubic feet) of job-control waste (Miller 1994b). The volume of unusable grit generated is estimated at 0.002 cubic meters (0.07 cubic feet) per day (Miller 1994a).

PROJECT-SPECIFIC ACTIONS:



Under each alternative, the facility would operate as described.

RECYCLING UNIT: Carbon Dioxide Blasting Facility

OBJECTIVE:

The carbon dioxide blasting facility would be located in C-Area (Miller 1994b) and is scheduled to be in operation by the second quarter of fiscal year 1995 (Miller 1994a). This facility uses solid carbon dioxide pellets (i.e., dry ice) to remove surface contaminants without degrading the surface (Hess 1994k).

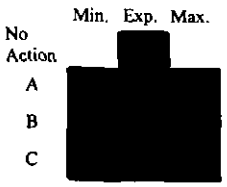
DESCRIPTION:

The carbon dioxide facility would produce solid dry ice pellets and pneumatically propel them at the contaminated surface. Upon contact, the pellets flash into the gaseous phase, simultaneously purging contaminants from the microscopic pores on the surface. Large particles are also dislodged by this flashing action. This nondestructive technology can be used on delicate materials and equipment
TE | (Hess 1994k).

Carbon dioxide and contaminant emissions are captured by the two sets of high efficiency particulate air filters installed in the enclosure (Miller 1994a). The wastes generated during the decontamination are spent high efficiency particulate air filters from the carbon dioxide blaster enclosure, removed material that does not reach the high efficiency particulate air filters, and job-control waste (i.e., protective clothing, radiological survey swipes, etc.). The spent high efficiency particulate air filters would be managed as low-level or mixed waste, depending on the equipment decontaminated. The decontamination of lead equipment would yield mixed waste, while the decontamination of steel equipment would yield low-level waste (Miller 1994c). Larger particles of foreign material which do
TE | not reach the high efficiency particulate air filters would be vacuumed from the blaster's enclosure, stored, and disposed of as low-level or mixed waste (Hess 1994k).

The number of high efficiency particulate air filters and volume of large contamination particles generated depends on the size and contamination level of the equipment decontaminated. The volume of job-control waste depends on the production level for the facility. Based on the equipment to be decontaminated during the second quarter of fiscal year 1995, waste generation is estimated at 0.03 cubic meters (1.1 cubic feet) of mixed waste and 0.23 cubic meters (8.1 cubic feet) of low-level job-control waste during that time (Miller 1994c).

PROJECT-SPECIFIC ACTIONS:



Under each alternative, the facility would operate as described.

RECYCLING UNIT: Kelly Decontamination Facility

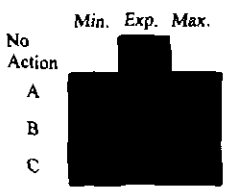
OBJECTIVE:

The Kelly decontamination unit is portable and would be used at various locations throughout SRS to decontaminate floors and installed equipment; it would be housed in C-Area (Miller 1994b). This decontamination system would use superheated water to pressure-clean contaminated surfaces (Miller 1994a).

DESCRIPTION:

Water and contaminated materials would be collected by the unit and treated through a separator and a demister/high efficiency particulate air filter. The Kelly unit generates 3.03 liters (0.8 gallons) per minute (Miller 1994a). The wastes generated would be liquid radioactive waste that would be transferred to 211-F for eventual transfer to the F- and H-Area tank farms and a filtercake that would be dewatered and stabilized prior to being placed in a 2.6-cubic-meter (90-cubic-foot) box and managed as low-level waste (Miller 1994c). TE

PROJECT-SPECIFIC ACTIONS:



Under each alternative, the facility would operate as described.

B.25 REPLACEMENT HIGH-LEVEL WASTE EVAPORATOR

OBJECTIVE:

The Replacement High-Level Waste Evaporator is currently in the design and construction phase. It is being built so that liquid high-level waste can be processed in the future to meet waste tank capacity requirements. Of the four existing evaporators at SRS, only two are operational; the Replacement High-Level Waste Evaporator is needed to meet the demand for waste evaporation and subsequent processing at the Defense Waste Processing Facility. Once operational, the new evaporator would have more than twice the design capacity of each of the 2H and 2F evaporators and would be able to process the Defense Waste Processing Facility recycle waste stream in addition to high-heat waste (i.e., waste that contains high levels of radioactivity). Without the Replacement High-Level Waste Evaporator, the tank farms would run out of required tank space, and the Defense Waste Processing Facility would be forced to stop processing high-level waste (WSRC 1993f).

Construction of the Replacement High-Level Waste Evaporator was initiated and is continuing as a categorical exclusion under then-current DOE NEPA guidelines (52 FR 47662). Regulatory oversight for the project was originally provided under RCRA and continues under the provisions identified in Industrial Wastewater Permit number 17,424-IW for F/H-Area tank farms. The planned startup date for
TE | the Replacement High-Level Waste Evaporator is May 1999 (WSRC 1994h).

DESCRIPTION:

Figure B.25-1 is a simplified process diagram of the Replacement High-Level Waste Evaporator. The Replacement High-Level Waste Evaporator, like the existing evaporators, could be described as a large pot in which the waste is heated by a bundle of bent tube steam coils. The evaporator will be constructed of stainless steel, approximately 4.3 meters (14 feet) in diameter and 8.2 meters (27 feet), contained in a reinforced concrete building. Liquid supernatant would be transferred to the evaporator from an evaporator feed tank. Within the evaporator, the supernatant would be heated to its boiling point, forming a vapor phase called "overheads." The overheads would be condensed and monitored to ensure that they contain no unexpected excessive amounts of entrained (captured) radionuclides. Following condensing and monitoring, the overheads would be transferred to the F/H-Area Effluent Treatment Facility for further treatment. The concentrated supernatant in the evaporator pot would be transferred to
TE | an evaporator receipt tank (WSRC 1994d).

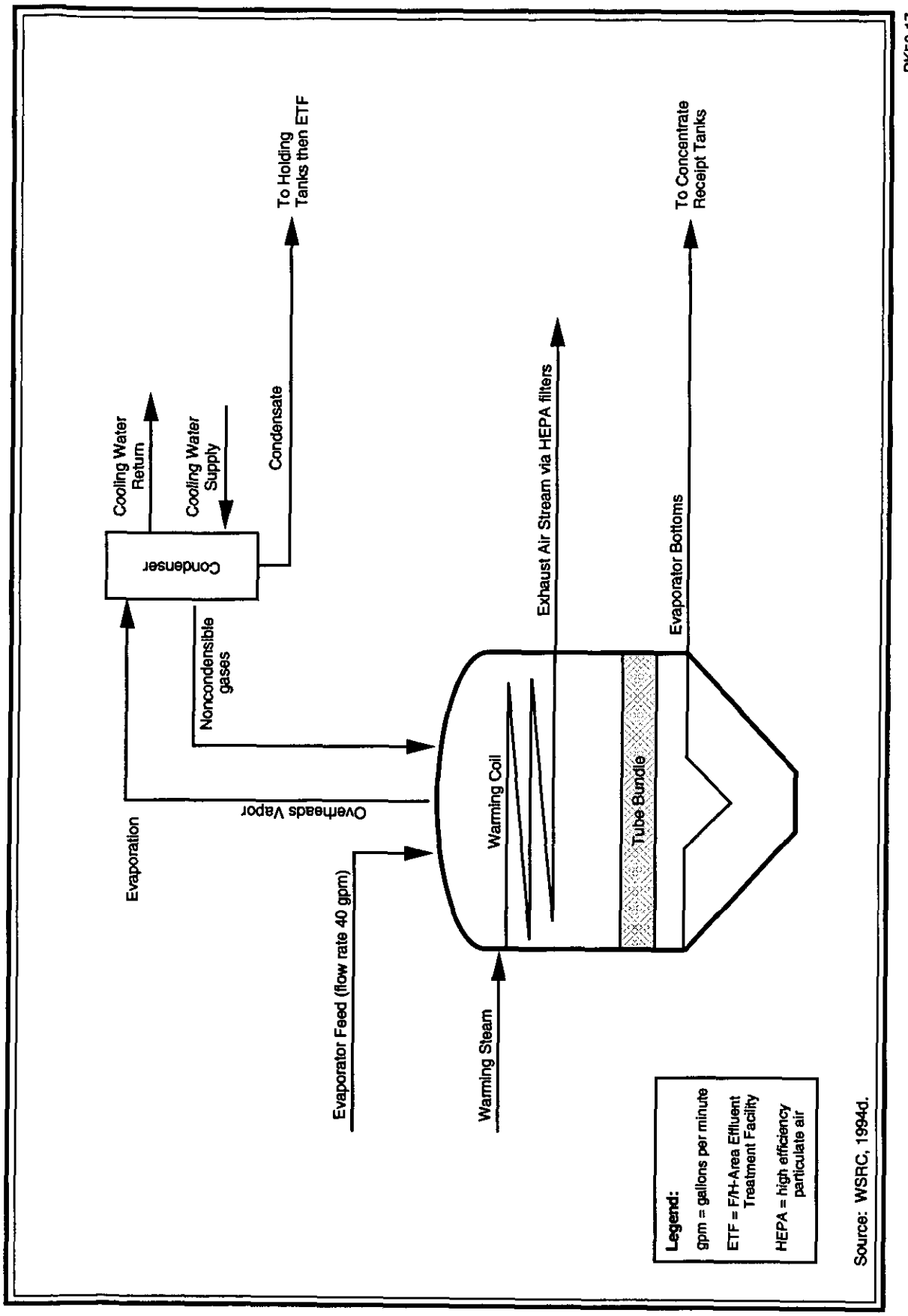
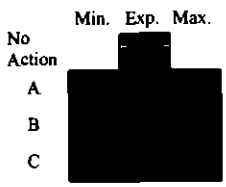


Figure B.25-1. Replacement High-Level Waste Evaporator - simplified diagram.

The Replacement High-Level Waste Evaporator is expected to process 13,815 cubic meters (3.6×10^6 gallons) of overheads per year (Campbell 1994a). Comparatively, the 2H and 2F evaporators have historically had a maximum annual overhead process rate of 12,900 and 14,000 cubic meters (3.4×10^6 and 3.7×10^6 gallons), respectively (Campbell 1994b).

Replacement High-Level Waste Evaporator design improvements over the existing evaporators include material changes in the heater tube bundle, elimination of de-entrainment equipment and the cesium removal column because of improvements in de-entrainment efficiency (WSRC 1991).

PROJECT-SPECIFIC ACTIONS:



Under each alternative, DOE would continue construction and begin operation of the Replacement High-Level Waste Evaporator. The operational rate of the Replacement High-Level Waste Evaporator would not change as a result of the reduced volumes anticipated in the minimum waste forecast or the increased volumes anticipated in the maximum waste forecast.

B.26 SAVANNAH RIVER TECHNOLOGY CENTER MIXED WASTE STORAGE TANKS

TE

OBJECTIVE:

The Mixed Waste Storage Tanks provide storage and treatment capacity for wastewater from the low-activity drain system and high-activity drain system that support research, development, and analytical programs at the Savannah River Technology Center (SRTC).

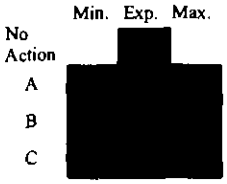
DESCRIPTION:

Ten interim status steel storage tanks are located below grade in concrete vaults at the Savannah River Technology Center in Building 776-2A. Seven tanks each have a capacity of 22 cubic meters (5,900 gallons) and three tanks each have a capacity of 14 cubic meters (3,670 gallons) (WSRC 1992h). These tanks are used to store liquid radioactive waste that could potentially be hazardous (hence mixed waste) due to corrosivity or toxicity for chromium, lead, mercury, or benzene.

Waste is segregated in the tanks by its radiological levels: high-activity (greater than 1,000 disintegrations per minute per milliliter alpha or beta-gamma activity) and low-activity (less than 1,000 disintegrations per minute per milliliter alpha or beta-gamma activity). When a tank is full it is sampled and analyzed for radioactivity and selected hazardous constituents. If the contents are determined to be nonhazardous, waste is transferred to the separation facility in F-Area. If the contents are determined to be hazardous, the waste is treated in the tank prior to transfer to F-Area.

If the waste is hazardous because of corrosivity, it would be made nonhazardous by adjusting the pH with an appropriate neutralizer. The waste would be treated by sorption on an appropriate ion exchange medium to remove the hazardous constituent(s) of chromium, lead, mercury and/or benzene. The ion exchange process can only remove chromium in the trivalent form (chromium III). If chromium were present in the hexavalent form (chromium VI), the waste would first be pretreated to convert the chromium VI to chromium III. This could be done by adding a reducing agent to the tank. After treatment, the waste would be transferred to the separation facility in F-Area (WSRC 1992h).

PROJECT-SPECIFIC ACTIONS:



Under each of the alternatives, DOE would continue to receive, store, and treat via ion exchange liquid mixed wastes in the Savannah River Technology Center Mixed Waste Storage Tanks. If required, the waste would also be treated by neutralization and/or chromium reduction. It is expected that 75 cubic meters (2,600 cubic feet) per year of high-activity waste and 75 cubic meters (2,600 cubic feet) per year of low-activity waste would be generated and managed at the Savannah River Technology Center Mixed Waste Storage Tanks (WSRC 1995). Because the waste is treated as it is generated, the 10 existing Savannah River Technology Center Mixed Waste Storage Tanks would have sufficient capacity for the 30-year analysis period. The treated wastewater would be transferred to the separation facility in F-Area and has been included in the liquid high-level waste volume forecasted for that facility.

TE

B.27 SHALLOW LAND DISPOSAL

TE

OBJECTIVE:

In general, shallow land disposal in this EIS refers to trench disposal.

DOE Order 5820.2A establishes performance objectives for the disposal of low-level wastes. A radiological performance assessment is required to ensure that the waste inventory and the proposed disposal method provide reasonable assurance that the performance objectives will be met. The radiological performance assessment projects the migration of radionuclides from the disposed waste to the environment and estimates the resulting dose to man. DOE has completed a radiological performance assessment for trench disposal of suspect soils (as part of the radiological performance assessment for the E-Area vaults). DOE anticipates that naval reactor hardware will be deemed suitable for shallow land disposal after additional data on the composition and configuration of the waste forms is obtained and can be incorporated in the radiological performance assessment. Stabilized waste forms resulting from the proposed treatment activities (i.e., vitrification and incineration) would be evaluated against the DOE Order 5820.2A performance objectives. Radiological performance assessments for these stabilized low-level wastes (wastes in which the radionuclides have been immobilized in a cement or glass matrix or encapsulated) are expected to demonstrate that shallow land disposal achieves the performance objectives of DOE Order 5820.2A.

For purposes of analysis in this EIS, stabilized waste forms and selected low-level wastes (suspect soils and naval hardware) are assumed to be suitable for shallow land disposal. The analyses provide groundwater concentrations as a result of shallow land disposal of suspect soils based on the radiological performance assessment's unit concentration factors and the EIS waste inventories. DOE expects that the releases resulting from the disposal of stabilized wastes and naval hardware in slit trenches would be comparable to those for unstabilized suspect soils and would comply with performance objectives specified by DOE Order 5820.2A. Therefore, for purposes of defining the alternatives in this EIS, DOE has assumed shallow land disposal for these wastes.

TC

DESCRIPTION:

Shallow land disposal (or trenches) was described in the *Final Environmental Impact Statement, Waste Management Operations* (ERDA 1977). Shallow land disposal (or shallow land burial) was also described in the *Waste Management Activities for Groundwater Protection Environmental Impact Statement* and identified as an acceptable technology for low-level waste under the preferred

"combination" alternative. Shallow land disposal has continued in the Low-Level Radioactive Waste Disposal Facility and is expected to continue at the E-Area vault site for some low-level wastes (e.g., suspect soil and low-activity equipment that is too large for disposal in the E-Area vaults).

Radioactive waste disposal activities in the Low-Level Radioactive Waste Disposal Facility (see Figure 3-33) commenced in 1972 and continue to the present. Areas within the Low-Level Radioactive Waste Disposal Facility include:

- engineered low-level trenches for disposal of containerized low-activity waste and suspect soils
- greater confinement disposal boreholes and engineered trenches for disposal of intermediate-activity waste that is compatible with trench disposal
- slit trenches for disposal of containerized intermediate-activity waste, bulky noncontainerized low-activity waste, loose soil and rubble, and containerized offsite wastes

Engineered low-level trenches are basically large open pits in which low-activity waste boxes are placed. The engineered low-level trenches are several acres in size and are approximately 6.7 meters (22 feet) deep. The other dimensions are adjusted to maximize use of burial space. The engineered low-level trenches have sloped sides and floor, allowing rainwater to flow to a collection sump. Once the trench is full of boxes, it is backfilled and covered with a minimum of 1.8 meters (6 feet) of soil. Soil that is suspected to be contaminated and cannot economically be demonstrated to be uncontaminated (i.e., suspect soil) is used as backfill material in engineered low-level trenches. To date three engineered low-level trenches have been filled and a fourth trench is currently receiving only suspect soils (Hess 1995b).

TC

Greater confinement disposal boreholes have been augered to a depth of about 9.1 meters (30 feet) and are lined with fiberglass (with the exception of one borehole which is lined with steel). The boreholes are encased within a 0.3-meter (1-foot) thick concrete annulus. Waste in the borehole is stabilized by grouting around the waste to fill voids. After the boreholes are filled, clay caps are placed over them. Each greater confinement disposal borehole is monitored for leaching of radionuclides into the surrounding medium. Existing boreholes have reached capacity, and construction of additional boreholes is not anticipated.

Greater confinement disposal engineered trenches are constructed of reinforced concrete and consist of four cells. A trench is approximately 30 meters (100 feet) long and 15 meters (50 feet) wide with four cells each 8 meters (25 feet) long and 15 meters (50 feet) wide with a disposal capacity of approximately

850 cubic meters (30,000 cubic feet) per cell. When a cell is not being used, steel covers are placed over it to minimize rainwater intrusion. Additionally, drainage channels direct water away from the trench. The trench has a leachate collection system to collect rainwater that may enter the cells (WSRC 1993b). The greater confinement disposal engineered trench has a capacity of 3,400 cubic meters (1.2×10^5 cubic feet) and is filled to 75 percent of capacity. There is 850 cubic meters (30,000 cubic feet) of capacity remaining. DOE discontinued disposal of low-level waste in this engineered trench on March 31, 1995, and has no future plans to use the remaining capacity or construct additional engineered trenches (Hess 1995b). TC

Slit trenches are 6.1 to 9.4 meters (20 to 30 feet) wide, 6.7 meters (22 feet) deep, and up to 300 meters (985 feet) long (WSRC 1994b). Shortly after waste is placed in a slit trench, it is covered with soil to control radiation exposure and to reduce the potential for spread of contamination through airborne releases (WSRC 1993b, 1994b). Once a trench is filled with waste, it is backfilled with a minimum of 1.8 to 2.4 meters (6 to 8 feet) of soil to reduce surface radiation dose rates to less than 5 millirem per hour, to reduce the potential for spread of contamination, and to minimize plant and animal intrusion into the waste (WSRC 1993b). For analysis purposes in the EIS, it is assumed that a slit trench has a nominal capacity of approximately 1,100 cubic meters (38,852 cubic feet) based upon trench dimensions of 6.1 meters (20 feet) wide, 6.1 meters (20 feet) deep, and 30 meters (100 feet) long.

DOE discontinued disposal of containerized low-level waste in the greater confinement disposal engineered trench and an engineered low-level trench on March 31, 1995. TC In September 1994, DOE began to use concrete vaults referred to as the low-activity waste vaults for disposal of containerized low-activity waste. In February 1995, DOE began to use concrete vaults referred to as intermediate-level waste vaults for disposal of intermediate-activity waste (Hess 1995b). TC

Naval reactor core barrels and reactor components are stored on gravel pads in the Low-Level Radioactive Waste Disposal Facility. The gravel pads have a total storage capacity of 697 square meters (7,500 square feet). If DOE determines that reactor component containers satisfy the performance objectives of DOE Order 5820.2A, these component containers would also be sent to shallow land disposal (WSRC 1994l). TE

PROJECT-SPECIFIC ACTIONS:

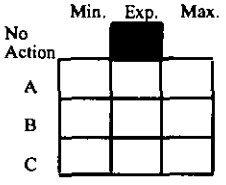
Table B.27-1 presents low-level waste management activities for shallow land disposal. TE

TE **Table B.27-1.** Total waste requiring shallow land disposal and number of slit trenches (cubic meters).[a,b]

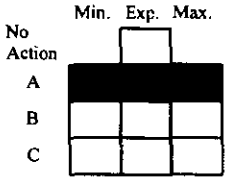
	Min.	Exp.	Max.
		30,876 m^3 total 29 trenches	
A	26,808 m^3 total 25 trenches	79,723 m^3 total 73 trenches	708,025 m^3 total 644 trenches
B	39,737 m^3 total 37 trenches	63,316 m^3 total 58 trenches	407,362 m^3 total 371 trenches
C	49,250 m^3 total 45 trenches	134,579 m^3 total 123 trenches	632,753 m^3 total 576 trenches

TC

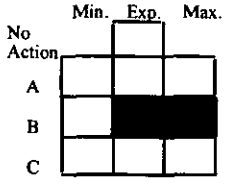
a. Source: Hess (1995a).
b. To convert to cubic feet, multiply by 35.31.



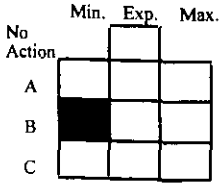
Under the no-action alternative, DOE would send suspect soils, naval hardware, and stabilized residuals from treatment of radioactive PCBs to shallow land disposal.



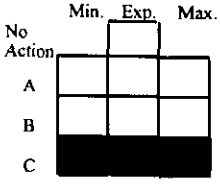
For each waste forecast of alternative A, DOE would send stabilized ash and blowdown from the Consolidated Incineration Facility and waste listed under the no-action alternative to shallow land disposal.



Under alternative B - expected and maximum waste forecasts, DOE would send For wastes from the non-alpha vitrification facility, stabilized residuals from the offsite smelter and metal melt, and waste listed under alternative A to shallow land disposal.



For alternative B - minimum waste forecast, DOE would dispose of the same waste as under alternative B expected and maximum waste forecasts, except for vitrified wastes from the non-alpha vitrification facility, by shallow land disposal. The non-alpha vitrification facility would not operate under the minimum waste forecast alternative B due to insufficient waste volume to warrant it. | TE



Under alternative C, DOE would send waste listed for alternative B - expected and maximum waste forecasts, except for residuals from the offsite metal melt, and vitrified waste from the alpha vitrification facility to shallow land disposal. | TC

TE

B.28 SOIL SORT FACILITY

OBJECTIVE:

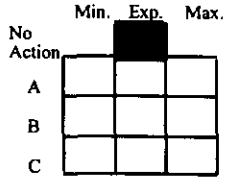
The soil sort facility would provide a process to determine whether soils are contaminated and segregate uncontaminated soils for reuse, reducing the volume of soil that would require treatment and/or disposal.

DESCRIPTION:

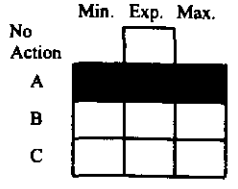
The soil sort facility would be a mobile assembly of standard sand-and-gravel handling equipment coupled with instrumentation for monitoring radiation, which would allow contaminated material transported along a conveyor system to be diverted from uncontaminated material. The ability to locate small particles of radioactive material dispersed throughout the soil would allow contaminants to be isolated and removed. No sorting of tritiated soils would be performed due to the lack of effective monitoring.

DOE anticipates that a soil sort facility sorting efficiency would yield a separation ratio of 60 percent contaminated to 40 percent uncontaminated soils for mixed waste soils and low-activity waste soils and 40 percent contaminated to 60 percent uncontaminated soils for suspect soils. Uncontaminated soils would be reused onsite as backfill (Hess 1994b).

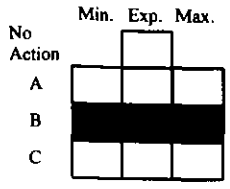
PROJECT -SPECIFIC ACTIONS:



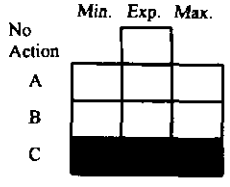
Under the no-action alternative, DOE would not construct or operate the mobile soil sort facility.



The mobile soil sort facility would be constructed and operated only for mixed waste soils under alternative A. The facility would commence operations in 2006.



Low-activity waste soil and suspect soil would be segregated under alternative B. The facility would commence operations in 1996. Because the non-alpha vitrification facility would not be required for the minimum waste forecast under alternative B, the soil sort facility would also process mixed waste soils under that scenario, beginning in 2006.



Under alternative C, the soil sort facility would not operate because the mixed and low-level waste soils would be treated at the non-alpha vitrification facility, which includes a soil sorting capability.

Under each alternative, estimated volumes of low-level and mixed waste processed by the soil sort facility are shown in Table B.28-1. TE

Table B.28-1. Estimated volumes of soil sorted for each alternative (cubic meters).[a,b] TE

	Min.	Exp.	Max.
		Facility not constructed	
A	23,873 m^3 of mixed waste soils 1,257 m^3 per year	88,331 m^3 of mixed waste soils 4,650 m^3 per year	440,060 m^3 of mixed waste soils 23,161 m^3 per year
B	19,192 m^3 of low-level waste soils 322 to 2,806 m^3 per year 23,873 m^3 of mixed waste soils 1,257 m^3 per year	48,489 m^3 of low-level waste soils 294 to 2,542 m^3 per year	776,707 m^3 of low-level waste soils 2,193 to 31,906 m^3 per year
C	Facility not constructed	Facility not constructed	Facility not constructed

TC

a. Source: Hess (1995a).
b. To convert to cubic feet, multiply by 35.31.

TE

B.29 SUPERCOMPACTOR

OBJECTIVE:

DOE is pursuing treatment options to reduce the volume of low-level wastes to more efficiently use the disposal capacity of the low-level waste vaults. In the draft EIS, DOE proposed to construct and operate an onsite supercompactor to accept equipment and additional job-control wastes that could not be compacted at the existing SRS compactor facilities. DOE has since determined that treatment capacity for many of these wastes is currently available through commercial vendors. Contracting with an offsite commercial vendor would allow DOE to obtain treatment capacity for its low-level wastes sooner than construction of an onsite facility (a contract could be executed by fiscal year 1996 as opposed to 2006 before beginning operations of an onsite facility). Details of the proposed commercial vendor treatments for low-level waste can be found in Appendix B.20. Although the commercial vendor treatment has replaced the onsite supercompactor in the proposed configuration for alternative B, DOE may need to develop onsite treatment capability in lieu of using commercial vendors in the future. Therefore, the waste volumes that could be treated in an onsite supercompactor facility and the associated impacts are presented in this appendix.

TC

DESCRIPTION:

The supercompactor would be located in E-Area and use high compression to exert significant pressure on compactible waste. The compaction efficiency of existing compactors is approximately 4 to 1, whereas the supercompactor could achieve compaction efficiencies of 12 to 1, for job-control waste (Hess 1994a). The system would consist of the following: compaction press, with mold to hold container during size reduction; hydraulic module to operate the press and auxiliary components; ventilation sub-system to control potentially radioactive dust generated during compaction; conveyor system to load and unload containers; liquid collection systems; sealed shipping container for final disposal; and auxiliary components and features to prepare waste for supercompaction. Liquid wastes from the supercompactor would be collected for treatment at the Consolidated Incineration Facility.

PROJECT-SPECIFIC ACTIONS:

TC

In the draft EIS, DOE proposed to construct and operate an onsite supercompactor under alternative B. DOE proposed to operate the facility from the years 2006 to 2024 to supercompact low-level waste comprised of low-activity job-control waste, tritiated job-control waste, and low-activity equipment.

Table B.29-1 presents annual and 30-year estimated volumes of low-level waste for the supercompactor facility as proposed under alternative B of the draft EIS. TE TC

Table B.29-1. Estimated volumes of supercompacted low-level waste for each alternative as proposed in the draft EIS (cubic meters).[a,b,c] TE

	Min.	Exp.	Max.
		None	
A	None	None	None
B	84,805 m^3 4,463 m^3 per year	108,285 m^3 5,699 m^3 per year	229,418 m^3 12,075 m^3 per year
C	None	None	None

TE

a. Source: Hess (1994b).
b. To convert to cubic feet, multiply by 35.31.
c. Details of the proposed commercial vendor treatments for low-level waste in the final EIS are in Appendix B.20.

SUMMARY OF IMPACTS:

The consequences of the supercompaction of low-level radioactive wastes at a new onsite facility were evaluated under alternative B of the draft EIS. In the final EIS, DOE has determined that treatment of low-level wastes can be obtained in a more timely and cost-effective manner by utilizing commercial vendors. Although it is not proposed as an action under any of the alternatives in the final EIS, DOE may need to develop an onsite supercompaction facility in lieu of using commercial vendors in the future. The consequences associated with this onsite treatment activity are described in Table B.29-2, based on the waste volumes considered for supercompaction in the draft EIS.

Table B.29-2. Summary of impacts from the operation of an onsite supercompactor as proposed in the draft EIS.[a]

Minimum Waste Forecast	Expected Waste Forecast	Maximum Waste Forecast
Waste disposal volumes[b]		
9,069 m^3 to LAW[c] vault disposal	13,129 m^3 to LAW vault disposal	32,392 m^3 to LAW vault disposal
Radiological air emissions		
Average annual radiological dose and resulting health effects to the public[d]		
Maximally exposed individual		
2.46×10^{-5} millirem	6.79×10^{-5} millirem	0.00293 millirem
1.23×10^{-11} probability of an excess fatal cancer	3.39×10^{-11} probability of an excess fatal cancer	1.47×10^{-9} probability of an excess fatal cancer
Average annual population dose[e]		
9.58×10^{-4} person-rem	0.00266 person-rem	0.115 person-rem
4.79×10^{-7} number of additional fatal cancers	1.33×10^{-6} number of additional fatal cancers	5.76×10^{-5} number of additional fatal cancers
Average annual radiological dose and resulting health effects to uninvolved workers		
640 meter uninvolved worker		
5.84×10^{-4} millirem	0.00161 millirem	0.070 millirem
2.92×10^{-10} probability of an excess fatal cancers	8.05×10^{-10} probability of an excess fatal cancer	3.50×10^{-8} probability of an excess fatal cancer
100 meter uninvolved worker		
0.0176 person-rem	0.0484 person-rem	2.09 person-rem
8.79×10^{-9} probability of a n excess fatal cancer	2.42×10^{-8} number of additional fatal cancers	1.05×10^{-6} number of additional fatal cancers
Direct exposure[f]		
Average annual radiological dose and resulting health effects to involved workers		
Maximally exposed individual[g]		
0.79 millirem	1.00 millirem	1.69 millirem
3.16×10^{-7} probability of an excess fatal cancer	4.00×10^{-7} probability of an excess fatal cancer	6.77×10^{-7} probability of an excess fatal cancer
Average annual involved worker population dose		
5.53 person-rem	7.00 person-rem	18.6 person-rem
0.00221 number of additional fatal cancers	0.00280 number of additional fatal cancers	0.00744 number of additional fatal cancers

a. Source: Hess (1994b).
b. Compacted waste disposal volumes are for the entire 30-year analysis period.
c. LAW = low activity waste.
d. Average annual dose and probability of fatal cancer obtained by dividing the total dose during the period of interest in this EIS and associated probability by the years of actual operation (i.e., 19 years).
e. Number of additional fatal cancers are per year of Consolidated Incineration Facility operation.
f. Direct exposure to involved workers is scaled to cesium-137. Direct exposure is normalized to the expected forecast average exposure provided by Hess (1994d).
g. Maximum exposure is assumed to be equal to the average worker exposure provided by Hess (1994d).

B.30 TRANSURANIC WASTE STORAGE PADS

TE

OBJECTIVE:

The transuranic waste storage pads provide retrievable storage for nonmixed and mixed alpha waste (10 to 100 nanocuries per gram) and transuranic waste (greater than 100 nanocuries per gram). The waste stored on the transuranic pads is generated at the Savannah River Technology Center, F-Area laboratories, the 235-F Plutonium Fabrication Facility, and the F- and H-Area separations facilities. Future storage needs also include alpha and transuranic wastes that would be generated by decontamination and decommissioning and environmental restoration activities.

DESCRIPTION:

Storage

The alpha and transuranic wastes are packaged, handled, and stored according to the quantity of nuclear material present and RCRA hazardous waste constituents present (i.e., as mixed waste). The waste is packaged in 55-gallon drums; carbon steel, concrete or polyethylene boxes; concrete culverts; or special containers.

DOE packages job-control waste in 55-gallon drums with carbon filter vents. The drums are assayed following packaging and categorized as less than or greater than 0.5 curies per package. The drums that are less than 0.5 curies per drum are placed directly on the transuranic pads for storage. The drums with greater than 0.5 curies are placed inside concrete culverts (because of the radiological activity) before being placed on the transuranic pads. The bulk waste is packaged in carbon steel, concrete, or polyethylene boxes or special containers where internal shielding may be used for greater than 0.5 curies per package. Transuranic waste that has a surface dose rate of greater than 200 millirem per hour per container is handled remotely. Remote-handled waste is packaged in concrete culverts for storage at the transuranic waste storage pads. The remote-handled waste comprises a very small percentage of the overall transuranic waste at SRS.

There are currently 19 transuranic waste storage pads in E-Area. Each pad is a reinforced concrete slab that slopes to the center and drains to one end where a sump is located. Pads' 1 and 2 dimensions are 15 meters by 38 meters (50 feet by 125 feet) and Pads' 14 through 19 are 18 meters by 49 meters (60 feet by 160 feet) (WSRC 1994k).

TE

Pads 1 through 5 are full of waste containers and covered with 0.3 meter (1 foot) of soil, a polyvinyl chloride top, and an additional 0.9 meter (3 feet) of soil which is seeded with grass. The mounds over Pads 1 through 4 are coated with an asphalt spray to control erosion. Pad 6 is full of waste containers and partially mounded by earth. The mounded soil provides shielding from the stored radionuclides and protects the waste from weather and human intrusion.

Pads 7 through 13, 18 and 19 are open-access pads with various types of containers configured without
TE | aisles. Pads 14 through 17 have weather enclosures to provide protection from rain for the stored waste drums until treatment and disposal. The enclosures are leak-proof with ultraviolet light protection, high wind load resistance, and no center supports. These pads would store only drums of waste. Pads 18 and
TE | 19 store only boxes of nonmixed transuranic waste at this time (WSRC 1994k).

Reconfiguration

Pads 7 through 13 have no aisles because SRS has been granted a variance to RCRA aisle spacing and labeling requirements until the containers are accessible. Pads 14 through 17 are not part of the variance and DOE has committed to providing aisles between the waste stored on these pads by 1998.

DOE would implement an alpha and transuranic waste storage strategy to reconfigure the containers on Pads 7 through 17 to meet RCRA interim status storage requirements, where applicable, and maximize the available space on the transuranic waste pads for future storage. DOE would transfer the non-alpha mixed wastes (i.e., wastes with less than 10 nanocuries per gram of transuranics) currently stored on the transuranic pads to other storage pads to provide additional space for alpha and transuranic wastes. The new configuration would include placing containers, other than drums, stacked one high on Pads 7 through 13 and stacking drums three high on Pads 14 through 17. As a result, DOE anticipates needing the space on Pads 18 and 19 to make up for the loss in storage capacity from providing aisles on Pads 14 through 17. As part of the storage strategy DOE is evaluating the use of reactor buildings as storage locations for the alpha and transuranic waste, but technical and regulatory considerations associated with the use of those facilities have not yet been addressed. Therefore, this EIS analysis assumes only pad
TE | storage for the alpha and transuranic waste (WSRC 1994m).

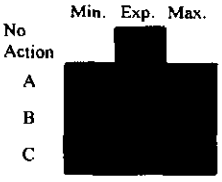
Retrieval

The retrieval portion of the facility's operations involve the removal of 55- or 83-gallon transuranic drums from the mounded Pads 2 through 6. The transuranic waste drums stored on these pads are about to reach their 20-year storage life based on the calculations for the mounded storage configuration

(WSRC 1994m). The retrieval program would be conducted with equipment designed to extract the drums from the mounds. | TE

The earthen mounds cover a close array of 55-gallon drums, stacked two high, sitting on the concrete pad. A weather enclosure would be erected over the pad prior to initiating retrieval. The soil would be removed from the mounds, exposing the drums. Each drum would be individually removed from the stack. The drums would be vented and purged of any gases that may have generated from waste material decomposition as a result of radiological contamination. The vented drums would then be placed in an overpack container fitted with a carbon composite filter to prevent future gas accumulation. Pads 2 through 6 would remain in service for transuranic waste storage following the retrieval operation. Pad 1 would not be retrieved because the waste is stored inside concrete culverts that are expected to provide adequate storage during the 30-year analysis period (WSRC 1994m). | TE

PROJECT-SPECIFIC ACTIONS:



Under the no-action alternative, the transuranic waste storage pads would store the nonmixed and mixed alpha waste and transuranic waste. The retrieval operation would begin in 1997 or 1998, and waste would be rearranged to conform with RCRA requirements and to maximize storage space on the existing pads.

In 1998, additional pads would be needed to increase the storage capacity. A total of 19 additional pads would be required by the year 2024 (Hess 1995a). | TC

For each waste forecast, alternatives A, B, and C would be identical to the no-action except that the amount of additional waste storage capacity would vary according to the transuranic and alpha waste treatment and disposal activities proposed for each alternative. Table B.30-1 presents the number of transuranic waste storage pads required for each alternative. | TE

TE | **Table B.30-1.** Number of additional transuranic waste storage pads that would be required under each alternative.[a]

	Min.	Exp.	Max.
		19 additional pads by 2024	
TC A	3 additional pad by 2006	12 additional pads by 2006	1,168 additional pads by 2006
TC B	2 additional pads by 2005	10 additional pads by 2006	1,168 additional pads by 2006
TC C	2 additional pads by 2004	11 additional pads by 2006	1,166 additional pads by 2006

a. Source: Hess (1995a).

B.31 TRANSURANIC WASTE CHARACTERIZATION/ CERTIFICATION FACILITY

TE

OBJECTIVES:

The transuranic waste characterization/certification facility would provide extensive containerized waste processing and certification capabilities. The facility would have the ability to open various containers (e.g., boxes, culverts, or drums); assay, examine, sort, decontaminate the alpha and transuranic wastes; reduce large wastes to 55-gallon-drum size; weld; and certify containers for disposal.

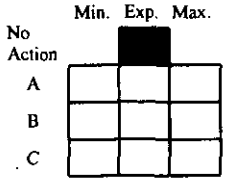
DESCRIPTION:

A transuranic waste characterization/certification facility would characterize and certify nonmixed and mixed alpha (10 to 100 nanocuries per gram) and transuranic wastes (greater than 100 nanocuries per gram). The facility would begin operation in 2007. The facility would prepare transuranic and alpha waste for treatment, macroencapsulate mixed alpha waste, and certify transuranic and alpha waste for disposal.

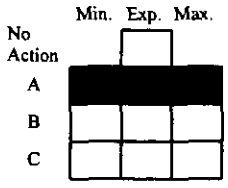
The transuranic waste characterization/certification facility would be located in E-Area adjacent to the alpha vitrification facility. The facility would use nondestructive assay and examination techniques to characterize the waste, open transuranic boxes, reduce the size of the waste, repackage waste in 55-gallon drums for direct disposal or processing by the alpha vitrification facility, and perform a second nondestructive assay and examination to confirm packaging. A 30 percent reduction in waste volume would be realized during repackaging except for transuranic waste to be disposed of at the Waste Isolation Pilot Plant under alternative A. Nondestructive assays (before and after repackaging) would be performed using alpha and neutron detectors. Nondestructive examinations (before and after repackaging) would be performed by real-time x-ray, much like the machines in airports, to identify the contents of the drum. The facility would also have the ability to vent and purge drums that had been stored in culverts and were not vented and purged during drum retrieval activities (Hess 1994a).

TC

PROJECT-SPECIFIC ACTIONS



Under the no-action alternative, the facility would be not constructed.



Under alternative A, the transuranic waste characterization/certification facility would segregate the alpha and transuranic waste according to the following four waste categories:

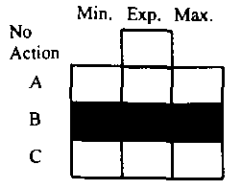
- nonmixed alpha waste
- mixed alpha waste
- plutonium-238 transuranic waste
- plutonium-239 transuranic waste

TC A 30 percent reduction in alpha waste and transuranic waste processed after 2018 and kept in storage at SRS would be realized. No reduction would be realized for transuranic waste processed for disposal at the Waste Isolation Pilot Plant (2008 - 2018).

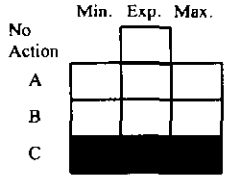
The second nondestructive assay and examination would be performed on vented drums to determine if the waste form (i.e., nonmixed and mixed alpha waste, or plutonium-238 or -239 transuranic waste) meets the applicable waste acceptance criteria. In alternative A, waste could be certified as packaged; repackaged and certified; or repackaged, treated (encapsulated), and certified for disposal. A drum of waste, regardless of its waste category, could be rejected from the second nondestructive assay and examination and be reprocessed in the transuranic waste characterization/certification facility so the waste form meets the waste acceptance criteria of the appropriate disposal facility.

The nonmixed alpha waste would be repackaged and disposed of at the low-activity waste vaults. Most of the mixed alpha waste would be considered hazardous debris in accordance with RCRA land disposal restrictions. DOE would request a treatability variance to macroencapsulate the mixed alpha waste that was not classified as hazardous debris. The mixed alpha waste would be macroencapsulated in steel drums by welding on the lids and sent to RCRA-permitted disposal.

Transuranic waste is identical in composition to alpha waste but has a higher activity (greater than 100 nanocuries per gram) from radiological contamination. The waste would be categorized solely on the dominant radioisotope content (i.e., plutonium-238 or -239) for shipping purposes. DOE would package the transuranic waste to meet the Waste Isolation Pilot Plant waste acceptance criteria.



In alternative B, the alpha and transuranic waste would initially be segregated into four categories as in alternative A. In addition, the mixed alpha waste and plutonium-238 transuranic wastes would be further divided into metallic and nonmetallic waste subcategories. The metallic mixed alpha waste would be macroencapsulated and sent to RCRA-permitted disposal vaults. The plutonium-238 transuranic waste metal would be packaged for disposal at the Waste Isolation Pilot Plant. The nonmetallic mixed alpha and plutonium-238 transuranic waste would be sent to the alpha vitrification facility for treatment. The nonmixed alpha waste would be repackaged and disposed at the low-activity waste vaults. Plutonium-239 waste would be segregated into high- and low-activity fractions. High-activity plutonium-239 transuranic waste would be sent to the alpha-vitrification facility for treatment. Low-activity plutonium-239 transuranic wastes would be packaged to meet the Waste Isolation Pilot Plant waste acceptance criteria. In alternative B, approximately one-third of the transuranic and alpha waste would be repackaged and sent to the alpha vitrification facility for further treatment. TC TC



In alternative C, the alpha and transuranic waste would initially be segregated into four categories as described in alternative A. Metal would be removed during sorting to decontaminate, recycle, and reuse. A third nondestructive assay and examination unit would certify decontaminated metal for reuse. Alpha and transuranic metal that could not be decontaminated would be repackaged in 55-gallon drums, along with the other waste categories, to be sent to the alpha vitrification facility for treatment.

Table B.31-1 presents the volume of waste to be processed in the transuranic waste characterization/ certification facility for each alternative. TE

TE **Table B.31-1.** Volume of waste that would be processed in the transuranic waste characterization/certification facility for each alternative (cubic meters).[a,b]

	Min.	Exp.	Max.
		Not constructed	
A	15,040 m^3 total ~ 1,219 m^3/yr macro[c] = 26 m^3/yr (315 m^3 total)	21,209 m^3 total ~ 1,681 m^3/yr macro = 35 m^3/yr (445 m^3 total)	551,083 m^3 total ~ 45,706 m^3/yr macro = 13,118 m^3/yr (158,160 m^3 total)
TC B	15,040 m^3 total ~ 1,219 m^3/yr macro = 32 m^3/yr (358 m^3 total)	21,210 m^3 total ~ 1,681 m^3/yr macro = 41 m^3/yr (520 m^3 total)	551,083 m^3 total ~ 45,706 m^3/yr macro = 4,251 m^3/yr (51,250 m^3 total)
C	15,040 m^3 total ~ 1,219 m^3/yr macro = 0	21,210 m^3 total ~ 1,681 m^3/yr macro = 0	551,083 m^3 total ~ 45,706 m^3/yr macro = 0

a. Source: Hess (1995a).
b. To convert to cubic feet, multiply by 35.31.
c. Macroencapsulated.

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DOE/EIS-0217
July 1995

APPENDIX C

LIFE-CYCLE TREATMENT, STORAGE, AND DISPOSAL FACILITY COSTS

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C.1 Cost Methodology

This section describes the methodology used to determine life-cycle costs for comparison of alternative treatment, storage, and disposal facilities. Life-cycle costs include preliminary planning, design, construction, operation, secondary waste disposal, and post-operation decommissioning. These costs are distributed along a timeline, and then converted to an equivalent cost in terms of the current value of money. Major components of life-cycle costs include building, equipment, operation and support manpower, and secondary waste disposal costs. The purpose of the cost model is to provide data that can differentiate between treatment options. The cost model consistently applies the same assumptions, such as labor cost rates, building square-footage costs, and others, to the estimating process. Conceptual design estimates for planned facilities and actual estimates for existing facilities are used where possible. For the purpose of this environmental impact statement (EIS), the U.S. Department of Energy (DOE) developed cost assumptions using Westinghouse Savannah River Company standard estimating techniques. For appropriate comparison, DOE assumed that treatment facilities that do not already exist would be located onsite. Each facility estimate includes option-specific costs for the major equipment, the number of man-hours per year required to operate the facility, the facility start-up date, the operating life of the facility, and the required design basis throughput. TE TE

Projected facility costs and manpower requirements differ between the draft and final EIS. This is due to the following factors: a refinement of the parameters that determine operating manpower, building, and equipment costs; a correction to the scope of no-action alternative costs to make them consistent with the other alternative – waste forecast estimates; and new initiatives in alternative B that lowered facility costs for this alternative. In addition, the costing methodology bases construction manpower requirements on building and equipment costs; therefore, both operating and construction employment differ between draft and final EIS. This, in turn, affects projections of socioeconomic and traffic impacts. Cost differences are shown in Table C-1. The cost analysis was changed to be consistent with the *Baseline Environmental Management Report* (DOE 1995) developed by DOE to ensure consistent reporting on estimating future facility construction and operation costs. This report is used to establish future budgetary requirements for the DOE complex. TC

Table C-1. Estimated cost of facilities for each alternative and waste forecast in the draft and final EIS.

	Minimum	Expected	Maximum
No action		Draft: $\$1.0\times10^9$ Final: $\$6.9\times10^9$	
A	Draft: $\$4.5\times10^9$ Final: $\$4.2\times10^9$	Draft: $\$7.9\times10^9$ Final: $\$6.9\times10^9$	Draft: $\$30\times10^9$ Final: $\$24\times10^9$
B	Draft: $\$5.0\times10^9$ Final: $\$4.2\times10^9$	Draft: $\$7.7\times10^9$ Final: $\$6.9\times10^9$	Draft: $\$22\times10^9$ Final: $\$20\times10^9$
C	Draft: $\$3.7\times10^9$ Final: $\$3.8\times10^9$	Draft: $\$5.7\times109$ Final: $\$5.6\times10^9$	Draft: $\$17\times10^9$ Final: $\$18\times10^9$

In most instances, the estimates are based on facilities for which there has been little, if any, conceptual design. The estimates were prepared only for the purpose of identifying salient cost differences between technologies. These facility estimates are not sufficiently mature to be used for budgeting purposes.

C.1.1 RELATIONSHIP TO *SRS DRAFT SITE TREATMENT PLAN* COST METHODOLOGY

The cost model developed for the *SRS Draft Site Treatment Plan* (DOE 1994a) was used as a basis for the EIS cost model. The major difference between the two models is the difference in scope of the two efforts. The draft sit treatment plan proposes specific treatments over the next 5 years for a known mixed waste inventory. This EIS examines alternatives for treating, storing, and disposing of wastes that would be generated over the next 30 years and investigates the consequences of each alternative. The EIS cost analyses consider low-level, hazardous, mixed, and transuranic wastes; the site treatment plan deals only with mixed wastes. The uncertainties in this EIS that affect the modelling of costs include the waste forecasts (amounts of waste generated), schedules (treatment need dates), and availability of funds.

C.1.2 APPLICATION OF COST METHODOLOGY FOR OPTIONS SELECTION

Process and materials descriptions were developed for full treatment, storage, and disposal options evaluated in the in-depth analysis in Section 2.3 of this EIS. From these descriptions, a list of the required processing equipment, the sizes and types of buildings needed, and the necessary support equipment was developed. To provide equivalent comparisons of the options, it was initially assumed

that 1,000 cubic meters (35,300 cubic feet) of waste would be processed per year by each facility. The costs for processing equipment, buildings, and support equipment were developed using Savannah River Site (SRS) experience and information from a waste management facilities cost report (Feizollahi and Shropshire 1992) prepared for the DOE Idaho National Engineering Laboratory. The manpower requirements were estimated with the COSTPRO (Hess 1994a) program used by Westinghouse Savannah River Company for estimating onsite work. TE

Because the in-depth options analysis evaluated individual treatability groups, it was not sufficiently broad to identify an integrated system of treatment, storage, and disposal facilities for the entire SRS. The in-depth options analysis was supplemented with a second analysis that considered the availability of excess capacity in existing facilities and the environmental advantages and economies of scale achieved by expanding planned facilities to accommodate additional treatability groups that would otherwise require other stand-alone treatment, storage, and disposal facilities. The cost to dispose of secondary waste was developed from existing SRS facilities and included in the cost model.

As an example, Table C-2 (and Figure C-1) illustrates the economies of scale for the non-alpha vitrification facility. It displays the total cost and the total and incremental cost per unit volume of throughput. The calculation procedure is described in detail in Section C.2. The table indicates that unit costs decreases from approximately $7,700 to $2,000 per cubic meter when annual throughput increases from 1,000 to 5,000 cubic meters. TC

Table C-2. Economies of scale for the non-alpha vitrification facility.[a] TC

Annual throughput (cubic meters)	Total throughput (cubic meters)[b]	Life-cycle cost ($1,000)	Total Unit Cost ($ per cubic meter)[c]	Incremental Unit Cost ($ per cubic meter)[c]
1,000	19,000	146,501	7,711	7,711
2,000	38,000	159,190	4,189	668
3,000	57,000	171,881	3,015	668
4,000	76,000	184,573	2,429	668
5,000	95,000	197,267	2,082	668

a. Source: Hess (1995).
b. To convert to cubic feet, multiply by 35.31.
c. To convert to $ per cubic feet, divide by 35.31.

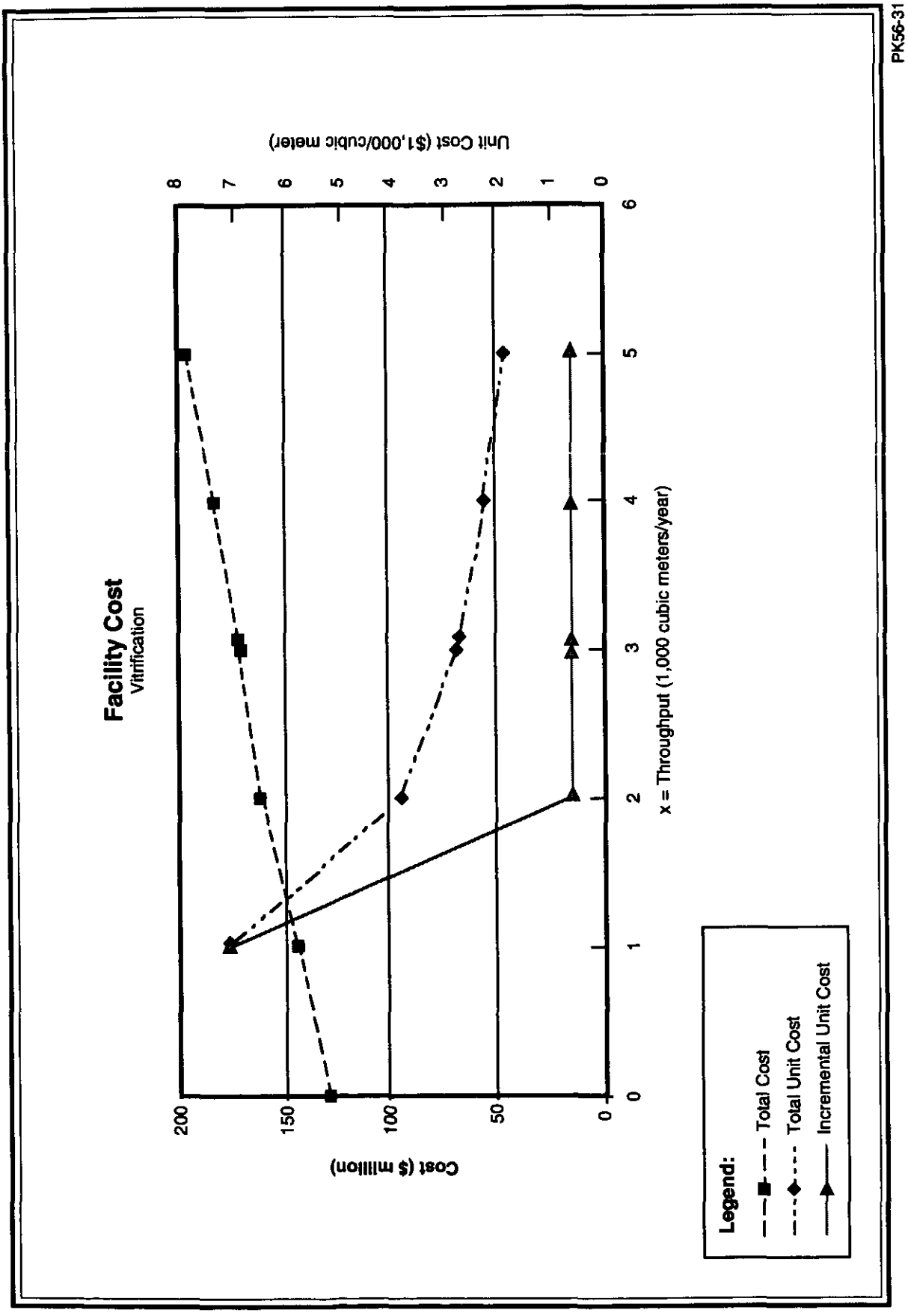

Figure C-1. An example of the economies of scale using the non-alpha vitrification facility and changes in throughput.

C.1.3 APPLICATION OF COST METHODOLOGY FOR ALTERNATIVE TREATMENT, STORAGE, AND DISPOSAL SCENARIOS

Facility costs vary with the amount of waste treated per year. Therefore, the cost model used for this EIS for equipment and buildings based on a 1,000 cubic meter (35,300 cubic feet) annual throughput was modified to account for the actual volume of waste the facility would be required to treat annually. The estimates from the Idaho National Engineering Laboratory facilities cost report were used as the basis for this part of the model. The equipment and facility descriptions in the Idaho National Engineering Laboratory report were examined to see how closely they matched the specifications of the treatments and processes described in this EIS. The Idaho National Engineering Laboratory estimates were modified as required to match the specifications in this EIS. Linear and exponential curves were fit to the Idaho National Engineering Laboratory costs versus capacity estimates. The linear model closely matched the data, so it was used. For further cost development, both equipment and building costs were defined as the coefficient (cost per cubic meter of waste processed) times the annual volume of waste plus a fixed cost. The coefficients and fixed values come from calculations that determine those values which provide the best fit between actual Idaho National Engineering Laboratory data and the linear (straight line) approximation (i.e., cost = cost coefficient × yearly volume + fixed cost). The COSTPRO model facility operating labor hours were also developed into a linear model. (Annual labor = labor coefficient × yearly volume + fixed labor; Tables C-3, C-4, and C-5 list the fixed values and coefficients developed for equipment cost, building cost, and labor, respectively.)

Table C-3. Examples of equipment cost factors for waste management facilities considered in this analysis.[a]

Facility	Fixed cost ($1,000)	Cost coefficient ($1,000/cubic meter/year)[b]
Off-site treatment and disposal	11,257	0.0699
Containment building - macroencapsulation	3,259	0.0385
Off-site smelter	10,521	0.2597
Transuranic waste characterization/certification facility	14,112	0.0396
Soil sort facility	10,983	0.2101
Containment building - decontamination	1,302	0.0035
Off-site low-level waste volume reduction	4,981	0.0265
Non-alpha vitrification facility	13,570	0.3361
Alpha vitrification facility	25,102	0.0840

TC

a. Source: Hess (1995).
b. To convert to $1,000 per cubic foot per year, divide by 35.31.

Table C-4. Examples of building cost factors for waste management facilities considered in this analysis.[a]

Facility	Fixed cost ($1,000)	Cost coefficient ($1,000/cubic meter/year)[b]
Off-site treatment and disposal	3,259	0.0241
Containment building - macroencapsulation	3,459	0.0243
Off-site smelter	8,744	0.2824
Transuranic waste characterization/certification facility	11,891	0.0396
Soil sort facility	2,470	0.0611
Containment building - decontamination	832	0.0120
Off-site low-level waste volume reduction	1,776	0.0040
Non-alpha vitrification facility	9,298	0.2403
Alpha vitrification facility	23,683	0.1123

a. Source: Hess (1995).
b. To convert to $1,000 per cubic foot per year, divide by 35.31.

Table C-5. Examples of annual labor cost factors for waste management facilities considered in this analysis.[a]

Facility	Fixed labor (manhours/year)	Labor coefficient (manhours/year/cubic meter)[b]
Off-site treatment and disposal	21,145	0.0699
Containment building - macroencapsulation	15,688	0.0385
Off-site smelter	52,581	0.2597
Transuranic waste characterization/certification facility	42,332	0.0396
Soil sort facility	14,196	0.2101
Containment building - decontamination	27,996	0.0035
Supercompactor	7,027	0.0265
Non-alpha vitrification facility	31,796	0.3361
Alpha vitrification facility	37,478	0.0840

a. Source: Hess (1995).
b. To convert to manhours per year per cubic foot, divide by 35.31.

The costs for storage and disposal facilities, most of which do not have equipment costs, were developed differently. The labor hours on a per-cubic-meter basis were developed with COSTPRO. The cost to build each facility was estimated by assuming that new facilities would hold the same amount of waste as existing facilities, dividing the waste that would need to be stored or disposed of by the facility volume capacity, and multiplying the resulting number of facilities needed by the cost of completed existing facilities.

C.1.4 SPECIAL CONSIDERATIONS FOR COST CALCULATIONS

DOE decided to assign costs to wastes with required treatments differently than to wastes for which treatment was optional. In the cost model, wastes with required treatments were assigned both the fixed costs for treatment and the variable costs associated with their specific volume (including equipment, building, and labor costs). The wastes with optional treatments were only assigned the variable costs associated with their additional volume. This methodology assumed that these wastes would use the excess capacity in facilities built to support required treatments. It also burdened wastes with specified treatments more than wastes with optional treatments.

A spreadsheet was developed for each alternative/forecast which listed the individual treatability groups and the options for treatment and disposal. The waste volume assigned to each option was entered along with the yearly fixed programmatic costs, the variable waste costs, and the volume reduction ratio achievable by that treatment option for the specific waste type. The variable waste costs included the cost to dispose of the secondary waste produced by the treatment. These inputs were summed and averaged over the 30-year analysis period and put into a specific treatment cost model. The total waste to be processed was averaged over the operating period of the facility for the sizing, costing, and operating manpower calculations. Based on waste volume, fixed costs, variable costs, volume reduction ratio, the facility operating period, and the input dates for design start and operations start, the treatment cost model calculated the equipment and building costs, total operating manhours, the pre-project costs, the total estimated cost to build the facility, the costs to decommission and dispose of the facility after all the waste has been treated, and the secondary waste disposal costs. The various costs were distributed over the appropriate time periods. The costs were then escalated and discounted to get a life-cycle cost, the present worth cost for the treatment option, and a cost per cubic meter of input waste. Costs calculated in the treatment cost model were returned to the spreadsheet for summation, which yielded the total option cost. The specifics of how these calculations were performed are discussed in Section C.2. TE

Another spreadsheet calculated the manpower required for each facility. Engineering, operation, and support manpower were included over all phases of the life cycle. The life cycle includes pre-project

planning, design and construction operations, and facility decontamination and decommissioning. A master labor spreadsheet collected the individual facility manpower calculations and generated totals for each treatment, storage, and disposal alternative.

C.2 Typical Cost Estimate

This section describes the calculation procedure for determining life-cycle cost. For illustration, each component is explained and calculated for the non-alpha vitrification facility (Hess 1994b, 1995).

Each component of the cost is calculated in units of thousands of dollars and shown as a total dollar value in parenthesis. The values have been rounded to the nearest thousand following calculation; they do not always equal the sum or product of the listed values.

C.2.1 TOTAL FACILITY COST

The total facility cost consists of pre-project costs, design and construction costs, contingency costs, operating costs, and post-operation costs. Escalation and discount rates are applied to the costs as they are incurred to determine life-cycle costs.

Each step of the calculation is illustrated for a typical facility. The cost factors for the non-alpha vitrification facility are presented in Table C-6.

C.2.1.1 Assumptions

The cost estimates are based on the following assumptions:

- Annual manpower (manhours/year) is calculated using the COSTPRO program and the assumption from the in-depth options analysis that 1,000 cubic meters (35,300 cubic feet) per year of waste would be processed through each facility.

- A uniform, fully burdened labor rate of $75/manhour in 1994 dollars is assumed for all workers for all activities, including design, construction, operation, and decontamination and decommissioning. The labor rate includes salary, benefits, and indirect expenditures (i.e., overhead).

Table C-6. Total facility cost for the non-alpha vitrification facility.

Throughput (cubic meters/year)	3,063
Equipment cost (Table C-2)	
Variable cost ($1,000/cubic meter/year)	0.3361
Fixed cost ($1,000)	13,570
Building cost (Table C-3)	
Variable cost ($1,000/cubic meter/year)	0.2403
Fixed cost ($1,000)	9,298
Annual operating manpower (Table C-4)	
Variable labor (manhours/cubic meter/year)	0.3361
Fixed labor (manhours/year)	31,796
Annual waste type support manpower (manhours/year)[a]	38,848
Labor rate ($1,000/manhour)	0.075
Is a RCRA[b] Part A Permit required?	No
Is a RCRA Part B Permit required?	Yes
Detailed design and construction start (year)	2002
Operation start (year)	2006
Operation period (years)	19
Disposal cost ($1,000/cubic meter)	7.636
Volume reduction ratio (x:1)	7.43[c]

TC

a. Administrative and other support personnel.
b. Resource Conservation and Recovery Act.
c. A weighted average of volume reduction ratios for each waste type based upon experience with vitrification facilities.

- The year in which project planning and preconceptual design start occurs is assumed for each facility to be 2 years before the detailed design and construction start.

- The operation start is the year in which the facility would begin operating.

- The operation period, in years, is the length of time the facility would be operating.

- The facility waste volume (throughput in cubic meters per year) is calculated from the total volume to be treated averaged over the operational period of the facility. Averaging the waste

volume defines a realistic design capacity for the equipment and building, not the peak waste generation rates.

- The manner in which the treated waste would ultimately be disposed is based on the disposal cost (calculated in dollars per cubic meter; to convert to dollars per cubic foot, divide by 35.31). The variable costs include the cost to build and operate the final disposal facilities.

- A volume reduction ratio (x:1) is used for each specific waste through each specific facility. The final disposal volume (after volume reduction) is multiplied times the disposal costs per unit volume of waste and added to the facility costs as a portion of the facility life-cycle costs.

C.2.1.2 Construction Costs

Construction costs consist of equipment costs, building costs, field indirect costs (e.g., auxiliary support personnel), field direct costs (e.g., temporary construction facilities), field and design engineering costs, construction management, and project management costs.

Equipment cost (EC)		
EC =	Cost coefficient	[0.3361] ×
	Throughput	[3,063] +
	Fixed cost	[13,570] =
		14,600 (or $14,600,000)
Building cost (BC)		
BC =	Cost coefficient	[0.2403] ×
	Throughput	[3,063] +
	Fixed Cost	[9,298] =
		10,034 (or $10,034,000)
Field indirect cost (FIC)		
FIC =	8 percent	[0,08] ×
	Equipment cost	[14,600] =
		1,168 (or $1,168,000)
Field direct cost (FDC)		
FDC =	14 percent	[0.14] ×
	Building cost	[10,034] =
		1,405 (or $1,405,000)
Engineering cost (ENGC)		
ENGC =	22 percent	[0.22] ×
	Equipment and building cost	[14,600 + 10,034] =
		5,419 (or $5,419,000)

Construction management cost (CMC)			
CMC =	7 percent Equipment and building cost	[0.07] × [14,600 + 10,034] = 1,724 (or $1,724,000)	
Project management cost (PMC)			
PMC =	9 percent Equipment and building cost	[0.09] × [14,600 + 10,034] = 2,217 (or $2,217,000)	
Total construction cost (TCC)			TC
TCC =	Equipment cost Building cost Field indirect cost Field direct cost Engineering cost Construction management cost Project management cost	[14,600] + [10,034] + [1,168] + [1,405] + [5,419] + [1,724] + [2,217] = 36,567 (or $36,567,000)	

C.2.1.3 Total Estimated Cost (TEC)

Total estimated cost is construction cost plus contingency (C). The contingency is the funding required to give an 80-percent confidence level that the project will be completed within the estimated funding and schedule. Estimates done at the conceptual planning level are typically ± 40 percent. For this effort a contingency of 35 percent of the construction cost was used.

Contingency (C)			
C =	35 percent total construction cost	[0.35] × [36,567] = 12,799 (or $12,799,000)	
			TC
Total estimated cost (TEC)			
TEC =	Construction cost Contingency	[36,567] + [12,799] = 49,366 (or $49,366,000)	

C.2.1.4 Pre-Project Costs

Based on experience with projects at SRS, the planning costs for project definition and implementation of DOE Order 4700, "Project Management System" requirements were estimated as 5 percent of the total

estimated cost, as calculated above, and preconceptual design costs were estimated as 10 percent of the total estimated cost.

TC

Planning cost (PLANC)		
PLANC =	5 percent Total estimated cost	[0.05] × [49,366] = 2,468 (or $2,468,000)
Preconceptual design cost (PDC)		
PDC =	10 percent Total estimated cost	[0.10] × [49,366] = 4,937 (or $4,937,000)

The permitting costs are based on an estimate of the need for new permits or required modifications to existing permits. A Resource Conservation and Recovery Act (RCRA) Part A permit or modification is estimated to cost $150,000. A RCRA Part B permit is estimated to cost $1,500,000.

Permitting cost (PC)		
PC =	Resource Conservation and Recovery Act Part B permit	1,500 (or $1,500,000)

Costs associated with preparation for operations (e.g., a procedure document) are estimated to be $150,000.

Preparation for operations costs (POC)	
POC =	150 (or $150,000)

TC

Pre-project cost (PPC)		
PPC =	Planning cost Preconceptual design cost Permitting cost Preparation for operation cost	[2,468] + [4,937] + [1,500] + [150] = 9,055 (or $9,055,000)

C.2.1.5 Facility Operating Costs

Two types of manpower requirements are considered. Operating manpower consists of personnel who actually operate the facility as estimated by the linear model developed from the COSTPRO program. Waste type support manpower includes administrative and other support personnel based on a

distribution of these requirements to each waste type as reported in *FY 1993 SRS Waste Cost Analysis* (Taylor, McDonnel, and Harley 1993).

Annual operating manpower (AOM)			
AOM =	Labor coefficient	[0.3361] ×	TC
	Throughput	[3,063] +	
	Fixed labor	[31,796] =	
		32,826 (manhours per year)	
Operating manpower cost (OMC)			
OMC =	Annual operating manpower	[32.826] ×	
	Labor rate in $1,000/hour	[0.075] ×	
	Facility operation period	[19] =	
		46,777 (or $46,777,000)	
Annual waste type support manpower (AWTSM)			TE
AWTSM =	Fixed amount	[38,848] =	
		38,848 (manhours per year)	
Waste type support manpower cost (WTSMC)			TE
WTSMC =	Annual waste type support manpower	[38,848] ×	
	Labor rate in $1,000/hour	[0.075] ×	
	Facility operation period	[19] =	
		55,358 (or $55,358,000)	

Utilities costs vary from 4 percent to 20 percent of the operating manpower cost. The variance is the following function of the equipment cost: F = 1 + 4 × equipment cost ÷ maximum equipment cost. The maximum equipment cost of the facilities identified in this EIS is 14,882 (or $14,882,000). TC

Utilities cost (UC)			
UC =	4 percent	[0.04]	TC
	Equipment cost factor	[1+4 × 14,600 ÷ 14,882] ×	
	Operating manpower cost	[46,777] =	
		9,214 (or $9,214,000)	
Material requirements cost (MRC)			
MRC =	60 percent	[0.60]×	
	Operating manpower cost	[46,777] =	
		28,066 (or $28,066,000)	
Maintenance cost (MC)			
MC =	36 percent	[0.36] ×	
	Operating manpower cost	[46,777] =	
		16,839 (or $16,839,000)	

Secondary waste disposal cost (SWDC)

SWDC =	Throughput	[3,063] ×
	Operating period	[19] ×
	Disposal cost	[7.636] ÷
	Volume reduction ratio	[7.43] =
		59,810 (or $59,810,000)

Total facility operating cost (TFOC)

TC	TFOC =	Operating manpower cost	[46,777] +
		Waste type support manpower cost	[55,358] +
		Utilities cost	[9,214] +
		Material requirements cost	[28,066] +
		Maintenance cost	[16,839] +
		Secondary waste disposal cost	[59,810] =
			216,064 (or $216,064,000)

C.2.1.6 Post-Operation Costs

The cost of decontamination and decommissioning the facility following its useful life is estimated as 80 percent of the initial equipment and building costs.

Post-operation cost (POC)

TC	POC =	80 percent	[0.80] ×
		Equipment and building cost	[14,600 + 10,034] =
			19,707 (or $19,707,000)

C.2.1.7 Total Unescalated Costs

Total unescalated cost (TUC)

TC	TUC =	Pre-project costs	[9,055] +
		Construction costs	[36,567] +
		Contingency costs	[12,799] +
		Facility operation costs	[216,064] +
		Post-operations costs	[19,707] =
			294,192 (or $294,192,000)

C.2.2 COST DISTRIBUTION

Annual pre-project cost (APPC)		
APPC =	Pre-project cost	[9,055] ÷
	Years prior to detailed design and construction start	[2] =
		4,527 (or $4,527,000) for each year, 2000 and 2001
Annual total estimated cost (ATEC)		
ATEC =	Total estimated cost	[49,366] ÷
	Period from detailed design and construction start to operation start	[4] =
		12,341 (or $12,341,000) for each year, 2002 through 2005
Annual facility operation cost (AFOC)		
AFOC =	Facility operation cost	[216,064] ÷
	Period of operation	[19] =
		11,371 (or $11,371,000) for each year, 2006 through 2024
Annual post-operation cost (APOC)		
APOC =	Post-operation cost	[19,707] ÷
	Years following operations	[3] =
		6,569 (or $6,569,000) for each year, 2025 through 2027

TC

Unescalated costs (based on the value of money in 1994), escalated costs, and discounted costs are listed by year in Table C-7.

C.2.3 ESCALATION

The escalation rates were taken from the DOE guidelines (DOE 1994b) for future-year estimating. The escalation rates are typically 3 percent, with the exception of 2.9 percent and 3.1 percent for fiscal year 1995 and fiscal year 1998, respectively.

Escalation factors are calculated as the previous year's escalation factor compounded by the appropriate escalation rate. For example, the escalation rate in 2000 is 3 percent. Therefore, the 2001 escalation factor is the 2000 factor (1.194) times 1.03 or 1.230. The escalated costs are the product of the unescalated cost and the corresponding escalation factor (Table C-7).

Table C-7. Cost distribution for the non-alpha vitrification facility.

Year	Unescalated cost ($1,000)	Escalation factor	Escalated cost ($1,000)	Discount factor at 6 percent	Discounted cost ($1,000)
1994		1.000		1.000	
1995		1.029		0.943	
1996		1.06		0.890	
1997		1.092		0.840	
1998		1.126		0.792	
1999		1.159		0.747	
2000	4,527	1.194	5,046	0.705	3,811
2001	4,527	1.230	5,568	0.665	3,703
2002	12,341	1.267	15,634	0.627	9,809
2003	12,341	1.305	16,103	0.592	9,531
2004	12,341	1.344	16,586	0.558	9,261
2005	12,341	1.384	17,083	0.527	8,999
2006	11,371	1.426	16,212	0.497	8,057
2007	11,371	1.469	16,699	0.469	7,829
2008	11,371	1.513	17,200	0.442	7,607
2009	11,371	1.558	17,716	0.417	7,392
2010	11,371	1.605	18,247	0.394	7,183
2011	11,371	1.653	18,795	0.371	6,980
2012	11,371	1.702	19,359	0.350	6,782
2013	11,371	1.754	19,939	0.331	6,590
2014	11,371	1.806	20,537	0.312	6,404
2015	11,371	1.86	21,154	0.294	6,222
2016	11,371	1.916	21,788	0.278	6,046
2017	11,371	1.974	22,442	0.262	5,875
2018	11,371	2.033	23,115	0.247	5,709
2019	11,371	2.094	23,809	0.233	5,547
2020	11,371	2.157	24,523	0.220	5,390
2021	11,371	2.221	25,259	0.207	5,238
2022	11,371	2.288	26,016	0.196	5,090
2023	11,371	2.357	26,797	0.185	4,946
2024	11,371	2.427	27,601	0.174	4,806
2025	6,569	2.500	16,423	0.164	2,698
2026	6,569	2.575	16,916	0.155	2,621
2027	6,569	2.652	17,423	0.146	2,547
TOTAL	294,192		534,348		172,674

TC

TE

C.2.4 DISCOUNTING

Discounting is the determination of the present cost of future payments. The present cost is less than the future payment because the money could be invested with some rate of return and be worth more later. The rate of return is assumed to remain constant at 6 percent per year; this rate is judged to be consistent with current prime lending rates and long-term rates of return.

Discounting is calculated in a manner similar to escalation; the previous factor is discounted by the appropriate discount rate. For example, the discount factor for 2001 is the 2000 factor (0.705) divided by 1.06 or 0.665. Discounted costs are the product of the escalated cost and the discount factor (Table C-7). Figure C-2 presents a graphic representation of the discounted, unescalated, and escalated costs.

C.3 Cost of Facilities

Costs for proposed facilities are presented for each alternative and waste forecast (Table C-8). The costs include those for pre-project, design and construction (except for existing facilities, which have already incurred design/construction costs), operation and maintenance, secondary waste disposal and facility decontamination and decommissioning. They are expressed as present 1994 costs and are based on draft site treatment plan escalation (approximately 3 percent) and a 6-percent discount rate. TC

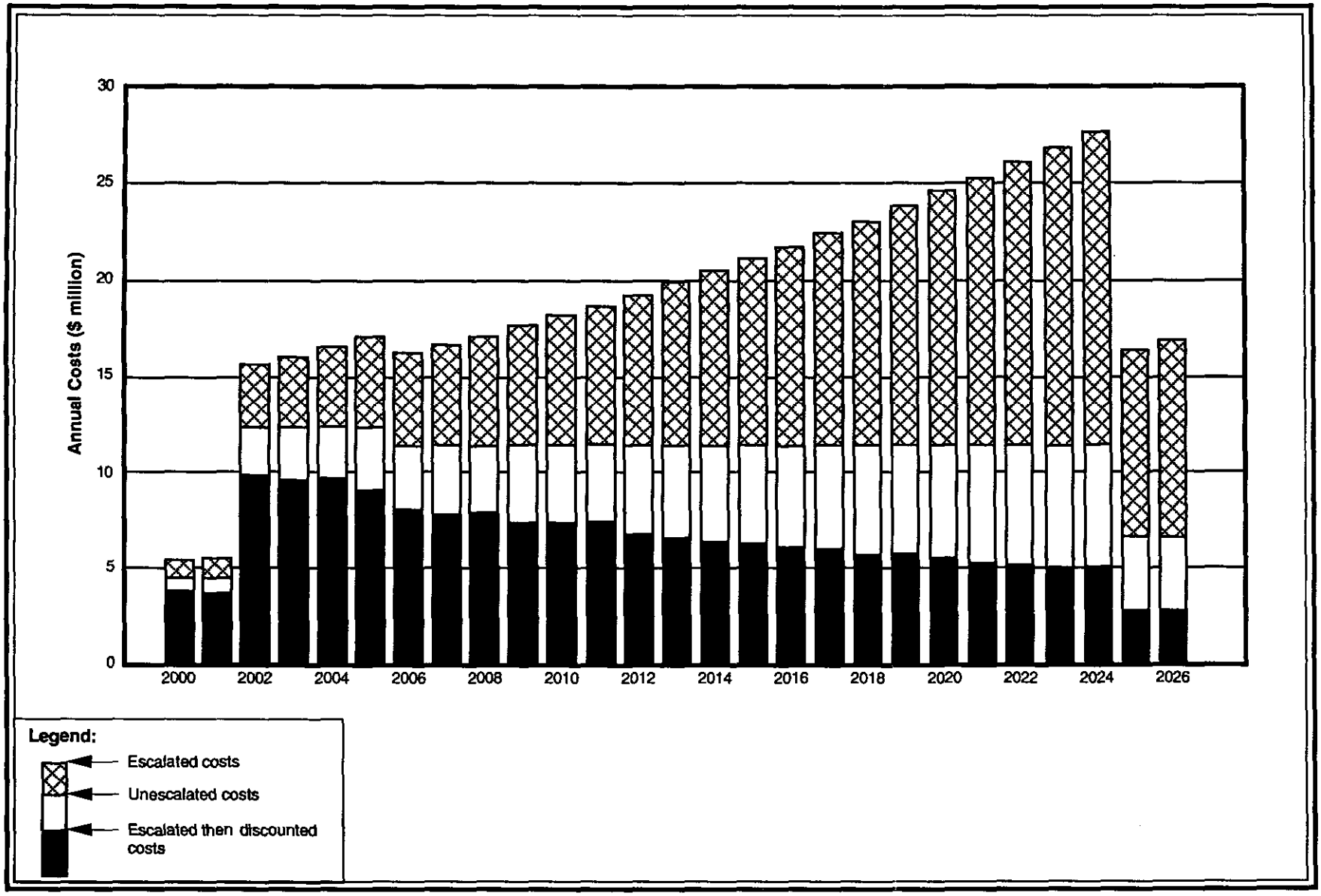

Figure C-2. Cost distribution for the non-alpha vitrification facility.

Table C-8. Cost of facilities in the *SRS Waste Management EIS* ($ million).[a,b]

Facility	Forecast	Alternative A	Alternative B	Alternative C	
Waste soil sort (new)	Minimum	52.6	54.0	53.6	
	Expected	56.2	58.2	58.1	
	Maximum	73.8	113.7	103.4	TE
Offsite low-level waste volume reduction	Minimum	b	57.1		
	Expected		58.4		
	Maximum		62.0		
Offsite treatment and disposal	Minimum	2,462.3	2,350.6	2,009.7	
	Expected	4,637.3	4,419.3	2,418.6	
	Maximum	7,404.7	7,109.6	2,798.6	
Non-alpha vitrification (new)	Minimum			194.7	
	Expected		172.7	299.6	
	Maximum		565.6	660.6	
Alpha vitrification (new)	Minimum		246.0	248.3	
	Expected		246.8	250.2	
	Maximum		359.3	416.4	
Transuranic waste characterization/ certification (new)	Minimum	121.9	121.9	121.9	
	Expected	120.7	120.7	120.7	
	Maximum	129.0	129.0	129.0	TC
Consolidated Incineration Facility	Minimum	125.9	296.9	115.7	
	Expected	206.9	353.6	143.1	
	Maximum	691.5	525.2	249.2	
Low-activity waste vaults (periodic requirements)	Minimum	264.4	21.5	83.4	
	Expected	340.8	32.5	103.1	
	Maximum	848.2	105.1	197.8	
Intermediate-level vaults (periodic requirement)	Minimum	144.0	117.6	33.6	
	Expected	192.2	192.3	77.4	
	Maximum	684.1	436.7	100.1	
Low-level waste non-vault disposal (periodic requirement)	Minimum	62.9	58.9	62.3	
	Expected	78.3	62.3	86.7	
	Maximum	294.6	92.8	317.4	
Long-lived storage (periodic requirement)	Minimum	33.0	33.0	33.1	
	Expected	33.8	33.8	33.8	
	Maximum	34.2	34.3	34.3	
Transuranic waste storage (periodic requirement)	Minimum	39.4	16.5	25.1	
	Expected	105.4	106.0	107.2	
	Maximum	5,900.0	5,898.2	5,816.7	

Table C-8. (continued).

Facility	Forecast	Alternative A	Alternative B	Alternative C
Offsite smelter	Minimum		214.2	214.1
	Expected		214.6	214.3
	Maximum		216.4	215.1
Offsite lead decontamination	Minimum	117.3	117.3	117.0
	Expected	210.7	210.7	210.7
	Maximum	472.2	472.2	472.2
Waste Isolation Pilot Plant	Minimum	276.7	127.1	72.6
	Expected	357.1	152.3	77.0
	Maximum	4,287.5	1,896.7	496.1
RCRA-permitted disposal vaults	Minimum	81.4	98.0	264.0
	Expected	92.6	121.0	1,128.6
	Maximum	1,405.9	562.5	4,448.1
Compactors	Minimum	117.1	24.0	31.3
	Expected	117.1	24.0	33.4
	Maximum	50.9	22.5	32.4
M-Area air stripper	Minimum	0.003	0.003	0.003
	Expected	0.016	0.016	0.016
	Maximum	0.017	0.017	0.017
Containment building (new)	Minimum	145.0	134.4	49.1
	Expected	177.2	159.1	49.2
	Maximum	336.4	254.1	49.3
Mixed waste storage (periodic requirement)	Minimum	125.0	112.8	111.7
	Expected	208.8	208.8	208.9
	Maximum	1,826.6	1,583.9	1,574.1
Total	Minimum	4,168.9	4,201.7	3,841.0
	Expected	6,935.3	6,947.2	5,620.7
	Maximum	24,439.6	20,439.9	18,110.9

a. Source: Hess (1995).
b. Shaded areas indicate the alternatives that do not use the facility.

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APPENDIX D

INNOVATIVE AND EMERGING WASTE MANAGEMENT TREATMENT TECHNOLOGIES

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SUMMARY

This appendix to the Waste Management Environmental Impact Statement (EIS) provides summaries of innovative and emerging technologies being evaluated at Savannah River Site (SRS) and other locations that have the potential for treating hazardous, radioactive, or mixed (hazardous and radioactive) wastes at SRS. This EIS considered 85 technologies, many of which were screened out during the options analysis process described in Section 2.3 of this EIS. This appendix discusses many of those technologies that were eliminated from detailed consideration in Section 2.3 as well as some developing technologies that were not considered in Section 2.3. TE TE

Many of these technologies are either not commercially available, have not undergone demonstrations for the waste types at SRS, or have not been shown to be either economically or technically viable (i.e., have not achieved engineering breakthrough). However, some of the 26 emerging technologies described in this appendix may prove viable in the future and may be chosen for more detailed design and operations analyses based on the outcome of demonstrations. The in-depth options analysis used to select treatment technologies was biased towards choosing proven solutions to U.S. Department of Energy (DOE) waste management issues. As other technologies mature, these may warrant consideration. TE

The technologies summarized here treat contaminated matrices that contain plastic, paper (and other forest products), metals, aqueous liquids, and organic liquids. These waste matrices are generated through activities such as site operations, decontamination and decommissioning, or environmental restoration. Some technologies have been available for years, but application of the technology to waste management would be considered innovative.

The treatment summaries were prepared from a number of literature sources and interviews and have been grouped by categories of waste treatment: (1) biological, (2) chemical, (3) physical, (4) stabilization, and (5) thermal.

D.1 Background

This appendix provides summaries of 52 innovative and emerging technologies that have the potential for treating hazardous, radioactive, or mixed (hazardous and radioactive) wastes at SRS. Eighty-five technologies were considered, many of which were screened out during the options analysis process described in Section 2.3 of the EIS. Table D-1 defines each of the technologies and identifies its purpose (volume reduction, stabilization, or decontamination). For the most part, the technologies discussed in this appendix are not commercially available, have not undergone full-scale demonstrations for the waste types present at SRS, or have not been shown to be either economically or technically viable. However, many of the emerging technologies described in this appendix may prove viable in the future and may be chosen for more detailed design and operations analyses based on the outcome of full-scale demonstrations, other commercial applications, or use by the U.S. Department of Energy (DOE) on similar wastes.

Section 2.3 of the EIS evaluated 85 processes and technologies in 5 treatment categories. The treatment categories used in the prescreening process (biological, chemical, physical, stabilization, and thermal) are also used in this appendix for consistency. The treatment categories include both conventional and emerging processes and technologies. Some examples of conventional processes include evaporation, compaction, storage, and incineration. These types of processes are not addressed in this appendix. Examples of innovative technologies include electrodialysis, plasma torch, supercritical water oxidation, and white rot fungus. These types of innovative and emerging technologies are addressed in detail in this appendix.

Table D-2 provides a comparison of 26 innovative technologies included in Section 2.3 with those in Appendix D. Several of the process technologies identified in Section 2.3 are subdivided into more discrete technologies discussed in Appendix D. For example, Section 2.3 identified the technology process of fluidized bed incineration (number 13 on Table D-2); Appendix D identifies two specific subtypes of fluidized bed incineration. Appendix D also identifies six emerging technologies [acoustic barrier particle separator (D.5.1), high-energy electron irradiation (D.5.8), gas-phase chemical reduction (D.4.4), nitrate to ammonia and ceramic process (D.4.5), electrochemical oxidation (D.4.12), and mediated electrochemical oxidation (D.4.13)] that are not specifically addressed in Section 2.3.

Table D-1. Technologies considered for treatment of SRS waste.

Technology purpose			Technology and description
1[a]	2[b]	3[c]	
	•		Abrasive blasting - a process in which solids such as sand or dry ice pellets in a pressurized fluid matrix are sprayed against a radiologically contaminated surface to decontaminate the surface.
		•	Acid/base digestion, solids dissolution - a process to dissolve solids in an acid/base bath in the presence of a metal catalyst to remove contaminants. The dissolved metal solution would then be treated via chemical precipitation for removal of the metal.
•		•	Asphalt based microencapsulation - a thermally driven process to dewater a waste and trap the residual solids in a liquid asphalt matrix that solidifies for disposal.
		•	Absorption - the transfer of contamination that is mixed with one phase into another phase.
		•	Aerobic biotreatment - the use of aerobic bacteria in a bioreactor to remove aromatic organic contaminants from soils, sediments, and sludges.
		•	Alkaline chlorination - an emerging application of the dechlorination technology. The technology involves dechlorination of halogenated compounds such as polychlorinated biphenyls and other chlorinated compounds by a substitution reaction. The secondary wastes from the reaction require disposal.
		•	Activated sludge - the use of an activated sludge material like an activated charcoal for the removal of organic materials from wastes.
		•	Anaerobic digestion - the use of nonaerobic bacteria (i.e., bacteria that do not require oxygen) in a bioreactor for the consumption of specific organic contaminants from aqueous wastes.
•		•	Advanced electrical reactor - a graphite electrode DC arc furnace in which two electrodes are attached to the waste being processed. A plasma arc is generated between the electrodes that generates 1700°C temperatures, causing the soil/metal mixture to be stratified into a metal phase, a glass phase, and a gas phase. The phases are separated and treated separately.
		•	Air stripping - used for the removal of volatile organic compounds from aqueous waste streams. The liquid waste is intimately contacted with air resulting in mass transfer of the organic compound from liquid phase to the gas phase.
		•	Amalgamation - the property of mercury in which it unites or alloys with other metals. This is used in the tritium production process where gold traps remove mercury.
		•	Alkali metal dechlorination - an emerging application of the dechlorination technology. The technology involves dechlorination of halogenated compounds such as polychlorinated biphenyls and other chlorinated compounds by a substitution reaction. The secondary wastes from the reaction require disposal.
		•	Alkali metal/polyethylene glycol - an emerging application of the dechlorination technology. The technology involves dechlorination of halogenated compounds such as polychlorinated biphenyls and other chlorinated compounds by a substitution reaction. The secondary wastes from the reaction require disposal.
		•	Blast furnaces - used together with reverberatory furnaces for the removal of lead from excavated materials. Also see smelting.

Table D-1. (continued).

Technology purpose			Technology and description
1	2	3	
		•	Bio-reclamation - or bioremediation is a normally in situ process whereby biological agents that degrade hydrocarbons are mixed with organically contaminated soil to remove these contaminants from the soil.
		•	Carbon adsorption - the use of a bed of granular activated carbon or charcoal for the removal of chlorinated hydrocarbons, aromatic solvents, and fuels from an aqueous waste.
		•	Circulation bed combustion - uses high velocity air to entrain circulating solids and create a highly turbulent combustion zone that destroys toxic hydrocarbons such as PCBs.
		•	Catalytic dehydrochlorination - an emerging application of the dechlorination technology. The technology involves dechlorination of halogenated compounds such as polychlorinated biphenyls and other chlorinated compounds by a substitution reaction. The secondary wastes from the reaction require disposal.
		•	Cementation - a process in which contaminated wastewater is mixed with cement to solidify and stabilize the contaminants for storage.
		•	Centrifugation - the use of a centrifuge to separate solids from a liquid waste for further processing.
		•	Chemical hydrolysis - the use of a reactive chemical species in water to detoxify or neutralize the hazardous constituents. This is usually used for the recovery of spent solvents.
		•	Chelation - an ion exchange process in which the exchange media possesses unusually high selectivity for certain cations.
		•	Chemical oxidation/reduction - the use of a variety of oxidation or reduction processes for the removal of contaminants from waste materials/processes.
		•	Compaction - the use of a mechanical device, normally hydraulically operated, to reduce the volume of waste before its disposal. Compactors generate less than 1,000 tons of compressive force.
		•	Chemical precipitation - removes dissolved hazardous metal species from water to permit conventional water disposal through a permitted outfall. The solution is mixed with chemical additives that cause the generation of insoluble compounds of the metal which can then be filtered.
		•	Crystallization - the removal of dissolved solids from solution by subcooling the solution either directly or indirectly to a temperature lower than the pure component freezing point of the dissolved solid. This may be accomplished with or without the addition of a diluent solvent.
		•	Dissolved air flotation - an adsorptive-bubble separation method in which dissolved air is used for the removal of solid particulate contaminants.
		•	Distillation - a process for the removal of solid contaminants from solution by separating the constituents of the liquid mixture via partial vaporization of the mixture and the separate recovery of the vapor and the solid contaminant residue.

Table D-1. (continued).

Technology purpose			Technology and description
1	2	3	
		•	Electrodialysis - a process for the removal of dissolved ionic contaminants from solution by pumping the solution through very narrow compartments that are separated by alternating charged cation-exchange and anion-exchange electrode membranes which are selectively permeable to positive and negative ions, respectively.
		•	Evaporation - the removal of water via vaporization from aqueous solutions of nonvolatile substances, thus leaving the residual contaminant for further processing for disposal.
		•	Fluidized bed incinerator - an incinerator in which the solid waste particles are held in suspension via the injection of air at the bottom of the bed (complete destruction of the waste) or an incinerator in which a bed of limestone material is held in suspension as waste is incinerated to induce chemical capture to form stable compounds which can be readily disposed of.
		•	Filtration - the process in which fluid is passed through a medium which traps and thus removes solid particles from the fluid stream.
		•	Flocculation - the use of fine particles that are anionically or cationically charged for ion removal that aggregate into a larger mass, that can be filtered out, as the ion exchange process occurs.
		•	High temperature metal recovery - the use of smelting or blast furnaces for the recovery of metals such as lead.
		•	Heavy media separation - a process that takes advantage of the presence of a waste constituent that is heavier than the others by using any of a number of available methodologies for segregation of the heavier constituent.
	•		High pressure water steam/spray - used for the decontamination of surfaces having loosely held contamination. One of these methods is commonly known as hydrolazing.
		•	Industrial boilers - used for the burning of permitted organic wastes for energy recovery.
		•	Ion exchange - a process in which a bed of solid resin material carrying an ionic charge (+ or -) accompanied by displaceable ions of opposite charge is used to displace metal ions dissolved in the solution flowing through the resin bed, thus removing the metals from the solution.
		•	Industrial kilns - see industrial boilers above.
		•	Lime-based pozzolans - a solidification and stabilization process that takes advantage of siliceous or aluminous materials that react chemically with lime at ordinary temperatures in the presence of moisture to produce a strong cement. The process is used for contaminated soils, sludges, ashes, and other similar wastes.
		•	Liquid/liquid extraction - a process for separating components in solution via the transfer of mass from one immiscible liquid phase into a second immiscible liquid phase.
		•	Liquid injection incinerators - an incinerator used for the destruction of liquid organic wastes only.
		•	Macroencapsulation - the coating or containing of a solid waste form with another material to stabilize the waste form.

Table D-1. (continued).

Technology purpose			Technology and description
1	2	3	
•		•	Molten glass - the product resulting from the vitrification process where waste solids are exposed to high temperatures. The molten glass is allowed to cool to a homogeneous, nonleachable solid for disposal.
•		•	Microwave solidification - a process which uses microwave energy to heat and melt homogeneous wet or dry solids into a vitrified final waste form that possesses high-density and leach-resistant attributes.
		•	Molten salt destruction - a process for destruction of organic waste constituents where the waste is injected into a molten bed of salt along with an oxidizing gas such as air. The organics are destroyed and the residual molten salts are drained and dissolved in water for further processing.
		•	Neutralization - normally the addition of an acid to an alkaline solution to initiate the precipitation of contaminants.
		•	Oxidation by hydrogen peroxide - an organic contaminant removal process that uses hydrogen peroxide to oxidize the contaminants for removal.
		•	Oil/water separation - the process by which a mechanical device removes oil from water by taking advantage of the density difference that causes it to float on water.
		•	Ozonation - a chemical oxidation process in which ozone, an oxidizing agent, is added to a waste to oxidize organic materials into carbon dioxide and water vapor. This offgas would be passed through a carbon bed for the removal of generated volatile organic vapors.
•		•	Polymerization - a thermally driven process to dewater a waste and trap the residual solids in a liquid polymer matrix that solidifies for disposal.
		•	Phase separation - any process that takes advantage of the presence of two phases in a waste stream or waste product to segregate one of the phases from the other.
•		•	Plasma arc torch - used as the heat source for a vitrification process in which the waste is fed into a centrifuge in which the plasma torch is installed, where it is uniformly heated and mixed.
•		•	Pyrolysis - the use of extremely high temperatures for the destruction of organic contaminants and the fusion of inorganic waste into a homogeneous, nonleachable glass matrix.
		•	Rotating biocontactors - a bioremediation process in which the biological reactor body rotates to enhance the mixing and contact of the waste with the biological agents.
•			Recycle - the process by which any substance, material, or object is processed for reuse.
•			Repackaging/containerize - the process by which waste is resorted and placed in containers that result in increased space-efficiency and cost-effectiveness for disposal.
•		•	Rotary kiln incinerator - an incinerator that uses a rotating kiln body for the burning of the waste material being fed.
		•	Reverse osmosis - separates hazardous constituents from a solution by forcing the water to flow through a membrane by applying a pressure greater than the normal osmotic pressure.

Table D-1. (continued).

Technology purpose			Technology and description
1	2	3	
		•	Roasting/retorting - the oxidation and driving off of solid contaminants via the use of high temperatures.
		•	Super critical extraction - a process for the extraction of organic contaminants from waste products via the use of a reactor in which the temperature and pressure are elevated to values greater than the triple point of water.
		•	Solvent extraction - a process whereby solvents or liquefied gases (such as propane or carbon dioxide) are used to extract organics from sludges, contaminated soils, and waste water.
	•		Sealing - the process that is used to trap surface contamination to a surface from which it is not readily removable. The surface is coated with a matrix that seals the contamination in place.
		•	Sedimentation - the partial separation or concentration of suspended solid waste particles from a liquid by gravity settling.
		•	Soil flushing/washing - a process in which water and chemical additives are added to contaminated soil to produce a slurry feed to a scrubbing machine that removes contaminated silts and clay from granular soil particles.
	•		Scarification/grinding/planing - the use of a high speed rotating mechanical device for the removal of fixed surface contamination.
•			Shredding/size reduction - the process by which a shredder is used to cut contaminated paper, plastics, cardboard, etc. into smaller pieces to provide volume reduction prior to disposal.
		•	Smelting - used to treat stainless steel for the removal of radionuclides. The stainless steel is fed into reverberatory or blast furnaces with additives which serve to separate the radionuclides from the slag, leaving clean metal.
		•	Sorption - the selective transfer of one or more solutes or contaminants from a fluid phase to a batch of rigid particles.
	•		Spalling - the use of a mechanical impact device to chip away a contaminated surface. The surface is spalled to a depth that is no longer contaminated and the chipped debris is disposed of.
•			Sorting/reclassifying - the process by which waste is sorted to optimize the way in which it is disposed to provide for the most space efficient and cost effective packaging of the waste.
		•	Steam stripping - the use of superheated steam to oxidize complex organic compounds to carbon monoxide, carbon dioxide, water, hydrogen, and methane. The destruction of the organics is then completed at high temperature using an electrically heated reactor.
		•	Supercritical water oxidation - an aqueous phase oxidation treatment in which organic waste, water, and an oxidant (air or oxygen) are combined in a tubular reactor at temperatures above the critical point of water.
•			Supercompaction - the use of a compactor that has a capacity of greater than 1,000 tons compressive force for increased volume reduction and the compaction of items not effectively compacted by a normal compactor.

Table D-1. (continued).

Technology purpose			Technology and description
1	2	3	
		•	Thermal desorption - a process used for the removal of organics from sludges at a temperature of 350 - 600°F which is high enough to volatilize the organics for adsorption capture but low enough to prevent the emission of significant quantities of metals that can occur with incineration.
		•	UV photolysis - a process that removes organic contaminants from aqueous waste streams via the use of ultra-violet radiation to oxidize the contaminants.
	•		Vibratory finishing - the use of a mechanical vibratory tool for the decontamination of surfaces having fixed contamination.
•		•	Vitrification - a high temperature process by which waste is treated in a furnace at temperatures which drive off organics for further treatment and reduce the inorganic waste to a homogeneous, nonleachable glass slag that is discharged into a mold or drum for disposal.
		•	Wet air oxidation - a process in which the waste is heated and passed, along with compressed air, into an oxidation reactor where oxidation of the organic contaminants takes place.
		•	White rot fungus - a lignin-degrading fungi that is used to inoculate organic materials which are mechanically mixed with contaminated soils to break down the contaminants.
	•		Water washing/spraying - the use of low pressure water to rinse contaminated surfaces for the removal of loosely held contamination.

a. Volume reduction.
b. Decontamination.
c. Immobilization/stabilization.

Innovative technologies for treating radioactive, hazardous, and mixed wastes are currently being developed and demonstrated by DOE and the U.S. Environmental Protection Agency (EPA). DOE demonstrations generally focus on radioactive and mixed waste treatments and are funded by the DOE
TC | Office of Technology Development (EM-50) through the Mixed Waste and Landfill Focus Areas. Technologies are developed and demonstrated at the eight national laboratories.

EPA technology demonstrations are supported by the Risk Reduction Engineering Laboratory and the Superfund Innovative Treatment Evaluation program. Most Superfund Innovative Treatment Evaluation demonstrations focus on hazardous wastes generated at Superfund sites. Many of the technologies evaluated by the Superfund Innovative Treatment Evaluation program may be applicable to radioactive and mixed wastes.

SRS generates large quantities of solid low-level radioactive waste, and currently utilizes vault or shallow land disposal. Most solid low-level radioactive waste is job-control waste, a fraction of which is compacted on site prior to vault disposal. Several technologies described in this appendix can potentially

Table D-2. Comparison of Section 2.3 process technologies and Appendix D technologies.

Section 2.3 Type/Technology	Corresponding Appendix D Type/Technology
1. Physical/Electrodialysis	Physical/Electrodialysis
2. Physical/Evaporation	Chemical/Evaporation and Catalytic Oxidation
3. Physical/Sedimentation and Flocculation	Physical/Binding, Precipitation, and Physical Separation
4. Physical/High Pressure H_20 Steam/Spray	Physical/Pressure Washing and Hydraulic Jetting
5. Physical/Ion Exchange	Chemical/Resorcinol-Formaldehyde Ion Exchange Resin
6. Physical/Soil Flushing/Washing	Physical/Soil Washing
7. Physical/Steam Stripping	Physical/Steam Reforming
8. Physical/Filtration	Physical/Chemical Treatment, and Ultrafiltration; Heavy Metals and Radionuclide Polishing Filter; Membrane Microfiltration
9. Stabilization/Lime-Based Pozzolans	Stabilization/Pozzolaric Solidification
10. Stabilization/Polymerization	Stabilization/Polyethylene Encapsulation Stabilization/Vinyl/Ester Styrene Solidification
11. Stabilization/Vitrification	Thermal/Electric Melter Vitrification Thermal/Stirred Melter Vitrification Thermal/Modular Vitrification Thermal/In-Situ Vitrification Thermal//Vortec Process
12. Thermal/Advanced Electrical Reactor	Thermal/Graphite Electrode DC Arc Furnace
	Thermal/Packed Bed Reactor, Silent Discharge Plasma Apparatus
13. Thermal/Fluidized Bed Incinerator	Thermal/Fluidized Bed Cyclonic Agglomerating Incinerator Thermal/Catalytic Combustion in a Fluidized Bed Reactor
14. Thermal/High Temperature Metal Recovery	Thermal/Quantum-Catalytic Extraction Process
15. Thermal/Molten Glass	Thermal/Electric Melter Vitrification Thermal/Stirred Melter Vitrification Thermal/Modular Vitrification
16. Thermal/Molten Salt Destruction	Thermal/Molten Salt Oxidation and Destruction Process
17. Thermal/Infrared Incinerators	Thermal/Infrared Thermal Destruction
18. Thermal/Circulating Bed Combustion	Thermal/Cyclonic Furnace
19. Thermal/Supercritical Water Oxidation	Chemical/Supercritical Water Oxidation
20. Thermal/Wet Air Oxidation	Thermal/Wet Air Oxidation
21. Biological/Aerobic Biotreatment	Biological/Bioscrubber Biological/Biosoprtion
22. Biological/White Rot Fungus	Biological/White Rot Fungus
23. Chemical/Alkali Metal Dechlorination, Alkali metal/ Polyethylene glycol	Chemical/Dechlorination
24. Chemical/Catalytic Dehydrochlorination	Chemical/Aqueous Phase Catalytic Exchange Evaporation and Catalytic Oxidation
	Biocatalytic Destruction
25. Chemical/Crystallization	Physical/Freeze Crystallization
26. Chemical/Ultraviolet Photolysis	Physical/Ultraviolet Oxidation

TE

be used to reduce the volume and stabilize solid low-level radioactive waste. Stabilization would
TE | minimize potential radionuclide migration following direct shallow land disposal. Hazardous wastes generated at SRS include organic and aqueous liquids, most of which are treated and taken off site for disposal. Mixed wastes, which include most of the matrices described above, are being stored until adequate treatment and disposal capacity is identified at SRS or offsite.

Wastes containing greater than 100 nanocuries per gram of transuranic alpha-emitting radionuclides with half-lives greater than 20 years are considered transuranic wastes. These wastes pose special handling, storage, and disposal problems due to the inhalation and ingestion risks posed by alpha particles and to long half-lives and potential criticality concerns from plutonium radionuclides. DOE plans to ship transuranic wastes for disposal at the Waste Isolation Pilot Plant, located near Carlsbad, New Mexico. The earliest projected date for the Waste Isolation Pilot Plant to begin disposing of these wastes is 1998. Although transuranic wastes are not required by law to be treated or stabilized, treatment and conversion of these wastes to a stabilized waste form (such as glass or slag) could reduce the volume of the wastes and minimize potential releases and human and environmental exposures during onsite storage, prior to disposal at the Waste Isolation Pilot Plant. Disposal of mixed transuranic wastes at the Waste Isolation Pilot Plant is dependent on a Resource Conservation and Recovery Act (RCRA) no-migration petition being granted by the State of New Mexico and EPA.

DOE is currently funding several technology development projects at SRS through the Savannah River Technology Center and the Vendor Forum program, both of which are managed by the Westinghouse Savannah River Company. Many Savannah River Technology Center projects are conducted jointly with universities (such as Clemson University and Georgia Institute of Technology) and industrial partners. Innovative technology programs funded at SRS include plasma arc treatment of solid low-level radioactive waste, vitrification of various waste forms using a portable vitrification unit, noble metal reclamation from electronic components, dechlorinating radioactive polychlorinated biphenyls (PCBs) in a solid matrix, extraction of uranium from contaminated soil, treatment of tritiated oils and groundwater, acoustic wave treatment, and waste stabilization using several different binders.

EPA and DOE recently collaborated at SRS on a Superfund Innovative Treatment Evaluation project to demonstrate the feasibility of treating contaminated groundwater with an electron beam. Contaminated groundwater was pumped past the beam to determine destruction efficiencies of hazardous organics at different electron beam dose rates.

D.2 Introduction

Table D-3 provides summary information by technology type, technology, the development status of the technology, the type of waste that can be treated by the technology, and the waste form generated by the technology for all technologies addressed in this appendix. Most of these technologies are still at the bench, pilot, or demonstration stage of development and are not commercially available. The technologies summarized here treat contaminated matrices that contain plastic, paper (and other forest products), metals, aqueous liquids, and organic liquids. These waste matrices are generated through activities such as site operations, decontamination and decommissioning, or environmental restoration. Some technologies, such as vitrification and plasma furnaces, have been available for years. Vitrification of liquid high-level radioactive waste is a proven technology.

The treatment summaries were prepared from a number of literature sources and interviews and have been grouped by categories of waste treatment: (1) biological, (2) chemical, (3) physical, (4) stabilization, and (5) thermal.

D.3 Biological Treatment Technologies

Biological treatment methods have been used to treat organic wastes for years. These methods rely on microorganisms to degrade organic compounds to simpler compounds (such as carbon dioxide and water). Sanitary waste water treatment plants rely on biological methods to treat domestic waste water prior to its discharge to surface water. Several industrial wastewaters (such as phenolic and pulp and paper wastes) are also treated using biological methods. Complete degradation (mineralization) of complex hydrocarbons (such as PCBs or polyaromatic hydrocarbons) is more difficult to achieve. Degradation rates are controlled by energy available from breaking chemical bonds and factors affecting enzymatic activity (such as water solubility, pH, temperature, and metals concentration). In general, biological treatment methods are effective for many simple, water-soluble organics. Biological treatment of aqueous-phase organics in industrial wastes often results in the production of sludges contaminated with heavy metals (such as cadmium and lead). These technologies are generally most effective for relatively homogeneous wastes in dilute aqueous solutions.

Innovative approaches to biological treatments include in situ treatment of contaminated groundwater by alternating aerobic (in the presence of oxygen) and anaerobic (without oxygen) conditions using microorganisms (such as white rot fungus, which may be more effective for hydrophobic compounds), and special techniques (such as special reactor vessels, co-substrates, and nutrients) to select microorganisms for optimal degradation rates of compounds that are difficult to treat.

Table D-3. Summary of emerging technologies.

Technology type	Technology	Development status[a]	Waste type[b]	Waste form
Biological	Bioscrubber	Bench	Off-gas/Organics	Liquid and Gas
Biological	Biosorption	Pilot	HLW/Mixed	Supernatant/Saltcake
Biological	White Rot Fungus	Bench	Carbon-Based	Solid and Liquid
Chemical	Aqueous Phase Catalytic Exchange	Bench	Tritiated Water	Liquid
Chemical	Biological/Chemical Treatment	Pilot	Heavy Metal	Solid
Chemical	Dechlorinization	Bench	Mixed/PCB	Solid and Soil
Chemical	Gas-Phase Chemical Reduction	Full	PCBs, Dioxins	Liquid and Sludge
Chemical	Nitrate to Ammonia and Ceramic Process	Bench	Mixed	Aqueous
Chemical	Resorcinol-Formaldehyde Ion Exchange Resin	Bench	HLW	Supernatant
Chemical	Supercritical Water Oxidation	Bench	Mixed	Solid and Liquid
Chemical	Wet Air Oxidation	Bench	LLW/Mixed	Solid and Liquid
Chemical	Wet Chemical Oxidation (Acid Digestion)	Bench	Mixed	Solid and Liquid
Chemical	Evaporation and Catalytic Oxidation	Full	VOC/PCB/Mixed	Solid and Sludge
Chemical	Biocatalytic Destruction	Bench	LLW/Mixed	Aqueous
Chemical	Electrochemical Oxidation	Pilot	Mixed	Solid and Liquid
Chemical	Mediated Electrochemical Oxidation	Pilot	Mixed	Solid and Oils
Physical	Acoustic Barrier Particulate Separator	Pilot	Off-Gas	Particulate
Physical	Chemical Binding/Precipitation/Physical Separation	Pilot	LLW/Mixed	Water/Sludge/Soil
Physical	Chemical Treatment and Ultrafiltration	Pilot	Heavy Metal	Liquid
Physical	Heavy Metals and Radionuclide Polishing Filter	Bench	LLW/Heavy Metal	Liquid
Physical	Membrane Microfiltration	Pilot	Heavy Metal	Solid and Liquid
Physical	Electrodialysis	Full	Metals	Liquid
Physical	Freeze Crystallization	Pilot	Mixed	Liquid
Physical	High-Energy Electron Irradiation	Full	Organics	Liquid and Sludge
Physical	Ultraviolet Oxidation	Full	Organics	Liquid
Physical	Pressure Washing and Hydraulic Jetting	Full	LLW	Solid
Physical	Soil Washing	Bench	LLW	Solid and Soil
Physical	Steam Reforming	Full	Mixed	Solid/Liquid/Sludge
Stabilization	Polyethylene Encapsulation	Full	Mixed	Solid and Sludge
Stabilization	Pozzolanic Solidification and Stabilization	Full	LLW/Mixed	Solid and Sludge
Stabilization	Vinyl Ester Styrene Solidification	Full	LLW/Mixed	Solid
Thermal	Flame Reactor	Full	Organics/Metals	Solid/Sludge/Soil
Thermal	Thermal Desorption Process	Full	LLW/Mixed	Liquid
Thermal	Unvented Thermal Process	Bench	Mixed	Solid and Liquid
Thermal	Molten Salt Oxidation and Destruction Process	Pilot	Mixed	Solid and Liquid
Thermal	Quantum-Catalytic Extraction Process	Bench	Mixed/Metals	Solid/Liquid/Gas
Thermal	Infrared Thermal Destruction	Full	Organic/Metal	Solid/Liquid
Thermal	Plasma Hearth Process	Bench	LLW/TRU/Mixed	Solid and Liquid
Thermal	Plasma Arc Centrifugal Treatment	Pilot	Mixed	Solid/Liquid/Gas

Table D-3. (continued).

Technology type	Technology	Development status[a]	Waste type[b]	Waste form	
Thermal	Graphite Electrode DC[c] Arc Furnace	Pilot	LLW/TRU/Mixed	Solid	TE
Thermal	Packed Bed Reactor/Silent Discharge Plasma Apparatus	Bench	PCB/Mixed	Liquid	
Thermal	Electric Melter Vitrification	Bench	HLW/LLW/Mixed	Solid and Sludge	
Thermal	Stirred Melter Vitrification	Bench	LLW/Mixed	Solid and Sludge	
Thermal	Modular Vitrification	Pilot	LLW/Mixed	Solid and Sludge	
Thermal	Vortec Process	Pilot	Mixed	Solid and Liquid	
Thermal	In Situ Soil Vitrification	Full	TRU/Mixed	Buried and Soil	
Thermal	Reactive Additive Stabilization Process	Bench	Mixed/LLW/TRU	Solid and Liquid	
Thermal	Cyclonic Furnace	Pilot	Mixed	Solid/Liquid/Gas	
Thermal	Fluidized Bed Cyclonic Agglomerating Incinerator	Pilot	Mixed	Solid/Liquid/Gas	
Thermal	Catalytic Combustion in a Fluidized Bed Reactor	Bench	Mixed	Solid and Liquid	
Thermal	Microwave Solidification	Pilot	Mixed	Wet and Dry Solids	
Various	Mixed Waste Treatment Process	Pilot	Mixed	Soil	

a. Bench - Technology is being proven on a bench-scale level.
Pilot - Technology has been proven on a bench-scale level and is being tested and evaluated on a pilot-scale level.
Full - Technology is being demonstrated for full-scale commercial or government application.

b. HLW = High-level radioactive waste. TE
LLW = Low-level radioactive waste.
PCB = Polychlorinated biphenyls.
TRU = Transuranic.
VOC = Volatile organic compounds.

c. DC = Direct current. TE

D.3.1 BIOSCRUBBER

The bioscrubber technology removes organic contaminants in air streams from soil, water, or air decontamination processes and is especially suited to wastes containing dilute aromatic solvents at relatively constant concentrations. The bioscrubber technology digests trace organic emissions using a filter with an activated carbon medium that supports microbial growth. The bioactive medium converts diluted organics into carbon dioxide, water, and other nonhazardous compounds. The filter provides biomass removal, nutrient supplement, and moisture addition. Recently developed bioscrubbers have a potential biodegradation efficiency 40 to 80 times greater than existing filters. A disadvantage of the bioscrubber is its inability to treat high concentrations of aromatics at a high capacity, as required by systems at SRS. A pilot-scale unit with a 4-cubic-foot-per-minute capacity is currently being field tested for the EPA's Superfund Innovative Treatment Evaluation Emerging Technology Program. The bench-scale bioscrubbers successfully removed trace concentrations of toluene at greater than a 95 percent removal efficiency (EPA 1993).

D.3.2 BIOSORPTION

Biosorption is a process by which specialized bacteria are used to biosorb radionuclides and metals. Biosorption consists of the separation and volume-reduction of dilute aqueous-phase radionuclides, metals, and nitrate salts. Liquids and salts are fed to a bioreaction system where radionuclides and metals are concentrated and supernated through biosorption by specialized bacteria. The microorganisms are grown in a bioreactor and are recycled to a biosorption tank where they are mixed with the liquids and salts. Microorganisms biosorb the metals and radionuclides and are removed by filtration to generate a biomass sludge that can be volume-reduced and stabilized through incineration or vitrification. The filtrate, which contains nitrate salts, organics, and low levels of metals, flows to the bioreactor where the nitrate salts are reduced to nitrogen gas and bicarbonate solution and any remaining metals are further adsorbed by the bacteria. After filtration, the effluent from the bioreactor is a salt solution. The process is anticipated to be safe (the system operates at standard temperature and pressure with natural bacteria), energy-efficient, and cost-effective. Uncertainties include potential toxic effects of radionuclides and metals on the bacteria and the volume and characteristics of the sludge. Biosorption of residual underground tank surrogate waste has been demonstrated in the laboratory and is currently in scale-up design for field demonstration at the Idaho National Engineering Laboratory (DOE 1993, 1994a, b).

TE

D.3.3 WHITE ROT FUNGUS

White rot fungus (*Phanerochaete chrysosporium*) is used to degrade a variety of carbon-based contaminants, including PCBs, chlorinated solvents, hydrocarbons, and cyanide. The naturally occurring fungi degrade the contaminants to byproducts, such as inorganic salts, carbon dioxide and water. The ability of this fungus to biodegrade contaminants can be attributed, at least in part, to its natural lignin-degrading system that it uses to decay fallen trees to provide its primary food source, cellulose.

In order to support sustained degradation of chemicals, a carbon source for the fungi must be present and readily available. Examples of bulking agents that can serve as a carbon source include wood chips, corn cobs, and other complex carbohydrates. Degradation rates increase with pollutant chemical concentration, and the toxicity of the chemicals rarely affects the fungi. The microorganisms are able to survive and grow in many adverse conditions and substances, including used 20-weight motor oil and coal-tar-contaminated soils.

A waste treatment system based on white rot fungus can degrade many recalcitrant environmental organic pollutants. The white rot fungus treatment method offers the ability to treat a wide variety of chemical organic pollutants. This treatment method is still in research and development stages. However, experimental results indicate that high degradation of many common pollutants (including pesticides, herbicides, and dyes) is possible. However, the application of this technology to radioactive and mixed wastes may be limited due to potential radiological effects on the white rot fungus organism.

Bench-scale testing of white rot fungus treatment was conducted under a cooperative agreement with the EPA (Connors, no date; Bumpus et al. 1989). TE

D.4 Chemical Treatment Technology

Chemical treatment methods have traditionally been used to treat virtually all types of wastes. These methods can be applied to hazardous, radioactive, and mixed wastes and are compatible with liquids, solids, sludges, and gases.

There are two basic types of chemical treatment methods, chemical extraction and chemical destruction. Chemical extraction technologies separate the contaminants from the waste, while chemical destruction technologies either destroy the hazardous constituent or remove the hazardous characteristic. The type of chemical treatment method applied to a waste stream depends on its physical and chemical properties, regulatory requirements, secondary waste disposal options, and performance assessments.

Innovative approaches to chemical treatment include oxidation/reduction methods (such as supercritical water oxidation, ultraviolet oxidation, and low-temperature reduction of nitrate in ammonia) and the use of newly developed ion exchange resins.

Electrochemical treatment is a direct oxidation/reduction process that is used to treat liquid wastes containing recoverable metals or cyanide. This process involves immersing cathodes and anodes in a waste liquid and introducing a direct electric current. Electrolytic recovery of single metal species can be high and may yield pure or nearly pure forms. Process times are a function of variables such as purity desired, electrode potential, and current, electrode surface area, ionic concentrations, and agitation.

DOE is developing innovative electrochemical treatment processes to demonstrate oxidation of organics and the biocatalytic destruction of nitrate and nitrite salts.

D.4.1 AQUEOUS-PHASE CATALYTIC EXCHANGE FOR DETRITIATION OF WATER

The aqueous-phase catalytic exchange method was originally used to remove organics from waste streams in closed-environment systems. Aqueous-phase catalysis is also applicable to the detritiation of aqueous wastes, and experiments have shown that this process may be able to lower contaminated groundwater tritium levels by two orders of magnitude with an acceptable catalyst bed lifetime. DOE has recently proposed an expansion of its testing of aqueous-phase catalysis. A catalyst manufactured in the United States will be evaluated for use in detritiation of waste water from SRS and other DOE facilities. Performance comparisons will be made with a Canadian-manufactured catalyst (Sturm 1994).

D.4.2 BIOLOGICAL/CHEMICAL TREATMENT

The biological/chemical treatment technology involves a two-stage process to treat wastes contaminated with organics and metals. The process includes chemical leaching of the waste to remove metals (this is similar to soil-washing techniques or mixed ore metals extraction) and bioremediation to remove organics and metals. The process results in an end product of recovered, salable metal or metal salts, biodegraded organic compounds, and stabilized residues. The incoming waste is first exposed to the leaching solution and filtered to separate oversized particles. The leaching solution disassociates metal compounds from the waste. The metal compounds form metal ions in the aqueous leachate and can be removed by liquid ion exchange, resin ion exchange, or oxidation/reduction. After the metals are extracted, the slurried waste is allowed to settle and neutralize. Next, the slurry is transferred to a bioreactor where micronutrients are added to support microbial growth and initiate biodegradation. The residual leaching solution and biodegradable organic compounds are aerobically degraded in the

bioreactor. The combined metal leaching and bioremediation processes may be less expensive than separate processes. For treatment of organic compounds, chemical treatment may facilitate biological treatment, especially for PCBs. Bench-scale tests conducted for the EPA's Superfund Innovative Treatment Evaluation Emerging Technology Programs show that a variety of heavy metals and organic pollutants can be remediated by the process. Pilot-scale testing of the process is being conducted (EPA 1993).

D.4.3 DECHLORINATION

The Dechlor/KGME process involves the dechlorination of liquid-phase halogenated compounds, particularly PCBs. KGME, a proprietary reagent, is the active species in a nucleophilic substitution reaction in which the chlorine atoms on the halogenated compounds are replaced with fragments of the reagent. The products of the reaction are a substituted aromatic compound (which is no longer a PCB aroclor) and an inorganic chloride salt. These secondary wastes require treatment and disposal.

KGME is the potassium derivative of 2-methoxyethanol (glyme) and is generated in situ by adding stoichiometric quantities of potassium hydroxide (KOH) and glyme. The KOH and glyme are added to a reactor vessel along with the contaminated waste. The KGME is formed by slowly raising the temperature of the reaction mixture to about 110 °C, although higher temperatures can be beneficial. The reaction product mixture is a fairly viscous solution containing reaction products and the unreacted excess reagent. After this mixture has cooled to about 93°C (199°F), water is added to help quench the reaction and extract the inorganic salts from the organic phase.

The DeChlor/KGME process is applicable to liquid-phase halogenated aromatic compounds, including PCBs, chlorobenzenes, polychlorinated dibenzodioxins, and polychlorinated dibenzofurans. Waste streams containing from less than 1 to up to 1,000,000 parts per million (100 percent) of PCBs can be treated. Laboratory tests have shown destruction removal efficiencies greater than 99.98 percent for materials containing 220,000 parts per million of PCBs (22 percent).

DOE has recently proposed to evaluate this process for treating solid waste contaminated with PCBs and radioactivity. Although this technology has been demonstrated for treatment of liquid PCB wastes, it has not been demonstrated for treating porous, fine-grained solids contaminated with PCBs.

PCB-contaminated radioactive wastes are currently stored at several DOE facilities. Due to the capacity limitations of the Oak Ridge incinerator regulated by the Toxic Substances Control Act and RCRA, the mixed wastes will be stored for more than 10 years before they can be disposed of. The Consolidated

Incineration Facility at SRS is not permitted to incinerate PCB wastes; however, this is a viable option. The Dechlor/KGME process may be an alternative to incineration and long-term storage. However, some secondary wastes would still require disposal.

Laboratory testing will be conducted with nonradioactive surrogate materials, and if the results are acceptable, additional testing will be performed on representative radioactive waste samples. Pilot-scale testing of the Dechlor/KGME process can then be carried out to evaluate the efficiency of PCB
TE | destruction and the suitability of the process for treating nonradioactive surrogate waste (EPA 1991).

D.4.4 GAS-PHASE CHEMICAL REDUCTION

The gas-phase chemical reduction process uses a gas-phase reduction reaction of hydrogen with organic compounds at elevated temperatures. The process occurs at elevated temperatures to convert aqueous and oily hazardous contaminants to a gaseous, hydrocarbon-rich product. A mixture of atomized waste, steam, and hydrogen is injected into a specially designed reactor. The hydrogen must be specially handled to prevent any potential for explosion. The mixture swirls down the outer reactor wall and passes a series of electric heaters that raise the temperature to 850°C (1,562°F). The reduction reaction occurs as the gases travel toward the scrubber where hydrogen chloride, heat, water, and particulates partition out.

Gas-phase chemical reduction is suitable for the treatment of PCBs, dioxins, and chlorinated solvents. Demonstration tests were performed on wastewater containing an average PCB concentration of 4,600 parts per million and waste oil containing an average of 24.5 percent PCBs. Destructive removal efficiencies of 99.9999 percent were attained during the test runs that were conducted for the EPA's Superfund Innovative Treatment Evaluation Demonstration Program at a Toxic Substances Control Act/RCRA permitted landfill (EPA 1993).

D.4.5 NITRATE TO AMMONIA AND CERAMIC PROCESS

The nitrate to ammonia and ceramic process is used to destroy nitrates present in aqueous, mixed wastes. The process products are an insoluble ceramic waste form and ammonia, which can be further processed through a catalyst bed to produce nitrogen and water vapor. This technology includes a low-temperature process for the reduction of nitrate to ammonia gas in a stirred ethylene glycol-cooled reactor. The process uses an active aluminum (from commercial or scrap sources) to convert nitrate to ammonia gas with the liberation of heat. Silica is added to the reactor, depending on the sodium content of the waste. The aluminum-silica-based solids precipitate to the bottom of the reactor and are further processed by

dewatering, calcination, pressing, and sintering into a ceramic waste form. The process results in a 70 percent volume reduction; however, the process is highly exothermic, so safety controls are required, and an inert gas is required to prevent a potential explosive reaction between the ammonia and hydrogen produced in the reactor.

Bench-top experiments at the Hanford Site have confirmed that the nitrate to ammonia and ceramic process will reduce the nitrate present in aqueous waste to ammonia and hydrated alumina. When silica is added, the reactor product can be used to produce an alumina-silica-based ceramic. Bench-top experiments also demonstrated process dependence on feed constituents and reaction rates. Determination of properties of the waste, such as leachability, is continuing (DOE 1994b). | TE

D.4.6 RESORCINOL-FORMALDEHYDE ION EXCHANGE RESIN

Resorcinol-formaldehyde ion exchange resin beds can be used to remove ionic radionuclides (such as cesium) from high-level radioactive supernatant at 10 times the capacity of baseline phenol-formaldehyde resin beds. Resorcinol-formaldehyde ion exchange resin technology is applicable to high-level wastes that contain high-alkalinity, cesium-supernatant salt solutions. The cesium in the waste is the result of reprocessing spent nuclear power reactor fuels. High-level waste supernatant can be processed through ion exchange columns where cesium undergoes selective sorption in the resorcinol-formaldehyde ion exchange resin and is effectively removed from the waste. After the columns become saturated, they can be removed from service so the cesium can be eluted from the resin with acid. The concentrated cesium can be sent for vitrification, while the regenerated column can be returned to service. The high-level radioactive supernatant that was originally sent through the ion exchange columns can then be stabilized. Spent exhausted resin can be rigorously eluted to lower its cesium content, followed by incineration or chemical destruction. Resorcinol-formaldehyde ion exchange resin has 10 times the capacity of baseline resins, and no volatile organic compounds are formed from radiolysis; however, offgas treatment may be necessary due to the formation of small quantities of hydrogen gas. This technology is fairly limited in its application. Additional contaminants, such as actinides, strontium-90, and mercury must be removed prior to stabilization of the supernatant.

Bench-scale testing has shown that resorcinol-formaldehyde ion exchange resin appears useful over a wide range of concentrations and temperatures. A system prototype is being developed for demonstration at the Hanford Site (DOE 1994a). | TE

D.4.7 SUPERCRITICAL WATER OXIDATION

Supercritical water oxidation is an aqueous-phase oxidation treatment for organic wastes in which organic waste, water, and an oxidant (such as air or oxygen) are combined in a tubular reactor at temperatures and pressures above the critical point of water. The organic constituents are reduced to water, carbon dioxide, and various biodegradable acids. The process occurs above the critical point of water because the water in the liquid waste becomes an excellent solvent for the organic materials contained in the waste.

Supercritical water oxidation is a closed loop system with very small secondary waste generation. Although this process occurs at mild temperatures [400 to 650°C (752 to 1,202°F)] compared to incineration [1,000 to 1,200°C (1,832 to 2,191°F)], the high pressure creates a need for additional process containment, especially when treating radioactive waste. The process is limited to dilute liquid wastes and has not been demonstrated on solid wastes. This treatment method has been tested with a bench-scale system, using cutting oil containing a simulated radionuclide. During bench-scale testing, oxidation efficiencies greater than 99.99 percent were achieved; however, the resulting solid effluent contained levels of the simulated radionuclide that suggest that actual treatment effluent would require further treatment as a radiological hazard. DOE has completed bench-scale testing using mixed waste surrogates, and has begun designing the hazardous waste pilot plant. The hazardous waste pilot plant will be used to identify additional technology needs and to demonstrate currently available technology using hazardous and surrogate mixed waste (DOE 1993, 1994c).

D.4.8 WET AIR OXIDATION

The wet air oxidation process is a treatment method used to destroy organic contaminants in liquid waste streams. Oxidizing organic substances can degrade them into carbon dioxide and water. The waste is heated and passed, along with compressed air, into the oxidation reactor where the chemical reactions take place.

Commercially available wet air oxidation methods are limited to treating dilute (less than 10 percent by weight organics) liquid wastes; however, the addition of a metal catalyst can drastically alter the treatability of the waste. A metal catalyst may allow degradation of halogenated aromatic compounds (such as PCBs) and condensed-ring compounds. A method that uses a metal catalyst to assist in the waste treatment process is currently being bench-scale tested for hazardous, radioactive, and mixed wastes. This method has been successful in treating liquid wastes as well as solid wastes. The

bench-scale studies have been performed using a batch oxidation reactor and a continuous oxidation reactor; both showing promising results.

The bench-scale tests have proven that sufficient oxidation rates can be achieved using wet oxidation methods with the addition of a metal catalyst. Experiments showed that oxidation rates for organic solids are highly dependent on surface area of the solid and the interfacial contact area in the reaction vessels; therefore, efficient mixing is very important. A scheme has been identified to allow separation of radioactive and toxic metals from the process solution (DOE 1993; Wilks 1989).

D.4.9 WET CHEMICAL OXIDATION (ACID DIGESTION)

Wet chemical oxidation uses nitric acid, air, and a catalyst to oxidize liquid and solid organic wastes. The wet chemical oxidation, or acid digestion, process is currently under investigation at SRS for its applicability for treating hazardous and mixed wastes. An advantage of such a process is that it requires only moderate temperatures and pressures; however, several parameters are still under investigation. Research on operating temperatures and catalyst and oxidant concentrations must be completed before initiating feasibility studies on the various applications. Early experiments, however, showed promising results for treating specific waste types.

Because this technology is still in initial bench-scale development, the applicability of the system to a variety of wastes is difficult to predict. Theoretically, however, this process should be able to successfully treat many hazardous, low-level radioactive, and mixed wastes. The current system could produce large amounts of secondary waste products, such as spent acids, that would require additional treatment (DOE 1993; Apte 1993).

D.4.10 EVAPORATION AND CATALYTIC OXIDATION

The evaporation and catalytic oxidation system treats a variety of hazardous liquid wastes by reducing the waste volume and oxidizing volatile contaminants. The proprietary technology combines evaporation with catalytic oxidation to concentrate and destroy contaminants, producing a nontoxic product condensate. The system consists of (1) an evaporator that reduces the influent volume, (2) a catalytic oxidizer that oxidizes the volatile contaminants in the vapor, (3) a scrubber that removes acid gases produced during oxidation, and (4) a condenser that condenses the vapor leaving the scrubber. The treatment would be most effective on liquid wastes containing mixtures of metals, volatile and nonvolatile organics, volatile inorganics, and radionuclides. The technology destroys contaminants and produces a nontoxic product condensate without using expensive reagents or increasing the volume of

the total waste. A pilot-scale facility at the Clemson Technical Center has been developed for treating radioactive, hazardous, and mixed wastes under EPA's Superfund Innovative Treatment Evaluation Demonstration Program. Secondary wastes streams such as evaporator bottoms and sludges would still require disposal. Limitations include potential heavy metal effects on catalysts and a fairly narrow
TC | applicability. A commercial system is in operation in Hong Kong (EPA 1993).

D.4.11 BIOCATALYTIC DESTRUCTION

DOE is developing an enzyme-based reactor system to treat aqueous mixed and low-level radioactive wastes that have high nitrate and nitrite concentrations. The process involves the use of both electrical potential and enzymes to convert the nitrates and nitrites to nitrogen and water. The use of enzymes generates large specific catalytic activity without the need for additional chemical reagents or the production of secondary waste streams.

Removal of nitrates and nitrites from aqueous mixed waste and low-level radioactive waste by the biocatalytic destruction process can be used to pretreat waste in preparation for stabilization by solidification. Laboratory testing, consisting of immobilization of enzymes necessary for reducing nitrates to nitrogen and water, is being conducted by DOE's Argonne National Laboratory (DOE 1994b).

D.4.12 ELECTROCHEMICAL OXIDATION

Electrochemical treatment of hazardous, mixed, and low-level radioactive waste is a direct oxidation process. Oxidation of the organic constituents of the waste can occur in the electrochemical cell through two methods. The process can take place at the cell anode by direct oxidation or with the addition of an oxidizing agent to react with the organics in the cell. This process is limited to the treatment of relatively homogeneous liquid wastes and has been limited to lab-scale demonstrations. Pilot-scale and commercial systems are being developed, and large-scale experiments using a commercially available industrial electrochemical cell have been performed at Lawrence Livermore National Laboratory. A bench-scale electrochemical oxidation unit for destroying waste benzene was developed and demonstrated at SRS (Moghissi et al. 1993; DOE 1993).

D.4.13 MEDIATED ELECTROCHEMICAL OXIDATION

Mediated electrochemical oxidation is a method that was originally developed to treat an insoluble form of plutonium, and it later proved to be an effective method to treat combustible materials. The process utilizes a strong oxidizing agent (a form of silver), which chemically destroys combustible materials and

converts the waste into carbon dioxide and water. Mediated electrochemical oxidation can effectively dissolve metals, has a very efficient destruction rate, and operates at near-ambient conditions. The process could produce a secondary waste containing a form of silver that would pose disposal problems.

Bench-scale and pilot-scale testing at DOE's Rocky Flats Plant have shown that the mediated electrochemical oxidation process is capable of achieving high destruction efficiencies for selected, nonradioactive surrogate materials (Moghissi et al. 1993).

D.5 Physical Treatment Technologies

Physical treatment methods are diverse and rely on physical properties, such as electromagnetic or particulate radiation, high pressure, or gravity. Innovative physical treatment technologies include the use of sound waves to separate particulates from aqueous-phase liquids, the use of electron beams to treat hazardous organics in groundwater, the use of pressure filters to remove metals and radionuclides, and the use of precipitation following coagulation and chemical binding. Several physical treatment technologies, such as the electron beam and filtration methods, are energy intensive.

D.5.1 ACOUSTIC BARRIER PARTICULATE SEPARATOR

This technology is a treatment method for high-temperature, high-throughput offgas streams. The offgas is injected into the separation chamber where an acoustic wave is produced and directed against the flow of the gas. The acoustic wave causes particulates in the offgas to move opposite the gas flow and toward the chamber wall. There, the particulates collect and precipitate into a collection hopper and are removed from the system. Applications include the separation and removal of particles. The process has the potential for high removal efficiencies at high throughput; however, high temperatures must be maintained for condensation and particulate precipitation. Additional treatment, such as the use of high efficiency particulate air filters, may be necessary for some wastes. A pilot-scale system is currently in the design and construction phase under EPA's Superfund Innovative Treatment Evaluation Emerging Technology Program (EPA 1993).

D.5.2 CHEMICAL BINDING/PRECIPITATION/PHYSICAL SEPARATION OF RADIONUCLIDES

Chemical binding/precipitation/physical separation of radionuclides is an innovative technology used to treat contaminated low-level radioactive and mixed waste water, sludges, and soils. The treatment combines a chemical binding process and a physical separation process. The initial step of the combined

treatment process involves rapid mixing of the waste with a fine powder containing reactive binding agents, such as complex oxides. The binding agents react with most of the radionuclides and heavy metals in the waste by absorption, adsorption, or chemisorption. The reactions yield precipitates or coagulum in the processed slurry.

Water is then separated from the solids. This involves a two-stage process that combines clarifier technology, microfiltration (to separate solid material by particle size and density), and dewatering using a sand filter. The resulting waste contains radionuclides, heavy metals, and other solids that can be stabilized for disposal. The demonstrated technology should produce a dewatered sludge that meets toxicity characteristic leaching procedure criteria; however, adding reagents tends to increase the production of waste product. This process may be limited by the quality of the water separated from the solids. Demonstrations under EPA's Superfund Innovative Treatment Evaluation Demonstration Program are expected to show the technology's applicability to wastes containing radium, thorium, uranium, man-made radionuclides, and heavy metals (EPA 1993).

D.5.3 CHEMICAL TREATMENT AND ULTRAFILTRATION

The chemical treatment and ultrafiltration process is used to remove trace concentrations of dissolved metals from waste water. The process produces a volume-reduced water stream that can be treated ultimately for disposal. Waste water is passed through a prefilter to remove suspended particles. The prefiltered waste water is sent to a conditioning tank for pH adjustment and addition of water-soluble macromolecular compounds that form complexes with heavy metal ions. Next, a polyelectrolyte is added to achieve metal particle enlargement by forming metal-polymer complexes. The chemically treated waste water is circulated through a cross-flow ultrafiltration membrane. The filtered water is drawn off, while the contaminants are recycled through the ultrafiltration membrane until the desired concentration is reached. The concentrated stream can be withdrawn for further treatment, such as solidification. Initial bench and pilot-scale tests were successful; however, field demonstrations at Chalk River Laboratories, Ontario, indicated that pretreatment methods need further evaluation.

DOE is currently considering alternative methods of waste water pretreatment for ultrafiltration, including the use of water-soluble chelating polymers for actinide removal and the use of reagents and polymeric materials that exhibit selectivity for cations of heavy metals. Bench-scale tests have been conducted at DOE's Rocky Flats Plant in collaboration with the EPA's Superfund Innovative Treatment Evaluation Demonstration Program (EPA 1992a).

D.5.4 HEAVY METALS AND RADIONUCLIDE POLISHING FILTER

The heavy metals and radionuclide polishing filter uses a colloidal sorption method to remove ionic colloidal, complexed, and chelated heavy metal radionuclides from waste water streams. This technology must be combined with an oxidation process in order to treat waste water that is also contaminated with hydrocarbons, hazardous organics, or radioactive mixed wastes. This technology consists of a colloidal sorption unit that contains a high-efficiency, inorganic, pressure-controlled filter bed. Pollutants are removed from the waste water via surface sorption and chemical complexing in which trace inorganics, metals, transuranic, and low-level wastes can be efficiently treated. The polishing filter can be used for batch or continuous flow processing. Bench tests at DOE's Rocky Flats Plant were conducted for the removal of uranium-234 and -238, plutonium-239, and americium-241 with successful results; however, a measurable analysis was not possible due to the low activity levels of the radionuclide. Bench-scale testing is being conducted under EPA's Superfund Innovative Treatment Evaluation Demonstration Program in collaboration with DOE's Rocky Flats Plant (EPA 1993).

D.5.5 MEMBRANE MICROFILTRATION

The membrane microfiltration system is designed to remove solid particles from liquid wastes. Specifically, this technology can treat hazardous waste suspensions and process wastewaters containing heavy metals. The system uses an automatic pressure filter with a special Tyvek filter material (Tyvek T-980) made of spunbonded olefin. The material is a thin, durable plastic fabric with tiny openings that allow water and smaller particles (less than one-ten-millionth meter in diameter) to pass, while larger particles accumulate on the filter to form a filtercake. The filtercake can be collected for further treatment prior to disposal. This technology is best suited for liquid waste containing less than 5,000 parts per million solids; however, the system is capable of treating wastes containing volatile organics because the system is enclosed. The technology was demonstrated with encouraging results, including removal efficiencies from 99.75 to 99.99 percent and filtercake that passed RCRA toxicity characteristic leaching procedure standards. The technology is being demonstrated under the EPA's Superfund Innovative Treatment Evaluation Demonstration Program at the Palmorton Zinc Superfund Site (EPA 1993).

TE

D.5.6 ELECTRODIALYSIS

This technology is used for metals recovery in aqueous liquid wastes generated in a production process. Electrodialysis uses membrane technology for selective removal of contaminants from a liquid waste. The liquid waste is usually aqueous with contaminants in ionic form. A direct current electrical potential

is used to selectively transport the ions through a membrane where the ionic contaminants can be collected for further treatment.

This technology is not appropriate for treating liquid organic wastes; however, recovery of hazardous metals such as cadmium, nickel, zinc, copper, and chromium is possible. Limitations include operating in a batch mode using reagent-grade chemicals. Electrodialysis technology is commercially available and several membrane technologies suitable for use with an electrodialysis system are being developed under EPA's Superfund Innovative Treatment Evaluation Emerging Technology and Demonstration program (Apte 1993; DOE 1993).

D.5.7 FREEZE CRYSTALLIZATION

Freeze crystallization technology is based on differences in the freezing points of waste components. During freeze crystallization, a liquid waste is cooled using a refrigerant. As the phase changes from liquid to solid, crystals of solvent and contaminant solutes form separately. These crystals can then be gravity separated.

Freeze crystallization can be used to treat liquid mixed wastes containing inorganics, organics, heavy metals, and radionuclides in which the freezing temperatures of the various constituents differ significantly. The technology offers some advantages over other processes. For example, the process offers high decontamination and volume reduction factors, it requires no additives, and it operates at low temperatures and pressures, making it intrinsically safe. However, the technology is limited to those wastes that contain contaminants that crystallize easily. This project is being developed for DOE applications and is in the small pilot-scale development and demonstration stage. The technology will be demonstrated at the proprietor's pilot plant in Raleigh, North Carolina (DOE 1994b).

D.5.8 HIGH-ENERGY ELECTRON IRRADIATION

Electron irradiation process equipment consists of an electron accelerator that accelerates a beam of electrons to 95 percent of the speed of light. The beam is directed into a thin stream of waste water or sludge where free radicals are produced to react with the hazardous organics. Although the electron beam is a form of ionizing radiation, the process does not produce activated radioisotopes.

High-energy electron irradiation of aqueous solutions and sludges removes various hazardous organic compounds from aqueous wastes containing 8 percent solids. The process of irradiation produces large quantities of free radicals in the form of aqueous electrons, hydrogen radicals, and hydroxyl radicals.

The hydroxyl ions can recombine to form hydrogen peroxide. These very reactive chemical species react with organic contaminants, oxidizing them to nontoxic byproducts, such as carbon dioxide, water, and salts.

Electron irradiation may be suitable for the treatment of halocarbons, aromatics, and nitrates. Disadvantages of this process include high power requirements and interferences from solids. The process produces low concentrations of aldehydes and formic acid; however, at these concentrations those compounds are not toxic. Both a full-scale facility and a mobile demonstration unit have been developed. The process is currently being demonstrated for the treatment of volatile organic compounds at SRS through EPA's Superfund Innovative Treatment Evaluation Demonstration Program. In addition, DOE's Los Alamos National Laboratory is evaluating the suitability of electron irradiation for treating aqueous mixed wastes and sludges contaminated with organics and nitrates (DOE 1994b; EPA 1993, 1994).

D.5.9 ULTRAVIOLET OXIDATION

Ultraviolet oxidation uses ultraviolet radiation, ozone, and hydrogen peroxide to destroy toxic organic compounds in water. Ultraviolet oxidation is a common treatment for industrial and municipal waste water. Although commercial systems are available for dilute waste forms, destruction of high organic concentrations requires additional oxidizing agents, such as ozone and hydrogen peroxide. Ultraviolet radiation breaks down the hydrogen peroxide to products that chemically convert organic materials into carbon dioxide and water. This technology operates at near-ambient conditions and generates a very small amount of secondary waste but operates at a slower destruction rate than other technologies. System demonstrations with contaminated groundwater met regulatory standards for volatile organic compounds.

Pilot-scale demonstrations were completed under the EPA's Superfund Innovative Treatment Evaluation Demonstration Program. The technology is fully commercial and is used by various industries as well as DOE for site cleanup activities. The units operate at waste flow rates ranging from 5 to 1,050 gallons per minute (EPA 1993).

D.5.10 PRESSURE WASHING AND HYDRAULIC JETTING

Pressure washing and hydraulic jetting decontamination techniques effectively remove surface contamination from solid materials. These techniques are applicable for decontamination of equipment and in the recovery of reusable or recyclable materials.

Pressure washing consists of a combination of pressurized water washing and chemical cleaning. During pressure washing, an alkaline solvent is used to remove the surface oxide, and an acidic solvent is used to dissolve any remaining residue. Liquid wastes produced from this process can be concentrated into a sludge waste form for further treatment.

The hydraulic jetting process uses a high-pressure hydrolaser to remove surface contaminants. An abrasive additive can be used to remove more persistent contaminants. This process produces a secondary liquid waste that requires further treatment by solidification.

SRS plans to demonstrate washing and jetting technologies for the treatment of low-level lead shielding. The decontaminated lead shielding can be released for reuse, while the process liquid wastes would be concentrated and solidified into a waste form that meets toxicity characteristic leaching procedure standards (Scientific Ecology Group, Inc. 1993).

D.5.11 SOIL-WASHING

Soil-washing consists of deagglomeration, density separation, particle-sizing, and water-rinsing of contaminated soils. Process water can be containerized, recirculated, and treated to remove suspended and dissolved contaminants. Soil washing technologies are being tested using bench-scale commercial equipment to provide equipment costs and operating estimates. Experiments are also being conducted to develop secondary soil treatment technologies that reduce contaminant levels below the levels already achievable with standard attrition, extraction, and leaching procedures.

The soil-washing process has been used to separate uranium from soil at the Fernald Environmental Management Project. The multi-phase soil-washing process begins with a soil and leachate mixture, which is fed into an attrition scrubber to solubilize the uranium from the soil. Next, the mixture flows into a mineral jig where fine uranium particles and contaminated solutions are separated from the soil. The contaminated materials overflow from the jig while the clean soils exit from the bottom. The bottom soils are then screened and washed to remove any uranium residuals. The overflow slurry is collected for appropriate disposal. The bench-scale unit can treat both solid and liquid wastes. Each waste form, however, must be fed into the attrition scrubber separately. Limitations of this technology include handling and disposal of secondary wastes. A bench-scale soil-washing demonstration is being planned at SRS, and several demonstrations are being conducted by the EPA's Superfund Innovative Treatment Evaluation Demonstration Program (EPA 1993).

D.5.12 STEAM REFORMING

Steam reforming consists of a waste evaporation system in which liquid or slurried low-level radioactive and mixed wastes are gasified by exposure to super-heated steam. The gasified organic materials are sent to an electrically heated detoxification reactor where they are converted to nontoxic vapors by thermal decomposition. The detoxified gases are then fed to adsorber beds to remove trace organics, metals, and halogens and are oxidized to carbon dioxide and water and vented to the atmosphere. Steam reforming is currently being tested for its applicability to mixed wastes and may prove to be a viable alternative to incineration. A current project includes demonstration tests corroborated by Sandia National Laboratories and Synthetica Technologies. The project focuses on destruction of organics, nitrate decomposition, and mercury processing and uses a commercial steam reforming unit. Commercial steam reforming has been shown to destroy most of the organic solvents and polymeric organics commonly found in mixed wastes.

A commercial steam reforming unit, the synthetic detoxifier, is currently being tested at SRS. The SRS system has produced destruction and removal efficiencies greater than 99.9 percent for simulated benzene wastes; however, carbon formations caused prohibitive pressure drops in the system. The current acceptable waste is limited to low-heating-value organics because of carbon limitations. Waste acceptance may also be limited to aqueous liquids and small, dry, heterogeneous solids (DOE 1993, 1994a, b).

D.6 Stabilization Technologies

Stabilization and solidification treatment methods are used to immobilize radionuclides and other hazardous inorganic compounds (such as heavy metals) using matrices (such as low sulfur cement or other grouting compounds, polyethylene and other thermoplastics, or bitumen). Stabilization and solidification can effectively immobilize wastes, and costs are lower than other methods, such as vitrification and plasma arc technologies. The primary disadvantage is that waste volumes are increased by the addition of the binding agent. Also, the final waste form is not as leach-resistant as glass or slag. Although cement can result in an effective stabilization matrix, a lack of effective process and quality controls can cause major problems (e.g., failure to cure properly). Both the Oak Ridge Reservation and the Rocky Flats Plant experienced incidents when mixtures of waste and cement failed to cure properly.

At SRS, liquid low-level radioactive waste is currently being stabilized in a grout matrix at the Saltstone Facility. Stabilization is also being considered at SRS for wastes (such as ash and blowdown) from the Consolidated Incineration Facility.

D.6.1 POLYETHYLENE ENCAPSULATION

High-level and low-level mixed wastes containing heavy metals and chloride salts that cannot be stabilized by incineration or vitrification may be incorporated into the polyethylene encapsulation system. Encapsulation technologies provide a physical matrix to stabilize wastes, and are generally not affected by chemical reactions with the waste. Polymeric encapsulation can be used to stabilize a variety of wastes, including incinerator ash, sludges, aqueous concentrates, dry solids, and ion exchange resins. The result is a final waste form that exhibits extremely low leachability characteristics. During polyethylene encapsulation, the pretreated waste, binder, and additives are precisely metered and volumetrically fed to a polyethylene single-screw extruder, which produces the final waste form. Optimization of the polymer matrix is achieved by adjusting density, molecular weight, and melt index. The process extrudes a molten, homogeneous mixture of waste and polyethylene binder into a suitable mold. A transient infrared spectrometer system is used to confirm waste loading.

The technology was successfully applied to the treatment of hazardous and mixed wastes, such as sodium nitrate salt and sludges. Limitations include potential matrix effects by wastes containing excess water, potential biological reactions, potential hydrogen gas generation, and potential fire hazards in closed spaces. Recently, a full-scale demonstration was successfully completed at Brookhaven National Laboratory (DOE 1994b).

D.6.2 POZZOLANIC SOLIDIFICATION AND STABILIZATION

Pozzolanic solidification and stabilization is a technology used to treat soils, sludges, and liquid wastes that are contaminated with organics and metal-bearing wastes. The technology uses a proprietary reagent that chemically bonds with contaminants in the waste. The waste and reagent mixture is combined with a pozzolanic cement mixture to form a stable matrix. Prior to processing, the waste must be characterized for treatability to determine the type and quantities of reagents used in the process. The process begins with waste material sizing during which large debris is removed from the waste. The waste is mixed with the proprietary reagent in a high-shear mixer; then pozzolanic, cementitious materials are added. Limitations include potential setup problems with the waste and reagent mixtures. The technology has been commercially applied to treat wastes contaminated with organics and mixed wastes, and DOE's Brookhaven National Laboratory is continuing testing and demonstration of solidification technologies (EPA 1993).

D.6.3 VINYL ESTER STYRENE SOLIDIFICATION

Vinyl ester styrene solidification has been demonstrated commercially for the emulsification of ion exchange resins. The binder is pulled down through the resin packing bed with a vacuum, and the binder is allowed to solidify into a matrix that will pass toxicity characteristic leaching procedure testing. The emulsified waste forms have been accepted for burial at various sites, and DOE's Hanford Site has recently approved a vinyl ester waste form for inclusion on the Waste Form Acceptance List. DOE plans to demonstrate the viability of vinyl ester styrene solidification for low-level silver-coated packing material (Diversified Technologies 1993).

D.7 Thermal Treatment Technologies

Thermal treatment technologies use moderate or high temperatures to vaporize organics or high temperatures to convert organic waste constituents primarily to carbon dioxide and water vapor. Inorganic waste constituents (such as heavy metals and radionuclides) are concentrated into secondary wastes (such as ash, slag, glass, or blowdown) or captured in offgas treatment systems (such as high-efficiency particulate air filters or baghouses). Some volatile compounds are emitted through the stack. Removal efficiencies for metals are dependent on the chemical and thermodynamic properties of the element or compound. Mercury and cesium are considered volatile metals. Incineration technologies (such as rotary kilns and controlled air systems) have been used traditionally to destroy the organic portion of hazardous wastes, and incineration is the EPA-specified best demonstrated available technology for many hazardous organics (such as solvents and PCBs).

Alternatives to conventional incineration methods are being considered for treating wastes containing metals and radionuclides, including alpha-contaminated and transuranic wastes. Innovative technologies for these types of wastes include vitrification (which immobilizes inorganic contaminants in a glass matrix), plasma arc technology (which uses extremely high temperatures to produce a molten slag), and molten salt oxidation (which oxidizes organics into a molten salt solution). Vitrification and plasma arc technologies generally require secondary combustion chambers to destroy hazardous organics. These technologies have the advantage of producing final waste forms that are extremely leach-resistant, with very small environmental effects following final disposal. Disadvantages include high costs of startup and operation. In some cases, a combination of conventional and innovative technologies can be appropriate, such as vitrifying radionuclide-contaminated ash from a conventional incinerator.

DOE is supporting two full-scale vitrification projects at SRS: (1) the Defense Waste Processing Facility, a joule-heated melter which will be used to vitrify high level wastes, and (2) the M-Area Vendor

Treatment Facility, which will be used to vitrify electroplating sludges contaminated with radionuclides. Research and development projects related to vitrification are ongoing at SRS, universities (such as Clemson University), and other outside facilities. Plasma arc technology is being demonstrated at the Idaho National Engineering Laboratory, where soils and metals contaminated with transuranic radionuclides will be converted into a glassy slag. Studies related to molten salt oxidation are ongoing at Lawrence Livermore National Laboratory.

At SRS, thermal treatment technologies would be effective in reducing the volume of solid low-level radioactive waste, such as job-control waste, prior to final disposal. Alternative technologies (such as vitrification and plasma arc technology) would be effective in treating and stabilizing other waste forms (such as liquids and sludges and metal-bearing wastes).

D.7.1 FLAME REACTOR

The flame reactor is a patented, hydrocarbon-fueled, flash-smelting system that treats residues and wastes that contain metals. The reactor operates at temperatures exceeding 2,000 °C, at a capacity of 1 to 3 tons per hour. The wastes are processed with reducing gas that is produced by the combustion of solid or gaseous hydrocarbon fuels. Volatile metals are captured in a product dust collection system, while nonvolatile metals are separated as a molten alloy or encapsulated in the slag. Organic compounds are destroyed by thermal decomposition.

The unit has a high waste throughput; however, the wastes must be dry and fine enough that the reducing reaction can occur rapidly or efficiency of metal recovery is decreased. The flame reactor technology is applicable to specific waste forms, such as granular solids, soil, flue dusts, slag, and sludges containing heavy metals. The end products are a glass-like slag that passes the toxicity characterization leaching procedure criteria and a potentially recyclable heavy metal oxide. The technology is being developed under the EPA's Superfund Innovative Treatment Evaluation Demonstration Program (EPA 1992a, b, 1993).

D.7.2 THERMAL DESORPTION PROCESS

The thermal desorption process is a low-temperature thermal and physical separation process designed to separate organic contaminants from soils, sludges, and other media without decomposition. Contaminated solids are fed into an externally heated rotary dryer where temperatures range from 400 to 500 °C. A recirculatory inert carrier gas that is maintained at less than 4 percent oxygen to prevent combustion is used to transport volatilized contaminants from the dryer. Solids leaving the dryer are

sprayed with cooling water to help reduce dusting. The inert carrier gas is treated to remove and recover particulates, organic vapors, and water vapors. Organic vapors are condensed and treated separately; water is treated by carbon adsorption and used to cool and reduce dusting from treated solids or is discharged.

A full-scale system is being used to treat soils contaminated with PCBs. The system can treat up to 240 tons of soil per day and reduce it to a concentration of less than 2 parts per million. Two laboratory-scale systems are being used to treat hazardous and mixed wastes. A 7-ton-per-day soil treatment pilot-scale facility is also being used to treat different types of PCB contaminated soils under the EPA's Superfund Innovative Treatment Evaluation Demonstration Program.

The technology advantages include low temperature operation and treatment levels below 1 part per million. Disadvantages include concentrations of extremely hazardous organic compounds, generation of incomplete combustion products (such as dioxin), and the need to transport and/or treat recovered organic liquids (EPA 1993).

D.7.3 UNVENTED THERMAL PROCESS

The unvented thermal process is a high-temperature treatment process that destroys organic contaminants without releasing gaseous combustion products to the environment. The primary treatment unit is a fluidized-bed processor. The processor contains a bed of calcined limestone, which reacts with the offgases produced during the oxidation of organic constituents in the waste. Such gases include carbon dioxide, sulfur dioxide, and hydrogen dioxide. The resulting water vapor is collected and removed through a condenser, and the remaining gases (mostly nitrogen) are mixed with oxygen and returned to the oxidizer. The spent resin from the fluidized bed can then be treated and stabilized.

This process does not release gas from the system and so could attain better public acceptance than conventional thermal treatment technologies. Remaining hazardous byproducts would be mixed with cement-making materials to form a solid cement.

The unvented system favors certain types of wastes, depending on the availability of oxygen and emission limits. Potential wastes include those containing chlorinated hydrocarbons, solid and liquid mixed wastes, and hospital wastes. Mixed waste treatment is suited to the unvented system because it prevents radionuclide emissions.

The unvented thermal process for treating mixed wastes is under development at Argonne National Laboratories. The laboratory-scale experiments have not been completed. Work remains on sorption kinetics and recyclability of the limestone bed as well as verification of total organic destruction. The unvented thermal process could be viable for future use (International Incineration Conference 1993; DOE 1993).

D.7.4 MOLTEN SALT OXIDATION AND DESTRUCTION PROCESS

The molten salt oxidation and destruction process is a two-stage process for treating hazardous and mixed wastes by destroying the organic constituent of the waste. The treatment method involves injection of the waste into a molten bed of salt (specifically, a mixture of sodium-, potassium-, and lithium-carbonates). This pyrolysis stage is designed to operate at between 700 and 950 °C depending on the type of salt and the ash content of the waste. Oxidation occurs in the molten-salt bed because of the injection of an oxidizing gas (such as air) into the waste and molten salt mixture. This oxidation stage can occur at greater than 700 °C, if necessary. Heteroatom constituents of the waste (such as sodium chloride) are retained in the melt. Radioactive actinides are also retained in the melt. The lower operating temperature of this process (compared to incineration at 1,000 to 1,200 °C) decreases actinide volatilization. At the end of a run, the molten salt is drained out of the reactor and dissolved in water. The oxides and stable salts of the actinides precipitate and are filtered out for disposal as low-level radioactive or hazardous waste.

Treatable wastes that are appropriate for this method include organic liquids containing chlorinated solvents and PCBs, combustible low-ash solids, organic sludges, explosives, chemical warfare agents, rubbers, and plastics. Process uncertainties that must be resolved include the effects of ash and stable salt buildup on melt stability and spent salt processing, retention of particulates in the molten salt bed, and the process's tolerance to variations in operating conditions.

Although this system is not commercially available, it does exist as a pilot-scale project at the Lawrence Livermore National Laboratory. A conceptual design report for a full-scale demonstration facility has been issued. Construction is expected to start in 1996 (Moghissi et al. 1993; DOE 1993).

D.7.5 QUANTUM-CATALYTIC EXTRACTION PROCESS

The quantum-catalytic extraction process is a proprietary technology that allows organic and inorganic wastes to be recycled into useful resources of commercial value. The process involves the destruction of hazardous components and controlled partitioning of radionuclides into a solid, nonleachable waste form.

The technology consists of a molten metal bath that acts as a catalyst and a solvent that breaks the molecular bonds of the waste compounds. Upon introduction into the molten metal bath, the waste dissociates into its constituent elements and goes into metal solution. Once the constituent elements are dissolved, proprietary co-reactants are added to enable reformation and partitioning of desired products. The catalytic processing unit (the reactor that holds the molten metal bath) can handle most waste forms, including gases, pumpable liquids and slurries, fine solids, and bulk solids. The process is also equipped with an offgas system and allows injection of co-feeds (such as oxygen) to enhance oxidation of radioactive components.

Bench-scale experiments were conducted using surrogate radioactive materials to demonstrate the oxidation and partitioning of the radionuclides between the metal and vitreous phases and to optimize operating conditions. Decontamination of the metal was greater than 99 percent, and detection of trace amounts of surrogate radionuclides was limited by the analytical detection limit. The quantum-catalytic extraction process is currently being bench-tested to demonstrate ion exchange resin processing capabilities.

Technology development and demonstration efforts are being conducted under a DOE Planned Research and Development Agreement. The scope of work includes theoretical design of quantum-catalytic extraction process systems, radionuclide partitioning, optimization of the vitreous phase for stabilization of radionuclides, testing of waste regulated by RCRA, and conceptual design and development for treatment and recycling of heavily contaminated scrap metal.

A demonstration facility is under development at DOE's Oak Ridge Reservation. The demonstration facility targets the disposal of mixed waste that is regulated under RCRA land disposal restrictions and the Federal Facilities Compliance Act (Herbst et al. 1994; DOE 1994b).

D.7.6 INFRARED THERMAL DESTRUCTION

Infrared thermal destruction uses electrically powered silicon carbide rods to heat organic wastes to combustion temperatures. Any remaining combustibles must be incinerated in an afterburner. The technology is suitable for treating soils and sediments with organic contaminants and liquid wastes after pre-mixing with sand or soil. TE

The process consists of three components: (1) an electric-powered infrared primary chamber, (2) a gas-fired secondary combustion chamber, and (3) an emissions control system. Waste is fed to the primary chamber where it is heated to 1,000°C by exposure to infrared radiant heat. A blower delivers

air to the chamber to control the oxidation rate of the waste feed. Ash material from the primary chamber is quenched and conveyed to a hopper for later sampling and subsequent disposal. Volatile gases from the primary chamber flow to the secondary chamber where they undergo further oxidation at higher temperatures and a longer residence time. Gases from the secondary chamber are sent through an emissions control system for particulate separation and neutralization.

The system is capable of high throughput, but at a cost of high-power consumption. Process uncertainties requiring resolution include emission control system inefficiencies and retention of lead in the incinerated ash. Demonstrations have shown that the process should be capable of meeting RCRA and Toxic Substances Control Act standards for particulate and air emissions and PCB remediation.

Two evaluations of the infrared thermal destruction system were conducted under EPA's Superfund Innovative Treatment Evaluation Demonstration Program. Organics, PCBs, and metals were the target waste compounds during the full-scale demonstration at the Peak Oil Site in Tampa, Florida, and a pilot-scale demonstration at the Rose Township Demode Road Superfund Site in Michigan (EPA 1993).

D.7.7 PLASMA HEARTH PROCESS

Plasma technologies use a flowing gas between two electrodes to stabilize an electrical discharge, or arc. As an electric current flows through the plasma, energy is dissipated in the form of heat and light, resulting in joule heating of the process materials, forming a leach-resistant slag that can be modified by adding such materials as soil. The plasma hearth process relies on a stationary, refractory-lined primary chamber to produce and contain the high temperatures necessary for producing the slag.

The plasma hearth process begins when the waste, either solid or liquid, is fed into the primary plasma chamber where the heat from the plasma torch allows the organic compounds in the waste to be volatilized, oxidized, pyrolyzed, or decomposed. The remaining inorganic material is then fed to the secondary combustion chamber for high-temperature melting, producing a molten slag. Cooling and solidification of the slag provide a nonleachable high-integrity waste form. Offgas volumes are lower than those from conventional incineration units.

The plasma hearth process has undergone bench-scale testing by DOE at Argonne National Laboratories West and is currently undergoing demonstration-scale testing at Ukiah, California, to evaluate potential treatment of solid mixed wastes.

Advantages of plasma technologies include the ability to feed high amounts of metal-bearing wastes, including whole drums. The resulting slag requires no additional stabilization. The technology is extremely robust and can accept waste forms, including papers, plastics, metals, soils, liquids, and sludges. Based on these characteristics, very small characterization data are needed. In non-plasma vitrification technologies, combustion of the paper and plastics can produce soot and result in offgas problems (unless a primary burner is placed upstream of the vitrification unit).

A proof-of-principle demonstration has established the process's ability to treat a wide range of waste types in a single processing step that results in a final vitrified form. Ongoing projects for the plasma hearth process involve major hardware development and the determination of the level of characterization required of mixed waste prior to processing. The plasma hearth process is being developed at DOE's Idaho National Engineering Laboratory (International Incineration Conference 1994; DOE 1994b). TC

D.7.8 PLASMA ARC CENTRIFUGAL TREATMENT

The plasma arc centrifugal treatment furnace uses the plasma arc process with an internal rotating drum to treat hazardous, mixed, and transuranic wastes. In this process, the waste is fed into a molten bath (1,650 °C) created by a plasma arc torch. The feed material and molten slag are held in the primary chamber by centrifugal force. Within the plasma furnace, all water and organic waste material are volatilized. The organic material is also fully oxidized to carbon dioxide, water vapor, and acid gases, including sulfur dioxide and hydrochloric acid vapor.

Offgas is then treated by conventional treatment methods. Offgas streams pass through a wet filter to remove heat, humidity, and dust. Next, the offgas is treated in a caustic wet scrubber to remove sulfur oxides and halogen acids, a catalyst bed oxidizes nitric acid to nitrogen dioxide, and a catalytic wet scrubber removes nitrogen dioxide from the offgas. Finally, the cleansed gas stream passes through charcoal and high efficiency particulate air filters before being exhausted to the atmosphere. Nonvolatile waste material is fully oxidized and uniformly melted by the high-power electric arc and collected as molten slag which is then discharged as a nonleachable homogeneous glassy residue. The centrifugal action of the furnace keeps the slag toward the inner walls of the furnace until the rotation is slowed, which allows the slag to move toward the center. The slag then drains from the center of the furnace and is collected in a mold or a drum and allowed to cool and solidify.

This technology has been demonstrated to be applicable for the treatment of various waste types and forms, including hazardous, mixed, and transuranic wastes containing heavy metals and organic

contaminants. Demonstration results showed a minimum destructive removal efficiency greater than 99.99 percent, organic and inorganic material concentrations that met toxicity concentration leaching procedure standards, and offgas treatment that exceeded regulatory standards.

A full-scale demonstration of this process is being planned for the Idaho National Engineering Laboratory to remediate soils and debris contaminated with transuranic radionuclides.

SRS has plans to demonstrate a small-scale arc melter vitrification system that would meet all regulatory low-level mixed waste disposal requirements. The system provided will be used to establish operating costs and offgas/secondary waste characteristics for further evaluation and analysis. The operating temperatures of the plasma arc system are expected to allow a variety of low-level mixed wastes to be vitrified in a way that minimizes secondary waste generation and allows regulatory approved disposal of the resulting glassy slag (Feizollahi and Shropshire 1994; International Incineration Conference 1993, 1994; DOE 1993; EPA 1993, 1992c).

D.7.9 GRAPHITE ELECTRODE DC ARC FURNACE

The graphite electrode DC arc furnace has been demonstrated to be a useful alternative in processing low-level radioactive and mixed wastes that contain a high-weight-fraction of metals. The graphite electrode DC arc delivers thermal energy, using an arc of ionized gas (plasma), that is developed between two electrodes attached to the material being processed. Temperatures in excess of 1,700 °C are generated by the process, which causes the soil and metal mixture to be stratified into a metal phase, a glass phase, and a gas phase. The final metal and glass waste forms are highly densified. The high temperatures in the vicinity of the DC arc also serve to destroy organics, which results in greatly reduced offgas production relative to combustion treatments. A bench-scale furnace was successfully demonstrated for the DOE's Pacific Northwest Laboratory using a variety of soil mixtures containing metals, combustibles, sludges, and high-vapor-pressure metals. A pilot-scale furnace has been constructed, which includes provisions for containing alpha-emitting radionuclides, continuous waste processing, and the capability to separate the glass phase from the metal phase. Process uncertainties that evolved from the bench-scale testing include graphite electrode consumption and offgas system operations (International Incineration Conference 1993; DOE 1993).

D.7.10 PACKED BED REACTOR/SILENT DISCHARGE PLASMA APPARATUS

The packed bed reactor/silent discharge plasma apparatus is a two-stage oxidation system for destroying hazardous liquid wastes. The system may also be applicable for the destruction of PCB contaminated

mixed waste. The treatment method combines a thermal oxidation process in an excess air stream and a process to destroy the organic constituents from the reactor exhaust. The packed bed reactor provides thermal oxidation, and the silent discharge plasma unit provides the organic destruction. The plasma unit is operated at ambient temperature and pressure.

Most hazardous waste destruction occurs in the packed bed reactor by heat provided externally (that is, without an open flame). The reactor exhaust is treated in a cold plasma that is generated by electrical discharges in the silent discharge plasma unit. The contents of the plasma include hydroxide and phosphite radicals that react with the organics in the exhaust.

Uncertainties encountered during recent bench-scale tests include the proper packed bed reactor construction materials to resist corrosion and a silent discharge plasma dielectric that is capable of increased reactor exhaust flow.

Bench-scale tests have predicted a destruction removal efficiency greater than 99.9 percent for PCBs using this combined system for treating liquid waste. The production of hydroxide gas through the oxidation process could, however, cause severe corrosion problems if the current system is operated for an extended period of time. This could also produce a secondary waste containing corrosion byproducts contaminated with other potential waste constituents, such as tritium. Changes to the current system to help alleviate these problems are being studied at SRS's soil vapor extraction installation and Los Alamos National Laboratory (International Incineration Conference 1994).

D.7.11 ELECTRIC MELTER VITRIFICATION

Vitrification processes convert contaminated materials into oxide glasses. Suitable feed materials include frit, soils, sediments, and sludges. One vitrification process uses an electric melter to generate the heat needed to create molten glass; this is currently under development for pilot-scale tests. The melter is being evaluated on its ability to determine offgas composition, and to treat wastes using glass compositions that are tailored to the particular type of waste being treated.

In an electric melter, the glass can be kept molten through joule heating because the molten glass is an ionic conductor of relatively high electrical resistivity. As waste is fed into the vitrification unit from the top, the molten glass phase in the center of the unit heats the cold feed. Such a unit has a thick layer of cold feed product on top of the molten glass, which acts as a counter-flow scrubber that limits volatile emissions. This is an advantage over the exposed molten glass surfaces of fossil fuel melters.

The electric melter is expected to treat hazardous, mixed, and low-level radioactive wastes that have lower emissions of toxic offgases than conventional vitrification fossil fuel melters. The Defense Waste Processing Facility at SRS is a full-scale, joule-heated, vitrification unit that will immobilize high-level waste within a stable borosilicate glass matrix. An electric melter for vitrifying nonradioactive, hazardous wastes is being developed under the EPA's Superfund Innovative Treatment Evaluation Emerging Technology Program (EPA 1992d, 1993).

D.7.12 STIRRED MELTER VITRIFICATION

The Savannah River Technology Center has tested the application of a newly developed stirred tank melter for treatment and vitrification of mixed and low-level radioactive wastes (i.e., cesium-contaminated ion exchange resins). Two major problems in existing ion exchange resin melters led to the new technology development. First, the resins had a tendency to form a crust on the surface of the melt, allowing the cesium more opportunity to volatilize due to the increased time needed for the waste feed to be incorporated into the melt. Second, the organic resin caused significant reducing conditions in the melt which could increase the volatility of alkali metals (such as cesium) and affect glass quality.

The stirred melter could eliminate these problems. Because the melter is equipped with an impeller to agitate the melt, the crust formation could be reduced by continuous mixing and drawing of the surface into the melt. Increased oxygen exchange between the melt and the vapors above the surface of the melt could also reduce the negative effects of a reduced melt and could lower the amount of volatilized cesium and alkali metals.

Test results from a study conducted by Clemson University, in collaboration with DOE, show that vitrification of ion exchange resins, mixed, and low-level wastes in a stirred tank melter is operationally
TE | feasible (International Incineration Conference 1993, 1994; Moghissi and Benda 1991).

D.7.13 MODULAR VITRIFICATION

The modular vitrification technology is a vitrification process developed to stabilize mixed and low-level radioactive waste.

The system is composed of several stages to treat the various waste forms. First, aqueous wastes, sludges, and slurries enter an evaporator to eliminate excess water from the waste feed. Next the dried solids from the evaporator as well as other solids enter a two-section melter. The upper section, a gasification plenum, contains the solid waste, which feeds the lower section. In the lower cold-wall

crucible, molten glass supplies heat to evaporate residual water from the waste and gasifies the organic constituents. The heat also melts the inorganic components, which dissolve into the glass matrix.

Next, vitrified waste is formed and allowed to cool into solidified glass marbles. The marble form is used because of its convenience in handling, sampling, and annealing. Molten liquid metals are also tapped from the crucible and formed into metal cubes. Offgases are treated using conventional methods. Additional testing is necessary to verify system design parameters and to ensure compliance with all air emissions and other regulatory requirements.

Applicable waste forms for the modular vitrification system include dry active wastes, ion exchange resins, inorganic sludges and slurries, and mixed wastes. Full-scale testing and commercial operation of the system by VECTRA Technologies and Batelle Memorial Institute are expected in 1995 (Mason, no date; EPA 1992d). TE

D.7.14 VORTEC PROCESS

The vortec process is an oxidation and vitrification process for the remediation of soils, sediments, and sludges that are contaminated with organics and heavy metals. In the first step of the process, the slurried waste stream is introduced into a vertical vortex precombustor where water is vaporized, and the oxidation of organics is initiated. The waste stream is then fed to a counter-rotating vortex combustor, which provides suspension heating of the waste and secondary combustion of volatiles emitted from the precombustor. The preheated solid materials are delivered to a cyclone melter where they are separated to the chamber walls to form a vitrified waste product. The vitrified product and process exhaust gases are separated; after which, the exhaust gases are sent to process heat recovery and pollution control subsystems. The advantages of the vortec process include the ability to process waste contaminated with organics and heavy metals, recycle the pollution-control-system waste, and provide a vitrified product that passes toxicity characterization leaching procedure standards. A 20-ton-per-day, pilot-scale facility, located at an EPA-funded site, has operated successfully since 1988, producing a vitrified product that passes toxicity characterization leaching procedure standards. Transport systems are currently being designed for the treatment of DOE mixed wastes (EPA 1993).

D.7.15 IN SITU SOIL VITRIFICATION

In situ soil vitrification uses an electric current to melt and stabilize inorganic waste components while destroying organic waste components by pyrolysis. The process begins by inserting an array of electrodes into the ground. A starter path for electrical current is provided by placing flaked graphite and

frit on the ground surface between the electrodes (because of the low initial conductivity of the soil). As power is applied, the melt travels downward into the soil at a slow rate. The final waste form consists of a vitrified monolith with positive strength and leachability characteristics. Offgases are captured in a hood that is maintained at a negative pressure. Offgas treatment consists of quenching, scrubbing, mist elimination, heating, particulate filtration, and activated carbon adsorption.

The in situ soil vitrification process has successfully destroyed organic pollutants by pyrolysis and incorporated inorganic pollutants within a glass-like vitrified mass. The process, however, is limited by the physical characteristics of the soil (including void volume size, soil chemistry, rubble content, and the amount of combustible organics in the soil). The process has been operated in pilot-scale and full-scale tests at DOE's Hanford Site, Oak Ridge National Laboratory, and Idaho National Engineering Laboratory (EPA 1993).

D.7.16 REACTIVE ADDITIVE STABILIZATION PROCESS

The reactive additive stabilization process uses a high-surface-area additive to enhance the vitrification of SRS nickel electroplating sludges and incinerator wastes.

The additive used in the reactive additive stabilization process is a reactive high-surface-area silica. This additive was found to increase bonding of the waste species by increasing the solubility and tolerance of borosilicate and soda-lime-silica glass formulations. The silica also lowers the glassification temperature and allows large waste volume reductions due to increased waste loadings. The final glass is in compliance with applicable EPA standards.

The reactive additive stabilization process increases the rates of dissolution and retention of hazardous, mixed, and heavy metal species in the vitrified product. Volatility concerns are reduced because the reactive additive stabilization process lowers the melting temperatures of the waste due to the addition of the highly reactive, high-surface-area silica additive. The process typically reduces the waste volume by 86 to 97 percent and thus maximizes cost savings.

The reactive additive stabilization process is an acceptable method for vitrifying radioactive materials, transuranic wastes, incinerator ash, waste sludges, and other solid and aqueous wastes. Laboratory-scale studies at SRS have demonstrated that the reactive additive stabilization process is a viable process for treating hazardous and mixed wastes by achieving large waste-loading percentages, large volume-reduction percentages, and large cost savings (Moghissi et al. 1993).

D.7.17 CYCLONIC FURNACE

The cyclonic furnace is designed to treat solid, liquid, soil slurry, or gaseous wastes by high-temperature combustion and vitrification. The high turbulence in the combustion chamber helps ensure that temperatures are high enough (1,300 to 1,650°C) to melt high-ash-content feed material. Highly contaminated inorganic hazardous wastes and soils that contain heavy metals and organic constituents are the primary waste forms targeted by this technology. The processes can also be applied to mixed wastes containing lower-volatility radionuclides, such as strontium and transuranic elements.

The waste that enters the cyclonic furnace is melted, and the organics are destroyed in the resulting gas phase or in the molten slag layer that forms on the inner wall of the furnace barrel. Organics, heavy metals, and radionuclides are captured in the slag that exits the furnace from a tap at the cyclone throat. The slag then solidifies, rendering its hazardous constituents nonleachable.

This technology has been tested in pilot-scale demonstrations. Results showed that almost 95 percent of the noncombustible synthetic soil matrix is incorporated into the slag, and simulated radionuclides are immobilized. Current demonstrations are being performed under the EPA's Superfund Innovative Treatment Evaluation Demonstration Program (Roy 1992a, b; EPA 1993).

D.7.18 FLUIDIZED BED CYCLONIC AGGLOMERATING INCINERATOR

Fluidized bed technology uses a catalyst to facilitate complete destruction of hazardous species at low temperatures. The fluidized bed cyclonic agglomerating incinerator consists of a two-stage process in which solid, liquid, and gaseous organic wastes can be efficiently destroyed while solid, nonvolatile inorganic contaminants can be agglomerated into a pellet-sized, vitrified waste form. In the first stage, a fluidized bed reactor operates as a low-temperature desorption unit or a high-temperature agglomeration unit. Fuel, oxidant, and waste is fed to the fluidized bed reactor where the waste undergoes rapid gasification and combustion. Inorganic and metallic solids will be agglomerated into glassy pellets that will meet the requirements of the toxicity characteristic leaching procedure. Gases from the fluidized bed (which consist of products of both complete and incomplete combustion) are fed to the second stage of the process (which consists of a cyclonic combustor that will oxidize carbon monoxide and organics to carbon dioxide and water). Volatilized metals are collected in a downstream scrubber. This technology has undergone bench-scale demonstration. Toxicity characteristic leaching procedure test results, however, have been inconclusive to date. Design and construction of a pilot plant were completed, and testing is in progress.

The low operating temperatures of the fluidized bed process are not conducive to nitrogen oxide formation. Volatilization of radionuclides and heavy metals and acidic offgas can be treated in situ. Offgases can be treated with high efficiency particulate air filters. Fluidized bed technology is compatible with a wide range of wastes, including combustible and non-combustible solids, liquids, and sludges. From these wastes, the fluidized bed produces a secondary solid waste from catalyst attrition that requires further treatment. These solids are collected and solidified by other methods (e.g., polymer solidification, microwave solidification, or cementation) to produce a final waste form.

DOE and EPA are currently developing hybrid fluidization systems, such as the fluidized bed cyclonic agglomeration. Los Alamos National Laboratory is researching new techniques for monitoring radionuclides and heavy metals in the offgas stream. DOE is considering a project to demonstrate the feasibility of a fluidized bed unit to treat a radioactive solvent waste. The unit under consideration will include a patented combustion process that captures contaminants in-bed and prevents the formation of glass deposits as seen with conventional combustion techniques (EPA 1993).

D.7.19 CATALYTIC COMBUSTION IN A FLUIDIZED BED REACTOR

Catalytic combustion in a fluidized bed reactor is a low-temperature (525 to 600 °C) treatment for low-level mixed waste; it is currently in an active research and development stage. The anticipated waste for this process, however, is one primarily made of cellulosic matter, such as paper, latex, wood, and polyvinyl chlorides. Such wastes present processing problems because some compounds thermally degrade to yield toxic byproducts. For example, polyvinyl chloride degradation produces hydrochloric acid vapors, which can react to form chlorinated hydrocarbons. The addition of sorbants may, therefore, be required to implement in situ capture of chlorinated hydrocarbons.

Several advantages are offered by combining flameless fluidized bed combustion with catalytic after-burning, rather than by using high-temperature incineration. Two advantages are elimination of (1) the need for refractory lining in the reactor and (2) the emission of radioactive material from the fluidized bed. Radioactive material generally does not volatilize at temperatures below 800 °C.

Research at the Colorado School of Mines has been conducted to determine the catalysts that best contribute to the destruction of toxic (chemically hazardous) waste material. Tests have shown that catalysts containing chromia are the most successful in achieving high destruction and removal percentages. Research has also shown that this method could be a viable alternative method for volumetric reduction of low-level mixed waste. The studies have also shown that these methods may be applicable to transuranic wastes (Murray 1993; International Incineration Conference 1994).

D.7.20 MICROWAVE SOLIDIFICATION

Microwave solidification uses microwave energy to heat and melt homogeneous wet or dry solids into a vitrified final waste form that possesses high-density and leach-resistant attributes. The system includes an "in-drum" melting cavity that isolates the molten waste and the drum from the process equipment. Glass-forming frit is added to the waste contained in the drum, which is then exposed to high-energy microwaves to produce a vitrified final waste form that is suitable for land disposal. Advantages of microwave processing over conventional thermal treatment include an elimination of the need for heating elements or electrodes in direct contact with the waste, potential to reduce volatile radionuclide emissions, and a significant volume reduction. | TE

The process is energy efficient and controllable because of direct coupling between the microwave energy and the waste. The results of bench-scale experiments at DOE's Rocky Flats Plant are encouraging and support the potential use of microwave technology in the production of vitrified waste forms. Further work is being done to optimize critical process parameters, including waste loading and borax concentration in the glass-forming frit (International Incineration Conference 1994; DOE 1994b). | TE

D.7.21 MIXED WASTE TREATMENT PROCESS

The mixed waste treatment process treats contaminated soils by separating the hazardous and radioactive contaminants into organic and inorganic phases. This process is an integration of individually demonstrated technologies, including thermal desorption, gravity separation, water treatment, and chelant extraction. The initial treatment step involves sizing the incoming waste, after which volatile organics are removed by indirectly heating the waste in a rotating chamber. The volatilized organics and water are separately condensed, and the volatile organics are decanted for further treatment and disposal. The waste is rehydrated and inorganic constituents are removed by gravity separation, chemical precipitation, and chelant extraction. Gravity separation is used to separate higher density particles, a potassium ferrite formulation is added to precipitate radionuclides, and the insoluble radionuclides are removed through chelant extraction. The chelant solution then passes through an ion exchange resin to remove the radionuclides and is recycled to the process. The contaminants from all waste processes are collected as concentrates for recovery or disposal.

This technology has been developed for processing soil contaminated with organics, inorganics, and radioactive material. Bench-scale and pilot-scale testing for individual components of the treatment process is ongoing under EPA's Superfund Innovative Treatment Evaluation Emerging Technology Program using DOE, U.S. Department of Defense, and commercial wastes. Thermal separation has been

shown to remove and recover PCBs, gravity separation of radionuclides has been successfully demonstrated, and chelant extraction has long treated surface contamination in the nuclear industry (EPA 1993).

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APPENDIX E

SUPPLEMENTAL DATA

APPENDIX E

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SECTION 1

WATER RESOURCES

Table E.1-1. 1993 analytical data for National Pollutant Discharge Elimination System Outfall M-004 (M-Area Liquid Effluent Treatment Facility)-Permit SC#0000175.[a,b]

Parameter	Units[c]	Permit limits[d]	DMR[e] results	
			Minimum[f]	Maximum[f]
pH	Standard unit	6.0-10.0[g]	6.8	7.8
Nitrate (as N)	mg/L	RR[h]	51.1	1,700
Phosphate	mg/L	RR	0.238	17.3
Suspended solids	mg/L	31/60[i]	1	14
Oil and Grease	mg/L	RR	<1	11.9
Uranium	mg/L	RR	<0.02	0.128
Lead	mg/L	0.43/0.69[i]	<0.0012	0.0225
Nickel	mg/L	1.23/2.46[i]	<0.012	<0.3
Silver	mg/L	0.009/0.018[i]	<0.0005	<0.0025
Chromium	mg/L	0.62/1.24[i]	<0.02	<0.1
Aluminum	mg/L	3.2/6.43[i]	<0.05	1.3
Copper	mg/L	0.21/0.42[i]	<0.004	0.03
Zinc	mg/L	0.32/0.64[i]	<0.01	0.085
Cyanide	mg/L	0.62/1.24[i]	<0.005	<0.005
Cadmium	mg/L	0.05/0.1[i]	<0.01	<0.05
Gross Alpha Radioactivity	pCi/L	----------[j]	0.306[k]	4.99[k]
Nonvolatile (dissolved) Beta Radioactivity	pCi/L	----------[j]	0.408[k]	5.33[k]
Tritium	pCi/L	----------[j]	303[k]	1,560[k]

a. Source: Arnett (1994).
b. Parameters are those DOE routinely measures as a regulatory requirement or as a part of ongoing monitoring programs.
c. mg/L = milligrams per liter; a measure of concentration equivalent to the weight/volume ratio.
pCi/L = picocuries per liter; a unit of radioactivity; one trillionth of a curie.
d. Limits imposed by SCDHEC NPDES Permit SC#0000175.
e. 1993 results reported to SCDHEC on the monthly Discharge Monitoring Report (DMR).
f. The minimum concentration was the minimum concentration found in samples analyzed in 1993. The maximum concentration is the highest single result found during the 1993 sampling events.
g. First number is the minimum acceptable pH while the second number is the maximum acceptable pH.
h. RR = measure and report.
i. First number represents the daily average limit while the second number represents the daily maximum limit.
j. Radioactive limits are not included on the NPDES Permit.
k. Collected near the mouth of Tim's Branch, downstream of M-Area.

Table E.1-2. 1993 analytical data for National Pollutant Discharge Elimination System Outfall H-016 (F/H-Area Effluent Treatment Facility)-Permit SC#0000175.[a,b]

Parameters	Units[c]	Permit limits[d]	DMR[e] results	
			Minimum[f]	Maximum[f]
pH	Standard units	6.0-9.0[g]	6.4	9.0
Temperature	°C	32.2	14	30
BOD_5	mg/L	20/40[h,i]	<1	5
Nitrate (as N)	mg/L	RR[j]	1.78	66
Ammonia as Nitrogen	mg/L	20/RR	<0.01	0.15
Suspended Solids	mg/L	30/60[i]	<1	2
Oil and Grease	mg/L	10/15[i]	<1	10.1
Uranium	mg/L	RR	<0.02	<0.1
Lead	mg/L	0.29/0.58[i]	<0.0005	0.0094
Nickel	mg/L	RR	<0.03	<0.05
Mercury	mg/L	0.045/0.175[i]	<0.0001	<0.0005
Chromium	mg/L	1.71/2.77[i]	<0.02	<0.03
Aluminum	mg/L	RR	<0.05	0.053
Copper	mg/L	1.45/2.07[i]	<0.01	0.013
Zinc	mg/L	1.48/2.61[i]	<0.01	0.414
Manganese	mg/L	RR	<0.005	0.0343
Total Chlorine	mg/L	RR	<0.01	0.37
Gross Alpha Radioactivity	pCi/L	------ [k]	0.53[h]	3.90[h]
Nonvolatile (dissolved) Beta Radioactivity	pCi/L	------ [k]	0.497[h]	3.94[h]
Tritium	pCi/L	------- [k]	607[h]	13,200[h]
Strontium-89,90	pCi/L	------- [k]	<DL[l]	0.783[h]
Uranium/Plutonium	pCi/L	------- [k]	<DL	0.298[h]

a. Source: Arnett (1994).
b. Parameters are those DOE routinely measures as a regulatory requirement or as a part of ongoing monitoring programs.
c. mg/L= milligrams per liter; a measure of concentration equivalent to the weight/volume ratio.
pCi/L= picocuries per liter; a unit of radioactivity; one trillionth of a curie.
d. Limits imposed by the SCDHEC NPDES Permit SC#0000175.
e. 1993 results reported to SCDHEC on the monthly Discharge Monitoring Report (DMR).
f. The minimum concentration is the minimum concentration found in samples analyzed in 1993. The maximum concentration is the highest single result found during the 1993 sampling events.
g First number is the minimum acceptable pH while the second number is the maximum acceptable pH.
h. Collected downstream of Outfall H-016 on Upper Three Runs near Road C.
i. First number represents the monthly average limit while the second number represents the daily maximum limit.
j. RR = measure and report.
k. Radioactive limits are not included on the NPDES Permit.
l. <DL = analytical result less than the test procedure detection limit.

TE | **Table E.1-3.** Water quality in Beaver Creek Dam on SRS (calendar year 1992).[a,b]

Parameter	Unit of measure[c]	MCL[d,e] or DCG[f]	Minimum[g]	Maximum[g]
Aluminum	mg/L	0.05-0.2[h]	3.59	4.14
Ammonia	mg/L	NA[i,j]	0.048	0.40
Cadmium	mg/L	0.005[d]	<0.00004	0.0025
Calcium	mg/L	NA	2.68	4.41
Cesium-137	pCi/L	120		
Chloride	mg/L	250[h]	2.4	8.6
Chromium	mg/L	0.1[d]	<0.0004	0.0668
Copper	mg/L	1.3[k]	<0.0004	0.014
Dissolved oxygen	mg/L	>5.0[l]	5.8	10.0
Fecal coliform	Colonies per 100 ml	1,000[l]	3	22
Gross alpha radioactivity	pCi/L	15[d]	<DL	1.15
Iron	mg/L	0.3[h]	0.567	3.81
Lead	mg/L	0.015[k]	<0.0004	0.015
Magnesium	mg/L	NA	1.02	1.82
Manganese	mg/L	0.05[h]	<0.0004	0.412
Nickel	mg/L	0.1[d,e]	<0.0004	0.015
Nonvolatile (dissolved) beta radioactivity	pCi/L	50[d]	0.5	5.8
pH	pH units	6.5-8.5[h]	6.2	7.6
Phosphate	mg/L	NA	<0.01	1.5
Sodium	mg/L	NA	3.83	10.6
Sulfate	mg/L	250[h]	3.98	13.1
Suspended solids	mg/L	NA	1.0	31.8
Temperature	°C	32.2[m]	14.5	34
Tritium	pCi/L	20,000[d,e]	0.05	228
Zinc	mg/L	5[h]	<0.0004	0.017

a. Sources: Wike et al. (1994); Cummins, Martin, and Todd (1991).
b. Parameters are those DOE routinely measures as a regulatory requirement or as part of ongoing monitoring programs.
c. mg/L = milligrams per liter; a measure of concentration equivalent to the weight/volume ratio.
pCi/L = picocuries per liter; a picocurie is a unit of radioactivity; one trillionth of a curie.
d. Maximum Contaminant Level (MCL), EPA National Primary Drinking Water Standards (40 CFR Part 141). See glossary.
e. Maximum Contaminant Level, SCDHEC (1976). See glossary.
f. DOE Derived Concentration Guides (DCGs) for water (DOE Order 5400.5). DCG values are based on committed effective doses of 4 millirem per year for consistency with drinking water MCL of 4 millirem per year. See glossary.
g. Minimum concentrations of samples taken at the downstream monitoring station. The maximum listed concentration is the highest single result found during one sampling event. Less than (<) indicates concentration below analysis detection limit (DL).
h. Secondary Maximum Contaminant Level (SMCL), EPA National Secondary Drinking Water Regulations (40 CFR Part 143).
i. NA = none applicable.
j. Depends on pH and temperature.
k. Action level for lead and copper.
l. WQS = water quality standard. See glossary.
m. Shall not exceed weekly average of 32.2°C (90°F) after mixing nor rise more than 2.8°C (5°F) in 1 week unless appropriate temperature criterion mixing zone has been established.

Table E.1-4. Water quality in Fourmile Branch on SRS (calendar year 1993).[a,b] TE

Parameter	Unit of measure[c]	MCL[d,e] or DCG[f]	Minimum[g]	Maximum[g]
Aluminum	mg/L	0.05-0.2[h]	0.08	0.34
Ammonia	mg/L	NA[i,j]	ND[k]	0.04
Cadmium	mg/L	0.005[d]	ND	ND
Calcium	mg/L	NA	2.24	3.35
Cesium-137	pCi/L	120	8.44	19.4
Chemical oxygen demand	mg/L	NA	ND	ND
Chloride	mg/L	250[h]	2	5
Chromium	mg/L	0.1[d]	ND	ND
Copper	mg/L	1.3[l]	ND	ND
Dissolved oxygen	mg/L	>5.0[m]	6.4	11.3
Fecal coliform	Colonies per 100 ml	1,000[m]	23	440
Gross alpha radioactivity	pCi/L	15[d]	0.073	2.68
Iron	mg/L	0.3[h]	0.364	1.14
Lead	mg/L	0.015[l]	ND	0.003
Magnesium	mg/L	NA	0.565	0.636
Manganese	mg/L	0.05[h]	0.079	0.104
Mercury	mg/L	0.002[d,e]	ND	ND
Nickel	mg/L	0.1[d]	ND	ND
Nitrite/Nitrate (as nitrogen)	mg/L	10[d]	1.42	2.85
Nonvolatile (dissolved) beta radioactivity	pCi/L	50[d]	20.5	43.5
pH	pH units	6.5-8.5[h]	5.7	7.7
Phosphate	mg/L	NA	ND	ND
Sodium	mg/L	NA	6.29	10.6
Strontium-89/90	pCi/L	-	10.3	15.3
Sulfate	mg/L	250[h]	4	9
Suspended solids	mg/L	NA	2	9
Temperature	°C	32.2[n]	10	25.5
Total dissolved solids	mg/L	500[h]	40	78
Tritium	pCi/L	20,000[d,e]	33,600	68,900
Zinc	mg/L	5[h]	ND	0.011

a. Source: Arnett (1994).
b. Parameters are those DOE routinely measures as a regulatory requirement or as part of ongoing monitoring programs.
c. mg/L = milligrams per liter; a measure of concentration equivalent to the weight/volume ratio.
pCi/L = picocuries per liter; a picocurie is a unit of radioactivity; one trillionth of a curie.
d. Maximum Contaminant Level (MCL), EPA National Primary Drinking Water Standards (40 CFR Part 141). See glossary.
e. Maximum Contaminant Level, SCDHEC (1976). See glossary.
f. DOE Derived Concentration Guides (DCGs) for water (DOE Order 5400.5). DCG values are based on committed effective doses of 4 millirem per year for consistency with drinking water MCL of 4 millirem per year. See glossary.
g. Minimum concentrations of samples taken at the downstream monitoring station. The maximum listed concentration is the highest single result found during one sampling event.
h. Secondary Maximum Contaminant Level (SMCL), EPA National Secondary Drinking Water Regulations (40 CFR Part 143).
i. NA = none applicable.
j. Depends on pH and temperature.
k. ND = none detected.
l. Action level for lead and copper.
m. WQS = water quality standard. See glossary.
n. Shall not exceed weekly average of 32.2°C (90°F) after mixing nor rise more than 2.8°C (5°F) in 1 week unless appropriate temperature criterion mixing zone has been established.

TE | **Table E.1-5.** Water quality in Pen Branch on SRS (calendar year 1993).[a,b]

Parameter	Unit of measure[c]	MCL[d,e] or DCG[f]	Minimum[g]	Maximum[g]
Aluminum	mg/L	0.05-0.2[h]	0.096	0.398
Ammonia	mg/L	NA[i,j]	ND[k]	0.09
Cadmium	mg/L	0.005[d]	ND	ND
Calcium	mg/L	NA	0.976	5.03
Chemical oxygen demand	mg/L	NA	ND	ND
Chloride	mg/L	250[h]	3	10
Chromium	mg/L	0.1[d]	ND	ND
Copper	mg/L	1.3[l]	0.041	0.098
Dissolved oxygen	mg/L	>5.0[m]	6.3	10.6
Fecal coliform	Colonies per 100 ml	1,000[m]	18	320
Gross alpha radioactivity	pCi/L	15[d]	<DL[n]	1.27
Iron	mg/L	0.3[h]	0.361	0.705
Lead	mg/L	0.015[l]	ND	0.002
Magnesium	mg/L	NA	0.71	1.08
Manganese	mg/L	0.05[h]	0.038	0.096
Mercury	mg/L	0.002[d,e]	ND	ND
Nickel	mg/L	0.1[d]	ND	ND
Nitrite/Nitrate (as nitrogen)	mg/L	10[d]	0.15	0.26
Nonvolatile (dissolved) beta radioactivity	pCi/L	50[d]	0.368	2.86
pH	pH units	6.5-8.5[h]	5.9	7.8
Phosphate	mg/L	NA	ND	0.04
Sodium	mg/L	NA	3.49	9.35
Strontium-89/90	pCi/L	-	<DL	0.49
Sulfate	mg/L	250[h]	4	7
Suspended solids	mg/L	NA	2	12
Temperature	°C	32.2[o]	10.3	26.5
Total dissolved solids	mg/L	500[h]	42	79
Tritium	pCi/L	20,000[d,e]	17,200	65,000
Zinc	mg/L	5[h]	ND	0.012

a. Source: Arnett (1994).
b. Parameters are those DOE routinely measures as a regulatory requirement or as part of ongoing monitoring programs.
c. mg/L = milligrams per liter; a measure of concentration equivalent to the weight/volume ratio.
pCi/L = picocuries per liter; a picocurie is a unit of radioactivity; one trillionth of a curie.
d. Maximum Contaminant Level (MCL), EPA National Primary Drinking Water Standards (40 CFR Part 141). See glossary.
e. Maximum Contaminant Level, SCDHEC (1976). See glossary.
f. DOE Derived Concentration Guides (DCGs) for water (DOE Order 5400.5). DCG values are based on committed effective doses of 4 millirem per year for consistency with drinking water MCL of 4 millirem per year. See glossary.
g. Minimum concentrations of samples taken at the downstream monitoring station. The maximum listed concentration is the highest single result found during one sampling event.
h. Secondary Maximum Contaminant Level (SMCL). EPA National Secondary Drinking Water Regulations (40 CFR Part 143).
i. NA = none applicable.
j. Depends on pH and temperature.
k. ND = none detected.
l. Action level for lead and copper.
m. WQS = water quality standard. See glossary.
n. Less than (<) indicates concentration below analysis detection limit (DL).
o. Shall not exceed weekly average of 32.2°C (90°F) after mixing nor rise more than 2.8°C (5°F) in 1 week unless appropriate temperature criterion mixing zone has been established.

Table E.1-6. Water quality in Steel Creek on SRS (calendar year 1993).[a,b] TE

Parameter	Unit of measure[c]	MCL[d,e] or DCG[f]	Minimum[g]	Maximum[g]
Aluminum	mg/L	0.05-0.2[h]	ND[i]	0.138
Ammonia	mg/L	NA[j,k]	ND	0.05
Cadmium	mg/L	0.005[d]	ND	ND
Calcium	mg/L	NA	1.92	2.28
Cesium-137	pCi/L	120	3.75	3.75
Chemical oxygen demand	mg/L	NA	ND	ND
Chloride	mg/L	250[h]	4	9
Chromium	mg/L	0.1[d]	ND	ND
Copper	mg/L	1.3[l]	ND	ND
Dissolved oxygen	mg/L	>5.0[m]	6.4	11.4
Fecal coliform	Colonies per 100 ml	1,000[m]	2	142
Gross alpha radioactivity	pCi/L	15[d]	<DL[n]	1.22
Iron	mg/L	0.3[h]	0.053	0.224
Lead	mg/L	0.015[l]	ND	0.004
Magnesium	mg/L	NA	0.947	1.16
Manganese	mg/L	0.05[k]	ND	0.024
Mercury	mg/L	0.002[d,e]	ND	ND
Nickel	mg/L	0.1[d]	ND	ND
Nitrite/Nitrate (as nitrogen)	mg/L	10[d]	ND	0.17
Nonvolatile (dissolved) beta radioactivity	pCi/L	50[d]	0.688	2.79
pH	pH units	6.5-8.5[h]	5.9	7.9
Phosphate	mg/L	NA	ND	ND
Sodium	mg/L	NA	5.44	8.53
Strontium-90	pCi/L	8[f]	<DL	0.818
Sulfate	mg/L	250[h]	4	6
Suspended solids	mg/L	NA	ND	5
Temperature	°C	32.2[o]	10.2	29.6
Total dissolved solids	mg/L	500[h]	39	67
Tritium	pCi/L	20,000[d,e]	4,130	6,200
Zinc	mg/L	5[h]	ND	0.014

a. Source: Arnett (1994).
b. Parameters are those DOE routinely measures as a regulatory requirement or as part of ongoing monitoring programs.
c. mg/L = milligrams per liter; a measure of concentration equivalent to the weight/volume ratio.
pCi/L = picocuries per liter; a picocuries is a unit of radioactivity; one trillionth of a curie.
d. Maximum Contaminant Level (MCL), EPA National Primary Drinking Water Standards (40 CFR Part 141). See glossary.
e. Maximum Contaminant Level, SCDHEC (1976). See glossary.
f. DOE Derived Concentration Guides (DCGs) for water (DOE Order 5400.5). DCG values are based on committed effective doses of 4 millirem per year for consistency with drinking water MCL of 4 millirem per year. See glossary.
g. Minimum concentrations of samples taken at the downstream monitoring station. The maximum listed concentration is the highest single result found during one sampling event.
h. Secondary Maximum Contaminant Level (SMCL), EPA National Secondary Drinking Water Regulations (40 CFR Part 143).
i. ND = none detected.
j. NA = none applicable.
k. Depends on pH and temperature.
l. Action level for lead and copper.
m. WQS = water quality standard. See glossary.
n. Less than (<) indicates concentration below analysis detection limit (DL).
o. Shall not exceed weekly average of 32.2°C (90°F) after mixing nor rise more than 2.8°C (5°F) in 1 week unless appropriate temperature criterion mixing zone has been established.

TE | **Table E.1-7.** Water quality in Lower Three Runs on SRS (calendar year 1993).[a,b]

Parameter	Unit of measure[c]	MCL[d,e] or DCG[f]	Minimum[g]	Maximum[g]
Aluminum	mg/L	0.05-0.2[h]	ND[i]	0.092
Ammonia	mg/L	NA[j,k]	ND	0.06
Cadmium	mg/L	0.005[d]	ND	ND
Calcium	mg/L	NA	5.63	12.8
Chemical oxygen demand	mg/L	NA	ND	ND
Chloride	mg/L	250[h]	3	5
Chromium	mg/L	0.1[d]	ND	ND
Copper	mg/L	1.3[l]	ND	ND
Dissolved oxygen	mg/L	>5.0[m]	6.7	10.2
Fecal coliform	pCi/L	1,000[m]	72	12,200
Gross alpha radioactivity	mg/L	15[d]	<DL[n]	0.69
Iron	mg/L	0.3[h]	0.138	0.275
Lead	mg/L	0.015[l]	ND	0.002
Magnesium	mg/L	NA	0.553	0.79
Manganese	mg/L	0.05[h]	ND	0.024
Mercury	mg/L	0.002[d,e]	ND	ND
Nickel	mg/L	0.1[d]	ND	ND
Nitrite/Nitrate (as nitrogen)	mg/L	10[d]	ND	0.18
Nonvolatile (dissolved) beta radioactivity	pCi/L	50[d]	1.16	3.43
pH	pH units	6.5-8.5[h]	5.9	7.5
Phosphate	mg/L	NA	ND	ND
Sodium	mg/L	NA	1.97	2.98
Strontium-90	pCi/L	8[f]	<DL	0.048
Sulfate	mg/L	250[h]	2	4
Suspended solids	mg/L	NA	ND	10
Temperature	°C	32.2[o]	10.3	26.0
Total dissolved solids	mg/L	500[h]	33	69
Tritium	pCi/L	20,000[d,e]	131	907
Zinc	mg/L	5[h]	ND	0.031

a. Source: Arnett (1994).
b. Parameters are those DOE routinely measures as a regulatory requirement or as part of ongoing monitoring programs.
c. mg/L = milligrams per liter; a measure of concentration equivalent to the weight/volume ratio.
pCi/L = picocuries per liter; a picocurie is a unit of radioactivity; one trillionth of a curie.
d. Maximum Contaminant Level (MCL), EPA National Primary Drinking Water Standards (40 CFR Part 141). See glossary.
e. Maximum Contaminant Level, SCDHEC (1976). See glossary.
TE | f. DOE Derived Concentration Guides (DCGs) for water (DOE 5400.5). DCG values are based on committed effective doses of 4 millirem per year for consistency with drinking water MCL of 4 millirem per year. See glossary.
g. Minimum concentrations of samples taken at the downstream monitoring station. The maximum listed concentration is the highest single result found during one sampling event.
h. Secondary Maximum Contaminant Level (SMCL), EPA National Secondary Drinking Water Regulations (40 CFR Part 143).
i. ND = none detected.
j. NA = none applicable.
k. Depends on pH and temperature.
l. Action level for lead and copper.
m. WQS = water quality standard. See glossary.
n. Less than (<) indicates concentration below analysis detection limit (DL).
o. Shall not exceed weekly average of 32.2°C (90°F) after mixing nor rise more than 2.8°C (5°F) in 1 week unless appropriate temperature criterion mixing zone has been established.

SECTION 2

AIR QUALITY

TE **Table E.2-1.** Results of SRS modeling for toxic air pollutants (micrograms per cubic meter of air).[a,b]

Pollutant	Maximum allowable concentration ($\mu g/m^3$)	Concentration at SRS boundary ($\mu g/m^3$)	Percent of standard[c]
Low Toxicity CategoryTC			
Acetonitrile	1,750.00	0.00018	0.00
Ammonium Chloride	250.00	0.02379	0.01
Antimony	2.50	0.00112	0.04
Chlorine	75.00	7.63023	10.17
Cyanide	125.00	0.00000	0.00
Ethanolamine	200.00	0.00101	0.00
Formic Acid	225.00	2.41990	1.08
Furfural	200.00	0.00180	0.00
Hydrochloric Acid (Hydrogen Chloride)	175.00	1.05622	0.60
Hydrogen Cyanide	250.00	0.12935	0.05
Methyl Ethyl Ketone (2-Butone)	14,750.00	5.12159	0.03
Methyl Methacrylate	10,250.00	0.00002	0.00
Methylene Chloride	8,750.00	10.46781	0.12
Methyl Tert-Butyl Ether	(d)	0.49390	NA[e]
Naphthalene	1,250.00	0.00452	0.00
Nitric Acid	125.00	50.95952	40.77
Phosphoric Acid	25.00	0.46236	1.85
Styrene	5,325.00	0.00079	0.00
Trichloroethylene	6,750.00	6.43130	0.10
Moderate Toxicity Category			
Acetaldehyde	1,800.00	0.00180	0.00
Acrylamide	0.30	0.00180	0.60
Aldicarb	6.00	0.00737	0.12
Cresol	220.00	0.00180	0.00
Cumene	9.00	0.00110	0.01
p-Dichlorobenzene	4,500.00	0.00180	0.00
Diethanaolamine	129.00	0.00364	0.00
Dioctyl Phthalate	50.00	0.02569	0.05
Ethyl Benzene	4,350.00	0.58773	0.01
Ethyl Chloride	26,400.00	0.00007	0.00
Ethylene Dibromide	770.00	0.00180	0.00
Furfuryl Alcohol	400.00	0.00037	0.00
1,6-Diisocyanatehexamethylene	0.34	0.00110	0.32
Hydrogen Sulfide	140.00	0.20149	0.14
Hydroquinone	20.00	0.00010	0.00
Isophorone	250.00	0.00154	0.00
Maleic Anhydride	10.00	0.00180	0.02

Table E.2-1. (continued).

Pollutant	Maximum allowable concentration (μg/m³)	Concentration at SRS boundary (μg/m³)	Percent of standard[c]
Methyl Isobutyl Ketone	2,050.00	2.96016	0.14
Oxalic Acid	10.00	0.00026	0.00
Pentachlorophenol	5.00	0.00180	0.04
Phenol	190.00	0.02745	0.01
Phosgene (Carbonyl Chloride)	4.00	0.00180	0.05
Phosphorus (Yellow or White)	0.50	0.00013	0.03
Sodium Hydroxide	20.00	0.00940	0.05
Sulfuric Acid	10.00	0.00951	0.10
Tetrachloroethylene	3,350.00	2.00935	0.06
Xylene	4,350.00	39.36740	0.90
m-Xylene	4,350.00	0.00180	0.00
o-Xylene	4,350.00	0.00181	0.00
p-Xylene	4,350.00	0.00180	0.00
High Toxicity Category			
Acetophenone	(d)	0.00180	NA
Acrolein	1.25	0.01585	1.27
Acrylic Acid	147.50	0.00182	0.00
Acrylonitrile	22.50	0.01646	0.07
Aniline	50.00	0.00180	0.00
Arsenic	1.00	0.00191	0.19
Benzene	150.00	31.71134	21.14
Benzidine	(d)	0.00180	NA
Benzotrichloride	300.00	0.00180	0.00
Benzyl Chloride	25.00	0.00180	0.01
Beryllium	0.01	0.00000	0.00
Biphenyl	6.00	0.00138	0.02
Bis (chloromethyl) Ether	0.03	0.00180	6.00
Bromoform	25.85	0.00475	0.02
Cadmium Oxide	0.25	0.02136	8.54
Cadmium	0.25	0.00028	0.11
Carbon Disulfide	150.00	0.00208	0.00
Carbon Tetrachloride	150.00	0.00209	0.00
Catechol	297.00	0.00009	0.00
Chlordane	2.50	0.00181	0.07
Chlorobenzene	1,725.00	0.00209	0.00
Chloroform	250.00	4.95658	1.98
Chloromethyl Methyl Ether	(d)	0.00180	NA
Cobalt	0.25	0.20628	82.51
2,4-Dichlorphenoxy Acetic Acid	50.00	0.00180	0.00

Table E.2-1. (continued).

Pollutant	Maximum allowable concentration (μg/m³)	Concentration at SRS boundary (μg/m³)	Percent of standard[c]
Dibutyl Phthalate	25.00	0.13246	0.53
3,3-Dichlorobenzidine	0.15	0.00180	1.20
1,3-Dichloropropene	7.00	0.00208	0.03
Diethyl Phthalate	25.00	0.00000	0.00
3,3-Dimethoxybenzidene	0.30	0.00180	0.60
3,3-Dimethylbenzidine	(d)	0.00180	NA
Dimethylformamide	149.50	0.00024	0.00
Dimethyl Phthalate	25.00	0.00180	0.01
Dimethyl Sulfate	2.50	0.00180	0.07
2,4-Dinitrophenol	(d)	0.00180	NA
2,4-Dinitrotoluene	1.50	0.00180	0.12
Dioxane	450.00	0.00184	0.00
1,2-Diphenyl Hydrazine	(d)	0.00180	NA
Epichlorohydrin	50.00	0.00180	0.00
1,2-Butylene Oxide	(d)	0.00877	NA
Ethylene Dichloride	200.00	0.00183	0.00
Ethylene Glycol	650.00	0.19536	0.03
Ethylene Oxide	10.00	0.00180	0.02
Ethylene Thiourea	(d)	0.00180	NA
Ethylenimine	5.00	0.01802	0.36
1,1-Dichloroethane	2,025.00	0.00116	0.00
Formaldehyde	7.50	0.00269	0.04
Glycol Ethers	(d)	0.00031	NA
Heptachlor	2.50	0.00737	0.29
Hexachlorobenzene	(d)	0.00180	NA
Hexachlorobutadiene	1.20	0.00180	0.15
Hexachlorocylopentadiene	0.50	0.00180	0.36
Hexachloroethane	48.50	0.00180	0.00
Hexachloronapthalene	1.00	0.00000	0.00
Hexane	200.00	0.20551	0.10
Hydrazine	0.50	0.00180	0.36
Lindane	2.50	0.00180	0.07
Manganese Oxide	25.00	0.00066	0.00
Manganese	25.00	0.82129	3.29
Mercury	0.25	0.01393	5.57
Methyl Alcohol	1,310.00	2.87804	0.22
Methoxychlor	50.00	0.00180	0.00
Methyl Bromide	100.00	0.00158	0.00
Methyl Chloride	515.00	0.00200	0.00

Table E.2-1. (continued).

Pollutant	Maximum allowable concentration (μg/m³)	Concentration at SRS boundary (μg/m³)	Percent of standard[c]
1,1,1-Trichloroethane	9,550.00	80.83216	0.85
Methyl Hydrazine	1.75	0.00180	0.10
Methyl Iodide	58.00	0.00180	0.00
Curene	1.10	0.00180	0.16
Nickel Oxide	5.00	0.00183	0.04
Nickel	0.50	0.27106	54.21
Nitrobenzene	25.00	0.00314	0.01
p-Nitrophenol	0.00	0.00180	NA
2-Nitropropane	182.00	0.00180	0.00
Parathion	0.50	0.00737	1.47
Pentachloronitrobenzene	(d)	0.00180	NA
Phthalic Anhydride	30.30	0.00180	0.01
Polycyclic Organic Matter	160.00	0.00000	0.00
Propylene Dichloride	1,750.00	0.00079	0.00
Selenium	1.00	0.00000	0.00
Tetrachlorinated Dibenzo-p-Dioxins	0.00	0.00000	NA
1,1,2,2-Tetrachloroethane	35.00	0.00208	0.01
Toluene	200.00	9.27688	0.46
Toxaphene	2.50	0.00737	0.29
1,1,2-Trichloroethane	273.00	0.01646	0.01
2,4,6-Trichlorophenol	(d)	0.00180	NA
Triethylamine	207.00	0.00010	0.00
Vinyl Acetate	176.00	0.05518	0.03
Vinyl Chloride	50.00	0.00183	0.00
1,1-Dichloroethylene	99.00	0.00180	0.00

a. Source: WSRC (1993).
b. Concentrations are based on maximum potential emissions.
c. Percent of standard = $\frac{\text{Concentration at SRS boundary}}{\text{Maximum allowable concentration}} \times 100$
d. No standard established by regulatory agency.
e. NA - not applicable.

TE

Table E.2-2. Comparison of potential worker annual exposure to OSHA permissible exposure limits under alternative A (micrograms per cubic meter of air).[a]

Pollutant	OSHA PEL[b]	Expected forecast receptor locations		Minimum forecast receptor locations		Maximum forecast receptor locations	
		100 meters[c]	640 meters	100 meters	640 meters	100 meters	640 meters
M-Area Vendor							
Nitrogen dioxide	9,000	37.45	43.70	37.45	43.70	37.45	43.70
Sulfur dioxide	1.3×10^4	1.65	1.92	1.65	1.92	1.65	1.92
PM_{10}[d]	5,000	1.97	2.30	1.97	2.30	1.97	2.30
Bldg. 645-N (hazardous waste storage)							
Total suspended particulates	1.5×10^4	25.13	10.56	13.10	5.51	41.28	17.36
PM_{10}	5,000	8.79	3.70	4.49	1.89	14.54	6.11
Bldg. 645-2N (mixed waste storage)							
Total suspended particulates	1.5×10^4	6.60	2.78	1.78	0.75	32.84	13.81
PM_{10}	5,000	2.32	0.97	0.62	0.26	11.50	4.84
Soil sort facilities							
Total suspended particulates	1.5×10^4	11.00	4.63	0.31	0.13	54.74	23.02
PM_{10}	5,000	3.84	1.61	0.11	0.05	1.92	0.81
(Four) new solvent tanks							
Vinyl chloride	2,600	5.08	3.95	3.78	2.94	4.29	3.34
1,1 Dichloroethane	N/A[e]	0.38	0.30	0.29	0.22	0.33	0.25
Methyl ethyl Ketone	5.9×10^5	22.00	17.11	16.39	12.75	18.61	14.48
Chloroform	9,780	2.36	1.84	1.76	1.37	2.00	1.56
Carbon tetrachloride	1.26×10^4	0.19	0.15	0.14	0.11	0.16	0.13
Benzene	3,250	3.08	2.40	2.29	1.78	2.61	2.03
1,2 Dichloroethane	N/A	0.13	0.10	0.09	0.07	0.11	0.08
Trichloroethane	2.7×10^5	0.12	0.09	0.09	0.07	0.10	0.08
Tetrachloroethylene	1.7×10^5	0.03	0.02	0.02	0.02	0.02	0.02
Chlorobenzene	3.5×10^5	0.02	0.01	0.01	0.01	0.01	0.01
Transuranic waste characterization/ certification facility							
Vinyl chloride	2,600	0.02	0.01	0.01	0.01	0.39	0.34
1,1 Dichloroethane	N/A	0.001	9.8×10	8.1×10	7.0×10^{-4}	0.30	0.25
Methyl ethyl ketone	5.9×10^5	0.07	0.06	0.05	0.04	1.70	1.46
Chloroform	9,780	0.01	0.01	0.01	0.00	0.18	0.16
Carbon tetrachloride	1.26×10^4	$5.6\times10^-$	4.8×10	4.0×10	3.5×10^{-4}	0.015	0.013
Benzene	3,250	0.009	0.008	0.007	0.006	0.237	0.204
1,2 Dichloroethane	N/A	$3.8\times10^-$	3.2×10	2.7×10	2.3×10^{-4}	0.010	0.008
Trichloroethane	2.7×10^5	$3.6\times10^-$	3.1×10	2.5×10	2.2×10^{-4}	0.009	0.008
Tetrachloroethylene	1.7×10^5	$7.9\times10^-$	6.8×10	5.6×10	4.8×10^{-5}	0.002	0.002
Chlorobenzene	3.5×10^5	$5.0\times10^-$	4.3×10	3.5×10	3.0×10^{-5}	0.001	0.001
Containment building							
Total suspended particulates	1.5×10^4	4.34	2.64	2.28	1.38	15.41	9.36
PM_{10}	5,000	4.34	2.64	2.28	1.38	15.41	9.36

TC
TE

Table E.2-2. (continued).

Pollutant	OSHA PEL[b]	Expected forecast receptor locations		Minimum forecast receptor locations		Maximum forecast receptor locations		
		100 meters[c]	640 meters	100 meters	640 meters	100 meters	640 meters	
Vinyl chloride	2,600	0.24	0.15	0.13	0.08	1.08	0.66	
1,1 Dichloroethane	N/A	0.02	0.01	0.01	0.01	0.08	0.05	
Methyl ethyl ketone	5.9×10^5	26.40	16.04	25.46	15.47	32.38	19.68	
Chloroform	9,780	0.11	0.07	0.06	0.04	0.50	0.31	TC
Carbon tetrachloride	1.26×10^4	0.01	0.01	0.005	0.003	0.04	0.02	TE
Benzene	3,250	0.15	0.08	0.06	0.04	0.66	0.40	
1,2 Dichloroethane	N/A	0.006	0.004	0.003	0.002	0.03	0.02	
Trichloroethane	2.7×10^5	0.006	0.004	0.003	0.002	0.03	0.02	
Tetrachloroethylene	1.7×10^5	0.001	$7.4\times10^{-}$	5.4×10	3.3×10	0.006	0.003	
Chlorobenzene	3.5×10^5	7.6×10^{-4}	$4.6\times10^{-}$	3.4×10	2.1×10	0.004	0.002	

a. Source: NIOSH (1990).
b. OSHA PEL - Occupational Safety and Health Administration Permissible Exposure Limits.
c. To convert to feet multiply by 3.281.
d. Particulate matter less than 10 microns in diameter.
e. Not Applicable - No OSHA PEL assigned - Exposure should be kept as low as possible.

Table E.2-3. Comparison of potential worker exposure to OSHA permissible exposure limits under alternative C (micrograms per cubic meter of air).[a]

Facility/Pollutant	OSHA PEL[b]	Expected forecast receptor locations		Minimum forecast receptor locations		Maximum forecast receptor locations	
		100 meters[c]	640 meters	100 meters	640 meters	100 meters	640 meters
M-Area Vendor							
Nitrogen dioxide	9,000	37.45	43.70	37.45	43.70	37.30	43.52
Sulfur dioxide	1.3×10^4	1.65	1.92	1.65	1.92	1.65	1.92
PM_{10}[d]	5,000	1.97	2.30	1.97	2.30	1.97	2.30
Bldg. 645-2N (mixed waste storage)							
Total suspended particulates	15,000	6.60	2.78	1.78	0.75	32.84	13.81
PM_{10}	5,000	2.32	0.97	0.62	0.26	11.50	4.84
Soil sort facilities							
Total suspended particulates	15,000	15.63	6.57	4.34	1.83	75.38	31.69
PM_{10}	5,000	5.47	2.30	1.52	0.64	26.38	11.09
(Four) new solvent tanks							
Vinyl chloride	2,600	3.99	3.10	3.92	3.05	4.17	3.24
1,1 Dichloroethane	N/A[e]	0.30	0.23	0.30	0.23	0.32	0.25
Methyl ethyl ketone	5.9×10^5	17.28	13.44	17.00	13.22	18.06	14.04
Chloroform	9,780	1.86	1.44	1.82	1.42	1.94	1.51
Carbon tetrachloride	1.26×10^4	0.15	0.12	0.15	0.11	0.16	0.12
Benzene	3,250	2.42	1.88	2.38	1.85	2.53	1.97
1,2 Dichloroethane	N/A	0.10	0.08	0.10	0.08	0.10	0.08
TC Trichloroethane	2.7×10^5	0.09	0.07	0.09	0.07	0.10	0.08
TE Tetrachloroethylene	1.7×10^5	0.02	0.02	0.02	0.02	0.02	0.02
Chlorobenzene	3.5×10^5	0.01	0.01	0.01	0.01	0.01	0.01
Transuranic waste characterization/ certification facility							
Vinyl chloride	2,600	0.015	0.013	0.011	0.009	0.389	0.335
1,1 Dichloroethane	N/A	0.001	0.001	0.001	0.001	0.029	0.025
Methyl ethyl ketone	5.9×10^5	0.065	0.056	0.046	0.040	1.687	1.450
Chloroform	9,780	0.007	0.006	0.005	0.004	0.181	0.155
Carbon tetrachloride	1.26×10^4	5.6×10^{-4}	4.8×10^{-4}	4.0×10^{-4}	3.4×10^{-4}	0.015	0.013
Benzene	3,250	0.009	0.008	0.006	0.006	0.236	0.203
1,2 Dichloroethane	N/A	3.7×10^{-4}	3.2×10^{-4}	2.7×10^{-4}	2.3×10^{-4}	0.010	0.008
Trichloroethane	2.7×10^5	3.5×10^{-4}	3.0×10^{-4}	2.5×10^{-4}	2.2×10^{-4}	0.009	0.008
Tetrachloroethylene	1.7×10^5	7.9×10^{-5}	6.8×10^{-5}	5.6×10^{-5}	4.8×10^{-5}	0.002	0.002
Chlorobenzene	3.5×10^5	4.9×10^{-5}	4.2×10^{-5}	3.5×10^{-5}	3.0×10^{-5}	0.001	0.001
Containment building							
Vinyl chloride	2,600	0.059	0.036	0.028	0.017	0.219	0.133
1,1 Dichloroethane	N/A	0.004	0.003	0.002	0.001	0.017	0.010
Methyl ethyl ketone	5.9×10^5	24.91	15.13	24.65	14.98	26.21	15.92
Chloroform	9,780	0.028	0.017	0.013	0.008	0.102	0.062
Carbon tetrachloride	1.26×10^4	0.002	0.001	0.001	6.5×10^{-4}	0.008	0.005
Benzene	3,250	0.036	0.022	0.017	0.010	0.133	0.081
1,2 Dichloroethane	N/A	0.001	9.0×10^{-4}	7.1×10^{-4}	4.3×10^{-4}	0.005	0.003
Trichloroethane	2.7×10^5	0.004	0.002	0.002	9.2×10^{-4}	0.011	0.007
Tetrachloroethylene	1.7×10^5	8.1×10^{-4}	4.9×10^{-4}	3.4×10^{-4}	2.1×10^{-4}	0.002	0.001
Chlorobenzene	3.5×10^5	5.1×10^{-4}	3.1×10^{-4}	2.1×10^{-4}	1.3×10^{-4}	0.002	9.3×10^{-4}

Table E.2-3. (continued).

Facility/Pollutant	OSHA PEL[b]	Expected forecast receptor locations		Minimum forecast receptor locations		Maximum forecast receptor locations		
		100 meters[c]	640 meters	100 meters	640 meters	100 meters	640 meters	
Non-alpha vitrification								
Total suspended particulates	1.5×10^{4}	1.5×10^{-9}	0.215	4.4×10^{-10}	0.065	7.2×10^{-9}	1.056	
PM_{10}	5,000	1.5×10^{-9}	0.215	4.4×10^{-10}	0.065	7.2×10^{-9}	1.056	
Nitrogen oxides	9,000	3.2×10^{-9}	0.478	9.7×10^{-10}	0.143	1.6×10^{-8}	2.344	
Sulfur dioxide	1.3×10^{4}	2.0×10^{-11}	0.003	6.1×10^{-12}	9.0×10^{-4}	1.0×10^{-10}	0.015	
Carbon monoxide	4.0×10^{4}	2.9×10^{-12}	4.3×10^{-4}	8.7×10^{-13}	1.3×10^{-4}	1.4×10^{-11}	0.002	
Lead	100	3.0×10^{-12}	4.4×10^{-4}	8.9×10^{-13}	1.3×10^{-4}	1.5×10^{-11}	0.002	
Acetaldehyde	1.8×10^{5}	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Acrylamide	30	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Acrylonitrile	4,420	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Arsenic pentoxide	10	2.9×10^{-12}	4.3×10^{-4}	1.5×10^{-12}	2.2×10^{-4}	6.5×10^{-12}	9.6×10^{-4}	
Asbestos	0.2 fibers/m^3	6.6×10^{-14}	9.8×10^{-6}	1.6×10^{-14}	2.3×10^{-6}	1.8×10^{-13}	2.6×10^{-5}	
Benzene	3,250	7.1×10^{-11}	0.010	3.6×10^{-11}	0.005	1.6×10^{-10}	0.023	
Benzidine	N/A	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Bis(chloromethyl)ether	N/A	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Bromoform	5,000	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Carbon tetrachloride	1.2×610^{4}	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Chlordane	500[f]	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Chloroform	9,780	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Cr(+6) Compounds	50[f]	2.0×10^{-14}	2.9×10^{-6}	1.0×10^{-14}	1.5×10^{-6}	4.4×10^{-14}	6.5×10^{-6}	TC
Formaldehyde	1,224	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	TE
Heptachlor	500	1.5×10^{-12}	2.2×10^{-4}	7.6×10^{-13}	1.1×10^{-4}	2.2×10^{-12}	4.8×10^{-4}	
Hexachlorobenzene	N/A	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Hexachlorobutadiene	210[f]	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Hydrazine	100	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Nickel oxide	1,000	3.3×10^{-11}	0.005	7.9×10^{-12}	0.001	8.9×10^{-11}	0.013	
1,1,2,2-Tetrachloroethane	7,000	1.2×10^{-11}	0.002	6.1×10^{-12}	8.9×10^{-4}	2.6×10^{-11}	0.004	
1,1,2-Trichloroethane	4.5×10^{4}	5.9×10^{-13}	8.7×10^{-5}	3.0×10^{-13}	4.5×10^{-5}	1.3×10^{-12}	1.9×10^{-4}	
Toxaphene	500	1.5×10^{-12}	2.2×10^{-4}	7.6×10^{-13}	1.1×10^{-4}	3.2×10^{-12}	4.8×10^{-4}	
Alpha vitrification								
Total suspended particulates	1.5×10^{4}	8.2×10^{-10}	0.12	4.9×10^{-10}	0.07	2.1×10^{-8}	3.06	
PM_{10}	5,000	8.2×10^{-10}	0.12	4.9×10^{-10}	0.07	2.1×10^{-8}	3.06	
Nitrogen oxides	9,000	1.8×10^{-9}	0.27	1.1×10^{-9}	0.16	4.6×10^{-8}	6.78	
Sulfur dioxide	1.3×10^{4}	1.1×10^{-11}	0.002	6.8×10^{-12}	0.001	2.9×10^{-11}	0.004	
Carbon monoxide	4.0×10^{4}	1.6×10^{-12}	2.4×10^{-4}	9.7×10^{-13}	1.44×10^{-4}	4.1×10^{-11}	0.01	
Lead	100	1.7×10^{-12}	2.45×10^{-4}	1.0×10^{-12}	1.47×10^{-4}	4.2×10^{-11}	0.01	
Asbestos	0.2 fibers/m^3	6.6×10^{-15}	9.8×10^{-7}	4.0×10^{-15}	5.9×10^{-7}	1.7×10^{-13}	2.5×10^{-5}	
Nickel oxide	1,000	3.3×10^{-12}	4.9×10^{-4}	2.0×10^{-12}	2.93×10^{-4}	8.4×10^{-10}	0.01	

a. Source: NIOSH (1990).
b. OSHA PEL - Occupational Safety and Health Administration permissible exposure limits.
c. To convert to feet multiply by 3.281.
d. Particulate matter less than 10 microns in diameter.
e. N/A = not applicable. No OSHA PEL assigned. Exposure should be kept as low as possible. TE
f. Threshold limit value, time-weighted average (ACGIH 1993).

Table E.2-4. Comparison of potential worker exposure to OSHA permissible exposure limits under alternative B (micrograms per cubic meter of air).[a]

Pollutant	OSHA PEL[b]	Expected forecast receptor locations		Minimum forecast receptor locations		Maximum forecast receptor locations	
		100 meters[c]	640 meters	100 meters	640 meters	100 meters	640 meters
M-Area Vendor							
Nitrogen dioxide	9,000	37.45	43.70	37.45	43.70	37.30	43.52
Sulfur dioxide	1.3×10^{-4}	1.65	1.92	1.65	1.92	1.65	1.92
PM_{10}[d]	5,000	1.97	2.30	1.97	2.30	1.97	2.30
Bldg. 645-N (hazardous waste storage)							
Total suspended particulates	1.5×10^{4}	25.13	10.56	13.10	5.51	41.28	17.36
PM_{10}	5,000	8.79	3.70	4.49	1.89	14.54	6.11
Bldg. 645-2N (mixed waste storage)							
Total suspended particulates	15,000	6.60	2.78	1.78	0.75	32.84	13.81
PM_{10}	5,000	2.32	0.97	0.62	0.26	11.50	4.84
Soil sort facilities							
Total suspended particulates	15,000	10.79	4.54	3.39	1.43	64.79	27.24
PM_{10}	5,000	3.77	1.58	1.19	0.50	22.61	9.51
(Four) new solvent tanks							
Vinyl chloride	2,600	4.71	3.66	4.28	3.33	4.25	3.31
1,1 Dichloroethane	N/A[e]	0.36	0.28	0.32	0.25	0.32	0.25
Methyl ethyl ketone	5.9×10^{5}	20.39	15.86	18.56	14.43	18.39	14.30
Chloroform	9,780	2.19	1.70	1.99	1.55	1.98	1.54
Carbon tetrachloride	1.26×10^{4}	0.18	0.14	0.16	0.12	0.16	0.12
Benzene	3,250	2.86	2.22	2.60	2.02	2.58	2.00
1,2 Dichloroethane	N/A	0.12	0.09	0.11	0.08	0.11	0.08
Trichloroethane	2.7×10^{5}	0.11	0.09	0.10	0.08	0.10	0.08
Tetrachloroethylene	1.7×10^{5}	0.02	0.02	0.02	0.02	0.02	0.02
Chlorobenzene	3.5×10^{5}	0.02	0.01	0.01	0.01	0.01	0.01
Transuranic waste characterization/ certification facility							
Vinyl chloride	2,600	0.02	0.01	0.01	0.009	0.39	0.33
1,1 Dichloroethane	N/A	0.001	9.7×10^{-4}	8.0×10^{-4}	6.9×10^{-4}	0.29	0.25
Methyl ethyl Ketone	5.9×10^{5}	0.07	0.06	0.05	0.04	1.69	1.45
Chloroform	9,780	0.007	0.006	0.005	0.004	0.18	0.16
Carbon tetrachloride	1.26×10^{4}	5.6×10^{-4}	4.8×10^{-4}	3.9×10^{-4}	3.4×10^{-4}	0.01	0.01
Benzene	3,250	0.009	0.008	0.006	0.006	0.24	0.20
1,2 Dichloroethane	N/A	3.7×10^{-4}	3.2×10^{-4}	2.7×10^{-4}	2.3×10^{-4}	0.010	0.008
Trichloroethane	2.7×10^{5}	3.5×10^{-4}	3.1×10^{-4}	2.5×10^{-4}	2.2×10^{-4}	0.009	0.008
Tetrachloroethylene	1.7×10^{5}	7.9×10^{-5}	6.8×10^{-5}	5.6×10^{-5}	4.8×10^{-5}	0.002	0.002
Chlorobenzene	3.5×10^{5}	5.0×10^{-5}	4.3×10^{-5}	3.5×10^{-5}	3.0×10^{-5}	0.001	0.001
Containment building							
Total suspended particulates	1.5×10^{4}	2.96	1.80	1.48	0.90	10.26	6.23
PM_{10}	5,000	2.96	1.80	1.48	0.90	10.26	6.23
Vinyl chloride	2,600	0.17	0.10	0.08	0.05	0.74	0.45
1,1 Dichloroethane	N/A	0.01	0.01	0.01	15.25	29.82	0.03
Methyl ethyl Ketone	5.9×10^{5}	25.77	15.66	25.10	0.22	3.22	18.12
Chloroform	9,780	0.08	0.05	0.04	0.02	0.34	0.21
Carbon tetrachloride	1.26×10^{4}	0.01	0.004	0.003	0.002	0.03	0.02
Benzene	3,250	0.10	0.06	0.05	0.03	0.45	0.27
1,2 Dichloroethane	N/A	0.004	0.003	0.002	0.001	0.02	0.01
Trichloroethane	2.7×10^{5}	0.004	0.002	0.002	0.001	0.02	0.01
Tetrachloroethylene	1.7×10^{5}	7.8×10^{-4}	4.7×10^{-4}	3.7×10^{-4}	2.2×10^{-4}	3.9×10^{-3}	2.4×10^{-3}
Chlorobenzene	3.5×10^{5}	4.9×10^{-4}	3.0×10^{-4}	2.3×10^{-4}	1.4×10^{-4}	2.4×10^{-3}	1.5×10^{-3}

TC
TE

Table E.2-4. (continued).

Pollutant	OSHA PEL[b]	Expected forecast receptor locations 100 meters[c]	Expected forecast receptor locations 640 meters	Minimum forecast receptor locations 100 meters	Minimum forecast receptor locations 640 meters	Maximum forecast receptor locations 100 meters	Maximum forecast receptor locations 640 meters	
Non-alpha vitrification								
Total suspended particulates	1.5×10^{4}	1.5×10^{-9}	0.23	no vit[f]	no vit.	7.6×10^{-9}	1.11	
PM_{10}	5,000	1.5×10^{-9}	0.23	no vit.	no vit.	7.6×10^{-9}	1.11	
Nitrogen oxides	9,000	3.4×10^{-9}	0.50	no vit.	no vit.	1.7×10^{-8}	2.47	
Sulfur dioxide	1.3×10^{4}	2.1×10^{-11}	0.003	no vit.	no vit.	1.1×10^{-10}	0.02	
Carbon monoxide	4.0×10^{4}	3.1×10^{-12}	4.5×10^{-4}	no vit.	no vit.	1.5×10^{-11}	0.002	
Lead	100	3.1×10^{-12}	4.6×10^{-4}	no vit.	no vit.	1.5×10^{-11}	0.002	
Acetaldehyde	1.8×10^{5}	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Acrylamide	30	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Acrylonitrile	4,420	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Arsenic pentoxide	10	1.9×10^{-13}	2.8×10^{-5}	no vit.	no vit.	2.5×10^{-13}	3.7×10^{-5}	
Asbestos	0.2 fibers/m^3	1.3×10^{-14}	1.9×10^{-6}	no vit.	no vit.	6.1×10^{-14}	9.1×10^{-6}	
Benzene	3,250	4.5×10^{-12}	6.7×10^{-4}	no vit.	no vit.	6.0×10^{-12}	8.9×10^{-4}	
Benzidine	N/A	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Bis(chloromethyl)ether	N/A	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Bromoform	5,000	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Carbon tetrachloride	1.26×10^{4}	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Chlordane	500[g]	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Chloroform	9,780	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Cr(+6) Compounds	50[g]	1.3×10^{-15}	1.9×10^{-7}	no vit.	no vit.	1.7×10^{-15}	2.5×10^{-7}	
Formadelhyde	1,224	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	TC
Heptachlor	500	9.4×10^{-14}	1.4×10^{-5}	no vit.	no vit.	1.3×10^{-13}	1.8×10^{-5}	TE
Hexachlorobenzene	N/A	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Hexachlorobutadiene	210[f]	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Hydrazine	100	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Nickel oxide	1,000	6.3×10^{-12}	9.3×10^{-4}	no vit.	no vit.	3.1×10^{-11}	4.5×10^{-3}	
1,1,2,2-Tetrachloroethane	7,000	7.5×10^{-13}	1.1×10^{-4}	no vit.	no vit.	1.0×10^{-12}	1.5×10^{-3}	
1,1,2-Trichloroethane	4.5×10^{4}	3.8×10^{-14}	5.6×10^{-6}	no vit.	no vit.	5.0×10^{-14}	7.4×10^{-6}	
Toxaphene	500	9.4×10^{-14}	1.4×10^{-5}	no vit.	no vit.	1.3×10^{-13}	1.8×10^{-5}	
Alpha vitrification								
Total suspended particulates	1.5×10^{4}	3.3×10^{-10}	0.05	3.3×10^{-10}	0.05	1.2×10^{-8}	1.78	
PM_{10}	5,000	3.3×10^{-10}	0.05	3.3×10^{-10}	0.05	1.2×10^{-8}	1.78	
Nitrogen oxides	9,000	7.2×10^{-10}	0.11	7.2×10^{-10}	0.11	2.7×10^{-8}	3.97	
Sulfur dioxide	1.3×10^{4}	4.5×10^{-12}	6.7×10^{-4}	4.5×10^{-12}	6.1×10^{-4}	1.7×10^{-10}	0.02	
Carbon monoxide	4.0×10^{4}	6.5×10^{-13}	9.6×10^{-5}	6.5×10^{-13}	9.6×10^{-5}	2.4×10^{-11}	0.004	
Lead	100	6.6×10^{-13}	9.8×10^{-5}	6.6×10^{-13}	9.8×10^{-5}	2.5×10^{-11}	0.004	
Asbestos	0.2 fibers/m^3	2.7×10^{-15}	3.9×10^{-7}	2.7×10^{-15}	3.9×10^{-7}	9.8×10^{-14}	1.4×10^{-5}	
Nickel oxide	1,000	1.3×10^{-12}	2.0×10^{-4}	1.3×10^{-12}	2.0×10^{-4}	4.9×10^{-11}	0.007	

a. Source: NIOSH (1990).
b. OSHA PEL - Occupational Safety and Health Administration Permissible Exposure Limits.
c. To convert to feet multiply by 3.281.
d. Particulate matter less than 10 microns in diameter.
e. N/A = Not Applicable. No OSHA PEL assigned. Exposure should be kept as low as possible. TE
f. no vit. = no non-alpha vitrification occurring.
g. Threshold limit value, time-weighted average (ACGIH 1993).

Table E.2-5. Maximum SRS boundary-line concentrations of carcinogens without risk factors (micrograms per cubic meter).[a,b]

	Alternative A			Alternative B			Alternative C		
	Expected	Minimum	Maximum	Expected	Minimum	Maximum	Expected	Minimum	Maximum
Lead	1.0E-05	1.0E-05	1.0E-05	3.0E-05	3.0E-05	6.0E-05	2.5E-05	1.9E-05	6.6E-05
Dioxane	1.6E-07	9.9E-08	1.2E-07	1.4E-07	6.8E-08	1.2E-07	4.6E-07	2.4E-07	1.0E-06
Ethylene dibromide	4.1E-07	2.5E-07	3.1E-07	3.5E-07	1.7E-07	3.0E-07	1.1E-06	5.9E-07	2.5E-06
Ethylene dichloride	4.1E-07	2.5E-07	3.1E-07	3.5E-07	1.7E-07	3.0E-07	1.1E-06	5.9E-07	2.5E-06
Parathion	4.1E-07	2.5E-07	3.1E-07	3.5E-07	1.7E-07	3.0E-07	1.1E-06	5.9E-07	2.5E-06
Aniline	1.6E-07	9.9E-08	1.2E-07	1.4E-07	6.8E-08	1.2E-07	4.6E-07	2.4E-07	1.0E-06
Cresols	1.6E-07	9.9E-08	1.2E-07	1.4E-07	6.8E-08	1.2E-07	4.6E-07	2.4E-07	1.0E-06
Chloromethyl methyl Ether	1.45E-07	2.41E-08	8.77E-08	1.4E-07	6.8E-08	1.2E-07	4.6E-07	2.4E-07	1.0E-06
3, 3-Dichlorobenzidene	1.6E-07	9.9E-08	1.2E-07	1.4E-07	6.8E-08	1.2E-07	4.6E-07	2.4E-07	1.0E-06
1, 2-Diphenylhydrazine	1.6E-07	9.9E-08	1.2E-07	1.4E-07	6.8E-08	1.2E-07	4.6E-07	2.4E-07	1.0E-06
2, 4-Dinitrotoluene	1.6E-07	9.9E-08	1.2E-07	1.4E-07	6.8E-08	1.2E-07	4.6E-07	2.4E-07	1.0E-06
Methyl iodide	1.45E-07	2.41E-08	8.77E-08	1.4E-07	6.8E-08	1.2E-07	4.6E-07	2.4E-07	1.0E-06
Pentachlorophenol	1.6E-07	9.9E-08	1.2E-07	1.4E-07	6.8E-08	1.2E-07	4.6E-07	2.4E-07	1.0E-06
Benzyl chloride	1.0E-04	1.0E-04	1.0E-04	8.0E-08	4.1E-08	4.4E-07	4.6E-07	2.4E-07	1.0E-06

a. Source: EPA (1994).
b. Integrated Risk Information System (IRIS) contains EPA health risk information for Class A, B, and C (suspected, probable, and possible) carcinogens.

TC

SECTION 3

TRAFFIC AND TRANSPORTATION

Table E.3-1. Hazardous waste shipments during 30-year period of interest.

Waste	Shipping container	Containers per truck	Waste forecast: Min. volume (m^3)[a]	Waste forecast: Exp.[b] volume (m^3)	Waste forecast: Max. volume (m^3)	Alternative A: Min. shipments	Alternative A: Exp. shipments	Alternative A: Max. shipments	Alternative B: Min. shipments	Alternative B: Exp. shipments	Alternative B: Max. shipments	Alternative C: Min. shipments	Alternative C: Exp. shipments	Alternative C: Max. shipments
ONSITE SHIPMENTS[c]														
Inorganic debris	90 cu. ft. box	6	4,280	8,283	11,489	280	541	751	280	541	751	280	541	751
Soils	45 cu. ft. box	10	146,784	282,935	465,392	11,468	22,106	36,361	11,468	22,106	36,361	11,468	22,106	36,361
Filters	45 cu. ft. box	1	2,267	4,285	6,495	17,71	3,348	5,074	1,771	3,348	5,074	1,771	3,348	5,074
Aqueous liquids	3000 gal. truck	1	8,206	35,943	38,345	714	3,142	3,376	714	3,142	3,376	714	3,142	3,376
Organic debris	90 cu. ft. box	1	28	28	28	11	11	11	11	11	11	11	11	11
Organic sludge	55 gal. drum	1	2,327	4,545	6,867	11,635	22,725	34,335	11,635	22,725	34,335	11,635	22,725	34,335
Heterogeneous debris	90 cu. ft. box	2	6,188	11,690	15,642	1,213	2,292	3,067	1,213	2,292	3,067	1,213	2,292	3,067
Lead	22.5 cu. ft. box	1	2,764	5,266	7,725	4,339	8,267	12,127	4,339	8,267	12,127	4,339	8,267	12,127
Organic liquids	3000 gal. truck	1	2,238	4,523	6,495	197	398	572	197	398	572	197	398	572
CIF ashcrete[d]	55 gal. drum	48	(e)	(e)	(e)	72	132	198	72	132	198	55	66	73
Bulk	Bulk box	1	3,389	6,642	9,474	62	122	174	62	122	174	62	122	174
Inorganic sludge	55 gal. drum	30	2,327	4,545	6,867	388	758	1,145	388	758	1,145	388	758	1,145
Metal debris	90 cu. ft. box	4	7,800	14,220	20,974	765	1,394	2,056	765	1,394	2,056	765	1,394	2,056
Sand/rock/gravel	45 cu. ft. box	6	19,698	38,060	62,091	2,565	4,956	8,085	2,565	4,956	8,085	2,565	4,956	8,085
Paint waste	55 gal. drum	4	2,294	4,062	6,122	2,868	5,078	7,653	2,868	5,078	7,653	2,868	5,078	7,653
Glass debris	55 gal. drum	60	4,297	7,999	12,245	358	667	1,020	358	667	1,020	358	667	1,020
PCBs	55 gal. drum	1	2,437	2,437	2,280	12,185	12,185	11,400	12,185	12,185	11,400	12,185	12,185	11,400
OFFSITE SHIPMENTS[f]														
Various types[g]	40 foot van	25 m^3	(h)	(h)	(h)	8,093	14,745	24,843	7,713	14,725	23,780	6,558	7,944	9,233
Average daily shipments[i]				(No-Action)										
Hazardous waste				14		8	14	20	8	14	20	8	13	18

Source: Rollins (1995).

a. Cubic meters.
b. Expected waste volume is assumed to be the same as for the no-action alternative.
c. Onsite shipments average 8 kilometers (5 miles) each.
d. CIF = Consolidated Incineration Facility. Volumes from the Consolidated Incineration Facility vary depending on alternative. Source: Hess (1994a, b, c, and d).
e. Ashcrete volume varies depending on alternative (Ashcrete is not a hazardous waste).
f. Offsite shipments average 1,609 kilometers (1,000 miles) each.
g. Offsite shipments of hazardous waste types vary depending on alternative.
h. Hazardous waste volume varies depending on alternatives.
i. Daily shipments are estimated by totaling all shipments for each alternative/forecast and dividing this sum by 30 years and 250 working days per year.

Table E.3-2. Low-level and transuranic (TRU) waste shipments during the 30-year period of interest.

Waste	Shipping container	Containers per truck	Waste forecast: Min. volume (m^3)[a]	Waste forecast: Exp.[b] volume (m^3)	Waste forecast: Max. volume (m^3)	Alternative A: Min. shipments	Alternative A: Exp. shipments	Alternative A: Max. shipments	Alternative B: Min. shipments	Alternative B: Exp. shipments	Alternative B: Max. shipments	Alternative C: Min. shipments	Alternative C: Exp. shipments	Alternative C: Max. shipments	
ONSITE SHIPMENTS[c]															TE
Tritiated equipment	90 cu. ft. box	10	461	1,184	1,622	18	46	64	18	46	64	18	46	64	
Spent deionizers	Liner	1	30	30	30	11	11	11	11	11	11	11	11	11	
LLW job-control[d]	90 cu. ft. box	6	309,115	366,285	413,812	21,375	25,112	28,218	20,204	23,940	27,047	20,204	23,940	27,047	TE
Offsite job-control	90 cu. ft. box	10	12,600	12,600	25,200	494	494	988	494	494	988	494	494	988	
LLW equipment	90 cu. ft. box	6	(e)	(e)	(e)	2,220	4,543	15,386	1,707	3,319	10,525	1,177	2,089	5,471	TE
ILW job-control[f]	90 cu. ft. box	2	12,477	22,335	28,111	2,446	4,449	5,512	2,446	4,449	5,512	2,446	4,449	5,512	
Long-lived waste	55 gal. drum	1	1,003	3,302	4,643	5,015	16,510	23,215	5,015	16,510	23,215	5,015	16,510	23,215	
Tritiated job-control	90 cu. ft. box	10	1,558	3,860	133,994	61	151	5,255	61	151	5,255	61	151	5,255	
Low-level soils	45 cu. ft. box	10	8,068	19,791	311,923	630	1,548	24,371	630	1,548	24,371	630	1,548	24,371	
Suspect soils	45 cu. ft. box	10	12,102	29,669	467,884	946	2,318	36,556	946	2,318	36,556	946	2,318	36,556	
Tritiated soils	45 cu. ft. box	10	575	1,532	2,492	45	119	195	45	119	195	45	119	195	
CIF ashcrete[g]	55 gal. drum	48	(h)	(h)	(h)	0	0	0	1,922	1,527	3,471	737	947	1,033	TE
TRU waste[i] 10-100 nCi[j]	55 gal. drum	15	3,164	4,400	252,919	1,055	1,467	84,298	1,055	1,467	84,298	1,055	1,467	84,298	
TRU waste[i] >100 nCi, <0.5 Ci[k]	55 gal. drum	15	2,165	3,112	51,295	722	1,036	17,097	722	1,036	17,097	722	1,036	17,097	
TRU waste[i] >0.5 Ci[l]	55 gal. drum	15	2,228	3,202	52,780	742	1,066	17,591	742	1,066	17,591	742	1,066	17,591	
TRU waste[i] bulk	Bulk box	1	8,146	11,707	192,989	150	215	3,547	150	215	3,547	150	215	3,547	
TRU waste[i] remote	Bulk box	1	146	209	3,449	3	4	63	3	4	63	3	4	63	
OFFSITE SHIPMENTS[m]															TE
Offsite smelter	Railroad Car	NA	(n)	(n)	(n)	0	0	0	54	762	332	37	479	173	
LLW offsite[o]	40 ft van	25m^3	(p)	(p)	(p)	0	0	0	18,540	30,525	77,815	0	0	0	
Average daily shipments[q]				(No-Action)											
Transuranic waste				1		<1	1	16	<1	1	16	<1	1	16	
Low-level waste				7		4	7	19	6	9	20	4	7	17	TC

Source: Rollins (1995).

a. Cubic meters.
b. Expected waste volume is assumed to be the same as for the no-action alternative.
c. Onsite shipments average 8 kilometers (5 miles) each.
d. LLW = low-level waste.
e. Volumes of low-level equipment vary with alternative.
f. ILW = intermediate-level waste.
g. CIF = Consolidated Incineration Facility.
h. Volumes from the Consolidated Incineration Facility vary depending on alternative. Source: Hess (1994a, b, c, and d).
i. TRU = transuranic.
j. Includes mixed and nonmixed transuranic waste at 10-100 nanocuries per drum.
k. Includes mixed and nonmixed transuranic waste between 100 nanocuries and 0.5 curies per drum.
l. Includes mixed and nonmixed transuranic waste greater than 0.5 curies per drum.
m. Offsite shipments average 541 kilometers (336 miles) each.
n. Volumes to Offsite Smelter Facility vary with alternative.
o. Includes return shipments of processed waste.
p. Offsite low-level waste shipments vary by alternative.
q. Daily shipments are estimated by totaling all shipments for each alternative/forecast and dividing this sum by 30 years and 250 working days per year.

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Table E.3-3. Mixed waste shipments during the 30-year period of interest.

Waste	Shipping container	Containers per truck	Waste forecast			Alternative A			Alternative B			Alternative C		
			Min. volume (m^3)[a]	Exp.[b] volume (m^3)	Max. volume (m^3)	Min. shipments	Exp. shipments	Max. shipments	Min. shipments	Exp. shipments	Max. shipments	Min. shipments	Exp. shipments	Max. shipments
ONSITE SHIPMENTS[c]														
Inorganic debris	90 cu. ft. box	6	6,240	15,170	23,516	408	992	1,537	408	992	1537	408	992	1,537
Waste filters	45 cu. ft. box	1	1,256	2,851	3,858	981	2,227	3,014	981	2,236	3,014	981	2,227	3,014
Aqueous liquids	3000 gal. truck	1	8,957	32,862	51,026	788	2,893	4,492	788	2,893	4,492	788	2,893	4,492
Organic debris	90 cu. ft. box	1	242	241	27,769	95	95	10,890	95	95	10,890	95	95	10,890
Organic sludge	55 gal. drum	1	1,335	3,672	5,113	6,675	18,360	25,565	6,675	18,360	25,565	6,675	18,360	25,565
Heterogenous debris	90 cu. ft. box	2	10,594	25,699	126,967	2,077	5,039	24,896	2,077	5,039	24,896	2,077	5,039	24,896
Gold traps	55 gal. drum	1	3	3	3	14	14	14	14	14	14	14	14	14
M-Area glass	71 gal. drum	3	2,058	2,058	2,058	2,618	2,618	2,618	2,618	2,618	2,618	2,618	2,618	2,618
Lead	22.5 cu. ft. box	1	1,280	5,956	7,677	2,009	4,675	12,052	2,009	4,675	12,052	2,009	4,675	12,052
PUREX solvents	3000 gal. truck	1	345	345	345	30	30	30	30	30	30	30	30	30
Organic liquids	3000 gal. truck	1	1,149	2,879	7,873	101	253	693	101	253	693	101	253	693
CIF ashcrete[d]	55 gal. drum	48	(e)	(e)	(e)	4,941	13,301	82,407	4,897	445	1,331	62	109	849
Bulk	Bulk box	1	4,202	10,358	32,295	77	190	594	77	190	594	77	190	594
Inorganic sludge	55 gal. drum	30	1,299	3,636	5,046	217	606	841	217	606	841	217	606	841
Metal debris	90 cu. ft. box	4	6,768	12,897	53,719	664	1,264	5,267	664	1,264	5,267	664	1,264	5,267
Soils/sand/rock/gravel	45 cu. ft. box	6	22,186	88,329	440,062	2,889	11,501	57,300	2,889	11,501	57,300	2,889	11,501	57,300
Paint waste	55 gal. drum	4	1,468	2,133	2,598	1,835	2,666	3,248	1,835	2,666	3,248	1,835	2,666	3,248
Glass debris	55 gal. drum	60	1,652	2,997	7,558	138	250	630	138	250	630	138	250	630
OFFSITE SHIPMENTS[f]														
Lead	22.5 cu. ft. box	1	(g)	(g)	(g)	2,115	4,802	12,237	2,115	4,802	12,237	2,112	4,799	12,234
Average daily shipments[h]				(No-Action)										
Mixed waste				8		4	10	33	4	8	22	3	8	22

Source: Rollins (1995).

a. Cubic meters.
b. Expected waste volume is assumed to be the same as for the no-action alternative.
c. Onsite shipments average 8 kilometers (5 miles) each.
d. CIF = Consolidated Incineration Facility.
e. Volumes from the Consolidated Incineration Facility vary depending on alternative. Source: Hess (1994a, b, c, and d).
f. Offsite shipments average 541 kilometers (336 miles) each.
g. Volumes to offsite treatment facilities vary with alternative.
h. Daily shipments are estimated by totaling all shipments for each alternative and forecast and dividing this sum by 30 years and 250 working days per year.

Table E.3-4. Annual radiological doses from incident-free transportation during onsite transport of low-level, mixed, and transuranic waste under the no-action alternative.

	Waste stream	Dose from incident-free transportation		
		Uninvolved worker[a]	Involved workers	Uninvolved workers
1.	Tritiated equipment	2.37E-11	2.10E-06	4.56E-08
2.	Spent deionizers	2.89E-06	9.59E-02	4.42E-04
3.	Low-level job-control	9.27E-05	7.28E+00	1.80E-01
4.	Offsite job-control	2.03E-06	2.47E-01	3.94E-03
5.	Low-activity equip.	2.39E-06	3.24E+01	4.64E-03
6.	Inter.-level job-control	9.23E-03	7.52E+01	1.04E+00
7.	Long-lived	1.83E-03	3.10E+01	7.43E-01
8.	Tritiated job-control	3.08E-08	2.30E-03	5.95E-05
9.	Low-level waste soils	1.26E-07	1.33E-02	2.43E-04
10.	Suspect soils	1.90E-07	1.96E-02	3.68E-04
11.	Tritiated soils	9.72E-08	1.03E-02	1.88E-04
12.	MW inorganic debris[b]	9.06E-06	6.82E-01	1.76E-02
13.	Mixed waste soil	1.08E-05	1.14E+00	2.09E-02
14.	MW comp. filters	1.51E-06	1.36E-01	2.92E-03
15a.	0.01 Ci/m^3 TRU waste[c,d]	1.07E-10	3.92E-06	2.07E-07
15b.	1.5 Ci/m^3 TRU waste	1.18E-08	4.14E-04	2.29E-05
15c.	208 Ci/m^3 TRU waste	1.61E-06	5.91E-02	3.11E-03
15d.	Bulk eq. TRU waste	9.23E-09	2.46E-04	1.79E-05
15e.	Bulk eq. Rmt. TRU[e]	1.28E-04	8.58E-02	6.32E-03
16.	MW aqueous liquids	8.37E-06	4.24E-03	1.37E-02
17.	MW organic debris	1.28E-07	1.11E-02	3.33E-04
18.	Organic sludge	1.19E-06	1.20E-01	3.07E-03
19.	Heterogeneous debris	9.07E-06	1.37E+00	2.35E-02
19a.	Lead	6.33E-08	1.02E-02	1.64E-04
20.	PUREX solvents[f]	2.60E-08	1.77E-05	4.27E-05
21.	Organic liquids	2.29E-06	1.15E-03	3.75E-03
22.	Ashcrete[g]	0.00E+00	0.00E+00	0.00E+00
23.	Bulk waste	2.80E-06	8.00E-02	7.28E-03
24.	Inorganic sludge	2.24E-06	1.08E-01	5.82E-03
25.	Metal debris	2.58E-06	2.73E-01	6.70E-03
26.	Sand/rock/gravel	1.80E-06	1.94E-01	4.66E-03
27.	Paint waste	2.87E-07	6.13E-02	7.44E-04
28.	Glass debris	3.18E-06	1.18E-01	8.25E-03
Totals:[h]				
	Low-level	1.1E-02	1.5E+02	2.0E+00
	Mixed	5.5E-05	4.3E+00	1.2E-01
	Transuranic	1.3E-04	1.5E-01	9.5E-03

Source: Washburn (1995).

a. Dose in rem; all other doses in person-rem.
b. MW = Mixed waste.
c. Ci/m^3 = Curie per cubic meter.
d. TRU = Transuranic.
e. Rmt = Remotely-handled.
f. PUREX = Plutonium-uranium extraction.
g. Consolidated Incineration Facility does not operate under the no-action alternative so there would be no ashcrete.
h. For incident-free dose, the sum of waste streams 1 through 11 are used to calculate the corresponding dose of low level waste in Chapter 4 transportation sections; 12 through 14 and 16 through 28 constitute the mixed waste dose; and 15a through 15e constitute the transuranic dose. For each waste type, assumes the same individual has maximum exposure to each waste stream in a single year.

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Table E.3-5. Annual radiological doses from incident-free transportation during onsite transport of low-level, mixed, and transuranic waste for alternative A – expected waste forecast.

	Waste stream	Dose from incident-free transportation		
		Uninvolved worker[a]	Involved workers	Uninvolved workers
1.	Tritiated equipment	2.37E-11	2.10E-06	4.56E-08
2.	Spent deionizers	2.89E-06	9.59E-02	4.42E-04
3.	Low-level job-control	9.27E-05	7.28E+00	1.80E-01
4.	Offsite job-control	2.03E-06	2.47E-01	3.94E-03
5.	Low-activity equip.	1.25E-05	1.69E+02	2.42E-02
6.	Inter.-level job-control	9.23E-03	7.52E+01	1.04E+00
7.	Long-lived	1.83E-03	3.10E+01	7.43E-01
8.	Tritiated job-control	3.08E-08	2.30E-03	5.95E-05
9.	Low-level waste soils	1.26E-07	1.33E-02	2.43E-04
10.	Suspect soils	1.90E-07	1.96E-02	3.68E-04
11.	Tritiated soils	9.72E-08	1.03E-02	1.88E-04
12.	MW inorganic debris[b]	9.06E-06	6.82E-01	1.76E-02
13.	Mixed waste soil	1.08E-05	1.14E+00	2.09E-02
14.	MW comp. filters	1.51E-06	1.36E-01	2.92E-03
15a.	0.01 Ci/m^3 TRU waste[c,d]	1.07E-10	3.92E-06	2.07E-07
15b.	1.5 Ci/m^3 TRU waste	1.18E-08	4.14E-04	2.29E-05
15c.	208 Ci/m^3 TRU waste	1.61E-06	5.91E-02	3.11E-03
15d.	Bulk eq. TRU waste	9.23E-09	2.46E-04	1.79E-05
15e.	Bulk eq. Rmt. TRU[e]	1.28E-04	8.58E-02	6.32E-03
16.	MW aqueous liquids	8.37E-06	4.24E-03	1.37E-02
17.	MW organic debris	1.28E-07	1.11E-02	3.33E-04
18.	Organic sludge	1.19E-06	1.20E-01	3.07E-03
19.	Heterogeneous debris	9.07E-06	1.37E+00	2.35E-02
19a.	Lead	3.16E-08	5.11E-03	8.20E-05
20.	PUREX solvents[f]	2.60E-08	1.77E-05	4.27E-05
21.	Organic liquids	2.29E-06	1.15E-03	3.75E-03
22.	Ashcrete	4.1E-05	1.4E+00	7.9E-02
23.	Bulk waste	2.80E-06	8.00E-02	7.28E-03
24.	Inorganic sludge	2.24E-06	1.08E-01	5.82E-03
25.	Metal debris	2.58E-06	2.73E-01	6.70E-03
26.	Sand/rock/gravel	1.80E-06	1.94E-01	4.67E-03
27.	Paint waste	2.87E-07	6.13E-02	7.44E-04
28.	Glass debris	3.18E-06	1.18E-01	8.25E-03
	Totals:[g]			
	Low-level	1.1E-02	2.8E+02	2.0E+00
	Mixed	8.4E-05	5.3E+00	1.7E-01
	Transuranic	1.3E-04	1.5E-01	9.5E-03

Source: Washburn (1995).

a. Dose in rem; all other doses in person-rem.

b. MW = Mixed waste.

c. Ci/m^3 = Curie per cubic meter.

d. TRU = Transuranic.

e. Rmt = Remotely-handled.

f. PUREX = Plutonium-uranium extraction..

g. For incident-free dose, the sum of waste streams 1 through 12 are used to calculate the corresponding dose of low-level waste in Chapter 4 transportation sections; 12 through 14 and 16 through 28 constitute the mixed waste dose; and 15a through 15e constitutes the transuranic dose. For each waste type, assumes the same individual has maximum exposure to each waste stream in a single year.

Table E.3-6. Annual radiological doses from incident-free transportation during onsite transport of low-level, mixed, and transuranic waste for alternative A – minimum waste forecast.

	Waste	Dose from incident-free transportation		
		Uninvolved worker[a]	Involved workers	Uninvolved workers
1.	Tritiated equipment	9.21E-12	8.19E-07	1.78E-08
2.	Spent deionizers	2.89E-06	9.59E-02	4.42E-04
3.	Low-level job-control	7.82E-05	6.14E+00	1.52E-01
4.	Offsite job-control	2.03E-06	2.47E-01	3.94E-03
5.	Low-activity equip.	6.10E-06	8.28E+01	1.18E-02
6.	Inter.-level job-control	5.07E-03	4.14E+01	5.72E-01
7.	Long-lived	5.56E-04	9.41E+00	2.26E-01
8.	Tritiated job-control	1.25E-08	9.29E-04	2.40E-05
9.	Low-level waste soils	5.11E-08	5.43E-03	9.91E-05
10.	Suspect soils	7.75E-08	7.98E-03	1.50E-04
11.	Tritiated soils	3.66E-08	3.89E-03	7.09E-05
12.	MW inorganic debris[b]	3.73E-06	2.81E-01	7.22E-03
13.	Mixed waste soil	2.71E-06	2.87E-01	5.25E-03
14.	MW comp. filters	6.64E-07	6.01E-02	1.29E-03
15a.	0.01 Ci/m^3 TRU waste[c,d]	7.70E-11	2.81E-06	1.49E-07
15b.	1.5 Ci/m^3 TRU waste	8.25E-09	2.88E-04	1.60E-05
15c.	208 Ci/m^3 TRU waste	1.12E-06	4.12E-02	2.17E-03
15d.	Bulk eq. TRU waste	6.43E-09	1.71E-04	1.24E-05
15e.	Bulk eq. Rmt. TRU[e]	8.91E-05	5.97E-02	4.40E-03
16.	MW aqueous liquids	2.25E-06	1.14E-03	3.69E-03
17.	MW organic debris	1.28E-07	1.11E-02	3.33E-04
18.	Organic sludge	4.32E-07	4.37E-02	1.12E-03
19.	Heterogeneous debris	3.74E-06	5.65E-01	9.69E-03
19a.	Lead	1.36E-08	2.20E-03	3.52E-05
20.	PUREX solvents[f]	2.60E-08	1.77E-05	4.27E-05
21.	Organic liquids	1.82E-06	9.18E-04	2.98E-03
22.	Ashcrete	1.5E-05	5.9E-01	3.0E-02
23.	Bulk waste	1.14E-06	3.25E-02	2.95E-03
24.	Inorganic sludge	8.01E-07	3.86E-02	2.08E-03
25.	Metal debris	1.35E-06	1.44E-01	3.52E-03
26.	Sand/rock/gravel	4.53E-07	4.87E-02	1.17E-03
27.	Paint waste	1.98E-07	4.22E-02	5.12E-04
28.	Glass debris	1.75E-06	6.51E-02	4.55E-03
Totals:[g]				
	Low-level	5.7E-03	1.4E+02	9.8E-01
	Mixed	3.2E-05	2.0E+00	6.7E-02
	Transuranic	9.0E-05	1.0E-01	6.6E-03

Source: Washburn (1995).

a. Dose in rem; all other doses in person-rem.
b. MW = Mixed waste.
c. Ci/m^3 = Curie per cubic meter.
d. TRU = Transuranic.
e. Rmt = Remotely-handled.
f. PUREX = Plutonium-uranium extraction..
g. For incident-free dose, the sum of waste streams 1 through 12 are used to calculate the corresponding dose of low-level waste in Chapter 4 transportation sections; 12 through 14 and 16 through 28 constitute the mixed waste dose; and 15a through 15e constitutes the transuranic dose. For each waste type, assumes the same individual has maximum exposure to each waste stream in a single year.

Table E.3-7. Annual radiological doses from incident-free transportation during onsite transport of low-level, mixed, and transuranic waste for alternative A – maximum waste forecast.

	Waste stream	Dose from incident-free transportation: Uninvolved worker[a]	Involved workers	Uninvolved workers
1.	Tritiated equipment	3.24E-11	2.88E-06	6.25E-08
2.	Spent deionizers	2.89E-06	9.59E-02	4.42E-04
3.	Low-level job-control	1.05E-04	8.22E+00	2.03E-01
4.	Offsite job-control	4.06E-06	4.95E-01	7.88E-03
5.	Low-activity equip.	4.23E-05	5.74E+02	8.21E-02
6.	Inter.-level job-control	1.14E-02	9.32E+01	1.29E+00
7.	Long-lived	2.58E-03	4.36E+01	1.04E+00
8.	Tritiated job-control	1.07E-06	7.99E-02	2.07E-03
9.	Low-level waste soils	1.98E-06	2.10E-01	3.83E-03
10.	Suspect soils	3.00E-06	3.09E-01	5.81E-03
11.	Tritiated soils	1.59E-07	1.68E-02	3.07E-04
12.	MW inorganic debris[b]	1.40E-05	1.06E+00	2.72E-02
13.	Mixed waste soil	5.37E-05	5.70E+00	1.04E-01
14.	MW comp. filters	2.04E-06	1.85E-01	3.95E-03
15a.	0.01 Ci/m^3 TRU waste[c,d]	6.15E-09	2.25E-04	1.19E-05
15b.	1.5 Ci/m^3 TRU waste	1.95E-07	6.83E-03	3.78E-04
15c.	208 Ci/m^3 TRU waste	2.66E-05	9.75E-01	5.13E-02
15d.	Bulk eq. TRU waste	1.52E-07	4.06E-03	2.95E-04
15e.	Bulk eq. Rmt. TRU[e]	2.11E-03	1.42E+00	1.04E-01
16.	MW aqueous liquids	1.30E-05	6.60E-03	2.13E-02
17.	MW organic debris	1.47E-05	1.27E+00	3.82E-02
18.	Organic sludge	1.65E-06	1.68E-01	4.28E-03
19.	Heterogeneous debris	4.48E-05	6.77E+00	1.16E-01
19a.	Lead	8.16E-08	1.32E-02	2.11E-04
20.	PUREX solvents[f]	2.60E-08	1.77E-05	4.27E-05
21.	Organic liquids	3.64E-06	1.84E-03	5.96E-03
22.	Ashcrete	2.0E-04	7.8E+00	3.9E-01
23.	Bulk waste	8.73E-06	2.50E-01	2.27E-02
24.	Inorganic sludge	3.11E-06	1.50E-01	8.07E-03
25.	Metal debris	1.07E-05	1.14E+00	2.79E-02
26.	Sand/rock/gravel	8.98E-06	9.65E-01	2.32E-02
27.	Paint waste	3.50E-07	7.47E-02	9.06E-04
28.	Glass debris	8.03E-06	2.98E-01	2.08E-02
	Totals:[g]			
	Low-level	1.4E-02	7.2E+02	2.8E+00
	Mixed	3.3E-04	2.4E+01	7.0E-01
	Transuranic	2.1E-03	2.4E+00	1.6E-01

Source: Washburn (1995).

a. Dose in rem; all other doses in person-rem.

b. MW = Mixed waste.

c. Ci/m^3 = Curie per cubic meter.

d. TRU = Transuranic.

e. Rmt = Remotely-handled.

f. PUREX = Plutonium-uranium extraction..

g. For incident-free dose, the sum of waste streams 1 through 12 are used to calculate the corresponding dose of low-level waste in Chapter 4 transportation sections; 12 through 14 and 16 through 28 constitute the mixed waste dose; and 15a through 15e constitutes the transuranic dose. For each waste type, assumes the same individual has maximum exposure to each waste stream in a single year.

Table E.3-8. Annual radiological doses from incident-free transportation during onsite transport of low-level, mixed, and transuranic waste for alternative B – expected waste forecast.

	Waste stream	Dose from incident-free transportation		
		Uninvolved worker[a]	Involved workers	Uninvolved workers
1.	Tritiated equipment	2.37E-11	2.10E-06	4.56E-08
2.	Spent deionizers	2.89E-06	9.59E-02	4.42E-04
3.	Low-level job-control	9.27E-05	7.28E+00	1.80E-01
4.	Offsite job-control	2.03E-06	2.47E-01	3.94E-03
5.	Low-activity equip.	9.12E-06	1.24E+02	1.77E-02
6.	Inter.-level job-control	9.23E-03	7.52E+01	1.04E+00
7.	Long-lived	1.83E-03	3.10E+01	7.43E-01
8.	Tritiated job-control	3.08E-08	2.30E-03	5.95E-05
9.	Low-level waste soils	1.26E-07	1.33E-02	2.43E-04
10.	Suspect soils	1.90E-07	1.96E-02	3.68E-04
11.	Tritiated soils	9.72E-08	1.03E-02	1.88E-04
12.	MW inorganic debris[b]	9.06E-06	6.82E-01	1.76E-02
13.	Mixed waste soil	1.08E-05	1.14E+00	2.09E-02
14.	MW comp. filters	1.51E-06	1.36E-01	2.92E-03
15a.	0.01 Ci/m^3 TRU waste[c,d]	1.07E-10	3.92E-06	2.07E-07
15b.	1.5 Ci/m^3 TRU waste	1.18E-08	4.14E-04	2.29E-05
15c.	208 Ci/m^3 TRU waste	1.61E-06	5.91E-02	3.11E-03
15d.	Bulk eq. TRU waste	9.23E-09	2.46E-04	1.79E-05
15e.	Bulk eq. Rmt. TRU[e]	1.28E-04	8.58E-02	6.32E-03
16.	MW aqueous liquids	8.37E-06	4.24E-03	1.37E-02
17.	MW organic debris	1.28E-07	1.11E-02	3.33E-04
18.	Organic sludge	1.19E-06	1.20E-01	3.07E-03
19.	Heterogeneous debris	9.07E-06	1.37E+00	2.35E-02
19a.	Lead	3.16E-08	5.11E-03	8.20E-05
20.	PUREX solvents[f]	2.60E-08	1.77E-05	4.27E-05
21.	Organic liquids	2.29E-06	1.15E-03	3.75E-03
22.	Ashcrete	5.5E-05	2.1E+00	1.1E-01
23.	Bulk waste	2.80E-06	8.00E-02	7.28E-03
24.	Inorganic sludge	2.24E-06	1.08E-01	5.82E-03
25.	Metal debris	2.58E-06	2.73E-01	6.70E-03
26.	Sand/rock/gravel	1.80E-06	1.94E-01	4.67E-03
27.	Paint waste	2.87E-07	6.13E-02	7.44E-04
28.	Glass debris	3.18E-06	1.18E-01	8.25E-03
Totals:[g]				
	Low-level	1.1E-02	2.4E+02	2.1E+00
	Mixed	6.7E-05	4.8E+00	1.4E-01
	Transuranic	1.3E-04	1.5E-01	9.5E-03

Source: Washburn (1995).

a. Dose in rem; all other doses in person-rem.
b. MW = Mixed waste.
c. Ci/m^3 = Curie per cubic meter.
d. TRU = Transuranic.
e. Rmt = Remotely-handled.
f. PUREX = Plutonium-uranium extraction..
g. For incident-free dose, the sum of waste streams 1 through 12 are used to calculate the corresponding dose of low-level waste in Chapter 4 transportation sections; 12 through 14 and 16 through 28 constitute the mixed waste dose; and 15a through 15e constitutes the transuranic dose. For each waste type, assumes the same individual has maximum exposure to each waste stream in a single year.

Table E.3-9. Annual radiological doses from incident-free transportation during onsite transport of low-level, mixed, and transuranic waste for alternative B – minimum waste forecast.

	Waste stream	Dose from incident-free transportation		
		Uninvolved worker[a]	Involved workers	Uninvolved workers
1.	Tritiated equipment	9.21E-12	8.19E-07	1.78E-08
2.	Spent deionizers	2.89E-06	9.59E-02	4.42E-04
3.	Low-level job-control	7.82E-05	6.14E+00	1.52E-01
4.	Offsite job-control	2.03E-06	2.47E-01	3.94E-03
5.	Low-activity equip.	4.69E-06	6.37E+01	9.10E-03
6.	Inter.-level job-control	5.07E-03	4.14E+01	5.72E-01
7.	Long-lived	5.56E-04	9.41E+00	2.26E-01
8.	Tritiated job-control	1.25E-08	9.29E-04	2.40E-05
9.	Low-level waste soils	5.11E-08	5.43E-03	9.91E-05
10.	Suspect soils	7.75E-08	7.98E-03	1.50E-04
11.	Tritiated soils	3.66E-08	3.89E-03	7.09E-05
12.	MW inorganic debris[b]	3.73E-06	2.81E-01	7.22E-03
13.	Mixed waste soil	2.71E-06	2.87E-01	5.25E-03
14.	MW comp. filters	6.64E-07	6.01E-02	1.29E-03
15a.	0.01 Ci/m^3 TRU waste[c,d]	7.70E-11	2.81E-06	1.49E-07
15b.	1.5 Ci/m^3 TRU waste	8.25E-09	2.88E-04	1.60E-05
15c.	208 Ci/m^3 TRU waste	1.12E-06	4.12E-02	2.17E-03
15d.	Bulk eq. TRU waste	6.43E-09	1.71E-04	1.24E-05
15e.	Bulk eq. Rmt. TRU[e]	8.91E-05	5.97E-02	4.40E-03
16.	MW aqueous liquids	2.25E-06	1.14E-03	3.69E-03
17.	MW organic debris	1.28E-07	1.11E-02	3.33E-04
18.	Organic sludge	4.32E-07	4.37E-02	1.12E-03
19.	Heterogeneous debris	3.74E-06	5.65E-01	9.69E-03
19a.	Lead	1.36E-08	2.20E-03	3.52E-05
20.	PUREX solvents[f]	2.60E-08	1.77E-05	4.27E-05
21.	Organic liquids	1.82E-06	9.18E-04	2.98E-03
22.	Ashcrete	4.4E-05	1.7E+00	8.6E-02
23.	Bulk waste	1.14E-06	3.25E-02	2.95E-03
24.	Inorganic sludge	8.01E-07	3.86E-02	2.08E-03
25.	Metal debris	1.35E-06	1.44E-01	3.52E-03
26.	Sand/rock/gravel	4.53E-07	4.87E-02	1.17E-03
27.	Paint waste	1.98E-07	4.22E-02	5.12E-04
28.	Glass debris	1.75E-06	6.51E-02	4.55E-03
	Totals:[g]			
	Low-level	5.7E-03	1.2E+02	1.0E+00
	Mixed	4.4E-05	2.5E+00	9.1E-02
	Transuranic	9.0E-05	1.0E-01	6.6E-03

Source: Washburn (1995).

a. Dose in rem; all other doses in person-rem.
b. MW = Mixed waste.
c. Ci/m^3 = Curie per cubic meter.
d. TRU = Transuranic.
e. Rmt = Remotely-handled.
f. PUREX = Plutonium-uranium extraction..
g. For incident-free dose, the sum of waste streams 1 through 12 are used to calculate the corresponding dose of low-level waste in Chapter 4 transportation sections; 12 through 14 and 16 through 28 constitute the mixed waste dose; and 15a through 15e constitutes the transuranic dose. For each waste type, assumes the same individual has maximum exposure to each waste stream in a single year.

Table E.3-10. Annual radiological doses from incident-free transportation during onsite transport of low-level, mixed, and transuranic waste for alternative B – maximum waste forecast.

	Waste stream	Dose from incident-free transportation		
		Uninvolved worker[a]	Involved workers	Uninvolved workers
1.	Tritiated equipment	3.24E-11	2.88E-06	6.25E-08
2.	Spent deionizers	2.89E-06	9.59E-02	4.42E-04
3.	Low-level job-control	1.05E-04	8.22E+00	2.03E-01
4.	Offsite job-control	4.06E-06	4.95E-01	7.88E-03
5.	Low-activity equip.	2.89E-05	3.93E+02	5.61E-02
6.	Inter.-level job-control	1.14E-02	9.32E+01	1.29E+00
7.	Long-lived	2.58E-03	4.36E+01	1.04E+00
8.	Tritiated job-control	1.07E-06	7.99E-02	2.07E-03
9.	Low-level waste soils	1.98E-06	2.10E-01	3.83E-03
10.	Suspect soils	3.00E-06	3.09E-01	5.81E-03
11.	Tritiated soils	1.59E-07	1.68E-02	3.07E-04
12.	MW inorganic debris[b]	1.40E-05	1.06E+00	2.72E-02
13.	Mixed waste soil	5.37E-05	5.70E+00	1.04E-01
14.	MW comp. filters	2.04E-06	1.85E-01	3.95E-03
15a.	0.01 Ci/m^3 TRU waste[c,d]	6.15E-09	2.25E-04	1.19E-05
15b.	1.5 Ci/m^3 TRU waste	1.95E-07	6.83E-03	3.78E-04
15c.	208 Ci/m^3 TRU waste	2.66E-05	9.75E-01	5.13E-02
15d.	Bulk eq. TRU waste	1.52E-07	4.06E-03	2.95E-04
15e.	Bulk eq. Rmt. TRU[e]	2.11E-03	1.42E+00	1.04E-01
16.	MW aqueous liquids	1.30E-05	6.60E-03	2.13E-02
17.	MW organic debris	1.47E-05	1.27E+00	3.82E-02
18.	Organic sludge	1.65E-06	1.68E-01	4.28E-03
19.	Heterogeneous debris	4.48E-05	6.77E+00	1.16E-01
19a.	Lead	8.16E-08	1.32E-02	2.11E-04
20.	PUREX solvents[f]	2.60E-08	1.77E-05	4.27E-05
21.	Organic liquids	3.64E-06	1.84E-03	5.96E-03
22.	Ashcrete	7.6E-05	3.0E+00	1.5E-01
23.	Bulk waste	8.73E-06	2.50E-01	2.27E-02
24.	Inorganic sludge	3.11E-06	1.50E-01	8.07E-03
25.	Metal debris	1.07E-05	1.14E+00	2.79E-02
26.	Sand/rock/gravel	8.98E-06	9.65E-01	2.32E-02
27.	Paint waste	3.50E-07	7.47E-02	9.06E-04
28.	Glass debris	8.03E-06	2.98E-01	2.08E-02
	Totals:[g]			
	Low-level	1.4E-02	5.4E+02	2.7E+00
	Mixed	2.1E-04	1.9E+01	4.7E-01
	Transuranic	2.1E-03	2.4E+00	1.6E-01

Source: Washburn (1995).

a. Dose in rem; all other doses in person-rem.

b. MW = Mixed waste.

c. Ci/m^3 = Curie per cubic meter.

d. TRU = Transuranic.

e. Rmt = Remotely-handled.

f. PUREX = Plutonium-uranium extraction..

g. For incident-free dose, the sum of waste streams 1 through 12 are used to calculate the corresponding dose of low-level waste in Chapter 4 transportation sections; 12 through 14 and 16 through 28 constitute the mixed waste dose; and 15a through 15e constitutes the transuranic dose. For each waste type, assumes the same individual has maximum exposure to each waste stream in a single year.

Table E.3-11. Annual radiological doses from incident-free transportation during onsite transport of low-level, mixed, and transuranic waste for alternative C – expected waste forecast.

	Waste stream	Dose from incident-free transportation		
		Uninvolved worker[a]	Involved workers	Uninvolved workers
1.	Tritiated equipment	2.37E-11	2.10E-06	4.56E-08
2.	Spent deionizers	2.89E-06	9.59E-02	4.42E-04
3.	Low-level job-control	9.27E-05	7.28E+00	1.80E-01
4.	Offsite job-control	2.03E-06	2.47E-01	3.94E-03
5.	Low-activity equip.	5.74E-06	7.80E+01	1.11E-02
6.	Inter.-level job-control	9.23E-03	7.52E+01	1.04E+00
7.	Long-lived	1.83E-03	3.10E+01	7.43E-01
8.	Tritiated job-control	3.08E-08	2.30E-03	5.95E-05
9.	Low-level waste soils	1.26E-07	1.33E-02	2.43E-04
10.	Suspect soils	1.90E-07	1.96E-02	3.68E-04
11.	Tritiated soils	9.72E-08	1.03E-02	1.88E-04
12.	MW inorganic debris[b]	9.06E-06	6.82E-01	1.76E-02
13.	Mixed waste soil	1.08E-05	1.14E+00	2.09E-02
14.	MW comp. filters	1.51E-06	1.36E-01	2.92E-03
15a.	0.01 Ci/m^3 TRU waste[c,d]	1.07E-10	3.92E-06	2.07E-07
15b.	1.5 Ci/m^3 TRU waste	1.18E-08	4.14E-04	2.29E-05
15c.	208 Ci/m^3 TRU waste	1.61E-06	5.91E-02	3.11E-03
15d.	Bulk eq. TRU waste	9.23E-09	2.46E-04	1.79E-05
15e.	Bulk eq. Rmt. TRU[e]	1.28E-04	8.58E-02	6.32E-03
16.	MW aqueous liquids	8.37E-06	4.24E-03	1.37E-02
17.	MW organic debris	1.28E-07	1.11E-02	3.33E-04
18.	Organic sludge	1.19E-06	1.20E-01	3.07E-03
19.	Heterogeneous debris	9.07E-06	1.37E+00	2.35E-02
19a.	Lead	3.16E-08	5.11E-03	8.20E-05
20.	PUREX solvents[f]	2.60E-08	1.77E-05	4.27E-05
21.	Organic liquids	2.29E-06	1.15E-03	3.75E-03
22.	Ashcrete	1.6E-05	6.1E-01	3.1E-02
23.	Bulk waste	2.80E-06	8.00E-02	7.28E-03
24.	Inorganic sludge	2.24E-06	1.08E-01	5.82E-03
25.	Metal debris	2.58E-06	2.73E-01	6.70E-03
26.	Sand/rock/gravel	1.80E-06	1.94E-01	4.67E-03
27.	Paint waste	2.87E-07	6.13E-02	7.44E-04
28.	Glass debris	3.18E-06	1.18E-01	8.25E-03
	Totals:[g]			
	Low-level	1.1E-02	1.9E+02	2.0E+00
	Mixed	5.8E-05	4.4E+00	1.2E-01
	Transuranic	1.3E-04	1.5E-01	9.5E-03

Source: Washburn (1995).

a. Dose in rem; all other doses in person-rem.
b. MW = Mixed waste.
c. Ci/m^3 = Curie per cubic meter.
d. TRU = Transuranic.
e. Rmt = Remotely-handled.
f. PUREX = Plutonium-uranium extraction..
g. For incident-free dose, the sum of waste streams 1 through 12 are used to calculate the corresponding dose of low-level waste in Chapter 4 transportation sections; 12 through 14 and 16 through 28 constitute the mixed waste dose; and 15a through 15e constitutes the transuranic dose. For each waste type, assumes the same individual has maximum exposure to each waste stream in a single year.

Table E.3-12. Annual radiological doses from incident-free transportation during onsite transport of low-level, mixed, and transuranic waste for alternative C – minimum waste forecast.

	Waste stream	Dose from incident-free transportation		
		Uninvolved worker[a]	Involved workers	Uninvolved workers
1.	Tritiated equipment	9.21E-12	8.19E-07	1.78E-08
2.	Spent deionizers	2.89E-06	9.59E-02	4.42E-04
3.	Low-level job-control	7.82E-05	6.14E+00	1.52E-01
4.	Offsite job-control	2.03E-06	2.47E-01	3.94E-03
5.	Low-activity equip.	3.24E-06	4.39E+01	6.28E-03
6.	Inter.-level job-control	5.07E-03	4.14E+01	5.72E-01
7.	Long-lived	5.56E-04	9.41E+00	2.26E-01
8.	Tritiated job-control	1.25E-08	9.29E-04	2.40E-05
9.	Low-level waste soils	5.11E-08	5.43E-03	9.91E-05
10.	Suspect soils	7.75E-08	7.98E-03	1.50E-04
11.	Tritiated soils	3.66E-08	3.89E-03	7.09E-05
12.	MW inorganic debris[b]	3.73E-06	2.81E-01	7.22E-03
13.	Mixed waste soil	2.71E-06	2.87E-01	5.25E-03
14.	MW comp. filters	6.64E-07	6.01E-02	1.29E-03
15a.	0.01 Ci/m^3 TRU waste[c,d]	7.70E-11	2.81E-06	1.49E-07
15b.	1.5 Ci/m^3 TRU waste	8.25E-09	2.88E-04	1.60E-05
15c.	208 Ci/m^3 TRU waste	1.12E-06	4.12E-02	2.17E-03
15d.	Bulk eq. TRU waste	6.43E-09	1.71E-04	1.24E-05
15e.	Bulk eq. Rmt. TRU[e]	8.91E-05	5.97E-02	4.40E-03
16.	MW aqueous liquids	2.25E-06	1.14E-03	3.69E-03
17.	MW organic debris	1.28E-07	1.11E-02	3.33E-04
18.	Organic sludge	4.32E-07	4.37E-02	1.12E-03
19.	Heterogeneous debris	3.74E-06	5.65E-01	9.69E-03
19a.	Lead	1.36E-08	2.20E-03	3.52E-05
20.	PUREX solvents[f]	2.60E-08	1.77E-05	4.27E-05
21.	Organic liquids	1.82E-06	9.18E-04	2.98E-03
22.	Ashcrete	1.1E-05	4.5E-01	2.2E-02
23.	Bulk waste	1.14E-06	3.25E-02	2.95E-03
24.	Inorganic sludge	8.01E-07	3.86E-02	2.08E-03
25.	Metal debris	1.35E-06	1.44E-01	3.52E-03
26.	Sand/rock/gravel	4.53E-07	4.87E-02	1.17E-03
27.	Paint waste	1.98E-07	4.22E-02	5.12E-04
28.	Glass debris	1.75E-06	6.51E-02	4.55E-03
	Totals:[g]			
	Low-level	5.7E-03	1.0E+02	9.8E-01
	Mixed	2.3E-05	1.7E+00	5.0E-02
	Transuranic	9.0E-05	1.0E-01	6.6E-03

Source: Washburn (1995).

a. Dose in rem; all other doses in person-rem.

b. MW = Mixed waste.

c. Ci/m^3 = Curie per cubic meter.

d. TRU = Transuranic.

e. Rmt = Remotely-handled.

f. PUREX = Plutonium-uranium extraction..

g. For incident-free dose, the sum of waste streams 1 through 12 are used to calculate the corresponding dose of low-level waste in Chapter 4 transportation sections; 12 through 14 and 16 through 28 constitute the mixed waste dose; and 15a through 15e constitutes the transuranic dose. For each waste type, assumes the same individual has maximum exposure to each waste stream in a single year.

Table E.3-13. Annual radiological doses from incident-free transportation during onsite transport of low-level, mixed, and transuranic waste for alternative C – maximum waste forecast.

	Waste stream	Dose from incident-free transportation		
		Uninvolved worker[a]	Involved workers	Uninvolved workers
1.	Tritiated equipment	3.24E-11	2.88E-06	6.25E-08
2.	Spent deionizers	2.89E-06	9.59E-02	4.42E-04
3.	Low-level job-control	1.05E-04	8.22E+00	2.03E-01
4.	Offsite job-control	4.06E-06	4.95E-01	7.88E-03
5.	Low-activity equip.	1.50E-05	2.04E+02	2.92E-02
6.	Inter.-level job-control	1.14E-02	9.32E+01	1.29E+00
7.	Long-lived	2.58E-03	4.36E+01	1.04E+00
8.	Tritiated job-control	1.07E-06	7.99E-02	2.07E-03
9.	Low-level waste soils	1.98E-06	2.10E-01	3.83E-03
10.	Suspect soils	3.00E-06	3.09E-01	5.81E-03
11.	Tritiated soils	1.59E-07	1.68E-02	3.07E-04
12.	MW inorganic debris[b]	1.40E-05	1.06E+00	2.72E-02
13.	Mixed waste soil	5.37E-05	5.70E+00	1.04E-01
14.	MW comp. filters	2.04E-06	1.85E-01	3.95E-03
15a.	0.01 Ci/m^3 TRU waste[c,d]	6.15E-09	2.25E-04	1.19E-05
15b.	1.5 Ci/m^3 TRU waste	1.95E-07	6.83E-03	3.78E-04
15c.	208 Ci/m^3 TRU waste	2.66E-05	9.75E-01	5.13E-02
15d.	Bulk eq. TRU waste	1.52E-07	4.06E-03	2.95E-04
15e.	Bulk eq. Rmt. TRU[e]	2.11E-03	1.42E+00	1.04E-01
16.	MW aqueous liquids	1.30E-05	6.60E-03	2.13E-02
17.	MW organic debris	1.47E-05	1.27E+00	3.82E-02
18.	Organic sludge	1.65E-06	1.68E-01	4.28E-03
19.	Heterogeneous debris	4.48E-05	6.77E+00	1.16E-01
19a.	Lead	8.16E-08	1.32E-02	2.11E-04
20.	PUREX solvents[f]	2.60E-08	1.77E-05	4.27E-05
21.	Organic liquids	3.64E-06	1.84E-03	5.96E-03
22.	Ashcrete	3.6E-05	1.4E+00	6.9E-02
23.	Bulk waste	8.73E-06	2.50E-01	2.27E-02
24.	Inorganic sludge	3.11E-06	1.50E-01	8.07E-03
25.	Metal debris	1.07E-05	1.14E+00	2.79E-02
26.	Sand/rock/gravel	8.98E-06	9.65E-01	2.32E-02
27.	Paint waste	3.50E-07	7.47E-02	9.06E-04
28.	Glass debris	8.03E-06	2.98E-01	2.08E-02
	Totals:[g]			
	Low-level	1.4E-02	3.5E+02	2.6E+00
	Mixed	2.0E-04	1.9E+01	4.5E-01
	Transuranic	2.1E-03	2.4E+00	1.6E-01

Source: Washburn (1995).

a. Dose in rem; all other doses in person-rem.

b. MW = Mixed waste.

c. Ci/m^3 = Curie per cubic meter.

d. TRU = Transuranic.

e. Rmt = Remotely-handled.

f. PUREX = Plutonium-uranium extraction..

g. For incident-free dose, the sum of waste streams 1 through 12 are used to calculate the corresponding dose of low-level waste in Chapter 4 transportation sections; 12 through 14 and 16 through 28 constitute the mixed waste dose; and 15a through 15e constitutes the transuranic dose. For each waste type, assumes the same individual has maximum exposure to each waste stream in a single year.

Table E.3-14. Accident probabilities for onsite shipments of low-level, mixed, and transuranic waste by alternative and waste forecast.

	Waste	Alternative A			Alternative B			Alternative C		
		Expected	Minimum	Maximum	Expected	Minimum	Maximum	Expected	Minimum	Maximum
1.	Tritiated equipment	5.62E-07	2.19E-07	7.70E-07	5.62E-07	2.19E-07	7.70E-07	5.62E-07	2.19E-07	7.70E-07
2.	Spent deionizers	6.56E-08	6.56E-08	6.56E-08	6.56E-08	6.56E-08	6.56E-08	6.56E-08	6.56E-08	6.56E-08
3.	Low-level job-control	2.87E-04	2.42E-04	3.24E-04	2.87E-04	2.42E-04	3.24E-04	2.87E-04	2.42E-04	3.24E-04
4.	Offsite job-control	5.92E-06	5.92E-06	1.18E-05	5.92E-06	5.92E-06	1.18E-05	5.92E-06	5.92E-06	1.18E-05
5.	Low-activity equip.	5.45E-05	2.66E-05	1.85E-04	3.98E-05	2.05E-05	1.26E-04	2.51E-05	1.41E-05	6.57E-05
6.	Inter.-level job-control	5.28E-05	2.90E-05	6.54E-05	5.28E-05	2.90E-05	6.54E-05	5.28E-05	2.90E-05	6.54E-05
7.	Long-lived	1.97E-04	6.00E-05	2.78E-04	1.97E-04	6.00E-05	2.78E-04	1.97E-04	6.00E-05	2.78E-04
8.	Tritiated job-control	1.82E-06	7.34E-07	6.31E-05	1.82E-06	7.34E-07	6.31E-05	1.82E-06	7.34E-07	6.31E-05
9.	Low-level waste soils	1.85E-06	7.55E-07	2.92E-05	1.85E-06	7.55E-07	2.92E-05	1.85E-06	7.55E-07	2.92E-05
10.	Suspect soils	2.77E-05	1.13E-05	4.37E-04	2.77E-05	1.13E-05	4.37E-04	2.77E-05	1.13E-05	4.37E-04
11.	Tritiated soils	1.44E-06	5.41E-07	2.34E-06	1.44E-06	5.41E-07	2.34E-06	1.44E-06	5.41E-07	2.34E-06
12.	MW inorganic debris[a]	1.19E-05	4.88E-06	1.84E-05	1.19E-05	4.88E-06	1.84E-05	1.19E-05	4.88E-06	1.84E-05
13.	Mixed waste soil	7.08E-05	1.78E-05	3.53E-04	7.08E-05	1.78E-05	3.53E-04	7.08E-05	1.78E-05	3.53E-04
14.	MW comp. filters	2.66E-05	1.17E-05	3.61E-05	2.66E-05	1.17E-05	3.61E-05	2.66E-05	1.17E-05	3.61E-05
15a.	0.01 Ci/m^3 TRU waste[b,c]	1.76E-05	1.26E-05	1.01E-03	1.76E-05	1.26E-05	1.01E-03	1.76E-05	1.26E-05	1.01E-03
15b.	1.5 Ci/m^3 TRU waste	1.24E-05	8.63E-06	2.05E-04	1.24E-05	8.63E-06	2.05E-04	1.24E-05	8.63E-06	2.05E-04
15c.	208 Ci/m^3 TRU waste	1.28E-05	8.88E-06	2.10E-04	1.28E-05	8.88E-06	2.10E-04	1.28E-05	8.88E-06	2.10E-04
15d.	Bulk eq. TRU waste	2.57E-06	1.79E-06	4.24E-05	2.57E-06	1.79E-06	4.24E-05	2.57E-06	1.79E-06	4.24E-05
15e.	Bulk eq. Rmt. TRU[d]	4.79E-08	3.33E-08	7.90E-07	4.79E-08	3.33E-08	7.90E-07	4.79E-08	3.33E-08	7.90E-07
16.	MW aqueous liquids	3.46E-05	9.32E-06	5.38E-05	3.46E-05	9.32E-06	5.38E-05	3.46E-05	9.32E-06	5.38E-05
17.	MW organic debris	1.51E-06	1.51E-06	1.74E-04	1.51E-06	1.51E-06	1.74E-04	1.51E-06	1.51E-06	1.74E-04
18.	Organic sludge	2.93E-04	1.06E-04	4.07E-04	2.93E-04	1.06E-04	4.07E-04	2.93E-04	1.06E-04	4.07E-04
19.	Heterogeneous debris	8.03E-05	3.31E-05	3.97E-04	8.03E-05	3.31E-05	3.97E-04	8.03E-05	3.31E-05	3.97E-04
19a.	Lead	7.45E-05	3.20E-05	1.92E-04	7.45E-05	3.20E-05	1.92E-04	7.45E-05	3.20E-05	1.92E-04
20.	PUREX solvents[e]	3.71E-07	3.71E-07	3.71E-07	3.71E-07	3.71E-07	3.71E-07	3.71E-07	3.71E-07	3.71E-07

TC

Table E.3-14. (continued).

Waste	Alternative A			Alternative B			Alternative C		
	Expected	Minimum	Maximum	Expected	Minimum	Maximum	Expected	Minimum	Maximum
21. Organic liquids	8.89E-06	7.07E-06	1.41E-05	8.89E-06	7.07E-06	1.41E-05	8.89E-06	7.07E-06	1.41E-05
22. Ashcrete[f]									
23. Bulk Waste	3.03E-06	1.23E-06	9.44E-06	3.03E-06	1.23E-06	9.44E-06	3.03E-06	1.23E-06	9.44E-06
24. Inorganic Sludge	9.66E-06	3.45E-06	1.34E-05	9.66E-06	3.45E-06	1.34E-05	9.66E-06	3.45E-06	1.34E-05
25. Metal Debris	2.01E-05	1.06E-05	8.39E-05	2.01E-05	1.06E-05	8.39E-05	2.01E-05	1.06E-05	8.39E-05
26. Sand/Rock/Gravel	2.63E-05	6.61E-06	1.31E-04	2.63E-05	6.61E-06	1.31E-04	2.63E-05	6.61E-06	1.31E-04
27. Paint Chips/Solids	4.25E-05	2.92E-05	5.17E-05	4.25E-05	2.92E-05	5.17E-05	4.25E-05	2.92E-05	5.17E-05
28. Glass Debris	3.98E-06	2.20E-06	1.00E-05	3.98E-06	2.20E-06	1.00E-05	3.98E-06	2.20E-06	1.00E-05

TC

Source: Washburn (1995).

a. MW = Mixed waste.
b. Ci/m^3 = Curie per cubic meter.
c. TRU = Transuranic.
d. Rmt = Remotely-handled.
e. PUREX = Plutonium-uranium extraction
f. See Table E.3-16.

Table E.3-15. Radiological doses from a single accident during onsite transport of low-level, mixed, and transuranic waste under any alternative.

	Waste	Uninvolved workers	Involved workers	Uninvolved workers[a]	Probability	
1.	Tritiated equipment	7.15E+02	6.50E+01	9.24E-03	5.62E-07	
2.	Spent deionizers	5.76E-02	3.28E-03	4.69E-07	6.56E-08	
3.	Low-level job-control	3.83E-02	3.80E-03	5.42E-07	2.87E-04	
4.	Offsite job-control	6.40E-02	6.34E-03	9.04E-07	5.92E-06	
5.	Low-activity equip.	3.83E-02	3.80E-03	5.42E-07	1.04E-05	
6.	Inter.-level job-control	6.18E-01	1.08E-02	1.54E-06	5.28E-05	
7.	Long-lived low-level waste	6.96E-01	8.44E-03	1.21E-06	1.97E-04	
8.	Tritiated job-control	2.03E-03	2.59E-04	3.69E-08	1.82E-06	
9.	Low-level waste soils	6.39E+01	6.35E+00	9.06E-04	1.85E-06	
10.	Suspect soils	6.39E+00	6.35E-01	9.06E-05	2.77E-05	
11.	Tritiated soils	6.45E+01	6.80E+00	9.70E-04	1.44E-06	
12.	MW inorganic debris[b]	1.37E-02	1.36E-03	1.94E-07	1.19E-05	
13.	Mixed waste soil	1.44E+02	1.43E+01	2.04E-03	7.07E-05	
14.	MW comp. filters	7.18E-03	7.14E-04	1.02E-07	2.66E-05	
15a.	0.01 Ci/m^3 TRU waste[c,d]	2.22E+00	1.95E-01	2.78E-05	1.76E-05	
15b.	1.5 Ci/m^3 TRU waste	3.33E+02	2.92E+01	4.17E-03	1.24E-05	
15c.	208 Ci/m^3 TRU waste	4.61E+04	4.05E+03	5.78E-01	1.28E-05	
15d.	Bulk eq. TRU waste	3.09E+05	2.72E+04	3.88E+00	2.6E-06	
15e.	Bulk eq. Rmt. TRU[e]	3.09E+05	2.72E+04	3.88E+00	4.79E-08	TC
16.	MW aqueous liquids	3.57E-03	3.54E-04	5.05E-08	3.46E-05	
17.	MW organic debris	2.96E+01	2.84E+00	4.05E-04	1.51E-06	
18.	Organic sludge	2.32E+00	2.22E-01	3.17E-05	2.93E-04	
19.	Heterogeneous debris	5.92E+01	5.68E+00	8.10E-04	8.03E-05	
19a.	Lead	3.71E-01	3.56E-02	5.08E-06	1.49E-04	
20.	PUREX solvents[f]	2.50E-01	2.19E-02	3.13E-06	3.71E-07	
21.	Organic liquids	3.57E-03	3.54E-04	5.05E-08	8.89E-06	
22.	Ashcrete[g]					
23.	Bulk waste	6.32E-01	6.05E-02	8.64E-06	3.03E-06	
24.	Inorganic sludge	6.95E+01	6.67E+00	9.51E-04	9.66E-06	
25.	Metal debris	5.90E+00	5.68E-01	8.10E-05	2.01E-05	
26.	Sand/rock/gravel	8.90E+01	8.56E+00	1.22E-03	2.63E-05	
27.	Paint chips/solids	9.25E+00	8.89E-01	1.27E-04	4.25E-05	
28.	Glass debris	1.39E+02	1.33E+01	1.90E-03	3.98E-06	

Source: Washburn (1995).

a. Dose in rem; all other doses in person-rem.
b. MW = Mixed waste.
c. Ci/m^3 = Curie per cubic meter.
d. TRU = Transuranic.
e. Rmt = Remotely-handled.
f. PUREX = *Plutonium-uranium extraction.*
g. The dose from an accident involving ashcrete varies among alternatives. See Table E.3-16.

Table E.3-16. Probability of and radiological dose from a single accident during onsite transport of low-level and mixed waste ashcrete from the Consolidated Incineration Facility under each alternative.[a]

Waste forecast	Onsite population	Offsite population	Offsite MEI[b]	Probability
Alternative A				
Expected				
Low-level waste	4.3E-02	4.2E-03	6.0E-07	6.1E-05
Mixed waste	4.3E-02	4.2E-03	6.0E-07	1.4E-04
Minimum				
Low-level waste	7.9E-02	7.5E-03	1.1E-06	1.7E-05
Mixed waste	7.9E-02	7.5E-03	1.1E-06	3.9E-05
Maximum				
Low-level waste	2.2E-02	2.1E-03	3.0E-07	3.0E-04
Mixed waste	2.2E-02	2.1E-03	3.0E-07	6.9E-04
Alternative B				
Expected				
Low-level waste	3.5E-01	3.4E-02	4.9E-06	2.8E-05
Mixed waste	3.5E-01	3.4E-02	4.9E-06	7.5E-06
Minimum				
Low-level waste	1.3E-01	1.3E-02	1.8E-06	3.8E-05
TC Mixed waste	1.3E-01	1.3E-02	1.8E-06	4.1E-05
Maximum				
Low-level waste	2.9E-01	2.8E-02	4.0E-06	4.2E-05
Mixed waste	2.9E-01	2.8E-02	4.0E-06	1.6E-05
Alternative C				
Expected				
Low-level waste	6.0E-01	5.6E-02	8.0E-06	9.1E-06
Mixed waste	6.0E-01	5.6E-02	8.0E-06	1.9E-06
Minimum				
Low-level waste	5.2E-01	4.9E-02	7.0E-06	6.9E-06
Mixed waste	5.2E-01	4.9E-02	7.0E-06	1.2E-06
Maximum				
Low-level waste	6.4E-01	6.0E-02	8.6E-06	1.2E-05
Mixed waste	6.4E-01	6.0E-02	8.6E-06	8.1E-06

Source: HNUS (1995).

a. The Consolidated Incineration Facility would not operate under the no-action alternative, so no ashcrete would be generated.

b. MEI = Maximally exposed individual.

Table E.3-17. Radiological doses from incident-free transportation and accidents during offsite transport of low-level (low-activity equipment), mixed waste (lead), and low-level waste volume reduction.

Description	Annual dose from incident-free transportation			Dose from a single potential accident	
	Remote MEI[a]	Involved workers	Remote population	Remote Population	
		Alternative A – Expected Waste Forecast			
Low-activity equipment[b]	NA[c]	NA	NA	NA	
Lead	3.2E-08	3.6E-01	7.5E-02	4.7E-03	
		Alternative A – Minimum Waste Forecast			
Low-activity equipment[b]	NA	NA	NA	NA	
Lead	1.4E-08	1.6E-01	3.2E-02	4.7E-03	
		Alternative A – Maximum Waste Forecast			
Low-activity equipment[b]	NA	NA	NA	NA	
Lead	8.2E-08	9.3E-01	1.9E-01	4.7E-03	
		Alternative B – Expected Waste Forecast			
Low-activity equipment	5.2E-05	1.7E+01	2.6E+01	4.8E-04	
Lead	3.2E-08	3.6E-01	7.5E-02	4.7E-03	
Low-level volume reduction	8.1E-05	1.6E+01	6.4E+00	3.7E+02	
		Alternative B – Minimum Waste Forecast			
Low-activity equipment	2.7E-05	8.8E+00	1.3E+01	4.8E-04	TC
Lead	1.4E-08	1.6E-01	3.2E-02	4.7E-03	TE
Low-level volume reduction	6.6E-05	2.0E+01	5.2E+00	3.7E+02	
		Alternative B – Maximum Waste Forecast			
Low-activity equipment	1.6E-04	5.4E+01	8.2E+01	4.8E-04	
Lead	8.2E-08	9.3E-01	1.9E-01	4.7E-03	
Low-level volume reduction	9.6E-05	8.0E+01	7.5E+00	3.7E+02	
		Alternative C – Expected Waste Forecast			
Low-activity equipment	3.3E-05	1.1E+01	1.6E+01	4.8E-04	
Lead	3.2E-08	3.6E-01	7.5E-02	4.7E-03	
		Alternative C – Minimum Waste Forecast			
Low-activity equipment	1.8E-05	6.0E+00	9.2E+00	4.8E-04	
Lead	1.4E-08	1.6E-01	3.2E-02	4.7E-03	
		Alternative C – Maximum Waste Forecast			
Low-activity equipment	8.6E-05	2.8E+01	4.3E+01	4.8E-04	
Lead	8.2E-08	9.3E-01	1.9E-01	4.7E-03	

Source: Washburn (1995). TE

a. Remote maximally exposed individual along transportation route. Dose is rem; all others in person-rem.

b. No low-activity equipment would be shipped offsite under alternative A. TE

c. NA = not applicable.

Table E.3-18. Waste volumes (in cubic meters) shipped in each alternative.

	Waste	No-Action	Alternative A			Alternative B			Alternative C		
			Expected	Minimum	Maximum	Expected	Minimum	Maximum	Expected	Minimum	Maximum
1.	Tritiated equipment	1.18E+03	1.18E+03	4.61E+02	1.62E+03	1.18E+03	4.61E+02	1.62E+03	1.18E+03	4.61E+02	1.62E+03
2.	Spent deionizers	3.00E+01	3.00E+01	3.00E+01	3.00E+01	3.00E+01	3.00E+01	3.00E+01	3.00E+01	3.00E+01	3.00E+01
3.	Low-level job-control	3.66E+05	3.66E+05	3.09E+05	4.14E+05	3.66E+05	3.09E+05	4.14E+05	3.66E+05	3.09E+05	4.14E+05
4.	Offsite job job-control	1.26E+04	1.26E+04	1.26E+04	2.52E+04	1.26E+04	1.26E+04	2.52E+04	1.26E+04	1.26E+04	2.52E+04
5.	Low-activity equip.	1.33E+04	6.95E+04	3.40E+04	2.35E+05	5.08E+04	2.61E+04	1.61E+05	3.20E+04	1.80E+04	8.37E+04
6.	Inter.-level job-control	2.27E+04	2.27E+04	1.25E+04	2.81E+04	2.27E+04	1.25E+04	2.81E+04	2.27E+04	1.25E+04	2.81E+04
7.	Long-lived	3.30E+03	3.30E+03	1.00E+03	4.64E+03	3.30E+03	1.00E+03	4.64E+03	3.30E+03	1.00E+03	4.64E+03
8.	Tritiated job-control	3.86E+03	3.86E+03	1.56E+03	1.34E+05	3.86E+03	1.56E+03	1.34E+05	3.86E+03	1.56E+03	1.34E+05
9.	Low-level waste soils	1.98E+04	1.98E+04	8.07E+03	3.12E+05	1.98E+04	8.07E+03	3.12E+05	1.98E+04	8.07E+03	3.12E+05
10.	Suspect soils	2.97E+04	2.97E+04	1.21E+04	4.68E+05	2.97E+04	1.21E+04	4.68E+05	2.97E+04	1.21E+04	4.68E+05
11.	Tritiated soils	1.53E+03	1.53E+03	5.75E+02	2.49E+03	1.53E+03	5.75E+02	2.49E+03	1.53E+03	5.75E+02	2.49E+03
12.	MW inorganic debris[a]	1.52E+04	1.52E+04	6.24E+03	2.35E+04	1.52E+04	6.24E+03	2.35E+04	1.52E+04	6.24E+03	2.35E+04
13.	Mixed waste soil	7.56E+04	7.56E+04	1.90E+04	3.77E+05	7.56E+04	1.90E+04	3.77E+05	7.56E+04	1.90E+04	3.77E+05
14.	MW comp. filters	2.85E+03	2.85E+03	1.26E+03	3.86E+03	2.85E+03	1.26E+03	3.86E+03	2.85E+03	1.26E+03	3.86E+03
15a.	0.01 ci/m^3 TRU waste[b,c]	4.40E+03	4.40E+03	3.16E+03	2.53E+05	4.40E+03	3.16E+03	2.53E+05	4.40E+03	3.16E+03	2.53E+05
15b.	1.5 ci/m^3 TRU waste	3.11E+03	3.11E+03	2.16E+03	5.13E+04	3.11E+03	2.16E+03	5.13E+04	3.11E+03	2.16E+03	5.13E+04
15c.	208 ci/m^3 TRU waste	3.20E+03	3.20E+03	2.23E+03	5.28E+04	3.20E+03	2.23E+03	5.28E+04	3.20E+03	2.23E+03	5.28E+04
15d.	Bulk eq. TRU waste	1.17E+04	1.17E+04	8.14E+03	1.93E+05	1.17E+04	8.14E+03	1.93E+05	1.17E+04	8.14E+03	1.93E+05
15e.	Bulk eq. rmt. TRU[d]	2.09E+02	2.09E+02	1.46E+02	3.45E+03	2.09E+02	1.46E+02	3.45E+03	2.09E+02	1.46E+02	3.45E+03
16.	MW aqueous liquids	3.27E+04	3.27E+04	8.81E+03	5.09E+04	3.27E+04	8.81E+03	5.09E+04	3.27E+04	8.81E+03	5.09E+04
17.	MW organic debris	2.42E+02	2.42E+02	2.42E+02	2.78E+04	2.42E+02	2.42E+02	2.78E+04	2.42E+02	2.42E+02	2.78E+04
18.	Organic sludge	3.67E+03	3.67E+03	1.34E+03	5.11E+03	3.67E+03	1.34E+03	5.11E+03	3.67E+03	1.34E+03	5.11E+03
19.	Heterogeneous debris	2.57E+04	2.57E+04	1.06E+04	1.27E+05	2.57E+04	1.06E+04	1.27E+05	2.57E+04	1.06E+04	1.27E+05
19a.	Lead	5.96E+03	2.98E+03	1.28E+03	7.68E+03	2.98E+03	1.28E+03	7.68E+03	2.98E+03	1.28E+03	7.68E+03
20.	PUREX solvents[e]	3.45E+02	3.45E+02	3.45E+02	3.45E+02	3.45E+02	3.45E+02	3.45E+02	3.45E+02	3.45E+02	3.45E+02
21.	Organic liquids	8.45E+03	8.45E+03	6.72E+03	1.34E+04	8.45E+03	6.72E+03	1.34E+04	8.45E+03	6.72E+03	1.34E+04
22.	Ashcrete[f]	0.00E+00	1.63E+05	4.49E+04	7.96E+05	2.81E+04	6.38E+04	4.62E+04	8.79E+03	6.55E+03	1.65E+04

Table E.3-18. (continued).

	Waste	No-Action	Alternative A			Alternative B			Alternative C			
			Expected	Minimum	Maximum	Expected	Minimum	Maximum	Expected	Minimum	Maximum	
23.	Bulk waste	1.04E+04	1.04E+04	4.20E+03	3.23E+04	1.04E+04	4.20E+03	3.23E+04	1.04E+04	4.20E+03	3.23E+04	
24.	Inorganic sludge	3.64E+03	3.64E+03	1.30E+-3	5.05E+03	3.64E+03	1.30E+-3	5.05E+03	3.64E+03	1.30E+-3	5.05E+03	
25.	Metal debris	1.29E+04	1.29E+04	6.77E+03	5.37E+04	1.29E+04	6.77E+03	5.37E+04	1.29E+04	6.77E+03	5.37E+04	
26.	Sand/rock/gravel	1.27E+04	1.27E+04	3.19E+03	6.32E+04	1.27E+04	3.19E+03	6.32E+04	1.27E+04	3.19E+03	6.32E+04	
27.	Paint waste	2.13E+03	2.13E+03	1.47E+03	2.60E+03	2.13E+03	1.47E+03	2.60E+03	2.13E+03	1.47E+03	2.60E+03	
28.	Glass debris	3.00E+03	3.00E+03	1.65E+03	7.56E+03	3.00E+03	1.65E+03	7.56E+03	3.00E+03	1.65E+03	7.56E+03	
29.	Low-activity equipment[g]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.68E+04	8.68E+03	5.31E+04	1.05E+04	5.94E+03	2.76E+04	
30.	Lead[g]	0.00E+00	2.98E+03	1.28E+03	7.68E+03	2.98E+03	1.28E+03	7.68E+03	2.98E+03	1.28E+03	7.68E+03	
31.	Low Level Job Control[h]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.87E+05	1.58E+05	2.10E+05	0.00E+00	0.00E+00	0.00E+00	
32.	Low Activity Equip[h]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.44E+05	9.85E+04	1.61E+05	0.00E+00	0.00E+00	0.00E+00	
33.	LLW from Decon[h]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.54E+05	2.29E+05	1.63E+06	0.00E+00	0.00E+00	0.00E+00	
34.	Supercompacted[h,i]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.02E+05	7.57E+04	1.01E+05	0.00E+00	0.00E+00	0.00E+00	
35.	Incinerate/S'compacted[h,i]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.19E+03	1.63E+03	2.19E+03	0.00E+00	0.00E+00	0.00E+00	
36.	Reduce/ Repkg (CIF) [h,i]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.26E+04	3.17E+04	4.21E+04	0.00E+00	0.00E+00	0.00E+00	
37.	Reduce/Repkg (vaults)[h,i]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E+04	1.39E+04	1.84E+04	0.00E+00	0.00E+00	0.00E+00	TC
38.	Metal / Supercompact[h,i]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.03E+04	8.72E+03	1.16E+04	0.00E+00	0.00E+00	0.00E+00	
39.	Supercompacted Equip.[h,i]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.44E+05	9.85E+04	1.61E+05	0.00E+00	0.00E+00	0.00E+00	
40.	Supercompacted Decon[h,i]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.54E+05	2.29E+05	1.63E+06	0.00E+00	0.00E+00	0.00E+00	
Onsite totals:	Low-level waste	4.74E+05	5.30E+05	3.92E+05	1.63E+06	5.26E+05	4.03E+05	1.58E+06	5.02E+05	3.83E+05	1.48E+06	
	Mixed waste	2.15E+05	3.40E+05	1.22E+05	1.59E+06	2.17E+05	1.21E+05	8.14E+05	2.14E+05	7.50E+04	8.09E+05	
	Transuranic waste	2.24E+04	2.24E+04	1.57E+04	5.50E+05	2.24E+04	1.57E+04	5.50E+05	2.24E+04	1.57E+04	5.50E+05	
Offsite totals:	Low-level waste	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.57E+06	9.54E+05	4.02E+06	1.05E+04	5.94E+03	2.76E+04	TC
	Mixed waste	0.00E+00	2.98E+03	1.28E+03	7.68E+03	2.98E+03	1.28E+03	7.68E+03	2.98E+03	1.28E+03	7.68E+03	

Source: Washburn (1995), Sinkowski (1995).

a. MW = mixed waste.
b. Ci/m^3 = Curies per cubic meter.
c. TRU = transuranic.
d. Rmt. = Remote-handled.
e. *PUREX = Plutonium-uranium solution.*
f. Ashcrete values are the result of processing of low-level and mixed waste only.
g. Offsite shipments.
h. Low-level volume reduction offsite shipments.
i. Low-level volume reduction return shipments to SRS.

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SECTION 4

OCCUPATIONAL AND PUBLIC HEALTH

Table E.4-1. Average number of workers assigned to onsite facilities.[a]

Facility	No-Action	Alternative A			Alternative B			Alternative C		
		Min.	Exp.	Max.	Min.	Exp.	Max.	Min.	Exp.	Max.
E-Area Vaults	7	7	7	14	7	7	14	3	3	5
Containment building	0	10	10	25	10	10	19	10	10	13
RCRA-Permitted Disposal Vaults	1	5	6	11	5	5	11	5	5	11
Long-Lived Waste Storage Building	1	1	1	1	1	1	1	1	1	1
MW Storage Buildings[b]	39	10	16	67	9	14	65	10	13	65
Non-alpha vitrification facility	0	0	0	0	0	13	25	51	63	79
Shallow land disposal	8	8	8	16	8	8	16	8	8	16
TRU waste characterization/certification facility[c]	5	26	38	122	20	20	107	20	20	107
TRU waste retrieval operations	4	4	4	4	4	4	4	4	4	4
TRU Waste Storage Pads	14	10	10	96	10	10	97	11	11	99
Alpha vitrification facility	0	0	0	0	40	40	119	40	40	119
Soil sort facility	0	3	3	3	3	3	3	3	3	3
Aqueous and Organic Waste Storage Tanks	15	0	0	0	0	0	0	0	0	0
Consolidated Incineration Facility	0	26	26	26	26	26	26	10	10	10
F/H-Area Effluent Treatment Facility	40	40	40	40	40	40	40	40	40	40
H-Area Tank Farm	1,562	1,562	1,562	1,562	1,562	1,562	1,562	1,562	1,562	1,562
Replacement High-Level Waste Evaporator	15	15	15	15	15	15	15	15	15	15
Waste removal operations	10	10	10	10	10	10	10	10	10	10
M-Area Compaction Facility	4	4	4	4	4	4	4	4	4	4
M-Area Liquid Effluent Treatment Facility	31	31	31	31	31	31	31	31	31	31
M-Area Vendor Treatment Facility	10	10	10	10	10	10	10	10	10	10
SRTC MW Tanks/Ion Exchange[d]	4	4	4	4	4	4	4	4	4	4
D-Area Ion Exchange Process	1	1	1	1	1	1	1	1	1	1
F-Area Tank Farm	308	308	308	308	308	308	308	308	308	308
253-H Compaction Facility	3	3	3	3	3	3	3	3	3	3
Waste management workers (average yearly)	2,082	2,098	2,117	2,373	2,131	2,148	2,495	2,163	2,178	2,520

a. Source: Hess (1994e).
b. MW = mixed waste.
c. TRU = transuranic.
d. SRTC = Savannah River Technology Center.

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Table E.4-2. Onsite facility workers annual dose during the 30-year period of interest (in person-millirem).[a]

Facility worker dose	Average[b] annual dose	No-Action	Alternative A			Alternative B			Alternative C		
			Min.	Exp.	Max.	Min.	Exp.	Max.	Min.	Exp.	Max.
E-Area Vaults	16	112	112	112	224	112	112	224	41	41	82
Containment building	250	0	2,375	2,375	6,333	2,375	2,375	4,750	2,375	2,375	3,167
RCRA-Permitted Disposal Vaults	16	12	86	97	172	86	86	172	86	86	172
Long-Lived Waste Storage Building	16	16	16	16	16	16	16	16	16	16	16
MW Storage Buildings[c]	16	624	160	256	1,072	144	224	1,040	160	208	1,040
Non-alpha vitrification facility	250	0	0	0	0	0	3167	6,333	12,667	15,833	19,792
Shallow Land Disposal	16	128	128	128	256	128	128	256	128	128	256
TRU waste characterization/certification facility[d]	220	1,100	5,720	8,360	26,840	4,400	4,400	23,540	4,400	4,400	23,540
TRU waste retrieval operations	220	880	880	880	880	880	880	880	880	880	880
TRU Waste Storage Pads	220	3,080	2,200	2,200	21,120	2,200	2,200	21,340	2,420	2,420	21,780
Alpha vitrification facility	250	0	0	0	0	9,917	9,917	29,750	9,917	9,917	29,750
Soil sort facility	220	0	697	697	697	697	697	697	697	697	697
Aqueous and Organic Waste Storage Tanks	16	240	0	0	0	0	0	0	0	0	0
Consolidated Incineration Facility	350	0	9,135	9,135	9,135	9,135	9,135	9,135	3,465	3,465	3,465
F/H-Area Effluent Treatment Facility	1	40	40	40	40	40	40	40	40	40	40
H-Area Tank Farm	21	32,804	32,804	32,804	32,804	32,804	32,804	32,804	32,804	32,804	32,804
Replacement High-Level Waste Evaporator	149	2,235	2,235	2,235	2,235	2,235	2,235	2,235	2,235	2,235	2,235
Waste removal operations	21	210	210	210	210	210	210	210	210	210	210
M-Area Compaction Facility	1	4	4	4	4	4	4	4	4	4	4
M-Area Liquid Effluent Treatment Facility	1	31	31	31	31	31	31	31	31	31	31
M-Area Vendor Treatment Facility	250	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500	2,500
SRTC MW Tanks/Ion Exchange[e]	8	32	32	32	32	32	32	32	32	32	32
D-Area Ion Exchange Process	2	2	2	2	2	2	2	2	2	2	2
F-Area Tank Farm	26	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
253-H Compaction Facility	1	3	3	3	3	3	3	3	3	3	3
Total annual dose, person-millirem		52,000	67,000	70,000	113,000	76,000	79,000	144,000	83,000	86,000	150,000
Average worker dose[f], millirem per year		25	32	33	47	36	37	58	38	40	60

a. Source: Hess (1994e).
b. Average annual dose for a facility worker.
c. MW = mixed waste.
d. TRU = transuranic.
e. SRTC = Savannah River Technology Center.
f. Average annual worker dose from all facilities.

Table E.4-3. Summary of facility-specific doses[a] to the offsite maximally exposed individual from atmospheric releases (in millirem). TE

Onsite facilities	No-Action	Alternative A			Alternative B			Alternative C		
		Minimum	Expected	Maximum	Minimum	Expected	Maximum	Minimum	Expected	Maximum
Consolidated Incineration Facility	(b)	0.09	0.212	0.568	0.255	0.318	0.689	0.0667	0.0916	0.215
Compaction facilities	1.55E-06	1.55E-06	1.55E-06	1.55E-06	5.18-08	5.18E-08	5.18E-08	1.99E-07	2.40E-07	2.48E-07
Onsite vitrification facilities	(b)	(b)	(b)	(b)	0.315	0.561	8.08	2.56	5.20	118
M-Area Vendor Treatment Facility[c]	0.00371	0.00371	0.00371	0.00371	0.00371	0.00371	0.00371	0.00371	0.00371	0.00371
Soil sort facilities	(b)	6.96E-07	2.58E-06	1.28E-05	8.17E-07	2.87E-06	1.75E-05	5.52E-07	2.03E-06	1.18E-05
Transuranic waste characterization/certification facility	(b)	0.0775	0.111	1.83	0.0775	0.111	1.83	0.0775	0.110	1.83
F/H-Area Effluent Treatment Facility	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
Containment building	(d)	1.22E-06	2. 41E-06	8.26E-06	7.99E-07	1.59E-06	5.55E-06	3.24E-07	6.82E-07	2.51E-06
30-year total	0.0037	0.171	0.327	2.41	0.651	0.994	10.6	2.71	5.40	120
Average annual dose[e]	1.24E-04	0.00571	0.0109	0.802	0.217	0.331	0.354	0.0902	0.18	4.02
Offsite facilities										
Supercompaction, sorting	(b)	6.66E-06	1.52E-05	3.88E-05	3.83E-04	4.85E-04	6.86E-04	6.66E-06	1.52E-05	3.88E-05
Smelt, incinerate, metal melt	(b)	(b)	(b)	(b)	0.0377	0.0514	0.0927	0.00607	0.0108	0.0284
30-year total		6.66E-06	1.52E-05	3.88E-05	0.0381	0.0519	0.0934	0.00608	0.0108	0.0284
Average annual dose[e]		2.22E-07	5.08E-07	1.29E-06	0.00127	0.00173	0.00311	2.03E-04	3.61E-04	9.47E-04

TC TE

Source: Chesney (1995).

a. Except where noted, the doses reported are for the 30-year period of interest.
b. Facility not operated in this alternative.
c. Doses are calculated from the center of SRS due to unavailability of other population data. TE
d. Routine operations are not expected to provide atmospheric releases.
e. Offsite-maximally-exposed individual average annual dose is determined by dividing the 30-year dose by 30. For onsite facilities the offsite maximally exposed individual is within 80 kilometers (50 miles) of SRS. For offsite facilities the offsite maximally exposed individual is considered to be within 80 kilometers (50 miles) of Oak Ridge, Tennessee. TE

TE **Table E.4-4.** Summary of facility-specific doses[a] to offsite population from atmospheric releases (person-rem).

Onsite facilities	No-Action	Alternative A			Alternative B			Alternative C		
		Minimum	Expected	Maximum	Minimum	Expected	Maximum	Minimum	Expected	Maximum
Consolidated Incineration Facility	(b)	5.31	12.6	33.9	15.1	18.8	36.2	3.95	5.42	12.6
Compaction facilities	6.15E-05	6.15E-05	6.15E-05	6.15E-05	2.05E-06	2.05E-06	2.05E-06	7.86E-06	9.49E-06	9.82E-06
Onsite vitrification facilities	(b)	(b)	(b)	(b)	12.5	24.4	330	141	293	6,790
M-Area Vendor Treatment Facility[c]	0.00851	0.00851	0.00851	0.00851	0.00851	0.00851	0.00851	0.00851	0.00851	0.00851
Soil sort facilities	(b)	2.75E-05	1.02E-04	5.08E-04	3.23E-05	1.14E-04	6.93E-04	2.56E-05	9.38E-05	5.47E-04
TC TE Transuranic waste characterization/ certification facility	(b)	2.92	4.19	69.1	2.92	4.19	69.1	2.92	4.19	69.1
F/H-Area Effluent Treatment Facility	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
Containment building	(b)	4.83E-05	9.56E-05	3.27E-04	3.16E-05	6.31E-05	2.20E-04	1.28E-05	2.70E-05	9.93E-05
30-year total	0.0857	8.24	16.8	103	30.5	47.4	436	148	302	6,880
Average annual dose[e]	2.86E-04	0.275	0.560	3.43	1.02	1.58	14.5	4.92	10.1	220
Offsite facilities										
Supercompaction, sorting	(b)	3.03E-06	6.93E-06	1.77E-05	1.74E-04	2.21E-04	3.13E-04	3.03E-06	6.93E-06	1.77E-05
Smelt, incinerate, metal melt	(b)	(b)	(b)	(b)	0.251	0.346	0.624	0.0409	0.0728	0.191
30-year total		3.03E-06	6.93E-06	1.77E-05	0.254	0.346	0.625	0.0409	0.0728	0.191
Average annual dose[e]		1.01E-07	2.31E-07	5.89E-07	0.00847	0.0115	0.0208	0.00136	0.00243	0.00637

Source: Chesney (1995).

a. Except where noted, the doses reported are for the 30-year period of interest.
b. Facility not operated in this alternative.
c. Doses are calculated from the center of SRS due to unavailability of other population data.
d. Routine operations are not expected to provide atmospheric releases.
e. Average annual dose is determined by dividing the 30-year dose by 30. For onsite facilities the offsite maximally exposed individual is within 80 kilometers (50 miles) of SRS. For offsite facilities the offsite maximally exposed individual is considered to be within 80 kilometers (50 miles) of Oak Ridge, Tennessee.

Table E.4-5. Summary of facility-specific doses[a] to the 640-meter (2,100 feet) uninvolved worker from atmospheric releases (in millirem). TE

Onsite facilities	No-Action	Alternative A			Alternative B			Alternative C		
		Minimum	Expected	Maximum	Minimum	Expected	Maximum	Minimum	Expected	Maximum
Consolidated Incineration Facility	(b)	1.77	4.25	11.5	*5.07*[c]	*6.28*	9.76	1.32	1.81	4.12
Compaction facilities	6.01E-05	6.01E-05	6.01E-05	6.01E-05	2.00E-06	2.00E-06	2.00E-06	7.67E-06	9.27E-06	9.59E-06
Onsite vitrification facilities	(b)	(b)	(b)	(b)	1.60	4.52	48.8	*42.7*	*92*	*219*
M-Area Vendor Treatment Facility	*0.00856*	0.00856	0.00856	0.00856	*0.00856*	*0.00856*	*0.00856*	*0.00856*	*0.00856*	0.00856
Soil sort facilities	(b)	2.69E-05	9.95E-05	4.96E-04	3.16E-05	1.11E-04	6.76E-04	6.76E-06	2.48E-05	1.45E-04
Transuranic waste characterization/ certification facility	(b)	*3.26*	*4.68*	*77.1*	3.26	4.68	*77.1*	3.26	4.68	77.1
F/H-Area Effluent Treatment Facility	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
Containment building	(b)	4.72E-05	9.33E-05	3.19E-04	3.09E-05	6.16E-05	2.14E-04	1.25E-05	2.64E-05	9.69E-05
Average annual dose[e]	2.85E-04	0.0109	0.156	2.57	0.169	0.209	2.57	1.42	3.07	73
Offsite facilities										
Supercompaction, sorting	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)
Smelt, incinerate, metal melt	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)

TC

Source: Chesney (1995).

a. Except where noted, the doses reported are for a 30-year period of interest.
b. Facility not operated in this alternative.
c. Italics indicate the facility that would produce the highest dose to any individual under each alternative/forecast. This maximum dose was used to calculate the average annual dose. TE
d. Routine operations are not expected to provide atmospheric releases.
e. Maximally exposed individual doses are not added; average annual dose is determined by dividing the 30-year dose from the highest impact facility (shown in italics) by 30. TE
f. The 640 meter worker is a receptor unique to DOE and is not evaluated by the Nuclear Regulatory Commission or agreement state licensees.

TE **Table E.4-6.** Summary of facility-specific doses[a] to the 100-meter (328 foot) uninvolved worker (in millirem) from atmospheric releases.

Onsite facilities	No-Action	Alternative A			Alternative B			Alternative C		
		Minimum	Expected	Maximum	Minimum	Expected	Maximum	Minimum	Expected	Maximum
Consolidated Incineration Facility	(b)	5.14	12.2	32.8	14.6	18.1	32.4	3.80	5.23	12
Compaction facilities	0.00169	0.00169	0.00169	0.00169	5.64E-05	5.64E-05	5.64E-05	2.16E-04	2.61E-04	2.70E-04
Onsite vitrification facilities	(b)	(b)	(b)	(b)	12.2	23.8	323	*136*[c]	*283*	*6,580*
M-Area Vendor Treatment Facility	*0.304*	0.304	0.304	0.304	0.304	0.304	0.304	0.304	0.304	0.304
TC Soil sort facilities	(b)	7.57E-04	0.0028	0.014	8.88E-04	0.00312	0.019	2.56E-05	9.40E-05	5.47E-04
Transuranic waste characterization/ certification facility	(b)	*112*	*161*	*2,650*	*112*	*161*	*2,650*	111	161	2,650
F/H-Area Effluent Treatment Facility	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)	(d)
Containment building	(b)	0.00133	0.00263	0.00899	8.69E-04	0.00173	0.00604	3.53E-04	7.42E-04	0.00273
Average annual dose[e]	0.0102	3.73	5.37	88.3	3.73	5.37	88.3	4.53	9.43	219
Offsite facilities										
Supercompaction, sorting	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)
Smelt, incinerate, metal melt	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)	(f)

Source: Chesney (1995).

a. Except where noted, the doses reported are for a 30-year period of interest.
b. Facility not operated in this alternative.
TE c. Italics indicate the facility that would produce the highest dose to any individual under each alternative/forecast. This maximum dose was used to calculate the average annual dose.
d. Routine operations are not expected to provide atmospheric releases.
TE e. Maximally exposed individual doses are not added; average annual dose is determined by dividing the 30-year dose from the highest impact facility (shown in italics) by 30.
f. The 100 meter worker is a receptor unique to DOE and is not evaluated by the Nuclear Regulatory Commission or agreement state licensees.

Table E.4-7. Summary of facility-specific doses[a] to the offsite maximally exposed individual (in millirem) from aqueous releases.

	No-Action	Alternative A			Alternative B			Alternative C		
Onsite facilities		Minimum	Expected	Maximum	Minimum	Expected	Maximum	Minimum	Expected	Maximum
Consolidated Incineration Facility	(b)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Compaction facilities	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Onsite vitrification facilities	(b)	(b)	(b)	(b)	(c)	(c)	(c)	(c)	(c)	(c)
M-Area Vendor Treatment Facility	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Soil sort facilities	(b)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Transuranic waste characterization/certification facility	(b)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
F/H-Area Effluent Treatment Facility	0.0208	0.0208	0.0208	0.0208	0.0208	0.0208	0.0208	0.0208	0.0208	0.0208
Containment building	(b)	(c)	(c)	2.07E-05	(c)	(c)	1.41E-05	(c)	(c)	(c)
30-year total	0.0208	0.0208	0.0208	0.0208	0.0208	0.0208	0.0208	0.0208	0.0208	0.0208
Average annual dose	6.93E-04	6.93E-04	6.93E-04	6.94E-04	6.93E-04	6.93E-04	6.94E-04	6.93E-04	6.93E-04	6.94E-04
Offsite facilities										
Supercompaction, sorting	(b)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Smelt, incinerate, metal melt	(b)	(b)	(b)	(b)	(c)	(c)	(c)	(c)	(c)	(c)

Source: Chesney (1995).

a. Except where noted, the doses reported are for a 30-year period of interest.

b. Facility not operated in this alternative.

c. Routine operations are not expected to provide liquid releases.

TC TE TE

TE

Table E.4-8. Summary of facility-specific doses[a] to the offsite population (in person-rem) from aqueous releases.

	No-Action	Alternative A			Alternative B			Alternative C		
Onsite facilities		Minimum	Expected	Maximum	Minimum	Expected	Maximum	Minimum	Expected	Maximum
Consolidated Incineration Facility	(b)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Compaction facilities	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Onsite vitrification facilities	(b)	(b)	(b)	(b)	(c)	(c)	(c)	(c)	(c)	(c)
M-Area Vendor Treatment Facility	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Soil sort facilities	(b)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Transuranic waste characterization/ certification facility	(b)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
F/H-Area Effluent Treatment Facility	0.0203	0.0203	0.0203	0.0203	0.0203	0.0203	0.0203	0.0203	0.0203	0.0203
Containment building	(b)	(c)	(c)	1.82E-04	(c)	(c)	1.24E-04	(c)	(c)	(c)
30-year total	0.203	0.203	0.203	0.204	0.203	0.203	0.204	0.203	0.203	0.203
Average annual dose	0.00678	0.00678	0.00678	0.00679	0.00678	0.00678	0.00679	0.00678	0.00678	0.00678
<u>Offsite facilities</u>										
Supercompaction, sorting	(b)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)
Smelter, incinerator, metal metal	(b)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)	(c)

TC

Source: Chesney (1995).

a. Except where noted, the doses reported are for the 30-year period of interest.

b. Facility not operated in this alternative.

c. Routine operations are not expected to provide liquid releases.

Table E.4-9. Compactor facility dose distribution by isotope for the no-action alternative.[a]

Radionuclides	Atmospheric releases (percent of total dose) MEI[b]	Population[c]	640-meter uninvolved worker[d] (2,100 feet)	100-meter uninvolved worker[d] (328 feet)	TE
Cobalt-60	7.08	6.13	11.21	8.56	
Cesium-134	6.13	3.94	5.15	3.90	
Cesium-137	19.81	28.86	25.85	19.39	
Europium-154	≤1.0[e]	≤1.0[e]	1.51	≤1.0[e]	
Tritium	18.44	18.31	11.37	12.11	
Plutonium-238	31.18	29.68	33.96	41.53	
Plutonium-239	≤1.0[e]	≤1.0[e]	≤1.0[e]	1.35	
Ruthenium-106	1.13	≤1.0[e]	≤1.0[e]	≤1.0[e]	
Strontium-90	8.36	4.44	1.75	2.16	
Uranium-234	3.99	4.37	5.57	6.87	
Other[f]	3.88	4.28	3.62	4.13	
	Millirem	Person-rem	Millirem	Millirem	
Total dose[g,h]	1.55E-06	6.15E-05	6.01E-05	1.69E-03	TE

Source: Blankenhorn (1994); Hess (1994f, g); Simpkins (1994a); and Chesney (1995). TE

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. Dose to 640-meter and 100-meter uninvolved workers are based on an 80-hour work week.
e. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" category. TE
f. Refer to Table E.4-34 for a listing of the radionuclides included in "Other." TE
g. Dose refers to committed effective dose equivalent (see glossary).
h. Total doses are for the 30-year period of interest.

TE **Table E.4-10.** Consolidated Incineration Facility dose distribution by isotope for alternative A.[a]

	Atmospheric releases (percent of total dose)			
Radionuclides	MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Cobalt-60	2.29	≤1.0[d]	3.33	3.38
Cesium-134	20.25	11.00	16.03	15.89
Cesium-137	66.44	81.97	78.79	77.00
Strontium-90	7.62	2.83	≤1.0[d]	≤1.0[d]
Other[e]	3.40	4.20	1.75	3.74
Total dose[f,g]	Millirem	Person-rem	Millirem	Millirem
Expected	0.21	12.60	4.25	12.20
Maximum	0.57	34.00	11.50	32.80
Minimum	0.090	5.31	1.77	5.14

TE Source: Blankenhorn (1994); Hertel et al. (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995).

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose is to the population within 80 kilometers (50 miles) of SRS.
d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total.
TE e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

Table E.4-11. Compactor facilities dose distribution by isotope for alternative A.[a] | TE

Radionuclides	Atmospheric releases (percent of total dose) MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)	TE
Cobalt-60	7.08	6.13	11.21	8.56	
Cesium-134	6.13	3.94	5.15	3.90	
Cesium-137	19.81	28.86	25.85	19.39	
Europium-154	≤1.0[d]	≤1.0[d]	1.51	≤1.0[d]	
Tritium	18.44	18.31	11.37	12.11	
Plutonium-238	31.18	29.68	33.96	41.53	
Plutonium-239	≤1.0[d]	≤1.0[d]	≤1.0[d]	1.35	
Ruthenium-106	1.13	≤1.0[d]	≤1.0[d]	≤1.0[d]	
Strontium-90	8.36	4.44	1.75	2.16	
Uranium-234	3.99	4.37	5.57	6.87	
Other[e]	3.88	4.28	3.62	4.13	
Total dose[f,g]	Millirem	Person-rem	Millirem	Millirem	
Expected	1.55E-06	6.15E-05	6.01E-05	1.69E-03	
Maximum	1.55E-06	6.15E-05	6.01E-05	1.69E-03	TC
Minimum	1.55E-06	6.15E-05	6.01E-05	1.69E-03	

Source: Blankenhorn (1994); Hess (1994f, g); Simpkins (1994a); and Chesney (1995). | TE

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total. | TE
e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other." | TE
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

TE | **Table E.4-12.** Soil sort facility dose distribution by isotope for alternative A.[a]

Radionuclides	Atmospheric releases (percent of total dose) MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Cobalt-60	7.08	6.13	11.21	8.56
Cesium-134	6.13	3.94	5.15	3.90
Cesium-137	19.81	28.86	25.85	19.39
Europium-154	≤1.0[d]	≤1.0[d]	1.51	≤1.0[d]
Tritium	18.44	18.31	11.37	12.11
Plutonium-238	31.18	29.68	33.96	41.53
Plutonium-239	≤1.0[d]	≤1.0[d]	≤1.0[d]	1.35
Ruthenium-106	1.13	≤1.0[d]	≤1.0[d]	≤1.0[d]
Strontium-90	8.36	4.44	1.75	2.16
Uranium-234	3.99	4.37	5.57	6.87
Other[e]	3.88	4.28	3.62	4.13
Total dose[f,g]	Millirem	Person-rem	Millirem	Millirem
Expected	2.58E-06	1.02E-04	9.95E-05	2.80E-03
Maximum	1.28E-05	5.08E-04	4.96E-04	1.40E-02
TC | Minimum	6.96E-07	2.75E-05	2.69E-05	7.57E-04

TE | Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995).

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
TE | d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total.
TE | e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

Table E.4-13. Transuranic waste characterization/certification facility dose distribution by isotope for alternative A.[a] TE

Radionuclides	Atmospheric releases (percent of total dose) MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Plutonium-238	83.65	83.66	83.85	83.89
Plutonium-239	15.38	15.37	15.17	15.13
Other[d]	0.97	0.97	0.98	0.98
Total dose[e,f]	Millirem	Person-rem	Millirem	Millirem
Expected	0.111	4.19	4.68	161
Maximum	1.83	69.1	77	2.650
Minimum	0.0775	2.92	3.26	112

TE TC TE TC

Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995). TE

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. Refer to Table E.4-34 for a listing of the radionuclides included in "Other." TE
e. Dose refers to committed effective dose equivalent (see glossary).
f. Total doses are for the 30-year period of interest.

TE | **Table E.4-14.** Containment building dose distribution by isotope for alternative A.

Radionuclides	Atmospheric releases (percent of total dose) MEI[a]	Population[b]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)	Aqueous releases (percent of total dose) MEI[a]	Population[b]
Cobalt-60	7.08	6.13	11.21	8.56	≤1.0[c]	5.97
Cesium-134	6.13	3.94	5.15	3.90	81.85	21.81
Cesium-137	19.81	28.86	25.85	19.39	≤1.0[c]	≤1.0[c]
Europium-154	≤1.0[c]	≤1.0[c]	1.51	≤1.0[c]	≤1.0[c]	≤1.0[c]
Tritium	18.44	18.31	11.37	12.11	10.51	32.22
Plutonium-238	31.18	29.68	33.96	41.53	4.62	28.48
Plutonium-239	≤1.0[c]	≤1.0[c]	≤1.0[c]	1.35	≤1.0[c]	≤1.0[c]
Ruthenium-106	1.13	≤1.0[c]	≤1.0[c]	≤1.0[c]	≤1.0[c]	2.37
Strontium-90	8.36	4.44	1.75	2.16	≤1.0[c]	≤1.0[c]
Uranium-234	3.99	4.37	5.57	6.87	≤1.0[c]	≤1.0[c]
Other[d]	3.88	4.28	3.62	4.13	3.02	9.17
Total dose[e,f]	Millirem	Person-rem	Millirem	Millirem	Millirem	Person-rem
Expected	2.41E-06	9.56E-05	9.33E-05	0.00263	(g)	(g)
TC Maximum	8.26E-06	3.27E-04	3.19E-04	0.00899	2.07E-05	1.82E-04
Minimum	1.22E-06	4.83E-05	4.72E-05	0.00133	(g)	(g)

TE | Source: Blankenhorn (1994); Hess (1994g, h); Simpkins (1994a); and Chesney (1995).

a. MEI = maximally exposed individual.

b. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS. For aqueous releases, the dose is to the people using the Savannah River from SRS to the Atlantic Ocean.

TE | c. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total.

TE | d. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."

e. Dose refers to committed effective dose equivalent (see glossary).

f. Total doses are for the 30-year period of interest.

g. Routine operations are not expected to produce aqueous releases.

Table E.4-15. Mixed waste offsite vendor dose distribution by isotope for alternative A.[a] TE

Radionuclides	Atmospheric releases (percent of total dose)	
	MEI[b]	Population[c]
Cesium-134	≤1.0[d]	1.62
Cesium-137	1.68	1.92
Tritium	75.92	32.52
Plutonium-238	13.54	44.04
Plutonium-239	≤1.0[d]	1.39
Strontium-90	1.49	≤1.0[d]
Uranium-234	3.68	12.12
Uranium-236	≤1.0[d]	2.13
Other[e]	3.69	4.26
Total dose[f,g]	Millirem	Person-rem
Expected	1.52E-05	6.93E-06
Maximum	3.88E-05	1.77E-05
Minimum	6.66E-06	3.03E-06

TC

TC

Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995). TE

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total. TE
e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other." TE
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

TE | **Table E.4-16.** Consolidated Incineration Facility dose distribution by isotope for alternative B.[a]

Radionuclides	Atmospheric releases (percent of total dose) MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Cobalt-60	2.26	1.72	3.32	3.33
Cesium-134	19.92	10.88	15.99	15.78
Cesium-137	65.28	80.97	78.62	76.38
Strontium-90	7.50	2.80	≤1.0[d]	≤1.0[d]
Tritium	2.30	≤1.0[d]	≤1.0[d]	≤1.0[d]
Other[e]	2.74	3.63	2.06	4.48
Total dose[f,g]	Millirem	Person-rem	Millirem	Millirem
Expected	0.318	18.8	6.28	18.1
Maximum	0.689	32.6	9.76	32.4
Minimum	0.255	15.1	5.07	14.6

TC

TE | Source: Blankenhorn (1994); Hertel et al. (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995).

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose is to the population within 80 kilometers (50 miles) of SRS.
d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total.
TE | e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

Table E.4-17. Onsite compactor facility dose distribution by isotope for alternative B.[a] TC TE

Radionuclides	Atmospheric releases (percent of total dose) MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)	TE
Cobalt-60	7.08	6.13	11.21	8.56	
Cesium-134	6.13	3.94	5.15	3.90	
Cesium-137	19.81	28.86	25.85	19.39	
Europium-154	≤1.0[d]	≤1.0[d]	1.51	≤1.0[d]	
Tritium	18.44	18.31	11.37	12.11	
Plutonium-238	31.18	29.68	33.96	41.53	
Plutonium-239	≤1.0[d]	≤1.0[d]	≤1.0[d]	1.35	
Ruthenium-106	1.13	≤1.0[d]	≤1.0[d]	≤1.0[d]	
Strontium-90	8.36	4.44	1.75	2.16	
Uranium-234	3.99	4.37	5.57	6.87	
Other[e]	3.88	4.28	3.62	4.13	
Total dose[f,g]	Millirem	Person-rem	Millirem	Millirem	
Expected	5.18E-08	2.05E-06	2.00E-06	5.64E-05	
Maximum	5.18E-08	2.06E-06	2.00E-06	5.64E-05	TC
Minimum	5.18E-08	2.05E-06	2.00E-06	5.64E-05	

Source: Blankenhorn (1994); Hess (1994f, g); Simpkins (1994a); and Chesney (1995). TE

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" category. TE
e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
f. Dose refers to committed effective dose equivalent (see glossary). TE
g. Total doses are for the 30-year period of interest.

TE **Table E.4-18.** Onsite vitrification facilities dose distribution by isotope for alternative B.[a]

Radionuclides	Atmospheric releases (percent of total dose) MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Cesium-134	4.04	3.00	7.97	4.30
Cesium-137	13.21	22.25	39.07	20.75
TC Plutonium-238	67.42	61.29	42.37	61.47
Plutonium-239	12.26	11.16	7.80	11.16
Other[d]	3.07	2.30	2.79	2.31
Total dose[e,f]	Millirem	Person-rem	Millirem	Millirem
TC Expected	0.561	24.4	4.52	23.8
Maximum	8.08	330	48.8	323
Minimum	0.315	12.5	1.60	12.2

TE Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995).

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
TE d. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
e. Dose refers to committed effective dose equivalent (see glossary).
f. Total doses are for the 30-year period of interest.

Table E.4-19. Soil sort facility dose distribution by isotope for alternative B.[a] TE

	Atmospheric releases (percent of total dose)			
Radionuclides	MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Cobalt-60	7.08	6.13	11.21	8.56
Cesium-134	6.13	3.94	5.15	3.90
Cesium-137	19.81	28.86	25.85	19.39
Europium-154	≤1.0[d]	≤1.0[d]	1.51	≤1.0[d]
Tritium	18.44	18.31	11.37	12.11
Plutonium-238	31.18	29.68	33.96	41.53
Plutonium-239	≤1.0[d]	≤1.0[d]	≤1.0[d]	1.35
Ruthenium-106	1.13	≤1.0[d]	≤1.0[d]	≤1.0[d]
Strontium-90	8.36	4.44	1.75	2.16
Uranium-234	3.99	4.37	5.57	6.87
Other[e]	3.88	4.28	3.62	4.13
Total dose[f,g]	Millirem	Person-rem	Millirem	Millirem
Expected	2.87E-06	1.14E-04	1.11E-04	0.00312
Maximum	1.75E-05	6.93E-04	6.76E-04	0.0190
Minimum	8.17E-07	3.23E-05	3.16E-05	8.88E-04 TC

Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995). TE

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total. TE
e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other." TE
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

TE | **Table E.4-20.** Transuranic waste characterization/certification facility dose distribution by isotope for alternative B.[a]

Radionuclides	Atmospheric releases (percent of total dose)			
	MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Plutonium-238	83.65	83.66	83.85	83.89
Plutonium-239	15.38	15.37	15.17	15.13
Other[d]	0.97	0.97	0.98	0.98
Total dose[e,f]	Millirem	Person-rem	Millirem	Millirem
Expected	0.111	4.19	4.68	161
Maximum	1.83	69.1	77.1	2,650
Minimum	0.0775	2.92	3.26	112

TC | Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995).

a. *Routine operations are not expected to produce aqueous releases.*
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
TE | d. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
e. Dose refers to committed effective dose equivalent (see glossary).
f. Total doses are for the 30-year period of interest.

Table E.4-21. Containment building dose distribution by isotope for alternative B. TE

Radionuclides	Atmospheric releases (percent of total dose) MEI[a]	Population[b]	640-meter uninvolved worker (2,100 feet)	100 meter uninvolved worker (328 feet)	Aqueous releases (percent of total dose) MEI[a]	Population[b]
Cobalt-60	7.08	6.13	11.21	8.56	≤1.0[c]	5.97
Cesium-134	6.13	3.94	5.15	3.90	81.85	21.81
Cesium-137	19.81	28.86	25.85	19.39	≤1.0[c]	≤1.0[c]
Europium-154	≤1.0[c]	≤1.0[c]	1.51	≤1.0[c]	≤1.0[c]	≤1.0[c]
Tritium	18.44	18.31	11.37	12.11	10.51	32.22
Plutonium-238	31.18	29.68	33.96	41.53	4.62	28.48
Plutonium-239	≤1.0[c]	≤1.0[c]	≤1.0[c]	1.35	≤1.0[c]	≤1.0[c]
Ruthenium-106	1.13	≤1.0[c]	≤1.0[c]	≤1.0[c]	≤1.0[c]	2.37
Strontium-90	8.36	4.44	1.75	2.16	≤1.0[c]	≤1.0[c]
Uranium-234	3.99	4.37	5.57	6.87	≤1.0[c]	≤1.0[c]
Other[d]	3.88	4.28	3.62	4.13	3.02	9.17
Total dose[e,f]	Millirem	Person-rem	Millirem	Millirem	Millirem	Person-rem
Expected	1.59E-06	6.31E-05	6.16E-05	1.78E-03	(g)	(g)
Maximum	5.55E-06	2.20E-04	2.14E-04	6.04E-03	1.41E-05	1.24E-04
Minimum	7.99E-07	3.16E-05	3.09E-05	8.69E-04	(g)	(g)

TE TE TC

Source: Blankenhorn (1994); Hess (1994g, h); Simpkins (1994a); and Chesney (1995). TE

a. MEI = maximally exposed individual.
b. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS. For aqueous releases, the dose is to the people using the Savannah River from SRS to the Atlantic.
c. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total. TE
d. Refer to Table E.4-34 for a listing of the radionuclides included in "Other." TE
e. Dose refers to committed effective dose equivalent (see glossary).
f. Total doses are for the 30-year period of interest.
g. Routine operations are not expected to produce aqueous releases.

TC TE **Table E.4-22.** Offsite supercompaction, sorting, repackaging dose distribution by isotope for alternative B.[a]

Radionuclides	Atmospheric releases (percent of total dose)	
	MEI[b]	Population[c]
Cesium-134	≤1.0[d]	1.62
Cesium-137	1.68	1.92
Tritium	75.92	32.52
Plutonium-238	13.54	44.04
Plutonium-239	≤1.0[d]	1.39
Strontium-90	1.49	≤1.0[d]
Uranium-234	3.68	12.12
Uranium-236	≤1.0[d]	2.13
Other[e]	3.69	4.26
Total dose[f,g]	Millirem	Person-rem
Expected	4.85E-04	2.21E-04
TC Maximum	6.86E-04	3.13E-04
Minimum	3.83E-04	1.74E-04

TE Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995).

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
TE d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total.
TE e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

Table E.4-23. Offsite smelting, incineration, and metal melt dose distribution by isotope for alternative B.[a] TC TE

Radionuclides	Atmospheric releases (percent of total dose)	
	MEI[b]	Population[c]
Cesium-134	31.68	31.37
Cesium-137	44.16	36.07
Strontium-90	11.09	3.18
Uranium-234	9.24	21.21
Uranium-236	≤1.0[d]	3.71
Other[e]	3.83	4.46
Total dose[f,g]	Millirem	Person-rem
Expected	0.0514	0.346
Maximum	0.0927	0.624
Minimum	0.0377	0.254

TC

Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995). TE

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total. TE
e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other." TE
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

TE | **Table E.4-24.** Consolidated Incineration Facility dose distribution by isotope for alternative C.[a]

Radionuclides	Atmospheric releases (percent of total dose) MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Cobalt-60	2.26	1.72	3.32	3.35
Cesium-134	19.93	10.88	15.97	15.77
Cesium-137	65.45	81.11	78.67	76.46
Strontium-90	7.50	2.80	≤1.0[d]	≤1.0[d]
Other[e]	4.86	3.49	2.04	4.42
Total dose[f,g]	Millirem	Person-rem	Millirem	Millirem
Expected	0.091	5.42	1.81	5.23
Maximum	0.215	12.60	4.12	12.00
Minimum	0.0667	3.95	1.32	3.81

TE | Source: Blankenhorn (1994); Hertel et al. (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995).

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose is to the population within 80 kilometers (50 miles) of SRS.
TE | d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total.
TE | e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

Table E.4-25. Compactor facilities dose distribution by isotope for alternative C.[a] | TE

Radionuclides	Atmospheric releases (percent of total dose) MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)	TE
Cobalt-60	7.08	6.13	11.21	8.56	
Cesium-134	6.13	3.94	5.15	3.90	
Cesium-137	19.81	28.86	25.85	19.39	
Europium-154	≤1.0[d]	≤1.0[d]	1.51	≤1.0[d]	
Tritium	18.44	18.31	11.37	12.11	
Plutonium-238	31.18	29.68	33.96	41.53	
Plutonium-239	≤1.0[d]	≤1.0[d]	≤1.0[d]	1.35	
Ruthenium-106	1.13	≤1.0[d]	≤1.0[d]	≤1.0[d]	
Strontium-90	8.36	4.44	1.75	2.16	
Uranium-234	3.99	4.37	5.57	6.87	
Other[e]	3.88	4.28	3.62	4.13	
Total dose[f,g]	Millirem	Person-rem	Millirem	Millirem	
Expected	2.40E-07	9.49E-06	9.27E-06	2.61E-04	TC
Maximum	2.48E-07	9.82E-06	9.59E-06	2.70E-04	
Minimum	1.99E-07	7.86E-06	7.67E-06	2.16E-04	

Source: Blankenhorn (1994); Hess (1994f, g); Simpkins (1994a); and Chesney (1995). | TE

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total. | TE
e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other." | TE
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

TE **Table E.4-26.** Onsite vitrification facilities dose distribution by isotope for alternative C.[a]

Radionuclides	Atmospheric releases (percent of total dose) MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Cobalt-60	≤1.0[d]	≤1.0[d]	3.11	2.94
Strontium-90	6.41	2.51	≤1.0[d]	≤1.0[d]
Cesium-134	17.13	9.82	15.37	14.21
Cesium-137	56.08	22.99	75.48	68.69
TC Plutonium-238	13.96	9.81	3.99	9.93
Plutonium-239	2.54	≤1.0[d]	≤1.0[d]	≤1.0[d]
Other[e]	3.88	4.86	2.05	4.24
Total dose[f,g]	Millirem	Person-rem	Millirem	Millirem
Expected	5.20	293	92	283
Maximum	118	6,790	2,190	6,580
Minimum	2.56	141	42.70	136

TE Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995).

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total.
TE e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

Table E.4-27. Soil sort facility dose distribution by isotope for alternative C.[a] TE

Radionuclides	Atmospheric releases (percent of total dose) MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Cobalt-60	8.37	8.14	19.89	15.29
Cesium-134	7.38	5.15	9.57	7.19
Cesium-137	24.12	38.23	46.91	34.70
Europium-154	≤1.0[d]	≤1.0[d]	2.78	2.15
Tritium	11.81	10.41	3.89	7.38
Plutonium-238	29.92	25.60	12.37	24.98
Plutonium-239	≤1.0[d]	≤1.0[d]	≤1.0[d]	≤1.0[d]
Ruthenium-106	1.32	≤1.0[d]	≤1.0[d]	≤1.0[d]
Strontium-90	9.92	4.74	≤1.0[d]	≤1.0[d]
Uranium-234	3.34	3.49	≤1.0[d]	4.15
Other[e]	3.82	4.24	4.58	4.16
Total dose[f,g]	Millirem	Person-rem	Millirem	Millirem
Expected	2.03E-06	9.38E-05	2.48E-05	9.40E-05
Maximum	1.18E-05	5.47E-04	1.45E-04	5.47E-04
Minimum	5.52E-07	2.56E-05	6.76E-06	2.56E-05

TE TE TC

Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995). TE

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total. TE
e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
f. Dose refers to committed effective dose equivalent (see glossary). TE
g. Total doses are for the 30-year period of interest.

TE | **Table E.4-28.** Transuranic waste characterization/certification facility dose distribution by isotope for alternative C.[a]

	Atmospheric releases (percent of total dose)			
Radionuclides	MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Plutonium-238	83.65	83.66	83.85	83.89
Plutonium-239	15.38	15.37	15.17	15.13
Other[d]	0.97	0.97	0.98	0.98
Total dose[e,f]	Millirem	Person-rem	Millirem	Millirem
Expected	0.111	4.19	4.68	161
Maximum	1.83	69.1	77	2,650
Minimum	0.0775	2.92	3.26	112

Source: Blankenhorn (1995); Hess (1994g); Simpkins (1994a); and Chesney (1995).

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
e. Dose refers to committed effective dose equivalent (see glossary).
f. Total doses are for the 30-year period of interest.

Table E.4-29. Containment building dose distribution by isotope for alternative C.[a] TE

Radionuclides	Atmospheric releases (percent of total dose) MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Cobalt-60	≤1.0[d]	≤1.0[d]	≤1.0[d]	≤1.0[d]
Cesium-134	≤1.0[d]	≤1.0[d]	≤1.0[d]	≤1.0[d]
Cesium-137	≤1.0[d]	≤1.0[d]	≤1.0[d]	≤1.0[d]
Europium-154	≤1.0[d]	≤1.0[d]	≤1.0[d]	≤1.0[d]
Tritium[e]	99	99	99	99
Plutonium-238	≤1.0[d]	≤1.0[d]	≤1.0[d]	≤1.0[d]
Plutonium-239	≤1.0[d]	≤1.0[d]	≤1.0[d]	≤1.0[d]
Ruthenium-106	≤1.0[d]	≤1.0[d]	≤1.0[d]	≤1.0[d]
Strontium-90	≤1.0[d]	≤1.0[d]	≤1.0[d]	≤1.0[d]
Uranium-234	≤1.0[d]	≤1.0[d]	≤1.0[d]	≤1.0[d]
Other[f]	≤1.0[d]	≤1.0[d]	≤1.0[d]	≤1.0[d]
Total dose[g,h]	Millirem	Person-rem	Millirem	Millirem
Expected	2.17E-02	8.52E-01	5.16E-01	1.55E+01
Maximum	2.17E-02	8.52E-01	5.16E-01	1.55E+01
Minimum	2.17E-02	8.52E-01	5.16E-01	1.55E+01

Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995). TE

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total. TE
e. Tritium releases due to processing of tritium contaminated mercury pumps.
f. Refer to Table E.4-34 for a listing of the radionuclides included in "Other." TE
g. Dose refers to committed effective dose equivalent (see glossary).
h. Total doses are for the 30-year period of interest.

TE | **Table E.4-30.** Mixed waste offsite vendor dose distribution by isotope for alternative C.[a]

Radionuclides	Atmospheric releases (percent of total dose)	
	MEI[b]	Population[c]
Cesium-134	≤1.0[d]	1.62
Cesium-137	1.68	1.92
Tritium	75.92	32.52
Plutonium-238	13.54	44.04
Plutonium-239	≤1.0[d]	1.39
Strontium-90	1.49	≤1.0[d]
Uranium-234	3.68	12.12
Uranium-236	≤1.0[d]	2.13
Other[e]	3.69	4.26
Total dose[f,g]	Millirem	Person-rem
Expected	1.52E-05	6.93E-06
Maximum	3.88E-05	1.77E-05
Minimum	6.66E-06	3.03E-06

TE | Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995).

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
TE | d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total.
TE | e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

Table E.4-31. Offsite smelter dose distribution by isotope for alternative C.[a] TE

	Atmospheric releases (percent of total dose)	
Radionuclides	MEI[b]	Population[c]
Cesium-134	31.68	31.37
Cesium-137	44.16	36.07
Strontium-90	11.09	3.18
Uranium-234	9.24	21.21
Uranium-236	≤1.0[d]	3.71
Other[e]	3.83	4.46
Total dose[f,g]	Millirem	Person-rem
Expected	0.0108	0.0728
Maximum	0.0284	0.191
Minimum	0.00607	0.0409

TC

Source: Blankenhorn (1994); Hess (1994g); Simpkins (1994a); and Chesney (1995). TE

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. The contribution from this radionuclide to the given receptor is less than or equal to 1.0 percent and is accounted for in the "Other" total. TE
e. Refer to Table E.4-34 for a listing of the radionuclides included in "Other." TE
f. Dose refers to committed effective dose equivalent (see glossary).
g. Total doses are for the 30-year period of interest.

TE | **Table E.4-32.** F/H-Area Effluent Treatment Facility dose distribution by isotope for all alternatives.[a]

Radionuclides	Aqueous releases (percent of total dose)	
	MEI[b]	Population[c]
Cesium-137	70.52	18.79
Tritium	28.95	79.91
Other[d]	.053	1.30
	Millirem	Person-rem
Total dose[e,f,g]	0.0208	0.203

TC

TE | Source: Blankenhorn (1994); Hess (1994g, i); Poirier and Wiggins (1994), Simpkins (1994a); and Chesney (1995).

a. Routine operations are not expected to produce atmospheric releases.
b. MEI = maximally exposed individual.
c. For aqueous releases, the dose is to the people using the Savannah River from SRS to Atlantic Ocean.
TE | d. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
e. Dose refers to committed effective dose equivalent (see glossary).
f. Total doses are for the 30-year period of interest.
g. Includes releases from processing of Defense Waste Processing Facility recycle. Remains essentially constant for all alternatives.

Table E.4-33. M-Area Vendor Treatment Facility dose distribution by isotope for all alternatives.[a] | TE

Radionuclides	Atmospheric releases (percent of total dose)			
	MEI[b]	Population[c]	640-meter uninvolved worker (2,100 feet)	100-meter uninvolved worker (328 feet)
Uranium-234	32.67	31.49	32.10	32.31
Uranium-238	64.93	65.98	65.48	65.31
Other[d]	2.40	2.53	2.43	2.38
Total dose[e,f]	Millirem	Person-rem	Millirem	Millirem
All alternatives	0.00371	0.00851	0.00856	0.304

Source: Blankenhorn (1994); Hamby (1994); Hess (1994g, j); Simpkins (1994a); and Chesney (1995). | TE

a. Routine operations are not expected to produce aqueous releases.
b. MEI = maximally exposed individual.
c. For atmospheric releases, the dose to the population within 80 kilometers (50 miles) of SRS.
d. Refer to Table E.4-34 for a listing of the radionuclides included in "Other."
e. Dose refers to committed effective dose equivalent (see glossary).
f. Total doses are for the 30-year period of interest.

TE | **Table E.4-34.** Radionuclides listed under "Other" in Tables E.4-9 through E.4-33.[a]

Silver-110	Curium-246	Promethium-147	Strontium-89
Silver-110m	Curium-248	Promethium-148	Strontium-90
Aluminum-26	Chromium-51	Promethium-148m	Tantalum-182
Americium-241	Europium-154	Praseodymium-143	Terbium-160
Americium-243	Europium-155	Praseodymium-144	Technetium-99
Barium-137m	Europium-156	Plutonium-238	Tellurium-125m
Barium-140	Iron-55	Plutonium-239	Tellurium-127
Carbon-14	Iron-59	Plutonium-240	Tellurium-127m
Cadmium-113	Tritium	Plutonium-241	Tellurium-129
Cerium-141	Hafnium-181	Plutonium-242	Tellurium-129m
Cerium-144	Iodine-129	Rhodium-106	Uranium-233
Cobalt-58	Indium-113m	Ruthenium-103	Uranium-234
Cobalt-60	Indium-114	Ruthenium-103m	Uranium-235
Cesium-134	Krypton-85	Ruthenium-106	Uranium-236
Cesium-135	Lanthanum-140	Antimony-125	Uranium-238
Cesium-137	Manganese-54	Scandium-46	Yttrium-90
Californium-249	Nickel-59	Selenium-79	Yttrium 91
Californium-251	Nickel-63	Samarium-151	Zinc-65
Californium-252	Niobium-94	Tin-113	Zirconium-93
Californium-242	Niobium-95	Tin-119m	Zirconium-95
Californium-243	Niobium-95m	Tin-121m	Other Alpha
Californium-244	Neptunium-237	Tin-123	Other B/G[b]
Californium-245	Palladium-107	Tin-126	

Source: Blankenhorn (1994), Hunt (1994), and Chesney (1995).

a. Each of the listed radionuclides contribute less than or equal to 1.0 percent of the total dose unless identified as a major contributor to total dose.

b. B/G = Unidentifiable beta/gamma emitting radionuclides.

SECTION 5

ENVIRONMENTAL JUSTICE

LOCAL AREA DOSES

Figure 4-6 is a map of the area around SRS out to a distance of 80 kilometers (50 miles). This map identifies annular sectors around SRS by a letter-number combination. Table E.5-1 uses these annular sector identifiers to show:

- The fraction of total population dose in each annular sector.

- The fraction of total population dose that the average person in each annular sector will receive (the per capita dose in each sector).

The total population dose for any of the alternatives and forecasts can be multiplied by the appropriate fraction associated with any annular sector to obtain the total population dose to the annular sector, or the per capita dose in that sector for any of the forecasts. TE

Tables E.5-2 through E.5-11 show the estimated per capita 30-year dose for identified types of communities within the 80 kilometer region for each of the alternatives and forecasts. TE

Table E.5-1. Annular sector factors for local dose evaluations.[a]

Annular number and distance from center of SRS	Fraction of total population dose in annular sector					Fraction of total population dose that is dose to average person in annular sector				
	1 (5-10 mi)[b]	2 (10-20 mi)	3 (20-30 mi)	4 (30-40 mi)	5 (40-50 mi)	1 (5-10 mi)	2 (10-20 mi)	3 (20-30 mi)	4 (30-40 mi)	5 (40-50 mi)
Sector[c]										
A (N)	3.09E-04	2.79E-02	2.70E-02	8.63E-03	1.49E-02	1.19E-05	5.25E-06	2.69E-06	1.70E-06	1.22E-06
B (NNE)	5.86E-05	5.75E-03	4.71E-03	6.5-E-03	1.51E-02	9.77E-06	4.35E-06	2.28E-06	1.46E-06	1.05E-06
C (NE)	1.02E-05	1.35E-02	7.03E-03	8.33E-03	1.17E-02	1.02E-05	4.57E-06	2.40E-06	1.58E-06	1.15E-06
D (ENE)	2.76E-04	1.29E-02	9.56E-03	7.43E-03	4.15E-02	1.02E-05	4.12E-06	2.13E-06	1.39E-06	1.02E-06
E (E)	1.28E-03	2.21E-02	8.91E-03	9.67E-03	3.48E-03	8.27E-06	3.27E-06	1.68E-06	1.10E-06	8.02E-07
F (ESE)	2.55E-04	4.37E-03	2.79E-03	2.56E-03	2.24E-03	7.07E-06	2.81E-06	1.45E-06	9.44E-07	6.90E-07
G (SE)	1.29E-04	1.11E-03	6.78E-03	4.54E-03	4.25E-03	4.96E-06	2.02E-06	1.04E-06	6.79E-07	4.95E-07
H (SSE)	1.61E-04	6.63E-04	6.92E-04	8.10E-04	1.12E-03	4.04E-06	1.70E-06	9.00E-07	5.97E-07	4.40E-07
I (S)	2.25E-06	5.48E-04	7.24E-04	2.69E-03	9.34E-04	2.25E-06	9.83E-07	5.44E-07	3.71E-07	2.80E-07
J (SSW)	1.29E-05	2.42E-03	2.90E-03	4.11E-03	2.12E-03	6.46E-06	2.70E-06	1.45E-06	9.82E-07	7.22E-07
K (SW)	1.87E-04	4.17E-03	5.22E-03	4.06E-03	3.02E-03	1.10E-06	4.41E-06	2.33E-06	1.56E-06	1.14E-06
L (WSW)	5.18E-04	3.87E-03	1.32E-02	2.84E-03	5.31E-03	8.64E-06	3.50E-06	1.86E-06	1.24E-06	9.13E-07
M (W)	3.43E-04	8.52E-03	1.11E-02	7.51E-03	4.62E-03	6.24E-06	2.57E-06	1.40E-06	9.40E-07	6.82E-07
N (WNW)	2.89E-03	9.16E-03	1.57E-01	4.99E-02	8.33E-03	6.43E-06	2.74E-06	1.47E-06	9.92E-07	7.22E-07
O (NW)	2.23E-03	2.08E-02	1.57E-01	3.04E-02	2.48E-03	8.22E-06	3.52E-06	1.79E-06	1.14E-06	8.21E-07
P (NNW)	3.97E-03	8.47E-02	6.28E-02	9.74E-03	6.34E-03	1.09E-05	4.70E-06	2.31E-06	1.46E-06	1.04E-06

a. Source: Simpkins (1994b).
b. No population resides within 8 kilometers (5 miles) of the center of SRS.
c. Sector letter is letter shown on Figure 4-6. Letters in parentheses after the sector letter indicate the compass direction of the sector.

Table E.5-2. Estimated per capita 30-year dose for identified communities in 80-kilometer (50-mile) region for the no-action alternative.

Distance	All	Persons of color more than 50% of population	Persons of color 35% to 50% of population	Persons of color less than 35% of population	Low incomes more than 25% of population	Low incomes less than 25% of population
0-16 km (0-10 miles)	9.37E-08	8.49E-08	9.97E-08	8.67E-08	9.02E-08	9.55E-08
0-32 km (0-20 miles)	4.50E-08	3.54E-08	6.20E-08	4.10E-08	4.27E-08	4.57E-08
0-48 km (0-30 miles)	2.42E-08	1.89E-08	2.95E-08	2.49E-08	2.57E-08	2.37E-08
0-64 km (0-40 miles)	1.97E-08	1.73E-08	2.28E-08	1.94E-08	2.11E-08	1.93E-08
0-80 km (0-50 miles)	1.84E-08	1.59E-08	2.03E-08	1.88E-08	1.93E-08	1.82E-08

Total population dose = 0.0086 person-rem.

Table E.5-3. Estimated per capita 30-year dose for identified communities in 80-kilometer (50-mile) region for alternative A – expected waste forecast.

Distance	All	Persons of color more than 50% of population	Persons of color 35% to 50% of population	Persons of color less than 35% of population	Low incomes more than 25% of population	Low incomes less than 25% of population
0-16 km (0-10 miles)	1.85E-04	1.68E-04	1.97E-04	1.71E-04	1.78E-04	1.89E-04
0-32 km (0-20 miles)	8.89E-05	7.00E-05	1.22E-04	8.11E-05	8.45E-05	9.04E-05
0-48 km (0-30 miles)	4.78E-05	3.74E-05	5.84E-05	4.92E-05	5.09E-05	4.69E-05
0-64 km (0-40 miles)	3.89E-05	3.43E-05	4.51E-05	3.83E-05	4.17E-05	3.82E-05
0-80 km (0-50 miles)	3.64E-05	3.15E-05	4.01E-05	3.71E-05	3.81E-05	3.60E-05

Total population dose = 17 person-rem.

Table E.5-4. Estimated per capita 30-year dose for identified communities in 80-kilometer (50-mile) region for alternative A – minimum waste forecast.

Distance	All	Persons of color more than 50% of population	Persons of color 35% to 50% of population	Persons of color less than 35% of population	Low incomes more than 25% of population	Low incomes less than 25% of population
0-16 km (0-10 miles)	8.93E-05	8.10E-05	9.51E-05	8.26E-05	8.60E-05	9.10E-05
0-32 km (0-20 miles)	4.29E-05	3.37E-05	5.91E-05	3.91E-05	4.07E-05	4.36E-05
0-48 km (0-30 miles)	2.30E-05	1.81E-05	2.82E-05	2.37E-05	2.45E-05	2.26E-05
0-64 km (0-40 miles)	1.88E-05	1.65E-05	2.17E-05	1.85E-05	2.01E-05	1.84E-05
0-80 km (0-50 miles)	1.76E-05	1.52E-05	1.94E-05	1.79E-05	1.84E-05	1.73E-05

Total population dose = 8.2 person-rem.

Table E.5-5. Estimated per capita 30-year dose for identified communities in 80-kilometer (50-mile) region for alternative A – maximum waste forecast.

Distance	All	Persons of color more than 50% of population	Persons of color 35% to 50% of population	Persons of color less than 35% of population	Low incomes more than 25% of population	Low incomes less than 25% of population
0-16 km (0-10 miles)	1.12E-03	1.02E-03	1.19E-03	1.04E-03	1.08E-03	1.14E-03
0-32 km (0-20 miles)	5.39E-04	4.24E-04	7.42E-04	4.91E-04	5.12E-04	5.48E-04
0-48 km (0-30 miles)	2.89E-04	2.27E-04	3.54E-04	2.98E-04	3.08E-04	2.84E-04
0-64 km (0-40 miles)	2.36E-04	2.08E-04	2.73E-04	2.32E-04	2.53E-04	2.32E-04
0-80 km (0-50 miles)	2.21E-04	1.91E-04	2.43E-04	2.25E-04	2.31E-04	2.18E-04

Total population dose = 103 person-rem.

Table E.5-6. Estimated per capita 30-year dose for identified communities in 80-kilometer (50-mile) region for alternative C – expected waste forecast.

Distance	All	Persons of color more than 50% of population	Persons of color 35% to 50% of population	Persons of color less than 35% of population	Low incomes more than 25% of population	Low incomes less than 25% of population
0-16 km (0-10 miles)	3.29E-03	2.98E-03	3.50E-03	3.04E-03	3.17E-03	3.35E-03
0-32 km (0-20 miles)	1.58E-03	1.24E-03	2.18E-03	1.44E-03	1.50E-03	1.61E-03
0-48 km (0-30 miles)	8.49E-04	6.65E-04	1.04E-03	8.73E-04	9.04E-04	8.33E-04
0-64 km (0-40 miles)	6.92E-04	6.09E-04	8.01E-04	6.81E-04	7.41E-04	6.79E-04
0-80 km (0-50 miles)	6.47E-04	5.59E-04	7.13E-04	6.59E-04	6.76E-04	6.39E-04

Total population dose = 302 person-rem.

Table E.5-7. Estimated per capita 30-year dose for identified communities in 80-kilometer (50-mile) region for alternative C – minimum waste forecast.

Distance	All	Persons of color more than 50% of population	Persons of color 35% to 50% of population	Persons of color less than 35% of population	Low incomes more than 25% of population	Low incomes less than 25% of population
0-16 km (0-10 miles)	1.61E-03	1.46E-03	1.72E-03	1.49E-03	1.55E-03	1.64E-03
0-32 km (0-20 miles)	7.74E-04	6.09E-04	1.07E-03	7.06E-04	7.35E-04	7.87E-04
0-48 km (0-30 miles)	4.16E-04	3.26E-04	5.08E-04	4.28E-04	4.43E-04	4.08E-04
0-64 km (0-40 miles)	3.39E-04	2.99E-04	3.92E-04	3.34E-04	3.63E-04	3.33E-04
0-80 km (0-50 miles)	3.17E-04	2.74E-04	3.50E-04	3.23E-04	3.31E-04	3.13E-04

Total population dose = 148 person-rem.

Table E.5-8. Estimated per capita 30-year dose for identified communities in 80-kilometer (50-mile) region for alternative C – maximum waste forecast.

Distance	All	Persons of color more than 50% of population	Persons of color 35% to 50% of population	Persons of color less than 35% of population	Low incomes more than 25% of population	Low incomes less than 25% of population
0-16 km (0-10 miles)	7.49E-02	6.79E-02	7.98E-02	6.93E-02	7.22E-02	7.64E-02
0-32 km (0-20 miles)	3.60E-02	2.83E-02	4.96E-02	3.28E-02	3.42E-02	3.66E-02
0-48 km (0-30 miles)	1.93E-02	1.52E-02	2.36E-02	1.99E-02	2.06E-02	1.90E-02
0-64 km (0-40 miles)	1.58E-02	1.39E-02	1.82E-02	1.55E-02	1.69E-02	1.55E-02
0-80 km (0-50 miles)	1.47E-02	1.27E-02	1.62E-02	1.50E-02	1.54E-02	1.46E-02
Total population dose = 6,880 person-rem.						

Table E.5-9. Estimated per capita 30-year dose for identified communities in 80-kilometer (50-mile) region for alternative B – expected waste forecast.

Distance	All	Persons of color more than 50% of population	Persons of color 35% to 50% of population	Persons of color less than 35% of population	Low incomes more than 25% of population	Low incomes less than 25% of population
0-16 km (0-10 miles)	5.01E-04	4.54E-04	5.33E-04	4.64E-04	4.83E-04	5.11E-04
0-32 km (0-20 miles)	2.41E-04	1.89E-04	3.31E-04	2.19E-04	2.29E-04	2.45E-04
0-48 km (0-30 miles)	1.29E-04	1.01E-04	1.58E-04	1.33E-04	1.38E-04	1.27E-04
0-64 km (0-40 miles)	1.05E-04	9.28E-05	1.22E-04	1.04E-04	1.13E-04	1.03E-04
0-80 km (0-50 miles)	9.85E-05	8.52E-05	1.09E-04	1.00E-04	1.03E-04	9.73E-05
Total population dose = 46 person-rem.						

Table E.5-10. Estimated per capita 30-year dose for identified communities in 80-kilometer (50-mile) region for alternative B – minimum waste forecast.

Distance	All	Persons of color more than 50% of population	Persons of color 35% to 50% of population	Persons of color less than 35% of population	Low incomes more than 25% of population	Low incomes less than 25% of population
0-16 km (0-10 miles)	3.27E-04	2.96E-04	3.48E-04	3.02E-04	3.15E-04	3.33E-04
0-32 km (0-20 miles)	1.57E-04	1.23E-04	2.16E-04	1.43E-04	1.49E-04	1.60E-04
0-48 km (0-30 miles)	8.43E-05	6.61E-05	1.03E-04	8.68E-05	8.98E-05	8.28E-05
0-64 km (0-40 miles)	6.87E-05	6.05E-05	7.95E-05	6.77E-05	7.36E-05	6.74E-05
0-80 km (0-50 miles)	6.43E-05	5.56E-05	7.09E-05	6.55E-05	6.72E-05	6.35E-05

Total population dose = 30 person-rem.

Table E.5-11. Estimated per capita 30-year dose for identified communities in 80-kilometer (50-mile) region for alternative B – maximum waste forecast.

Distance	All	Persons of color more than 50% of population	Persons of color 35% to 50% of population	Persons of color less than 35% of population	Low incomes more than 25% of population	Low incomes less than 25% of population
0-16 km (0-10 miles)	4.43E-03	4.02E-03	4.72E-03	4.10E-03	4.27E-03	4.52E-03
0-32 km (0-20 miles)	2.13E-03	1.67E-03	2.93E-03	1.94E-03	2.02E-03	2.16E-03
0-48 km (0-30 miles)	1.14E-03	8.97E-04	1.40E-03	1.18E-03	1.22E-03	1.12E-03
0-64 km (0-40 miles)	9.32E-04	8.21E-04	1.08E-03	9.18E-04	9.99E-04	9.15E-04
0-80 km (0-50 miles)	8.72E-04	7.54E-04	9.61E-04	8.89E-04	9.12E-04	8.61E-04

Total population dose = 407 person-rem.

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APPENDIX F

ACCIDENT ANALYSIS

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F.1 Introduction

The potential for facility accidents and the magnitude of their effects are important factors in evaluating the waste management alternatives addressed in this environmental impact statement (EIS). This appendix presents accident information related to the facilities that are or could be involved with the waste management alternatives. By using postulated accident scenarios associated with the existing and proposed waste processing, storage, and disposal facilities, this appendix describes the potential consequences and risks of waste management activities to workers, the public, and the environment.

Postulated accident scenarios were developed for each waste type under the alternatives evaluated in this EIS. This appendix considers the five waste types generated and managed at SRS: high-level radioactive waste, low-level radioactive waste, hazardous waste, mixed waste, and transuranic waste.

F.2 General Accident Information

An accident, as discussed in this appendix, is an inadvertent release of radioactive or hazardous material from its confinement to the environment resulting in serious physical injury or substantial property damage. Initiating events are typically defined in three broad categories:

- *External initiators* originate outside the facility and potentially affect the ability of the facility to keep the material confined. Examples of external initiators are aircraft crashes, nearby explosions, and hazardous chemical releases from nearby facilities that could affect the ability of personnel to properly manage the radioactive/hazardous materials facility and its contents.

- *Internal initiators* originate within a facility and are usually the result of facility operation. Examples of internal initiators are equipment failures and human error.

- *Natural phenomena initiators* are natural occurrences such as floods, tornadoes, and earthquakes.

Sabotage and terrorist activities (i.e., intentional human initiators) could be either external or internal initiators.

For this appendix, "facility accidents" are accidents associated with facilities that support or are involved in the treatment, storage, or disposal of the five waste types identified in Section F.1. Accident scenarios associated with waste management activities performed at a specific facility are also considered "facility accidents."

The probability of an accident (i.e., annual frequency) and its consequences depend on the type of initiator(s), how often that initiator occurs, and the frequency with which the resulting chain of events would lead to a release of material. Potential accidents (and their effects) are grouped into four categories -- anticipated accidents, unlikely accidents, extremely unlikely accidents, and beyond extremely unlikely accidents -- based on their estimated annual frequency. Table F-1 lists, in decreasing order, these accident categories and their corresponding frequency ranges. For example, if an earthquake of sufficient magnitude to cause a release of material to the environment is expected to occur once every 5,000 years, the frequency for this accident is presented as 1 in 5,000, or 0.0002 (expressed as 2.0E-04; see Acronyms, Abbreviations, and the Use of Scientific Notation) per year (i.e., it is an unlikely accident per Table F-1).

Table F-1. Accident frequency categories.[a]

Frequency category	Frequency range (accidents per year)
Anticipated accidents	Occurs between once in 10 years and once in 100 years
Unlikely accidents	Occurs between once in 100 years and once in 10,000 years
Extremely unlikely accidents	Occurs between once in 10,000 years and once in 1,000,000 years
Beyond extremely unlikely accidents	Occurs less than once in 1,000,000 years

TE | a. DOE (1994a).

TC | DOE does not consider events that are expected to occur less often than once every 10 years to be "accidents." This does not imply that undesirable releases of radioactive or hazardous materials cannot occur more than once every 10 years. However, events with a probability of occurring more than once every 10 years are considered "abnormal events" because their occurrence is expected during the life of the facility, and they usually do not result in substantial onsite or offsite consequences. Potential effects from these releases are addressed in the Occupational and Public Health sections of this EIS. DOE implements physical and administrative controls on facility operations and activities to minimize the likelihood and impacts of such events. Personnel are trained and drilled on how to respond to and mitigate potential releases from abnormal events.

Table F-2 presents the relative risk of a one-in-a-million chance of dying from several different commonplace activities (WSRC 1994a).

Table F-2. Activities that have a one-in-one-million chance of causing death.

Smoking 1.4 cigarettes (lung cancer)
Eating 40 tablespoons of peanut butter (aflatoxins)
Eating 100 charcoal-broiled steaks (carcinogens from charcoal broiling)
Spending 2 days in New York City (air pollution)
Driving 40 miles in a car (accident)
Flying 2,500 miles in a jet (accident)
Canoeing for 6 minutes (accident)

F.3 Historic Perspective

Many of the actions proposed under the waste management alternatives considered in this EIS are continuations or variations of past SRS operations. DOE studies historic nonroutine events, abnormal occurrences, and accidents so similar events in present or future operations can be minimized or prevented. Historic events at facilities in the DOE complex are documented and tracked in two different computer data bases maintained by the U.S. Department of Energy (DOE) Office of Nuclear Energy at the Idaho National Engineering Laboratory: the Occurrence Reporting and Processing System (ORPS) and the Safety Performance Measurement System (SPMS). In addition, Savannah River Site (SRS) maintains computer data bases, such as the Waste Management Fault Tree Data Storage and Retrieval System, which track historic occurrence information and lessons learned specific to SRS facilities and operations. TE TE

Since the implementation of the Site Item Reportability and Issue Management (SIRIM) program in 1991, which assigns the responsibilities and requirements for reporting abnormal events and accidents at SRS, more than 425 abnormal events involving waste management activities and operations have been documented (WSRC 1994b, c). These events were reviewed to determine whether (1) workers were physically injured, (2) radioactive or hazardous material was inadvertently released to the environment, or (3) the occurrence, if not resolved, could have caused significant consequences to workers, members of the public, or the environment. One event, involving a procedural violation of the nuclear criticality safety limits (maximum permissible plutonium inventory per waste container) established for the Solid Waste Disposal Facility, was considered to have the potential to have caused major impacts (an inadvertent criticality and potential worker fatality). The criticality limits were exceeded because the plutonium inventory placed in the waste containers was incorrectly calculated. As an immediate corrective action, DOE suspended all shipments of transuranic waste to the Solid Waste Disposal Facility from SRS facilities that generate transuranic waste. Before resuming shipments, DOE (1) ensured that TE

no potential criticality hazards existed as a result of the limits being exceeded and (2) independently evaluated each facility that generates transuranic waste to ensure that the deficiencies had been resolved and that the facilities could correctly calculate the inventories of waste materials being sent to the Solid Waste Disposal Facility.

DOE also evaluated events that occurred prior to implementation of the Site Item Reportability and Issue Management System in 1991. The Waste Management Fault Tree Data Storage and Retrieval System data base documents several hundred events occurring between 1988 and 1991. Eight of the 13 events
TE | involving the management of liquid high-level radioactive wastes (such as is done at the F- and H-Area tank farms) involved worker doses in excess of established DOE limits; 2 involved liquid releases of radioactive material to Fourmile Branch; 1 involved an airborne release of radioactive particulates to the atmosphere; and 2 involved personnel assimilations of radioactive particulates.

Most of the abnormal events resulting from nontank farm operations were nonradiological in nature, such as minor physical injuries (e.g., cuts, falls), or involved minor leaks of radioactive material that did not result in airborne releases to the environment or a measurable dose to personnel. However, one event involved the flooding of a shallow land disposal unit as a result of heavy rains over a period of several days. This event, which occurred in August 1990, caused several metal boxes containing low-level radioactive waste to flood. In addition, when the trench flooded, several of the boxes floated, causing the stacking configuration of waste containers in the disposal unit to change. DOE assessments concluded that there were no releases of radioactive material to the environment.

Abnormal events from the beginning of Solid Waste Disposal Facility and the tank farm facilities operations in early 1953 through 1988 are discussed in the safety analysis reports for these facilities. At the tank farms, 17 occurrences were noted as significant: 9 liquid releases to Fourmile Branch, 6 personnel assimilations, and 2 airborne releases of radioactive particulates to the atmosphere. At the Solid Waste Disposal Facility, events primarily involved spills or leaks of organic solvents and small fires (limited to only one or a few waste containers) attributed to spontaneous chemical combustion resulting from improper packaging and did not result in measurable or significant releases of radioactive material. Since 1981, no fires have occurred in the transuranic waste storage drums, culverts, or carbon steel boxes at the Solid Waste Disposal Facility.

F.4 Accident Analysis Methodology

TE | National Environmental Policy Act (NEPA) guidance issued by the DOE Office of NEPA Oversight (DOE 1993) recommends that accident impact analyses "...reference Safety Assessments and Safety

Analysis Reports, if available." Most of the facilities considered in this EIS have pre-existing safety documentation that analyzes the consequences and risks associated with operating the facilities. In accordance with this NEPA guidance, existing safety documentation was referred to during the preparation of the accident analysis portion of this EIS. This appendix used three Westinghouse Savannah River Company technical reports (WSRC 1994c, d, and e) as the basis for the accident analysis information presented. These technical reports used safety analysis reports, preliminary safety analysis reports, hazard assessment documents, basis for interim operations documents, safety assessments, and other safety evaluations.

This analysis assessed the effects of radiological releases on four receptor groups in order to compare results among the alternatives. They are:

- uninvolved worker[1] at 100 meters: an individual 100 meters (328 feet) from the point of a release
- uninvolved worker at 640 meters: an individual 640 meters (2,100 feet) from the point of a release
- offsite maximally exposed individual: a hypothetical member of the public who lives along the SRS boundary and who would receive the largest exposure from a release | TE
- offsite population within 80 kilometers (50 miles): all the people within an 80-kilometer (50-mile) radius of SRS

AXAIR89Q (WSRC 1994f), a computer code developed specifically for analyzing the consequences of accidental releases of airborne radioactive particulates from SRS, was used to calculate the consequences to the receptor groups identified above for each of the accident scenarios postulated in this appendix. Consequences for the uninvolved workers and the offsite maximally exposed individual were calculated using 50 percentile meteorological assumptions (meaning that half the time meteorological conditions such as wind speed and barometric pressure are better than the assumption, and half the time they are worse), in accordance with DOE guidance (DOE 1993). DOE believes that the 50 percentile meteorological assumptions provide an estimate of the consequences under more realistic exposure conditions than would be expected if one of the postulated accidents occurs. The AXAIR89Q computer code, which calculates population doses differently than doses for individuals, is not programmed to | TE

[1]An uninvolved worker is a worker 100 meters (328 feet) or more from where an accident occurs and is usually not directly involved in the activity or operation being evaluated.

determine the population dose for meteorological conditions not exceeded 50 percent of the time. Therefore, for the offsite population within 80 kilometers (50 miles), DOE assumed very conservative meteorological conditions within 99.5 percentile. As a result, the consequences from postulated accidents are higher than would normally be expected for the offsite population.

As noted above, uninvolved workers are evaluated at 100 and 640 meters (328 and 2,100 feet). Typically, uninvolved workers at 100 meters (328 feet) are in a facility's emergency planning zone, which generally extends to the facility's boundary. However, uninvolved workers at 640 meters (2,100 feet) are likely to be outside a facility's emergency planning zone, and it typically would take longer to notify these workers of an accident at the facility. The purpose of presenting accident impacts for the uninvolved workers at these two distances is to provide a comparison of results for uninvolved workers who are likely to be initially aware of an accident and those who are not. It should be noted that the methodology described in the following sections does not take credit for emergency responses to accidents (e.g., evacuating personnel to a safe distance or notifying the public to take shelter) in determining potential effects on workers or members of the public. To minimize the potential for human exposures and impacts to the environment if an accident occurs, SRS has established an emergency plan
TE | (WSRC 1994d) that governs responses to accidents. Section F.8 summarizes the *SRS Emergency Plan*.

TE | A maximum credible design basis earthquake at SRS, estimated to occur once every 5,000 years, could potentially impact multiple facilities within a single facility area, resulting in the release of radioactive and/or toxic materials. It is also possible, although probably less likely, that an earthquake of the same magnitude could damage facilities in more than one facility area (e.g., F- and H-Areas), resulting in
TE | simultaneous releases to the environment. See Section F.6.

F.4.1 RADIOLOGICAL ACCIDENT ANALYSIS METHODOLOGY

This appendix presents quantitative impacts to SRS workers and members of the public from postulated radiological accidents using the following parameters: dose, accident frequency, latent fatal cancers, and risk of latent fatal cancers per year. These parameters were either referenced in or developed from information provided in the following technical reports: *Bounding Accident Determination for the Accident Input Analysis of the SRS Waste Management Environmental Impact Statement* (WSRC 1994e), *Solid Waste Accident Analysis in Support of the Savannah River Waste Management Environmental Impact Statement* (WSRC 1994c), and the *Liquid Waste Accident Analysis in Support of the Savannah River Waste Management Environmental Impact Statement* (WSRC 1994b). The quantities of radioactive materials and how these materials affect humans are important in determining health effects.

The International Commission on Radiological Protection has made specific recommendations for quantifying these health effects. Results are presented in terms of latent fatal cancers calculated using the ICRP-60 conversion factors of 0.0005 latent fatal cancers per rem for the public and 0.0004 latent fatal cancers per rem for workers if the dose is less than 20 rem. For doses of 20 rem or more, the ICRP-60 conversion factors are doubled (ICRP 1991).

A quantitative analysis of these facilities is not possible because some of the facilities proposed for waste management activities are in the pre-design or conceptual stage of development. Therefore, a qualitative discussion of accident impacts is provided for proposed facilities for which a quantitative accident analysis does not exist.

Additionally, this analysis presents potential impacts to involved workers[2] from postulated accidents qualitatively rather than quantitatively for several reasons, the most relevant being that no adequate methodology exists for calculating meaningful consequences at or near the location where the accidental release occurs. The following example illustrates this concept.

A typical method for calculating the dose to an involved worker is to assume that the material is released in a room occupied by the individual and that the material instantly disperses throughout the room. Because the involved worker is assumed to be in the room when the release occurs, this worker probably would breathe some fraction of the radioactive (or hazardous) materials for some number of seconds before leaving the room. Typically, estimates of exposure time are based on assumptions made about worker response to the incident (e.g., how long before the worker leaves the room, or whether during evacuation the worker passes through an area of higher airborne concentration). The uncertainty of estimation is extremely great, and no additional insight into the activity is available because the occurrence is assumed to be undesirable; therefore, it is not necessary to perform the calculations. Historical evidence indicates that room contaminations are nonfatal accidents with the potential for minor personnel contamination and assimilation.

DOE accepts that if the exposed individual is close enough to the location of the accident, it will be impossible to show acceptable dose consequences against typical guidelines. This is especially true if all accidents with a frequency as low as once in a million years -- beyond which it is not possible to statistically demonstrate protection of worker life from standard hazards in the workplace -- must be considered. For example, it is more likely that an employee would be fatally injured by falling

[2]An involved worker is a worker within 100 meters (328 feet) of a postulated accident who is usually directly involved in the activity or operation being evaluated.

equipment during an earthquake severe enough to occur only once every 5,000 years than from the radiological dose that individual would receive from materials released during the earthquake. Therefore, this appendix addresses potential consequences to involved workers qualitatively. DOE assumes that the immediate impacts of the accident (in this case an earthquake) to the worker would be from the facility in which the worker was located at the time of the accident; while the consequences from another facility affected during the earthquake would have little immediate impact upon an "involved" worker.

Many accident scenarios can be postulated for each SRS facility; to attempt to analyze all potential accident scenarios and their impacts would not be useful or meaningful. However, a broad spectrum of accidents can usually be identified and analyzed for a given facility to provide an understanding of the risks associated with performing activities in that facility. Safety analysis reports and other safety documentation usually analyze a broad spectrum of accidents that are considered credible (i.e., they are expected to occur at least once every one million years) and estimate their potential impacts on workers, the environment, and the public.

For this EIS, the term "representative bounding accident" means postulated events or accidents that have higher risks (i.e., consequences times frequencies) than other accidents postulated within the same
TE | frequency range. For example, the accident scenario within each frequency range (defined in Table F-1) that presents the highest risk (i.e., consequence times frequency) to the offsite maximally exposed individual is the representative bounding accident for that frequency range because its risk is higher than that of other accidents within the same frequency range. Determining the representative bounding accident is part of a "binning" process, whereby all the accident scenarios identified for a facility under a specific alternative would be assigned to a selected frequency range. The highest-risk accident scenario within each frequency range is then designated the representative bounding accident. It should be noted that the consequence value used to calculate risk is dose to the offsite maximally exposed individual.

Once the representative bounding accidents are identified, it is not necessary to further consider other accident scenarios for that particular alternative. The bounding accident scenarios are further evaluated to provide accident impacts for the receptor groups. An evaluation of the risks associated with the representative bounding accidents for facilities associated with a given alternative can establish an understanding of the overall risk to workers, members of the public, and the environment from operating facilities under a specific alternative. However, since some accident impacts are not represented in quantitative terms, the term "representative" must preface the phrase "bounding accident." This is because without a complete list of quantitative impacts from accidents for all facilities (existing and proposed), the true bounding accidents may not be absolutely defined. Figure F-1 shows the concept of

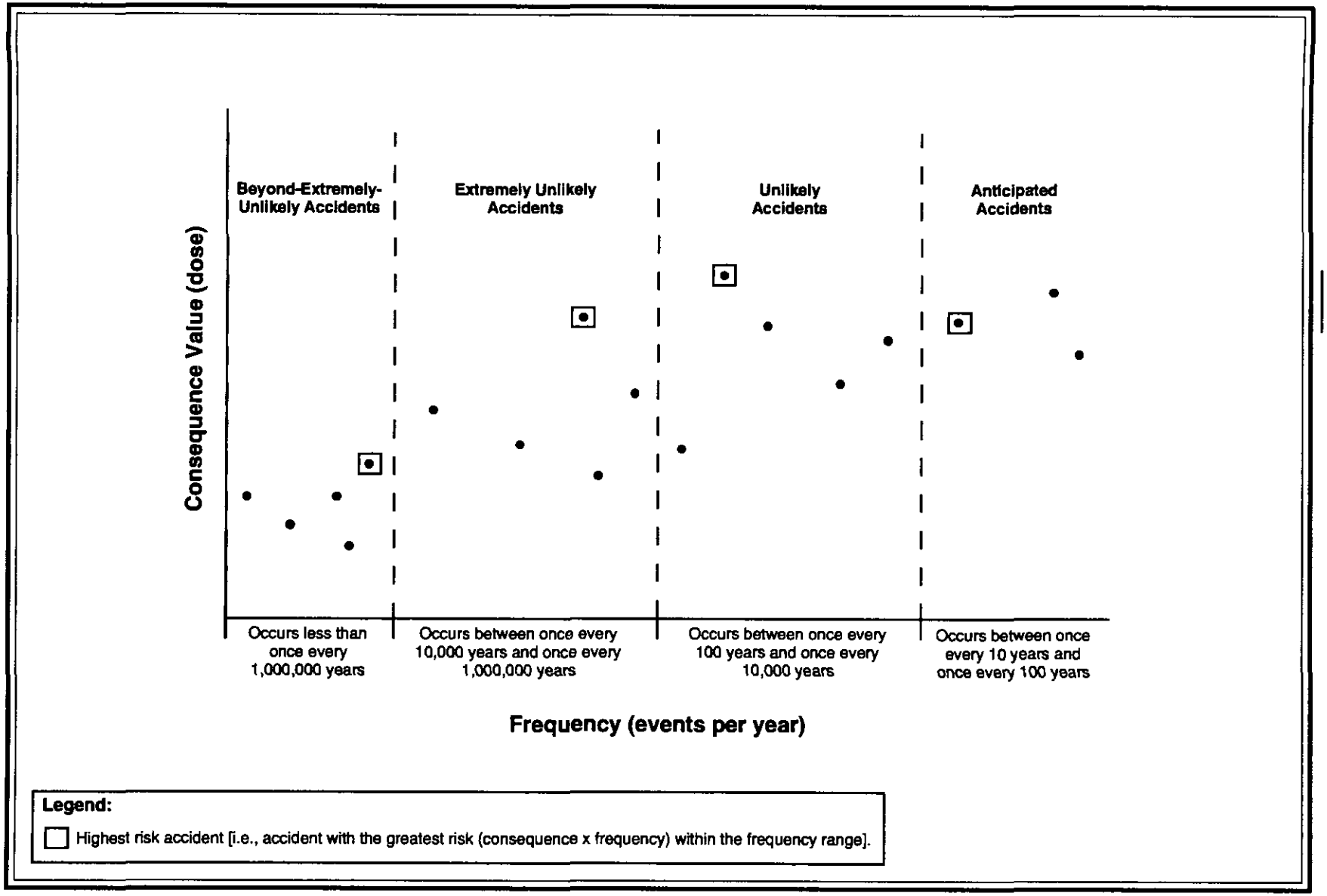

Figure F-1. Illustration of methodology used to determine bounding risk accidents.

bounding risk accidents. Section F.5 identifies the representative bounding accidents postulated for the facilities considered in this EIS.

F.4.2 CHEMICAL HAZARDS ANALYSIS METHODOLOGY

To fully understand the hazards associated with SRS facilities associated with the alternatives considered in this EIS, it is necessary to analyze potential accidents involving hazardous as well as radiological
TE | materials. Because the long-term health consequences of human exposure to hazardous materials are not as well understood as those related to radiation exposure, a determination of potential health effects from exposures to hazardous materials is more subjective than a determination of health effects from exposure to radiation. Therefore, the consequences of accidents involving hazardous materials postulated in this appendix are presented in terms of airborne concentrations at various distances from the accident. The quantities and airborne concentrations at various receptor locations were extracted from technical reports
TE | (WSRC 1994b, c) supporting this EIS.

Because safety documentation exists for many of the facilities within the scope of this EIS, it was used whenever possible to determine potential events involving hazardous materials and the health effects that could result from inadvertent releases of these materials to the environment. However, because these safety documents were developed for different purposes, the methodologies used to analyze potential events at the facilities are sometimes different. In general, the methodology used to develop most of the existing safety documentation included: (1) identifying hazardous materials present in quantities greater than reportable quantities (40 CFR 302.4), threshold planning quantities (40 CFR 355), or threshold quantities (40 CFR 29:1910.1000, Subpart Z); (2) modeling an unmitigated release of those hazardous materials to the atmosphere to determine airborne concentrations at the various receptor locations
TE | [100 meters (328 feet), 640 meters (2,100 feet), and the nearest SRS boundary]; and (3) comparing those airborne concentrations to Emergency Response Planning Guideline (ERPG) values established by the American Industrial Hygiene Association (AIHA 1991).

Three ERPG values (ERPG-1, -2, or -3) are typically assigned to hazardous materials or chemicals in terms of airborne concentration (milligrams per cubic meter or parts per billion). The types of emergency response actions required to minimize worker and public exposure are determined by considering which of the three ERPG values is exceeded. The three types of ERPG values defined are:

- ERPG-1: The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.

- ERPG-2: The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

- ERPG-3: The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.

The American Industrial Hygiene Association has not established ERPG values for some hazardous materials. When such materials would be present at SRS facilities in substantial quantities (exceeding the various threshold criteria), airborne concentrations of these materials at the various receptor locations were compared to the most restrictive exposure limits established by other recognized organizations to control worker exposures to hazardous materials. Table F-3 lists the hierarchy of exposure limits that DOE used in place of ERPG values to determine potential health effects resulting from the postulated hazardous material releases.

For facilities for which safety documentation was not developed in accordance with the methodology described above, the typical difference in the methodology involved which hazardous materials were required to be evaluated, not how the evaluations were performed. In the case of the Defense Waste Processing Facility's Organic Waste Storage Tank, for example, which was recently evaluated in the *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility* (DOE 1994b), hazardous materials designated "Extremely Hazardous Substances" in accordance with the Emergency Planning and Community Right-to-Know Act of 1986 were evaluated, rather than materials that exceed the reportable, threshold, or threshold planning quantities.

The potential events at the various facilities analyzed in this EIS that could release hazardous materials to the environment were evaluated using one of the methodologies described above. DOE further analyzes potential events involving hazardous materials at the Consolidated Incineration Facility and E-, B-, and N-Areas (WSRC 1994c). DOE further discusses the analysis methodology for events involving hazardous materials at the F/H-Area Effluent Treatment Facility, the F/H-Area tank farms, the Defense Waste Processing Facility's Organic Waste Storage Tank, and waste storage tanks at the Savannah River Technology Center (WSRC 1994b). TE TE

Although safety documentation exists for most of the facilities and facility areas that perform waste management activities, there is no safety documentation that analyzes potential events involving hazardous materials in M-Area. Using the second methodology described above, it was determined that

Table F-3. Hierarchy of established limits and guidelines used to determine impacts from postulated hazardous material accidents.[a]

Primary airborne concentration guideline	Hierarchy of alternative guidelines (if primary guidelines are unavailable)	Reference of alternative guideline
ERPG-3	EEGL[b] (30-minute exposure)	NAS (1985)
	IDLH[c]	NIOSH (1990)
ERPG-2	EEGL (60-minute exposure)	NAS (1985)
	LOC[d]	EPA (1987)
	PEL-C[e]	CFR (1990)
	TLV-C[f]	ACGIH (1992)
	TLV-TWA[g] multiplied by 5	ACGIH (1992)
ERPG-1	TWA-STEL[h]	CFR (1990)
	TLV-STEL[i]	ACGIH (1992)
	TLV-TWA multiplied by 3	ACGIH (1992)

a. This table is based on information presented in the *Toxic Chemical Hazard Classification and Risk Acceptance Guidelines for Use in DOE Facilities* (WSRC 1992).

b. Emergency Exposure Guidance Level (EEGL): "A concentration of a substance in air (as a gas, vapor, or aerosol) that may be judged by the Department of Defense to be acceptable for the performance of specific tasks during emergency conditions lasting for a period of 1 to 24 hours. Exposure at an EEGL might produce reversible effects that do not impair judgment and do not interfere with proper responses to an emergency." The EEGL is "...a ceiling guidance level for a single emergency exposure, usually lasting from 1 to 24 hours -- an occurrence expected to be infrequent in the lifetime of a person."

c. Immediately Dangerous to Life and Health (IDLH): "The maximum concentration from which, in the event of respirator failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing (e.g., severe eye irritation) or irreversible health effects."

d. Level of Concern (LOC): "The concentration of an extremely hazardous substance in air above which there may be serious irreversible health effects or death as a result of a single exposure for a relatively short period of time."

e. Permissible Exposure Limit - Ceiling (PEL-C): "The employee's exposure which shall not be exceeded during any part of the work day."

f. Threshold Limit Value - Ceiling (TLV-C): "The concentration that should not be exceeded during any part of the working exposure."

g. Threshold Limit Value - Time Weighted Average (TLV-TWA): "The time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect."

h. Time Weighted Average - Short-Term Exposure Limit (TWA-STEL): "The employee's 15-minute time weighted average exposure which shall not be exceeded at any time during a work day unless another time limit is specified...."

i. Threshold Limit Value - Short-Term Exposure Limit (TLV-STEL): "The concentration to which workers can be exposed continuously for a short period of time without suffering from (1) irritation, (2) chronic or irreversible tissue damage, or (3) narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue, or materially reduce work efficiency, and provided that the daily TLV-TWA is not exceeded."

sulfuric acid would be the only chemical present in M-Area in sufficient quantities to warrant further evaluation in this EIS. Consistent with the methodologies, DOE analyzed an unmitigated release of the entire sulfuric acid inventory in M-Area using a commercially available computer code called EPICode (Homann 1988) that models the atmospheric dispersion of chemicals released to the environment. DOE then compared the resulting airborne concentrations against the ERPG values for sulfuric acid to determine the potential health effects.

F.5 Accident Analysis by Waste Type

This section presents potential impacts from postulated radiological and chemical accidents at the facilities that are or could be involved in the management of waste materials at SRS. This section has been organized according to waste type, with an analysis for each of the alternatives presented in this EIS. Each of the following sections includes a list of the facilities, postulated radiological accident impacts, and postulated chemical accident impacts associated with the waste type.

F.5.1 HIGH-LEVEL WASTE

The following sections address the impacts of postulated accidents associated with the alternatives considered in this EIS for the management of liquid high-level waste.

F.5.1.1 Facilities and Accidents: High-Level Waste

The accident analyses considered all facilities and processes involved in the management of liquid high-level waste. The facilities were identified from the information on high-level waste provided in Chapter 2 of this EIS. The facilities involved in the management of high-level waste for all alternatives considered in this EIS are the F/H-Area Evaporators, the Replacement High-Level Waste Evaporator, the New Waste Transfer Facility, the F/H-Area tank farms, and the F/H-Area Effluent Treatment Facility. Descriptions of these facilities are provided in Appendix B. For each of these facilities, a list of postulated accident scenarios was developed to support high-level waste accident analyses for each alternative.

Table F-4 lists potential accidents associated with the management of high-level waste. These accidents were extracted from the technical reports supporting this EIS (WSRC 1994b, c, and e). | TE

Table F-4. List of potential accidents associated with the management of high-level waste.

No.	Accident description	Annual freq.	Dose[a] (rem)	Risk (rem/yr)
1	RHLWE[b] release due to a feed line break	7.00E-02	2.73E-03	1.91E-04
2	H-Area airborne release due to waste tank filter fire	2.50E-02	3.68E-03	9.20E-05
3	RHLWE[b] release due to design basis earthquake	2.00E-04	8.16E-02	1.63E-05
4	F-Area airborne release due to waste tank filter fire	2.50E-02	6.39E-04	1.60E-05
5	RHLWE[b] release due to evaporator pressurization and breach	5.09E-05	2.03E-01	1.04E-05
6	RHLWE[b] release due to hydrogen explosion	1.71E-04	4.58E-02	7.83E-06
7	H-Area airborne release due to organic fire - waste tank	5.00E-03	1.35E-03	6.75E-06
8	RHLWE[b] release due to HEPA[c] filter fire	1.00E-02	4.55E-04	4.55E-06
9	H-Area airborne release due to hydrogen fire - waste tank	5.00E-03	7.37E-04	3.69E-06
10	F-Area liquid release due to waste tank overflow	9.00E-02	2.37E-05	2.13E-06
11	H-Area liquid release due to waste tank overflow	9.00E-02	2.00E-05	1.80E-06
12	F-Area airborne release due to organic fire - waste tank	5.00E-03	2.34E-04	1.17E-06
13	H-Area liquid release due to earthquake	2.00E-04	3.41E-03	6.82E-07
14	F-Area airborne release due to hydrogen fire - waste tank	5.00E-03	1.28E-04	6.40E-07
15	H-Area airborne release due to hydrogen explosion - pump tank	2.00E-05	1.13E-02	2.26E-07
16	F-Area airborne release due to hydrogen explosion - pump tank	2.00E-05	7.80E-03	1.56E-07
17	H-Area airborne release due to waste tank overpressurization	1.00E-01	9.80E-07	9.80E-08
18	RHLWE[b] release due to design basis tornado	4.00E-05	6.20E-04	2.50E-08
19	Normal processing with tritium ETF[d] airborne release due to straight wind	1.20E-03	1.47E-05	1.76E-08
20	Normal processing other than tritium ETF[d] airborne release due to straight wind	1.20E-03	1.46E-05	1.75E-08
21	F-Area airborne release due to waste tank overpressurization	1.00E-01	1.70E-07	1.70E-08
22	Normal processing with tritium ETF[d] liquid release due to straight wind	1.20E-03	9.40E-06	1.13E-08
23	F-Area liquid release due to hydrogen explosion - pump tank	2.00E-05	5.47E-04	1.09E-08
24	Normal processing other than tritium ETF[d] liquid release due to straight wind	1.20E-03	7.70E-06	9.24E-09
25	Normal processing with tritium ETF[d] airborne release due to tornado	4.50E-05	2.04E-04	9.18E-09
26	Normal processing other than tritium ETF[d] airborne release due to tornado	4.50E-05	2.03E-04	9.14E-09
27	F-Area liquid release due to earthquake	2.00E-04	3.38E-05	6.76E-09
28	Normal processing with tritium ETF[d] airborne release due to earthquake	2.00E-04	2.77E-05	5.54E-09
29	H-Area liquid release due to hydrogen explosion - pump tank	2.00E-05	2.57E-04	5.14E-09
30	H-Area liquid release due to vehicle crash (scenario A; see #63)	3.50E-05	1.36E-04	4.76E-09
31	H-Area waste release from feed pump riser	1.90E-04	1.87E-05	3.55E-09
32	F-Area waste release from feed pump riser	1.90E-04	1.10E-05	2.09E-09
33	Normal processing with tritium ETF[d] liquid release due to earthquake	2.00E-04	9.40E-06	1.88E-09
34	Normal processing other than tritium ETF[d] liquid release due to earthquake	2.00E-04	7.70E-06	1.54E-09
35	H-Area airborne release due to hydrogen explosion - evaporator	5.00E-06	2.93E-04	1.47E-09
36	H-Area airborne release due to hydrogen explosion - CTS[e] tank	5.00E-06	2.93E-04	1.47E-09
37	H-Area liquid release due to waste tank overpressurization	1.00E-01	9.34E-09	9.34E-10
38	F-Area liquid release due to waste tank overpressurization	1.00E-01	5.52E-09	5.52E-10
39	H-Area liquid release due to tank leak	3.00E-02	1.76E-08	5.28E-10
40	Normal processing other than tritium ETF[d] airborne release due to earthquake	2.00E-04	2.50E-06	5.00E-10
41	Design basis ETF[d] liquid release due to straight wind	9.84E-06	4.70E-05	4.62E-10

Table F-4. (continued).

No.	Accident description	Annual freq.	Dose[a] (rem)	Risk (rem/yr)
42	Normal processing with tritium ETF[d] liquid release due to tornado	4.50E-05	9.40E-06	4.23E-10
43	Normal processing other than tritium ETF[d] liquid release due to tornado	4.50E-05	7.70E-06	3.47E-10
44	H-Area airborne release due to tornado	3.00E-05	9.90E-06	2.97E-10
45	F-Area liquid release due to tank leak	3.00E-02	8.82E-09	2.65E-10
46	F-Area airborne release due to tornado	3.50E-05	6.00E-06	2.10E-10
47	F-Area airborne release due to hydrogen explosion - evaporator	5.00E-06	3.25E-05	1.63E-10
48	F-Area airborne release due to hydrogen explosion - CTS[e] tank	5.00E-06	3.25E-05	1.63E-10
49	F-Area liquid release due to hydrogen explosion - CTS[e] tank	5.00E-06	3.04E-05	1.52E-10
50	H-Area liquid release due to hydrogen explosion - CTS[e] tank	5.00E-06	2.57E-05	1.29E-10
51	F-Area liquid release due to hydrogen explosion - evaporator	5.00E-06	2.37E-05	1.19E-10
52	Design basis ETF[d] airborne release due to straight wind	9.84E-06	1.12E-05	1.10E-10
53	Design basis ETF[d] airborne release due to tornado	3.69E-07	2.83E-04	1.04E-10
54	H-Area liquid release due to a hydrogen explosion - evaporator	5.00E-06	2.00E-05	1.00E-10
55	Normal processing with tritium ETF[d] airborne release due to transfer error	1.80E-02	4.46E-09	8.03E-11
56	Design basis ETF[d] liquid release due to earthquake	1.64E-06	4.70E-05	7.71E-11
57	Normal processing with tritium ETF[d] airborne release due to corrosion damage	8.80E-02	8.75E-10	7.70E-11
58	F-Area liquid release during catherization	7.00E-02	6.76E-10	4.73E-11
59	H-Area liquid release during catherization	7.00E-02	5.70E-10	3.99E-11
60	Normal processing other than tritium ETF[d] airborne release due to transfer error	1.80E-02	1.72E-09	3.10E-11
61	Normal processing other than tritium ETF[d] airborne release due to corrosion damage	8.80E-02	3.38E-10	2.97E-11
62	Design basis ETF[d] airborne release due to leaks	2.13E-02	1.35E-09	2.88E-11
63	H-Area liquid release due to a vehicle crash (scenario B; see #30)	3.50E-05	7.10E-07	2.49E-11
64	Design basis ETF[d] airborne release due to overflow	1.48E-03	1.44E-08	2.13E-11
65	Design basis ETF[d] liquid release due to tornado	3.69E-07	4.70E-05	1.73E-11
66	Design basis ETF[d] airborne release due to earthquake	1.64E-06	8.40E-06	1.38E-11
67	Normal processing with tritium ETF[d] airborne release due to a siphoning incident	2.60E-03	1.12E-09	2.91E-12
68	Design basis ETF[d] airborne release due to spill	1.48E-03	1.88E-09	2.78E-12
69	Normal processing other than tritium ETF[d] airborne release due to siphoning incident	2.60E-03	4.34E-10	1.13E-12
70	Design basis ETF[d] airborne release due to transfer error	1.48E-04	6.86E-09	1.02E-12
71	Design basis ETF[d] airborne release due to corrosion damage	7.22E-04	1.35E-09	9.75E-13
72	Design basis ETF[d] airborne release due to a siphoning incident	2.13E-05	1.73E-09	3.68E-14

a. The dose given is for the offsite maximally exposed individual using 99.5 percentile meteorology.
b Replacement High-Level Waste Evaporator.
c. High efficiency particulate air.
d. Effluent Treatment Facility.
e. Concentrate transfer system.

F.5.1.2 Accident Analysis for the High-Level Waste No-Action Alternative

This section addresses the effects of postulated accidents associated with the no-action alternative
TE | considered for high-level waste.

Impacts from Postulated Radiological Accidents

DOE identified the representative bounding accident scenarios for the no-action alternative from the list of potential radiological accidents presented in Table F-4. Figure F-2 identifies the highest-risk accident
TE | scenarios in each frequency range. As shown in Figure F-2, for all but the lowest frequency range, the representative bounding accidents are associated with the operation of the Replacement High-Level Waste Evaporator. Table F-5 lists the high-level waste representative bounding accidents, accident consequences, and latent fatal cancers for exposed workers and the public.

Accident Scenario 1 – Replacement High-Level Waste Evaporator release due to a feed line break: A break in the feed line to the Replacement High-Level Waste Evaporator could occur if feed was pumped after the feed line became plugged. The feed line can become plugged due to excess sludge and suspended solids collecting and solidifying in stagnation points within the feed line. If feed pumping continued, the excess pressure would eventually cause a rupture in the feed line or jumper connection. Numerous indicators would alert the operator of a feed line rupture. In the event of a break, the automatic level control system in the evaporator would indicate decreased lift activity as the level of liquid in the evaporator dropped. Because supernatant would now be accumulating in the evaporator cell, the evaporator sump and differential pressure sensors in the ventilation system would also indicate leakage. Finally, the radiation monitor in the stack would register an increase in the radiation level of material leaving the ventilation system.

The Replacement High-Level Waste Evaporator is planned to operate from 1999 to 2018, when DOE expects to have completed high-level waste management activities. Between 1994 and 1999 -- before the Replacement High-Level Waste Evaporator is operational -- the highest-risk accident in the
TC | anticipated accident range would be Accident Scenario 2: H-Area airborne release due to waste tank filter fire.

Accident Scenario 3 – Replacement High-Level Waste Evaporator release due to a design basis
TE | earthquake: Studies reported in the supporting technical report (WSRC 1994c) indicate that SRS is located in an area where moderate damage could occur from earthquakes. In this accident scenario, an earthquake is assumed to disrupt the operation of the evaporator facility. The feed input and bottoms

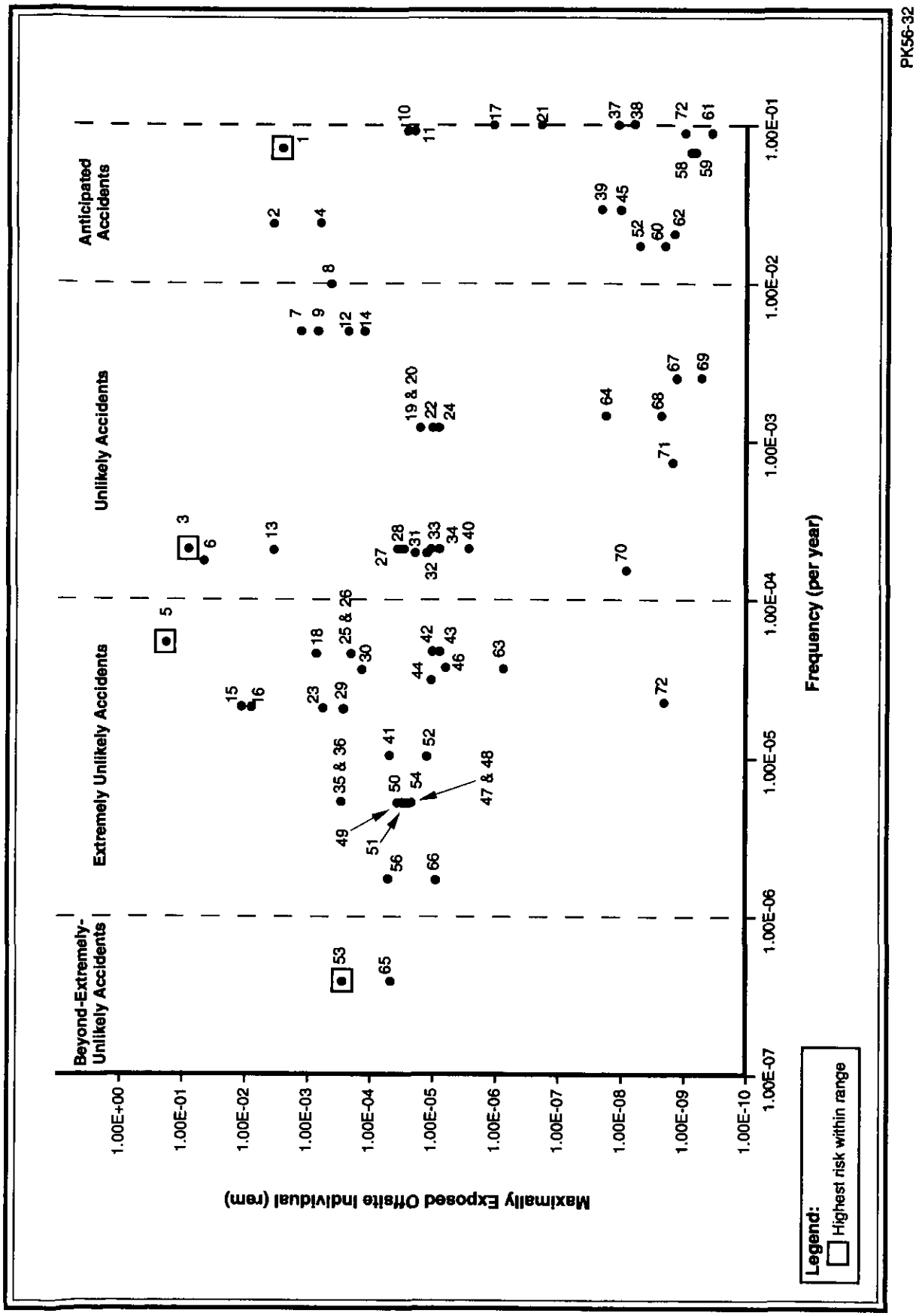

Figure F-2. Accidents that were analyzed for all alternatives for high-level waste facilities.

Table F-5. Representative bounding radiological accidents under the no-action alternative.

No.	Accident description	Frequency per year (accident range)	Accident consequences: Uninvolved worker at 100 meters (rem)	Accident consequences: Uninvolved worker at 640 meters (rem)	Accident consequences: Offsite maximally exposed individual (rem)	Accident consequences: Population within 80 kilometers[c] (person-rem)	Point estimate of increased risk per year[a] (increased risk of fatal cancers per occurrence)[b]: Latent fatal cancers: Uninvolved worker at 100 meters	Latent fatal cancers: Uninvolved worker at 640 meters	Latent fatal cancers: Offsite maximally exposed individual	Latent fatal cancers: Population within 80 kilometers
1	RHLWE[d] release due to a feed line break	7.00E-02[e] (anticipated)	6.41E-01	2.28E-02	3.76E-04	1.81E+01	1.79E-05 (2.56E-04)	6.38E-07 (9.12E-06)	1.32E-08 (1.88E-07)	6.34E-04 (9.05E-03)
3	RHLWE[d] release due to a design basis earthquake	2.00E-04 (unlikely)	1.92E+01	6.83E-01	1.12E-02	5.43E+02	1.54E-06 (7.68E-03)	5.46E-08 (2.73E-04)	1.12E-09 (5.60E-06)	5.43E-05 (2.72E-01)
5	RHLWE[d] release due to evaporator pressurization and breach	5.09E-05 (extremely unlikely)	4.79E+01	1.70E+00	2.80E-02	1.35E+03	1.95E-06 (3.83E-02)	3.46E-08 (6.80E-04)	7.13E-10 (1.40E-05)	3.44E-05 (6.75E-01)
53	Design basis ETF[e] airborne release due to tornado	3.69E-07 (beyond-extremely-unlikely)	2.17E-03	6.91E-05	3.90E-05	3.44E-04	3.20E-13 (8.68E-07)	1.02E-14 (2.76E-08)	7.20E-15 (1.95E-08)	6.35E-14 (1.72E-07)

a. Point estimate of increased risk per year is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor ¥ annual frequency.
b. Increased risk of fatal cancers per occurrence is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor.
c. A conservative assumption of 99.5 percentile meteorology was assumed for determining accident consequences for the exposed population within 80 kilometers. A less conservative meteorology (50 percentile) was used to determine the accident consequences for exposed individuals.
d. Replacement High-Level Waste Evaporator.
e. Effluent Treatment Facility.

output are assumed not to be affected during the earthquake, and the steam supply is assumed to continue to flow at the normal rate; therefore, the evaporator contents continue to be boiled off as normal. However, the demister is assumed to be damaged and its performance is degraded. The accident results in a release to the environment through a broken process line between the evaporator vessel demister and condenser. The highest-risk accident in this frequency range between 1994 and 1999 would be Accident Scenario 7: H-Area airborne release due to waste tank organic fire. TE TC

Accident Scenario 5 – Replacement High-Level Waste Evaporator release due to evaporator pressurization and breach: An evaporator breach would be possible if the internal pressure in the evaporator exceeded the design pressure, which could be caused by demister mesh pad blockage; excessive levels of condensate and vent line blockage; or steam bundle failures. A breach of the evaporator would result in an energetic release of the vessel contents into the evaporator cell and a subsequent unfiltered airborne release of waste into the atmosphere when the high efficiency particulate air filters become overloaded. The associated pressure increase would be detected by independent bubble tube pressure sensors within the evaporator vessel. These sensors are tied to interlocks that would provide for mitigation of the event. These devices must fail for an overpressurization to occur. From 1994 to 1999 -- before the Replacement High-Level Waste Evaporator is operational -- the highest-risk accident in this frequency range would be Accident Scenario 15: H-Area airborne release due to pump tank hydrogen explosion.

Accident Scenario 53 – Design basis F/H-Area Effluent Treatment Facility airborne release due to a tornado: Damage to equipment that would result in a release of radioactivity could occur during a sustained wind or tornado. The F/H-Area Effluent Treatment Facility is designed for a sustained wind speed of 137 kilometers (85 miles) per hour. Outside tanks and piping would be subjected to the full force of the wind and could be struck by windblown objects, either of which could result in a release of radioactivity. Equipment and piping located inside a process building could be damaged by roof debris and falling portions of the upper structure. Some of the liquid released would evaporate and become airborne and some would drain to surface water streams. No credit is taken for tank dikes, high efficiency particulate air filtration, or for a release from an elevated stack.

F.5.1.3 Accident Analysis for the High-Level Waste for Minimum, Expected, and Maximum Waste Forecasts

This section addresses the impacts of postulated accidents associated with alternatives A, B, and C considered for high-level waste. The facilities that support alternative A, alternative B, and alternative C and their periods of operation are identical to the facilities and periods of operation that support the TE

TE | no-action alternative. Thus, postulated radiological accident scenarios and their impacts are the same as described in Section F.5.1.2.

DOE assumes that conclusions for representative bounding accident scenarios for high-level waste management under the alternatives would not be changed by the minimum, maximum, and expected waste forecasts. Since the accident analysis for each accident scenario is based on a conservative assumption of peak utilization of the facility, differences between minimum, maximum, and expected waste forecast would only affect how long the facility would operate. Therefore, while consequence or frequency for postulated accidents are not changed, the expected duration of risk from a facility-specific accident scenario could be longer or shorter, as appropriate. Impacts for these cases are addressed in the representative bounding accident descriptions.

F.5.1.4 Impacts to Involved Workers from Accidents Involving High-Level Waste

The highest risk accident scenarios for high-level waste involve releases from the Replacement High-Level Waste Evaporator, tank farm tanks, or the F/H-Area Effluent Treatment Facility. These releases would be due to feed line breaks, overpressurizations and breaches, explosions, or natural disasters. Of these accident scenarios and their postulated releases, the ones associated with the Replacement High-Level Waste Evaporator are assumed to have the greatest potential for adverse effects on involved workers. This assumption is based on the higher consequences for the Replacement High-Level Waste Evaporator accident scenarios than those for the tank farm or F/H-Area Effluent Treatment Facility. While some exposure to involved workers could occur due to an accidental release, timely evacuation as the result of monitoring activities would prevent substantial radiological exposure. DOE assumes no fatalities would be likely from radiological consequences.

F.5.1.5 Impacts from High-Level Waste Chemical Accidents

The results of the chemical hazards assessment completed for chemicals stored or processed in facilities
TE | located in the area of the F/H-Area tank farms as addressed in the *Final Supplemental Environmental Impact Statement, Defense Waste Processing Facility* are presented in Table F-6. The calculated 100-meter (328-foot), 640-meter (2,100-foot), and offsite chemical concentrations are compared to the appropriate ERPG-1, -2, and -3 guideline concentrations. A nitric acid release from Building 241-61H is the only accident with calculated concentrations that exceed the ERPG-3 limit at 100 and 640 meters (328 and 2,100 feet).

Table F-6. Chemical hazards analysis results for the F/H-Area tank farm facilities.

Chemical	Release location	Quantity (kg)[a]	100-meter (328-foot) concentration (mg/m^3)[b]	640-meter (2,100-foot) concentration (mg/m^3)[b]	Offsite concentration (mg/m^3)[b]	ERPG-1[c] (mg/m^3)[b]	ERPG-2 (mg/m^3)[b]	ERPG-3 (mg/m^3)[b]
Nitric acid	Bldg. 241-61H	42,620.90	8.30E+02	1.00E+02	2.00E+00	5.20E+00	3.9E+01	7.70E+01
Phosphorous pentoxide	Bldg. 241-84H	0.45	7.50E-02	2.90E-02	3.10E-04	5.00E+00	2.50E+01	1.00E+02
Ammonia	Bldg. 242-24H	13.6	4.50E-03	1.80E-03	2.40E-05	1.70E+01	1.40E+02	7.00E+02
Hydrochloric acid	Bldg. 280-1H	22.7	7.60E-03	3.00E-03	3.90E-05	4.50E+00	3.00E+01	1.50E+02
Sulfuric acid	Bldg. 280-1F	3,828.80	3.70E-06	2.20E-07	3.20E-09	2.00E+00	1.00E+01	3.00E+01

a. Kilograms. To convert to pounds multiply by 2.2046.
b. Milligrams per cubic meters of air.
c. Emergency Response Planning Guideline. See Table F-3.

TE | Because the concentrations calculated for the SRS boundary for every chemical do not exceed the respective ERPG-1 concentrations (even assuming a total unmitigated release of all chemicals), specific accident scenarios (i.e., an accident initiator and resulting accident progression resulting in a release to the environment) were not developed, nor were corresponding frequencies of occurrence identified. More realistic accident scenarios and associated frequencies were not necessary because the bounding consequences for the unmitigated release of the entire inventory, however improbable, were within established guidelines.

The nitric acid concentrations that exceed the ERPG-3 limit could pose a risk of major reversible tissue damage. Because the chemical concentration in air decreases with distance from the release location, offsite individuals would be exposed to chemical concentrations less than the ERPG-1 limit. However, onsite personnel in the immediate area of a release could encounter concentrations that exceed the ERGP-3 limit. While perhaps not instantly lethal, even short exposures could be extremely dangerous.

The F/H-Area Effluent Treatment Facility is classified as a low-hazard facility based on the chemical hazards assessment contained in the *Effluent Treatment Facility Hazards Assessment Document* (WSRC 1993). Table F-7 lists the results of this chemical assessment. The calculated 100-meter (328-foot), 640-meter (2,100-foot), and offsite chemical concentrations are compared to the appropriate ERPG-1, -2, and -3 guideline concentrations. A nitrogen dioxide release from the storage area and a nitric acid release from process chemical storage tanks are the only postulated accidents with calculated concentrations that exceed the ERPG-3 limit at 100-meters (328-feet). However, no accidents resulted in air concentrations at 640-meters (2,100-feet) or the SRS boundary that exceeded ERPG-3 guidelines. Additionally, the nitrogen dioxide release scenario had a calculated concentration at the SRS boundary that exceeded the ERPG-1 guideline but remained under the ERPG-2 guideline.

No chemical hazards analysis or accident consequence analysis exist for the chemicals at the Replacement High-Level Waste Evaporator. However, it is assumed that the chemical hazards posed by this facility would be bounded by those posed by existing evaporators in the F/H-Area tank farms.

F.5.2 LOW-LEVEL WASTE

This section evaluates the impacts of postulated accidents associated with the alternatives considered in this EIS for the management of low-level waste.

Table F-7. F/H-Area Effluent Treatment Facility chemical hazards analysis results.

Segment description	Chemical	Quantity (kg)[a]	Onsite concentration 100 meters (328 feet) (mg/m^3)[b]	Onsite concentration 640 meters (2,100 feet) (mg/m^3)[b]	Offsite concentration (mg/m^3)[b]	ERPG-1[c] (mg/m^3)[b]	ERPG-2[c] (mg/m_3)[b]	ERPG-3[c] (mg/m^3)[b]
Waste water collection tanks	Lead	4.41E-01	1.07E-02	4.24E-04	2.15E-05	1.50E-01	2.50E-01	7.00E+02
Waste water collection tanks	Ammonia	5.51E+01	1.34E+00	5.31E-02	2.68E-03	1.74E+01	1.39E+02	6.95E+02
Treatment building chemicals	Ammonia	5.85E+01	1.42E+00	5.36E-02	2.85E-03	1.74E+01	1.39E+02	6.95E+02
Treatment building chemicals	Lead	3.39E-01	8.24E-03	3.27E-04	1.65E-05	1.50E-01	2.50E-01	7.00E+02
Treatment building chemicals	Mercury	5.79E+00	1.41E-01	5.59E-03	2.82E-04	1.50E-01	2.00E-01	2.80E+01
Outside tanks and HEPA[d] filters	Mercury	3.09E+00	7.53E-01	2.99E-02	1.50E-03	1.50E-01	2.00E-01	2.80E+01
Storage area	Nitrogen dioxide	3.30E+01	7.96E+01	3.16E+00	1.59E-01	8.00E-02	1.88E+00	5.64E+01
Storage area	Sodium hydroxide	3.02E+02	7.34E-02	2.91E-03	1.47E-04	2.00E+00	4.00E+01	1.00E+02
Storage area	Nitric acid	2.12E+02	5.17E+00	2.05E-01	1.03E-02	5.15E+00	3.87E+01	7.73E+01
Storage area	Oxalic acid	1.13E+04	2.76E+02	1.09E+01	5.52E-01	2.00E+00	5.00E+00	5.00E+02
Process chemical storage tanks	Sodium hydroxide	2.81E+03	6.83E-01	2.71E-02	1.37E-03	2.00E+00	4.00E+01	1.00E+02
Process chemical storage tanks	Nitric acid	7.41E+03	1.81E+02	7.18E-00	3.61E-01	5.15E+00	3.87E+01	7.73E+01
Acid and caustic tanks	Nitric acid	(e)	5.87E+00	2.33E-01	1.17E-02	5.15E+00	3.87E+01	7.73E+01
Acid and caustic tanks	Sodium hydroxide	4.01E+00	9.90E+00	3.93E-01	1.98E-02	2.00E+00	4.00E+01	1.00E+02

a. Kilograms. To convert to pounds multiply by 2.2046.
b. Milligrams per cubic meters of air.
c. Emergency Response Planning Guideline. See Table F-3.
d. High efficiency particulate air.
e. Quantity not available but is assumed to be bounded by the quantity for nitric acid in the Process Chemical Storage Tanks based upon comparison of airborne concentrations at 100 meters (328 feet).

F.5.2.1 Facilities and Accidents: Low-Level Waste

The accident analyses considered all facilities and processes involved in the management of low-level waste. The facilities were identified from the low-level waste information provided in Chapter 2 of this EIS. Table F-8 lists the facilities associated with each of the alternatives. Descriptions of these facilities are provided in Appendix B. For each facility, a list of postulated accident scenarios was developed to support the low-level waste accident analysis for each alternative.

Table F-8. Low-level waste facilities identified by alternative.

	List of facilities	No action	Alternative A (limited treatment configuration)	Alternative C (extensive treatment configuration)	Alternative B (moderate treatment configuration)
TE	E-Area vaults[a]	X	X	X	X
TE	Reactor compactor	X	X	X[b]	X[b]
	253-H compactor	X	X	X[b]	X[b]
	M-Area compactor	X	X	X[b]	X[b]
TC	Soil sort facility[c]				X
	Non-alpha vitrification facility[c]			X	
	Consolidated Incineration Facility			X	X
	Offsite smelter			X	X
	Shallow land disposal[d]	X	X	X	X

a. E-Area vaults includes low-activity waste vaults, intermediate-level tritium vaults, intermediate-level nontritium vaults; long-lived waste storage buildings.
b. These facilities are assumed to remain in operation until proposed facilities come on line.
c. Proposed facility.
d. Shallow land disposal includes the engineered low-level trenches, greater confinement disposal (boreholes and engineered trenches), and naval reactor hardware storage.

Table F-9 lists potential accidents associated with the management of low-level waste. This list was extracted from the technical reports supporting this EIS (WSRC 1994b, c, d, and e). All the accidents listed in Table F-9 are supported by quantitative analyses. It should be noted that because accident impacts for proposed facilities are mainly qualitative, they are not listed in the table.

Table F-9. List of potential accidents associated with the management of low-level waste.

No.	Accident description	Annual frequency	Dose[a] (rem)	Risk (rem/yr)	
1	Container breach at the EAV/ILNTV[b]	2.00E-02	2.60E-01	5.20E-03	
2	Fire at the EAV/LLWSB[c]	8.30E-02	4.70E-02	3.90E-03	
3	Fire at the EAV/LAWV[d]	8.30E-02	2.10E-02	1.74E-03	
4	Fire at the EAV/ILTV[e]	8.30E-02	1.90E-02	1.58E-03	
5	Container breach at the EAV/LAWV[d]	2.00E-02	4.00E-02	8.00E-04	
6	Container breach at the EAV/ILTV[e] (scenario A; see #8)	2.00E-02	3.60E-02	7.20E-04	
7	Fire at the EAV/ILNTV[b]	8.30E-02	8.60E-03	7.14E-04	
8	Container breach at the EAV/ILTV[e] (scenario B; see #6)	2.00E-02	3.10E-02	6.20E-04	
9	Container breach at the EAV/LLWSB[c]	2.00E-02	3.10E-02	6.20E-04	
10	Explosion at CIF[g] - tank farm sump and diked area	1.90E-07	6.85E-03	1.30E-04	
11	Fire at the ELLT[f]	8.30E-02	5.35E-05	4.44E-06	
12	Large fire at CIF[g]	2.34E-04	1.07E-02	2.50E-06	
13	High wind at the EAV/ILNTV[b]	1.00E-03	3.04E-04	3.04E-07	TC
14	Earthquake at CIF[g]	1.00E-03	2.65E-04	2.65E-07	
15	Tornado at the EAV/ILNTV[b]	2.00E-05	1.18E-02	2.36E-07	
16	Explosion at CIF[g] - Rotary Kiln	1.50E-04	1.57E-03	2.36E-07	
17	High velocity straight winds at CIF[g]	2.00E-02	5.23E-06	1.05E-07	
18	Tornado at the EAV/LAWV[d]	2.00E-05	4.90E-03	9.80E-08	
19	Tornado at the EAV/ILTV[e]	2.00E-05	4.40E-03	8.80E-08	
20	Unintentional exhumation of ELLT[f]	8.30E-02	3.90E-07	3.24E-08	
21	Explosion at CIF[g] - backhoe housing	4.00E-04	5.64E-05	2.26E-08	
22	High wind at the EAV/ILTV[e]	1.00E-03	2.00E-05	2.00E-08	
23	High wind at the EAV/LAWV[d]	1.00E-03	1.50E-05	1.50E-08	
24	Explosion at CIF[g] - tank farm tank	3.40E-07	5.36E-03	1.82E-09	

a. The dose given is for the offsite maximally exposed individual (MEI) using 99.5 percentile meteorology.
b. E-Area Vaults/Intermediate-Level Nontritium Vault.
c. E-Area Vaults/Long-Lived Waste Storage Buildings.
d. E-Area Vaults/Low-Activity Waste Vault.
e. E-Area Vaults/Intermediate-Level Tritium Vault.
f. Engineered low-level trenches.
g. Consolidated Incineration Facility.

F.5.2.2 Accident Analysis for the Low-Level Waste No-Action Alternative

This section addresses the effects of postulated accidents associated with the no-action alternative for low-level waste. The postulated accidents provide a baseline for comparison of the effects of the
TE | postulated accidents associated with the other alternatives.

Impacts from Postulated Radiological Accidents

From the list of potential radiological accidents presented in Table F-9, the representative bounding accident scenarios were identified for the no-action alternative through the binning process described in Section F.4.1. Figure F-3 identifies the highest-risk accident scenarios for the four frequency ranges. As shown in Figure F-3, most of the accidents were in the anticipated frequency range. This distribution of accidents is due to the levels of radioactivity associated with low-level waste. At the lower accident frequency ranges, the risks become quite small compared with those in the anticipated accident frequency range. Consequently, for the no-action alternative, it was not necessary to analyze an accident scenario beyond the extremely unlikely accident frequency range. Table F-10 lists the low-level waste representative bounding accidents, accident consequences, and latent fatal cancers for exposed workers and the public.

The low-level waste representative bounding accidents and their impacts, as identified in Table F-10, are described below:

TE | Accident Scenario 1 – Container breach at the intermediate-level nontritium vault (two containers, noncombustible waste): The intermediate-level nontritium vault would contain both combustible waste (paper, plastics, cloth, etc.) and noncombustible waste (scrap hardware) contaminated with mixed fission products. Accidents involving this scrap could result in the airborne release of this contamination. The major contributor to the dose would be the waste material, which becomes airborne as a result of the accident. In order to estimate the consequences of this accident, the following conservative assumptions were made:

- Two waste containers were breached. This assumption is based on the hypothetical situation in
TE | which one waste container was being placed (by crane) into the intermediate-level nontritium vault cell and was inadvertently dropped (through either human error or crane malfunction) on a
TE | second waste container already within the intermediate-level nontritium vault cell, resulting in a breach of both containers.

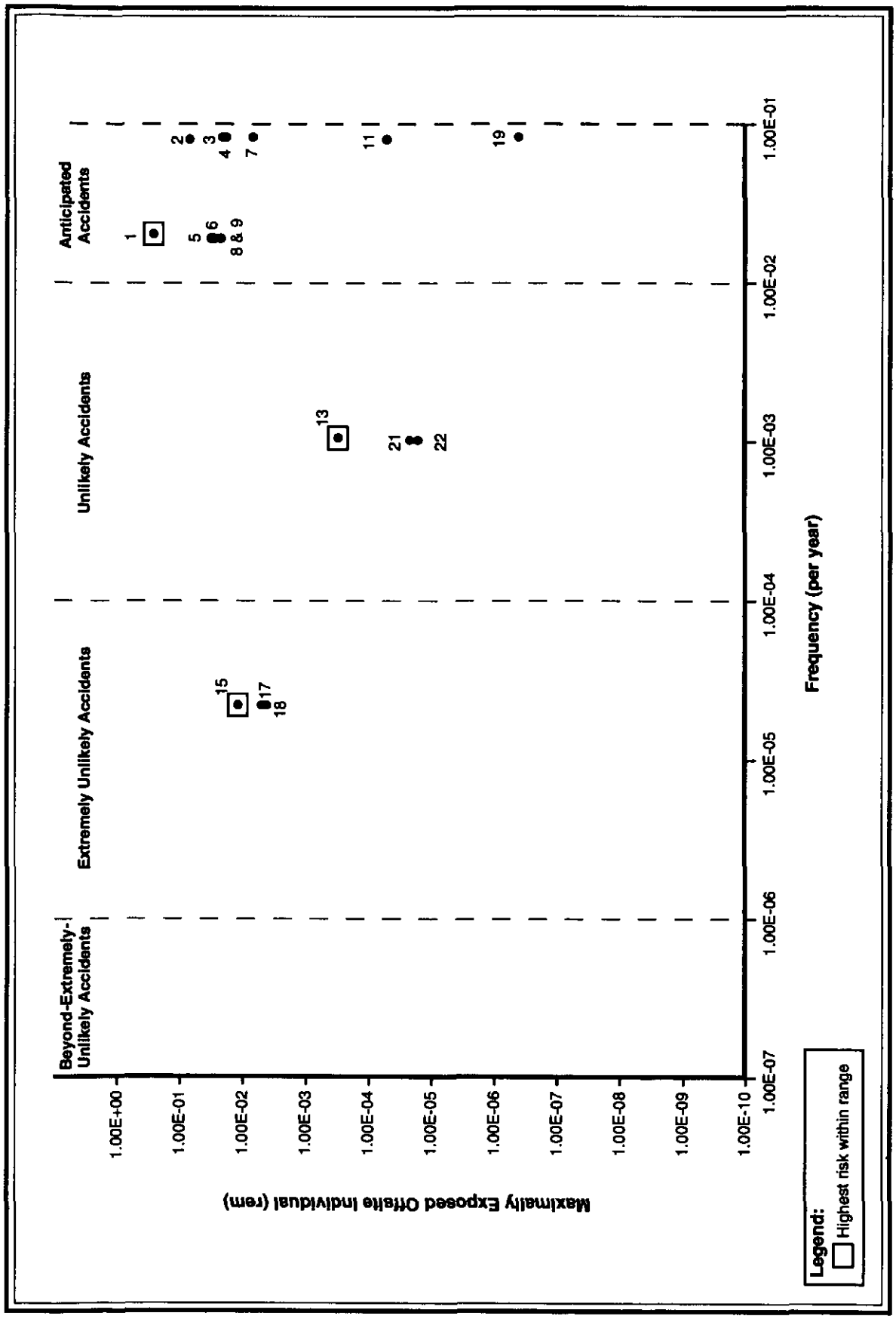

Figure F-3. Accidents that were analyzed for the no-action alternative and alternative A for low-level waste facilities.

Table F-10. Representative bounding radiological accidents for low-level waste under the no-action alternative.

No.	Accident description	Frequency per year (accident range)	Accident consequences: Uninvolved worker at 100 meters (rem)	Accident consequences: Uninvolved worker at 640 meters (rem)	Accident consequences: Offsite maximally exposed individual (rem)	Accident consequences: Population within 80 kilometers[c] (person-rem)	Point estimate of increased risk per year[a] (increased risk of fatal cancers per occurrence)[b]: Latent fatal cancers: Uninvolved worker at 100 meters	Uninvolved worker at 640 meters	Offsite maximally exposed individual	Population within 80 kilometers
1	Container breach at the ILNTV[d]	2.00E-02 (anticipated)	6.47E+01	2.30E+00	3.31E-02	1.68E+03	1.04E-03 (5.18E-02)	1.84E-05 (9.20E-04)	3.31E-07 (1.66E-05)	1.68E-02 (8.40E-01)
13	High wind at the ILNTV[d]	1.00E-03 (unlikely)	1.01E-03	6.08E-04	3.04E-04	2.11E+01	4.04E-10 (4.04E-07)	2.43E-10 (2.43E-07)	1.52E-10 (1.52E-07)	1.06E-05 (1.06E-02)
15	Tornado at the ILNTV[d]	2.00E-05 (extremely unlikely)	4.07E-04	7.73E-02	1.18E-02	1.18E+01	3.26E-12 (1.63E-07)	6.18E-10 (3.09E-05)	1.18E-10 (5.90E-06)	1.18E-07 (5.90E-03)

a. Point estimate of increased risk per year is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor ¥ annual frequency.
b. Increased risk of fatal cancers per occurrence is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor.
c. A conservative assumption of 99.5 percentile meteorology was assumed for determining accident consequences for the exposed population within 80 kilometers. A less conservative meteorology (50 percentile) was used to determine the accident consequences for exposed individuals.
d. Intermediate-Level Non-Tritium Vault.

- Analysis has shown that the radionuclide release due to rupture of a waste container in the intermediate-level nontritium vault that contains a noncombustible waste form would conservatively bound the release of an intermediate-level nontritium vault container that contains a combustible waste form. Therefore, it is conservatively assumed for this analysis that the two damaged waste containers have noncombustible waste as their contents. TC

- Radiological container inventory for the intermediate-level nontritium vault is based on 120 percent of the maximum estimated value. TC

Accident Scenario 13 – High wind at the intermediate-level nontritium vault (one container): In a moderate hazard facility, DOE (LLNL 1990) specifies a maximum wind speed of 175 kilometers (109 miles) per hour and a wind-driven missile in the form of a two-by-four plank weighing 6.8 kilograms (15 pounds) and traveling with a horizontal speed of 80 kilometers (50 miles) per hour at a maximum height of 9 meters (30 feet). The accident analyzed for this high-wind event is the breach of one container as the result of a wind-driven missile entering the open top of the intermediate-level nontritium vault and striking a waste container. It is assumed that 0.1 percent of the waste material becomes airborne. Analysis has shown that the radionuclide release would be the same as that for the container breach accident described above. Therefore, it is conservatively assumed that the high-wind-driven missile strikes containers that contain noncombustible waste. TE TE TE

Accident Scenario 15 – Tornado (220 kilometers per hour) at the intermediate-level nontritium vault (two containers): The accident analyzed for the 220-kilometer (137-mile) per hour tornado is the breach of two containers as the result of two tornado-driven missiles entering the open top of the intermediate-level nontritium vault and each striking one waste container, for a total of two failed containers. Analysis has shown that the radionuclide release would be the same as that for the container breach accident described above. Therefore, it is conservatively assumed that the tornado-driven missiles strike containers that contain noncombustible waste. TE TE

F.5.2.3 Accident Analysis for the Low-Level Waste Under Alternative B

This section addresses the impacts of postulated accidents for low-level waste associated with alternative B.

F.5.2.3.1 Impacts from Postulated Radiological Accidents

This section presents the potential effects of postulated radiological accidents at facilities identified in
TE | Table F-8 for the low-level waste management described in alternative B. Figure F-4 shows the highest-risk accident scenarios for the four frequency ranges. As shown in Figure F-4, most of the accidents analyzed were in the anticipated accident frequency range. The distribution of accidents analyzed is indicative of the levels of radioactivity associated with low-level waste. At the lower accident frequency ranges, the risks become quite small compared to those in the anticipated accident frequency range. Accidents associated with the Consolidated Incineration Facility occur in the less frequent accident ranges. Table F-11 lists the representative bounding accidents, accident consequences, and latent fatal cancers for exposed workers and the public. DOE assumes that conclusions regarding representative bounding accident scenarios could change as a result of the minimum, maximum, or expected waste
TE | forecasts. The accident analysis for each accident scenario is based on a conservative assumption of peak utilization of facilities. That is, the minimum, maximum, and expected waste forecasts would only affect how long the facilities would operate. Therefore, while the consequence or frequency of postulated accidents do not change, the expected duration of risk from a facility-specific accident scenario could be longer or shorter, depending on the case. The number of new facilities needed to meet the low-level waste management requirements could be affected by the minimum, maximum, and expected waste forecasts. Thus, the consequence or frequency of specific accident scenarios could be increased or decreased, depending on the case. Impacts for these cases will be addressed in the representative bounding accident descriptions.

TE | Accident Scenario 1 – Container breach at the intermediate-level nontritium vault (two containers, noncombustible waste): This accident scenario is detailed in Section F.5.1.2. This accident scenario is considered the representative bounding accident for the anticipated accident range. Under the expected waste forecast, four additional intermediate-level waste vaults are expected to be required. For the minimum waste forecast with two additional intermediate-level waste vaults, it could be assumed that the frequency of this accident would be less than for the expected waste forecast. For the maximum waste
TE | forecast with nine additional intermediate-level waste vaults, it could be assumed that the frequency would be greater than for the expected waste forecast (i.e., more containers are at risk of a breach).

Accident Scenario 12 – Large fire at the Consolidated Incineration Facility: Most fires at the Consolidated Incineration Facility would be caused by welding, electrical shorts, friction, materials in contact with hot process equipment, and smoking. Other causes would include lightning and explosions. The consequences of such fires would be monetary losses, injuries and death to personnel, and

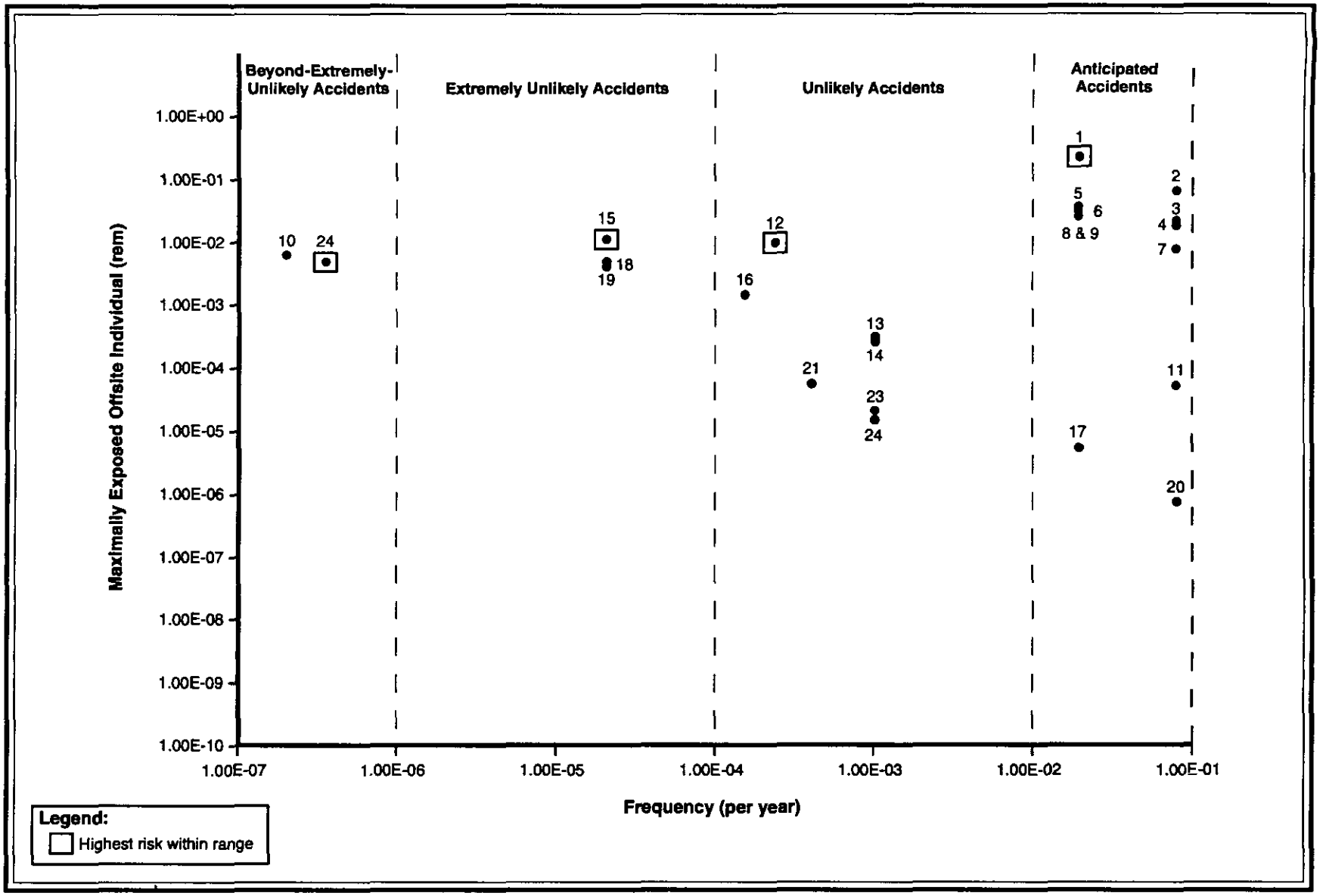

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Figure F-4. Accidents that were analyzed for alternative B for low-level waste facilities.

Table F-11. Representative bounding radiological accidents for low-level waste under alternative B.

	No.	Accident description	Frequency per year (accident range)	Accident consequences: Uninvolved worker at 100 meters (rem)	Accident consequences: Uninvolved worker at 640 meters (rem)	Accident consequences: Offsite maximally exposed individual (rem)	Accident consequences: Population within 80 kilometers[c] (person-rem)	Point estimate of increased risk per year[a] (increased risk of fatal cancers per occurrence)[b]: Latent fatal cancers: Uninvolved worker at 100 meters	Uninvolved worker at 640 meters	Offsite maximally exposed individual	Population within 80 kilometers
TC	1	Container breach at the ILNTV[d]	2.00E-02 (anticipated)	6.47E+01	2.30E+00	3.31E-02	1.68E+03	1.04E-03 (5.18E-02)	1.84E-05 (9.20E-04)	3.31E-07 (1.66E-05)	1.68E-02 (8.40E-01)
TE	12	Large fire at CIF[e]	2.34E-04 (unlikely)	2.55E+00	8.15E-02	1.40E-03	9.58E+01	2.39E-07 (1.02E-03)	7.63E-09 (3.26E-05)	1.64E-10 (7.00E-07)	1.12E-05 (4.79E-02)
TE	15	Tornado at the ILNTV[d]	2.00E-05 (extremely unlikely)	4.07E-04	7.73E-02	1.18E-02	1.18E+01	3.26E-12 (1.63E-07)	6.18E-10 (3.09E-05)	1.18E-10 (5.90E-06)	1.18E-07 (5.90E-03)
	24	Explosion at CIF[e] - tank farm	3.40E-07 (beyond-extremely-unlikely)	1.28E+00	4.07E-02	7.01E-04	4.79E+01	1.74E-10 (5.12E-04)	5.54E-12 (1.63E-05)	1.19E-13 (3.51E-07)	8.14E-09 (2.40E-02)

a. Point estimate of increased risk per year is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor ¥ annual frequency.
b. *Increased risk of fatal cancers per occurrence is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor.*
c. A conservative assumption of 99.5 percentile meteorology was assumed for determining accident consequences for the exposed population within 80 kilometers. A less conservative meteorology (50 percentile) was used to determine the accident consequences for exposed individuals.
d. Intermediate-Level Non-Tritium Vault.
e. Consolidated Incineration Facility.

radiological doses. This accident scenario is considered the representative bounding accident for the unlikely accident range.

For alternative B – minimum, maximum, and expected waste forecasts, the Consolidated Incineration Facility would operate from 1996 to 2024 and the highest-risk accident in this frequency range would be Accident Scenario 13: High wind at the intermediate-level nontritium vault.

Accident Scenario 15 – Tornado [220 kilometers (137 miles) per hour] at the intermediate-level nontritium vault: This accident scenario is detailed in Section F.5.2.2 and is considered the representative bounding accident for the extremely unlikely accident range. TE

Accident Scenario 24 – Explosion of tanks associated with the Consolidated Incineration Facility: Tanks located in the vicinity of the Consolidated Incineration Facility include two liquid waste blend tanks. These 16-cubic-meter (4,200-gallon) tanks receive wastes from various sources and blend them to a proper viscosity and heating value prior to feeding into the rotary kiln. Each tank is fitted with an agitator that continually mixes the waste and a heater that maintains the temperature. Fuel in the form of liquid waste is always present in the tanks. Potential ignition sources include a malfunction of the agitator or heater. Such a malfunction would have to include disintegration of an agitator impeller or an electrical short in the heater that overrode thermostatic control. A transfer error could also be an ignition source if highly incompatible materials were introduced into a tank. Lightning could be an ignition source if the tank was not properly grounded. Simultaneously, a nitrogen blanketing system would have to fail and oxygen would have to be introduced into the tank head space for an explosion to occur. Failure of the nitrogen blanketing system initiates visual and audible alarms and stops all tank-feed and transfer operations. Once the blanketing system failed, there would be a period of time before enough oxygen could diffuse into the tank head space to cause an explosion. This accident scenario is considered the representative bounding accident for the beyond-extremely-unlikely accident range.

For alternative B – minimum, maximum, and expected waste forecasts, the Consolidated Incineration Facility is expected to operate from 1996 to 2024. Technical reports identified no accidents from 1994 to 1996.

F.5.2.3.2 Impacts from New or Proposed Facilities

TC | Table F-8 identifies two proposed facilities under alternative B for which no quantitative accident analyses exist. These facilities are listed and briefly described below. Because these facilities are
TE | proposed and their designs are not necessarily complete, quantitative analyses at this time would provide non-meaningful risk information (because the designs could be changed) that could be compared to the risk information available for existing facilities. However, DOE will perform quantitative analyses
TE | throughout the design, construction, and operation phases of the soil sort facility in accordance with requirements, and DOE will ensure that the risks associated with operating these facilities are within established regulatory guidelines.

TC |

Soil sort facility – The soil sort facility would sort and segregate clean and contaminated soils. This facility would provide standard sand-and-gravel-handling equipment with instrumentation for monitoring radiation. Radiation detectors would divert contaminated material traveling along a conveyer system in a different direction from the clean soil. By locating small particles of radioactive material dispersed throughout the soil, contaminants could be isolated and removed. It is assumed that the accidents at the soil sort facility would be bounded by the accidents selected for alternative B.

Offsite smelter – DOE is currently studying the use of an offsite smelter to determine the economic feasibility of recycling low-level contaminated stainless-steel scrap obtained during the decommissioning of retired SRS facilities. The intended end products of the stainless-steel recycling process are containers [2.83-cubic meter (100-cubic foot) boxes and 55-gallon drums] for the disposal or storage of radioactive waste originating within the DOE complex. Since no decisions on siting, configuration of equipment, or even whether the project would be completed have been made at this time, DOE assumes that accidents involving an offsite smelter would be bounded by the accidents selected for alternative B.

Offsite low-level waste volume reduction – DOE plans to use an offsite vendor to supercompact, repackage, or incinerate low-level waste. None of the potential accidents involving low-level waste identified in Table F-9 occurred at the compactor facilities. Accidents identified for low-level waste at
TC | the Consolidated Incineration Facility were not representative bounding accidents. Therefore, DOE assumes that accidents involving an offsite volume-reduction facility would be bounded by the accidents selected for alternative B.

F.5.2.4 Accident Analysis for Low-Level Waste Under Alternative A

Alternative A emphasizes a limited treatment configuration. Its accident analysis is the same as that for the no-action alternative. The facilities under alternative A are identical to the facilities identified to support the no-action alternative. The impacts from the postulated radiological accident scenarios are the same as described in Section F.5.2.2 (Figure F-3).

F.5.2.5 Accident Analysis for Low-Level Waste Under Alternative C

Alternative C emphasizes an extensive treatment configuration. The facilities listed in Table F-8 for alternative C are similar to those that support alternative B for low-level waste, except that alternative C includes a proposed non-alpha vitrification facility. Since this facility does not present a representative bounding accident, the effects from the postulated radiological accident scenarios for alternative C are identical to those for alternative B, as described in Section F.5.2.3 (Figure F-4). A qualitative evaluation of the impacts associated with the non-alpha vitrification facility is as follows: TC

Non-alpha vitrification facility – The non-alpha vitrification facility would prepare waste for vitrification, vitrify it, and treat the secondary waste gases and liquids generated by the vitrification process. The waste would fall in the following treatability groups: soils, job-control waste, and equipment. The facility would consist of a thermal pretreatment unit, a melter, and an offgas treatment unit. The afterburner would enhance destruction of any remaining hazardous organic compounds prior to treatment in the offgas system. It can be assumed that the accident initiators for the non-alpha vitrification facility would be similar to those for the Defense Waste Processing Facility vitrification facility. However, the releases would be minor in comparison. It is also assumed that the offgas treatment unit accidents would be similar to those for the F/H-Area Effluent Treatment Facility.

F.5.2.6 Impacts to Involved Workers from Accidents Involving Low-Level Waste

The representative bounding accident scenarios for low-level waste involve the intermediate level nontritium waste vaults, the long-lived waste storage buildings, and the Consolidated Incineration Facility. For the intermediate level nontritium vaults, scenarios involve a container rupture, a tornado, and a high wind accident scenario. For the container-rupture scenario, dose contribution from direct

radiation exposure is not considered major because operations are carried out remotely. The following features are provided to control exposure and limit injuries to workers due to container rupture:

- The crane operator is shielded from waste containers.
- The crane operator has dosimetry with an audible alarm that sounds when a preset dose is reached.
- The waste container lifting-fixtures are remotely controlled from the crane control cab.
- Cell covers are installed over partially filled cells to provide radiation shielding.
- The cell cover lifting-fixture is remotely controlled from the crane control cab and the shielding plugs are remotely engaged and disengaged.

Because high winds and tornadoes can usually be predicted and proper precautions taken before major damage occurs, radiological and/or chemical effects to the facility workers due to high winds or tornadoes are considered to be minor. Procedures exist to discontinue operation and place waste containers in safe temporary storage areas in cases of inclement weather.

For the long-lived waste storage buildings accident scenario, a fire involving a dropped deionizer vessel was identified as the representative bounding accident. Although workers would only be expected to be in the immediate vicinity of the long-lived waste storage buildings during waste handling operations, they would be exposed to occupational and industrial types of injuries associated with a fire and could possibly receive a dose due to exposure to radioactive materials.

The accident scenarios for the Consolidated Incineration Facility involve a fire or explosion. The consequences to facility workers from either a fire or explosion in the immediate area include occupational and industrial types of injuries (possibly including death) as well as doses resulting from contact with radioactive materials.

While some exposure to involved workers could occur due to an accidental release of radioactive materials in all scenarios, DOE assumes no fatalities to workers would be likely from radiological consequences.

F.5.2.7 Impacts from Low-Level Waste Chemical Accidents

No chemical hazards assessment was performed for the low-level radioactive waste facilities. The chemical inventories for each facility that has hazard assessment documentation were compared to the reportable quantities as listed in 40 CFR Part 302.4. None of the facilities has sufficient quantities of hazardous chemicals to warrant a complete chemical analysis.

F.5.3 HAZARDOUS WASTE

Identification of Hazardous Waste Facilities

The accident analyses considered facilities and processes that support the management of hazardous waste. The facilities were identified from the hazardous waste information provided in Chapter 2. Table F-12 lists the facilities associated with each of the alternatives. Descriptions of these facilities are provided in Appendix B. | TE

Table F-12. Hazardous waste facilities identified by alternative. | TE

List of facilities	No-action alternative	Alternative A (limited treatment configuration)	Alternative C (extensive treatment configuration)	Alternative B (moderate treatment configuration)
Hazardous waste storage facilities	X	X	X	X
M-Area Air Stripper	X	X	X	X
Recycle units[a]	X	X	X	X
Containment building[b,c]			X	
Non-alpha vitrification facility[b]			X	
Consolidated Incineration Facility		X	X[d]	X

a. Recycle units include silver recovery, refrigerant recycle, lead melter, and solvent distillation. These units do not have quantitative or qualitative accident analyses available. Accidents for recycle units are assumed to be bounded by the accident scenarios selected for this alternative.
b. Proposed facility.
c. Accidents for the containment building are assumed to be the same as those identified for the Hazardous Waste/Mixed Waste Treatment Building identified in the technical report presenting accident analyses for solid wastes (WSRC 1994c). | TE
d. Facility operates until proposed facility comes on line.

TE | Although Table F-12 identifies several nuclear facilities (e.g., Consolidated Incineration Facility), there are no radiological accidents associated with hazardous waste. Radiological material with a hazardous waste component was identified as mixed waste and is addressed in Section F.5.4.

Since mixed waste facilities contain radioactive materials with a hazardous chemical component, and in some cases, results of the accident scenarios for mixed waste bound the chemical hazards at hazardous waste facilities, impacts from chemical hazards for hazardous waste are addressed in Section F.5.4.7 for mixed waste.

F.5.4 MIXED WASTE

The following evaluation addresses the impacts of postulated accidents associated with the alternatives considered in this EIS for the management of mixed waste.

F.5.4.1 Facilities and Accidents: Mixed Waste

The accident analyses considered facilities and processes that support the management of mixed waste.
TE | The facilities were identified from the mixed waste information provided in Chapter 2. Table F-13 lists the facilities associated with each of the alternatives. Descriptions of these facilities are provided in Appendix B. For each facility, a list of postulated-accident scenarios was developed to support the accident analysis for each mixed waste alternative. Accidents for RCRA disposal are assumed to be the same as those identified for the Hazardous Waste/Mixed Waste Disposal Facility vaults. The design of these vaults (concrete vaults with temporary steel covers) and their operations (waste containers are transferred from trucks to the vaults via overhead crane) are similar to that of the intermediate-level waste vaults. The postulated-accident scenarios for the intermediate-level nontritium vaults are assumed to bound the impacts of postulated accidents for RCRA disposal.

TE | Table F-14 lists potential accidents. This information was extracted from the technical reports supporting this EIS (WSRC 1994b, c, and e). While all the accidents listed in Table F-14 are supported by quantitative analyses, they are not listed in this table because accident impacts for proposed facilities are mainly qualitative.

Table F-13. Mixed-waste facilities identified by alternative. TE

List of facilities area[a]	No-action alternative	Alternative A (limited treatment configuration)	Alternative C (extensive treatment configuration)	Alternative B (moderate treatment configuration)
Organic waste storage tank	X	X	X	X
F/H-Area Effluent Treatment Facility	X	X	X	X
Mixed waste storage facilities	X	X	X	X
Solvent storage tanks S29-S30 and S33-S36	X	X	X	X
Aqueous and organic waste storage tanks	X			
SRTC mixed waste storage tanks (ion exchange)	X	X	X	X
M-Area Vendor Treatment Facility	X	X	X	X
RCRA disposal[a]	X	X	X	X
Process Waste Interim Treatment Facility (Bldg. 341-1M)		X	X	X
Containment building[b,c]		X	X	X
Non-alpha vitrification facility[b]			X	X
Soil sort facility[b]		X		
Consolidated Incineration Facility		X	X[d]	X
Dilute Effluent Treatment Facility (Bldg. 341-M)		X	X	X

a. Accidents for Resource Conservation and Recovery Act (RCRA) disposal are assumed to be the same as those identified for the Hazardous Waste/Mixed Waste Disposal Facility vaults identified in the technical report (WSRC 1994c). TE
b. Proposed facility.
c. Accidents for the containment building are assumed to be the same as those identified for the Hazardous Waste/Mixed Waste Treatment Building identified in the technical report presenting accident analyses for solid wastes (WSRC 1994c). TE
d. Facility operates until proposed facility comes on line.

F.5.4.2 Accident Analysis for the Mixed Waste No-Action Alternative

This section addresses the impacts of postulated accidents associated with the no-action alternative for treating mixed waste. The postulated accidents provide a baseline for comparison of the effects of the postulated accident associated with the action alternatives.

TE | **Table F-14.** List of potential accidents associated with the management of mixed waste.

No.	Accident description	Annual frequency	Dose[a] (rem)	Risk (rem/yr)
1	Container breach at the EAV/ILNTV[b]	2.00E-02	2.63E-01	5.26E-03
2	Fire at the EAV/ILNTV[b]	8.30E-02	8.60E-03	7.14E-04
3	Excessive open containers at the containment building	1.00E-02	5.68E-02	5.68E-04
4	Release due to multiple open containers at the containment building	3.00E-03	6.81E-02	2.04E-04
5	Excessive inventory at the containment building	5.00E-03	3.20E-02	1.60E-04
6	Earthquake at the containment building	1.50E-03	6.20E-02	9.30E-05
7	Drum spill and tritium release at the containment building	5.00E-03	1.60E-02	8.00E-05
8	Tornado at the containment building	2.00E-02	3.05E-03	6.10E-05
9	Release due to one open container at the containment building	7.74E-03	6.20E-03	4.80E-05
10	Evaporation/dispersal of two to ten containers at the containment building	2.00E-04	6.00E-02	1.20E-05
11	Earthquake at the SRTC[c] storage tanks	2.00E-04	5.84E-02	1.17E-05
12	F2 tornado at Building 316-M	1.12E-04	5.67E-02	6.35E-06
13	Earthquake (0.04g) at Building 316-M	2.00E-03	1.65E-03	3.30E-06
14	F3 tornado at Building 316-M	2.80E-05	1.18E-01	3.30E-06
15	High wind at the containment building	2.00E-02	1.53E-04	3.06E-06
16	Large fire for entire CIF[d]	2.34E-04	1.07E-02	2.50E-06
17	F4 tornado at Building 316-M	3.50E-06	4.72E-01	1.65E-06
18	Drop/Spill/Leak at the SRTC[c] storage tanks	1.50E-02	6.52E-05	9.77E-07
19	High wind at the EAV/ILNTV[b]	1.00E-03	3.40E-04	3.40E-07
20	Earthquake at CIF[d]	1.00E-03	2.65E-04	2.65E-07
21	Explosion at CIF[d] - rotary kiln	1.50E-04	1.57E-03	2.36E-07
22	Tornado at the EAV/ILNTV[b]	2.00E-05	1.18E-02	2.36E-07
23	High velocity straight winds at CIF[d]	2.00E-02	5.23E-06	1.05E-07
24	Explosion at the containment building releasing 50 percent of tritium inventory	1.00E-06	5.58E-02	5.58E-08
25	Fire at the containment building releasing 50 percent of tritium inventory	1.00E-06	5.58E-02	5.58E-08
26	Release at Building 341-1M Building due to earthquake	2.00E-04	1.54E-04	3.08E-08
27	Explosion at CIF[d] - backhoe housing	4.00E-04	5.64E-05	2.26E-08
28	Normal processing with tritium ETF[e] airborne release due to straight wind	1.20E-03	1.47E-05	1.76E-08
29	Normal processing other than tritium ETF[e] airborne release due to straight wind	1.20E-03	1.46E-05	1.75E-08
30	Rainwater flooding at the containment building	1.00E-06	1.60E-02	1.60E-08
31	Normal processing with tritium ETF[h] liquid release due to straight wind	1.20E-03	9.40E-06	1.13E-08
32	Aircraft crash into the containment building	1.60E-07	6.78E-02	1.08E-08
33	Normal processing other than tritium ETF[e] liquid release due to straight wind	1.20E-03	7.70E-06	9.24E-09
34	Normal processing with tritium ETF[e] airborne release due to tornado	4.50E-05	2.04E-04	9.18E-09
35	Normal processing other than tritium ETF[e] airborne release due to tornado	4.50E-05	2.03E-04	9.14E-09
36	Normal processing with tritium ETF[e] airborne release due to earthquake	2.00E-04	2.77E-05	5.54E-09

Table F-14. (continued). | TE

No.	Accident description	Annual frequency	Dose[a] (rem)	Risk (rem/yr)
37	Normal processing with tritium ETF[e] liquid release due to earthquake	2.00E-04	9.40E-06	1.88E-09
38	Explosion at CIF[d] - tank farm tank	3.40E-07	5.36E-03	1.82E-09
39	Normal processing other than tritium ETF[e] liquid release due to earthquake	2.00E-04	7.70E-06	1.54E-09
40	Explosion at CIF[d] - tank farm sump and diked area	1.90E-07	6.85E-03	1.30E-09
41	Normal processing other than tritium ETF[e] airborne release due to earthquake	2.00E-04	2.50E-06	5.00E-10
42	Design basis ETF[e] liquid release due to straight wind	9.84E-06	4.70E-05	4.62E-10
43	Normal processing with tritium ETF[e] liquid release due to tornado	4.50E-05	9.40E-06	4.23E-10
44	Normal processing other than tritium ETF[e] liquid release due to tornado	4.50E-05	7.70E-06	3.47E-10
45	Design basis ETF[e] airborne release due to straight wind	9.84E-06	1.12E-05	1.10E-10
46	Design basis ETF[e] airborne release due to tornado	3.69E-07	2.83E-04	1.04E-10
47	Normal processing with tritium ETF[e] airborne release due to transfer error	1.80E-02	4.46E-09	8.03E-11
48	Design basis ETF[e] liquid release due to earthquake	1.64E-06	4.70E-05	7.71E-11
49	Normal processing with tritium ETF[e] airborne release due to corrosion damage	8.80E-02	8.75E-10	7.70E-11
50	Normal processing other than tritium ETF[e] airborne release due to transfer error	1.80E-02	1.72E-09	3.10E-11
51	Normal processing other than tritium ETF[e] airborne release due to corrosion damage	8.80E-02	3.38E-10	2.97E-11
52	Design basis ETF[e] airborne release due to leaks	2.13E-02	1.35E-09	2.88E-11
53	Release at DETF[f] due to earthquake	2.00E-03	1.17E-08	2.34E-11
54	Design basis ETF[e] airborne release due to overflow	1.48E-03	1.44E-08	2.13E-11
55	Design basis ETF[e] liquid release due to tornado	3.69E-07	4.70E-05	1.73E-11
56	Design basis ETF[e] airborne release due to earthquake	1.64E-06	8.40E-06	1.38E-11
57	Normal processing with tritium ETF[e] airborne release due to a siphoning incident	2.60E-03	1.12E-09	2.91E-12
58	Design basis ETF[e] airborne release due to spill	1.48E-03	1.88E-09	2.78E-12
59	Normal processing other than tritium ETF[e] airborne release due to siphoning incident	2.60E-03	4.34E-10	1.13E-12
60	Design basis ETF[e] airborne release due to transfer error	1.48E-04	6.86E-09	1.02E-12
61	Design basis ETF[e] airborne release due to corrosion damage	7.22E-04	1.35E-09	9.75E-13
62	Design basis ETF[e] airborne release due to a siphoning incident	2.13E-05	1.73E-09	3.68E-14

a. The dose given is for the offsite maximally exposed individual using 99.5 percentile meteorology.
b. Intermediate-level nontritium vault.
c. Savannah River Technology Center.
d. Consolidated Incineration Facility.
e. F/H-Area Effluent Treatment Facility.
f. Dilute Effluent Treatment Facility (Bldg. 341-M).

F.5.4.2.1 Impacts from Postulated Radiological Accidents

TE From the list of potential radiological accidents presented in Table F-14, the representative bounding accident scenarios were identified for the no-action alternative using the binning process described in Section F.4.1. Figure F-5 shows the highest-risk accident scenarios for the various frequency ranges for the no-action alternative. As shown in Figure F-5, the accidents associated with mixed waste are analyzed over a broad spectrum of consequences and frequencies. The accident scenarios postulated for the F/H-Area Effluent Treatment Facility generally present lower consequences, while accident scenarios postulated for vault disposal facilities generally present higher consequences. Table F-15 lists the representative bounding accidents, accident consequences, and latent fatal cancers for exposed workers and the public.

TE Accident Scenario 1 – Container breach at the intermediate-level nontritium vault (two containers, noncombustible waste): This accident scenario is detailed in Section F.5.2.2 and is assumed to be representative of a mixed waste accident for vault disposal.

Accident Scenario 11 – Earthquake at the Savannah River Technology Center storage tanks: The earthquake (greater than 0.2*g*) is assumed to impose reaction loads on the above-grade confinement structure and damage the structure. The below-grade structures, including the tank cells, are expected to respond with the ground motion, so major damage is considered unlikely. Similarly, because of their wall thickness [1.27 centimeters (0.5 inch) stainless steel], short height [3.35 to 3.96 meters (11 to 13 feet)], and small diameter [3 to 3.66 meters (10 to 12 feet)], it is unlikely that the tanks would rupture. However, in this scenario, the tank and cell exhaust filtration is assumed to be disrupted. This disruption is accounted for by assuming that the inventory of two 13.6-cubic-meter (3,600-gallon) high-activity waste tanks is available for airborne release. It is estimated that 0.1 percent of the radionuclides contained in the tank becomes airborne.

Accident Scenario 14 – F3 tornado at Building 316-M: Building 316-M (mixed waste storage building) is an outdoor storage area on a concrete base, with a roof and no sidewalls. Waste is stored in approved containers, generally 55-gallon drums and large steel boxes. Based on a similar analysis for the Burial Ground, an F3 tornado [a tornado with rotational windspeeds of 254 to 331 kilometers (158 to 206 miles) per hour] is assumed to rupture 25 percent of the drums. It is assumed that 100 percent of the drum contents could be scattered.

Accident Scenario 46 – Design basis F/H-Area Effluent Treatment Facility airborne release due to tornado: This accident scenario is detailed in Section F.5.1.2.1.

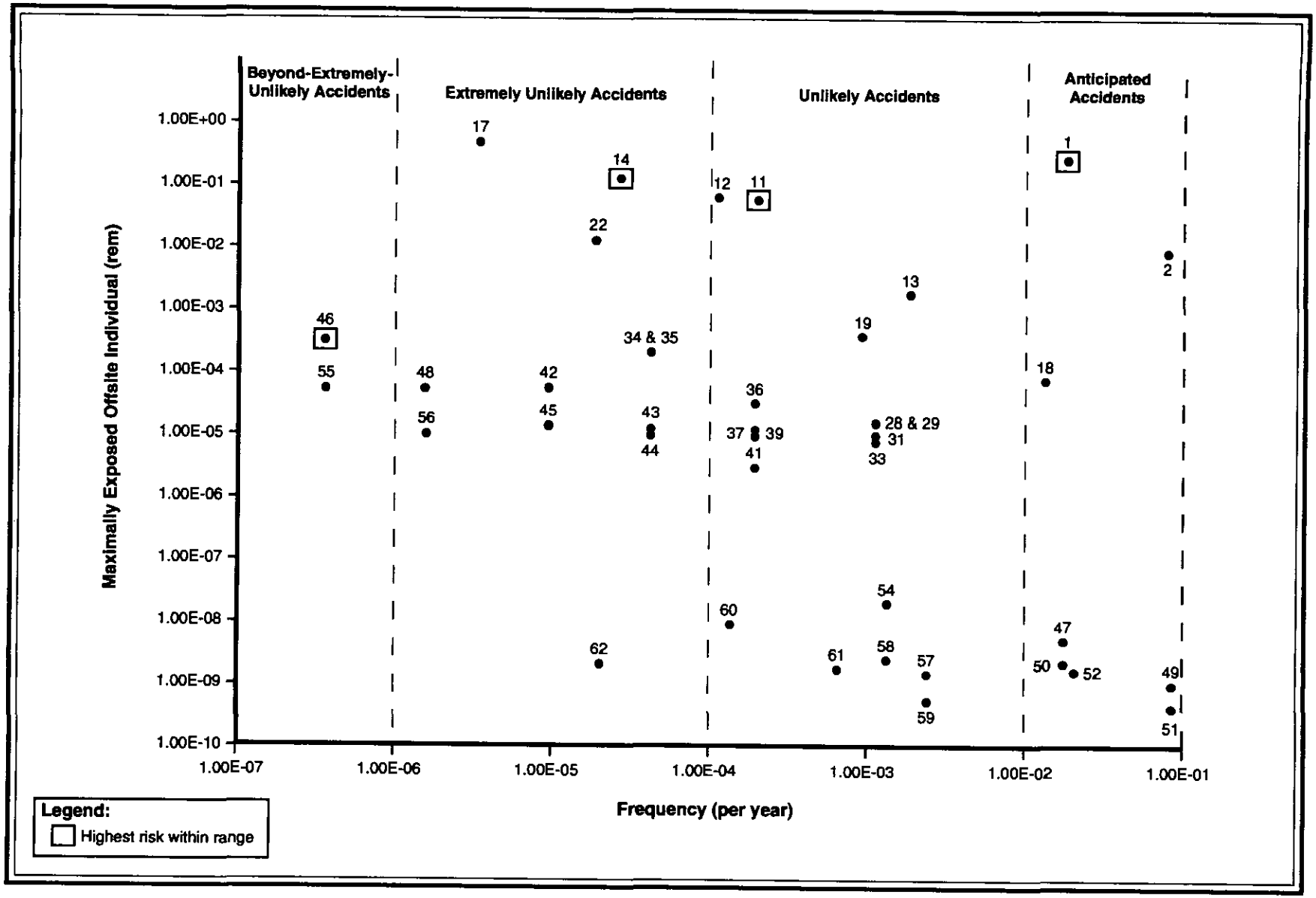


Figure F-5. Accidents that were analyzed for the no-action alternative for mixed waste facilities.

TE **Table F-15.** Representative bounding radiological accidents for the no-action alternative for mixed wastes.

No.	Accident description	Frequency per year (accident range)	Accident consequences: Uninvolved worker at 100 meters (rem)	Accident consequences: Uninvolved worker at 640 meters (rem)	Accident consequences: Offsite maximally exposed individual (rem)	Accident consequences: Population within 80 kilometers[c] (person-rem)	Point estimate of increased risk per year[a] (increased risk of fatal cancers per occurrence)[b]: Latent fatal cancers: Uninvolved worker at 100 meters	Uninvolved worker at 640 meters	Offsite maximally exposed individual	Population within 80 kilometers
1	Container breach at the ILNTV[d]	2.00E-02 (anticipated)	6.47E+01	2.30E+00	3.31E-02	1.68E+03	1.04E-03 (5.18E-02)	1.84E-05 (9.20E-04)	3.31E-07 (1.66E-05)	1.68E-02 (8.40E-01)
11	Earthquake at the SRTC[e] Storage Tanks	2.00E-04 (unlikely)	6.00E+00	1.92E-01	8.06E-03	3.60E+01	4.80E-07 (2.40E-03)	1.54E-08 (7.68E-05)	8.06E-10 (4.03E-06)	3.60E-06 (1.80E-02)
14	F3 tornado[f] at Building 316-M	2.80E-05 (extremely unlikely)	4.78E-04	1.15E-01	1.18E-01	7.98E-02	5.35E-12 (1.91E-07)	1.29E-09 (4.60E-05)	1.65E-09 (5.90E-05)	1.12E-09 (3.99E-05)
46	Design basis ETF[g] airborne release due to tornado	3.69E-07 (beyond-extremely-unlikely)	2.17E-03	6.91E-05	3.90E-05	3.44E-04	3.20E-13 (8.68E-07)	1.02E-14 (2.76E-08)	7.20E-15 (1.95E-08)	6.35E-14 (1.72E-07)

a. Point estimate of increased risk per year is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor ¥ annual frequency.
b. Increased risk of fatal cancers per occurrence is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor.
c. A conservative assumption of 99.5 percentile meteorology was assumed for determining accident consequences for the exposed population within 80 kilometers. A less conservative meteorology (50 percentile) was used to determine the accident consequences for exposed individuals.
d. Intermediate-Level Non-Tritium Vault.
e. Savannah River Technology Center.
f. F3 tornadoes have rotational wind speeds of 254 to 331 kilometers (158 to 206 miles) per hour.
g Effluent Treatment Facility.

F.5.4.2.2 Impacts from New or Proposed Facilities

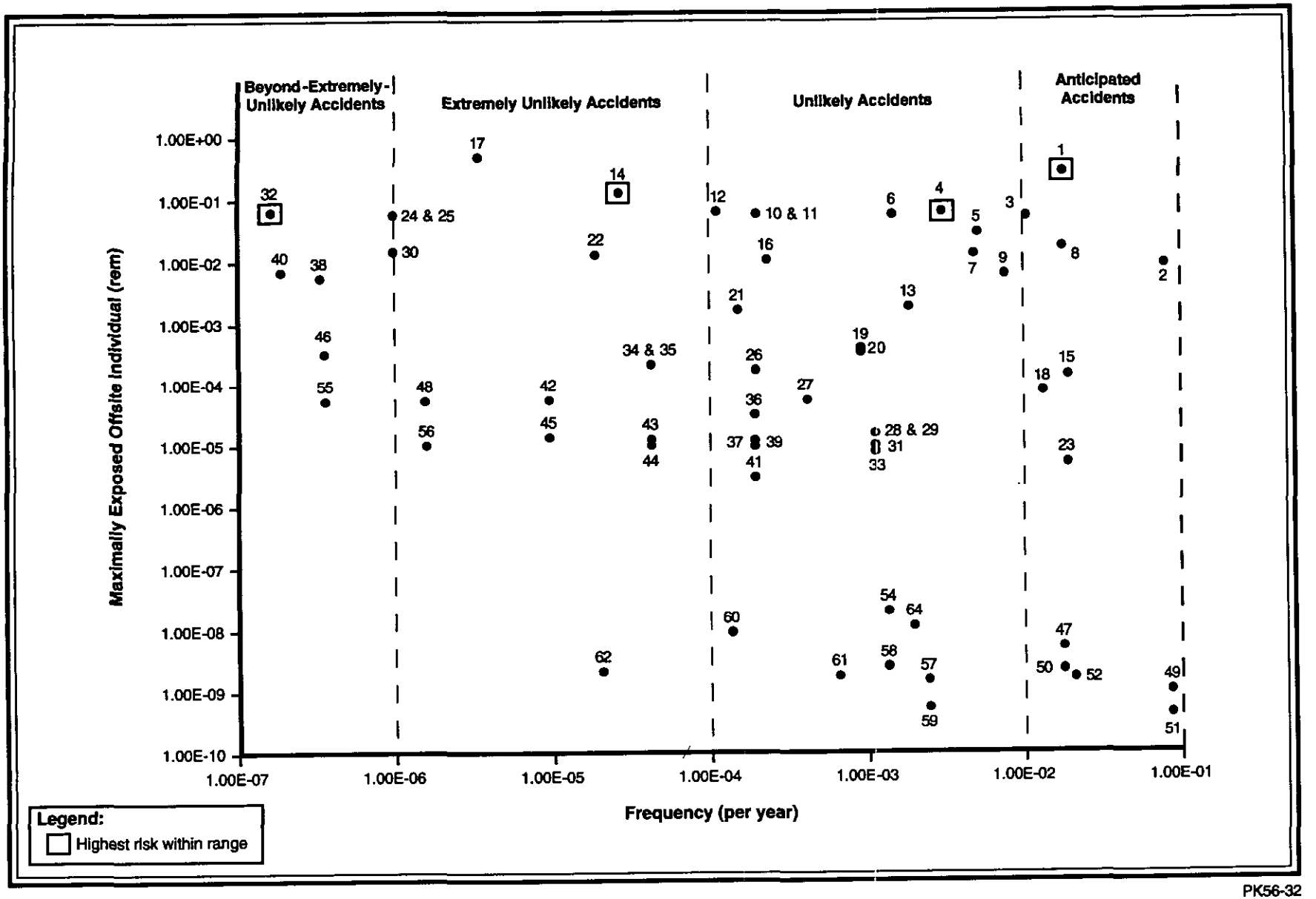
Table F-13 identifies no new or proposed facilities for the hazardous and mixed waste no-action alternative. TE

F.5.4.3 Accident Analysis for the Mixed Waste Under Alternative B

This section addresses the impacts of postulated accidents associated with alternative B for mixed wastes.

F.5.4.3.1 Impacts from Postulated Radiological Accidents

This section presents potential effects from postulated radiological accidents at facilities identified in Table F-13 for the management of mixed waste under alternative B. Figure F-6 shows the highest-risk accident scenarios for the various frequency ranges. As shown in Figure F-6, the accidents associated with mixed waste are analyzed over a broad spectrum of consequences and frequencies. The accident scenarios postulated for the F/H-Area Effluent Treatment Facility generally present lower consequences, while accident scenarios postulated for vault disposal facilities generally present higher consequences. Table F-16 lists the representative bounding accidents, accident consequences, and latent fatal cancers for exposed workers and the public for alternative B. DOE assumes that conclusions regarding representative bounding accident scenarios could change based on the minimum, maximum, and expected waste forecasts. The accident analyses for the accident scenarios are based on a conservative assumption of peak utilization of facilities [i.e., the minimum, maximum, and expected waste forecasts would only affect how long the facilities (e.g., the Consolidated Incineration Facility)] would operate. Therefore, while the consequence or frequency for postulated accidents do not change, the expected duration of risk from a facility-specific accident scenario could be longer or shorter, depending on the case. The number of new facilities needed to meet the mixed waste management requirements could be affected by the minimum, maximum, and expected waste forecasts. Thus, the consequence or frequency for specific accident scenarios could be increased or decreased, depending on the case. Impacts for the three cases are addressed in the representative bounding accident descriptions. TE TE



TE **Figure F-6.** Accidents that were analyzed for alternative B and alternative A for mixed waste facilities.

Table F-16. Representative bounding radiological accidents for mixed wastes under alternative B. TE

No.	Accident description	Frequency per year (accident range)	Accident consequences: Uninvolved worker at 100 meters (rem)	Accident consequences: Uninvolved worker at 640 meters (rem)	Accident consequences: Offsite maximally exposed individual (rem)	Accident consequences: Population within 80 kilometers[c] (person-rem)	Point estimate of increased risk per year[a] (increased risk of fatal cancers per occurrence)[b]: Latent fatal cancers: Uninvolved worker at 100 meters	Uninvolved worker at 640 meters	Offsite maximally exposed individual	Population within 80 kilometers
1	Container breach at the ILNTV[d]	2.00E-02 (anticipated)	6.47E+01	2.30E+00	3.31E-02	1.68E+03	1.04E-03 (5.18E-02)	1.85E-05 (9.20E-04)	3.31E-07 (1.66E-05)	1.68E-02 (8.40E-01)
4	Release due to multiple open containers at the containment building	3.00E-03 (unlikely)	3.91E-01	5.76E-01	8.13E-03	3.80E+02	4.69E-07 (1.56E-04)	6.91E-07 (2.30E-04)	1.22E-08 (4.07E-06)	5.70E-04 (1.90E-01)
14	F3 tornado[e] at Building 316-M	2.80E-05 (extremely unlikely)	4.78E-04	1.15E-01	1.18E-01	7.98E-02	5.35E-12 (1.91E-07)	1.29E-09 (4.60E-05)	1.65E-09 (5.90E-05)	1.12E-09 (3.99E-05)
32	Aircraft crash at the containment building	1.60E-07 (beyond-extremely-unlikely)	1.52E+01	5.41E-01	8.32E-03	3.99E+02	9.73E-10 (6.08E-03)	3.46E-11 (2.16E-04)	6.66E-13 (4.16E-06)	3.19E-08 (2.00E-01)

TE

a. Point estimate of increased risk per year is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor ¥ annual frequency.
b. Increased risk of fatal cancers per occurrence is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor.
c. A conservative assumption of 99.5 percentile meteorology was assumed for determining accident consequences for the exposed population within 80 kilometers. A less conservative meteorology (50 percentile) was used to determine the accident consequences for exposed individuals.
d. Intermediate-Level Non-Tritium Vault.
e. F3 tornadoes have rotational wind speeds of 254 to 331 kilometers (158 to 206 miles) per hour. TE

The representative bounding accidents and their impacts under the alternative B are briefly described below:

TE | Accident Scenario 1 – Container breach at the intermediate-level nontritium vault (two containers, noncombustible waste): This accident scenario is described in Section F.5.2.2 and is considered to be the representative bounding accident for the anticipated accident range.

Accident Scenario 4 – Release due to multiple (2 to 10) open containers at the containment building: The consequences of this accident scenario are bounded by the worst unmitigated accident scenario where the ventilation and scrubber systems of the containment building are assumed to fail. This accident scenario is considered the representative bounding accident for the unlikely accident range. Under the minimum, maximum, and expected waste forecasts, the containment building is expected to operate from 2006 to 2024. From 1994 to 2006 -- when the containment building is not operational -- the highest-risk accident in this frequency range would be Accident Scenario 18: Earthquake at the Savannah River Technology Center Storage Tanks.

Accident Scenario 14 – F3 tornado at Building 316-M: This accident scenario is detailed in Section F.5.4.2.1 and is considered the representative bounding accident for the extremely unlikely accident range. Utilization of this facility is expected to be the same under the minimum, maximum, and expected waste forecasts.

Accident Scenario 32 – Aircraft crash at the containment building: An aircraft could breach only that part of the containment building into which it crashes. DOE assumes that the consequences associated with this event are the same as for the worst unmitigated accident event for the entire containment building. Thus, whether one or all segments in the containment building are breached due to an aircraft crash, the consequences listed for this scenario are considered to be bounding. This accident scenario is considered the representative bounding accident for the beyond-extremely-unlikely-accident range. Under the minimum, maximum, and expected waste forecasts, the containment building is expected to operate from 2006 to 2024. From 1994 to 2006, the next highest risk accident in this frequency range would be Accident Scenario 50: Explosion at the Consolidated Incineration Facility tank farm sump and diked area.

F.5.4.3.2 Impacts from New or Proposed Facilities

Table F-13 identifies three proposed facilities under alternative B for which no quantitative accident analyses exist. Accidents associated with the soil sort facility are described in Section F.5.2.3.2 and with the non-alpha vitrification facility in Section F.5.2.5. TE

F.5.4.4 Accident Analysis for Mixed Waste Under Alternative A

The facilities listed in Table F-13 for alternative A are identical to those that support alternative B, except that alternative A does not include the non-alpha vitrification facility. Since this facility was not involved in the representative bounding accident, the effects from the postulated radiological accident scenarios for alternative A are identical to those described in Section F.5.4.3. TE

F.5.4.5 Accident Analysis for Mixed Waste Under Alternative C

The facilities listed in Table F-13 for alternative C are similar to those that support alternative B for mixed waste, except that the Consolidated Incineration Facility does not operate for the entire 30-year period under alternative C. Since this facility was not involved in the representative bounding accident, the effects from the postulated radiological accident scenarios for alternative C are identical to those described in Section F.5.4.3. TE

F.5.4.6 Impacts to Involved Workers from Accidents Involving Mixed Waste

The mixed waste accidents that have the highest risks involve the containment building. The accident initiators (aircraft crash, explosion, or tornado) are considered to be more dangerous to the worker than the resulting release of contaminants. The other accident scenarios (transfer errors or container damage) are not expected to cause serious injury to workers, because the operators will be equipped with a breathing supply via an air compressor airflow. An emergency supply of breathing air is provided for each worker from high pressure breathing air cylinders permanently connected to the breathing air systems.

F.5.4.7 Impacts from Mixed Waste Chemical Accidents

Because the mixed waste facilities contain radioactive materials with a hazardous chemical component, the results of the mixed waste accident scenarios bound the chemical hazards at hazardous waste

facilities. This section discusses the chemical hazards for mixed wastes, as well as those for hazardous wastes.

A chemical hazards analysis was performed for the Consolidated Incineration Facility as part of a safety analysis report. The basis for this analysis was that the chemical inventory would be such that an unmitigated release of all the material in one section of the facility would result in concentrations of
TE | chemicals at 100 meters (328 feet) less than one-half the concentration that is immediately dangerous to life and health (IDLH). The Consolidated Incineration Facility is considered a low hazard facility. The criteria for being a low hazard facility include the requirement that the nonradiological consequences associated with the highest accident frequencies are no greater than the specified IDLH value at
TE | 100 meters and 10 percent of the specified IDLH value at the SRS boundary. As reported in the technical report (WSRC 1994c), if releases are maintained below the IDLH onsite criterion, the releases are automatically below the IDLH offsite criterion. Since chemical inventories are controlled such that the worst-case nonradiological consequences can be no greater than 50 percent of the specified IDLH value at 100 meters (328 feet), both criteria are satisfied for the Consolidated Incineration Facility. As a result, further analysis is not necessary.

Preliminary chemical hazards analyses were performed for the E-Area mixed waste storage building, the N-Area mixed waste and hazardous waste storage buildings, and the B-Area hazardous waste storage building to determine the hazard categorization for each facility. The N-Area mixed waste and hazardous waste storage buildings have an inventory that bounds the E-Area mixed waste storage building and the B-Area hazardous waste storage building. The N-Area chemicals requiring further
TE | analysis to determine the potential consequences of their accidental release are listed in Table F-17. This table provides the maximum onsite and offsite airborne concentrations resulting from a postulated release of chemical inventory.

The Organic Waste Storage Tank associated with the Defense Waste Processing Facility would be the primary facility for the storage of benzene mixed waste. Benzene that has been separated from a precipitate slurry by distillation in the Defense Waste Processing Facility would be transferred approximately 112.7 meters (370 feet) to the Organic Waste Storage Tank in an above-ground pipe. Consequently, an explosion could occur in either the inner or outer tank or as a result of a benzene leak during a transfer. An explosion in either tank would occur if the oxygen concentration in the tank vapor space reaches the minimum required for combustion and the benzene vapor is ignited. A benzene release from the transfer line would form a pool on the ground, which would evaporate and form a vapor cloud. If ignited, the explosion of the vapor cloud could cause the Organic Waste Storage Tank to explode.

Table F-17. Mixed/hazardous waste chemical hazards analysis results.[a] TE

Chemical	Quantity (kg)[b]	Onsite concentration 100 meters (328 feet) (mg/m^3)[c]	Offsite Concentration (mg/m^3)[c]	ERPG-1[d] (mg/m^3)[c]	ERPG-2[d] (mg/m^3)[c]	ERPG-3[d] (mg/m^3)[c]
Arsenic	1.03E+03	4.5E-01	2.8E-04	6.00E-01	1.00E+00	1.00E+02
Benzene	3.0E+03	6.7E+02	4.2E-01	1.60E+01	1.60E+02	9.58E+03
Beryllium	1.0E+01	4.4E-03	2.8E-06	5.00E-03	1.00E-02	1.00E+01
Cadmium	6.0E+03	2.7E+00	1.7E-03	1.50E-01	2.50E-01	5.00E+02
Chromium	6.1E+03	2.7E+00	1.7E-03	1.50E+00	2.50+00	(e)
Lead	3.6E+05	1.6E+02	1.0E-01	1.50E-01	2.50E-01	7.00E+02
Mercury	3.4E+04	1.5E+01	9.4E-03	1.50E-01	2.00E-01	2.80E+01
Methyl chloride	6.5E+02	2.9E+02	1.8E-01	2.07E+02	4.13E+02	2.07E+04
Methyl ethyl ketone	8.0E+03	1.8E+03	1.1E+00	8.85E+02	2.95E+03	8.85E+03
Nickel	2.8E+01	4.4E-02	2.8E-05	3.00E+00	5.00E+00	(e)
Silver	1.1E+03	4.7E-01	3.0E-04	3.00E-01	5.00E-01	(e)
Trichloroethane	7.8E+04	3.5E+02	2.2E-01	1.91E+03	5.46E+03	1.64E+04
Xylene	3.3E+03	1.6E+01	9.9E-03	4.34E+02	8.69E+02	4.34E+03

a. The chemicals presented in this table are those for which concentration guidelines were available.
b. Kilograms. To convert to pounds, multiply by 2.2046.
c. Milligrams per cubic meter of air.
d. Emergency Response Planning Guideline. See Table F-3.
e. No equivalent value found.

In a tornado scenario, the Organic Waste Storage Tank is assumed to catastrophically fail as the result of a tornado-generated missile. As the benzene leaves the tank, "splashing" occurs, causing a fraction of the benzene to become an aerosol. The released benzene forms a pool [122 meters by 122 meters (400 feet by 400 feet)] bounded by the drainage ditch that surrounds the organic waste storage tank site. The tornado is assumed to remain in the vicinity of the pool for one minute. The evaporation rate from the pool during this minute is based on a tornado wind speed of 177 kilometers (110 miles) per hour.

Following the tornado, evaporation from the pool continues over the next 4 minutes under normal wind conditions of 10 miles per hour. It is assumed that after 5 minutes from the initial failure of the Organic Waste Storage Tank, the released benzene has completely drained to the drainage ditch. It is also assumed that normal wind conditions continue for the remainder of the event. Table F-18 presents the results for the two postulated Organic Waste Storage Tank chemical accident scenarios. TE

TE **Table F-18.** Chemical hazards accidents analysis results for the Organic Waste Storage Tank.

Accident description	Annual frequency	100-meter concentration (mg/m3)[a]	640-meter concentration (mg/m3)	Offsite concentration (mg/m3)	ERPG-1[b] (mg/m3)	ERPG-2 (mg/m3)	ERPG-3 (mg/m3)
Explosion at the OWST[c]	2.70E-04	1.40E+04	6.10E+02	5.70E+00	1.60E+01	1.60E+02	9.60E+03
Tornado at the OWST	1.00E-04	1.02E+04	1.21E+03	1.54E+01	1.60E+01	1.60E+02	9.60E+03

a. Milligrams per cubic meter of air.
b. Emergency Response Planning Guideline. See Table F-3.
c. Organic Waste Storage Tank.

Safety documentation does not analyze potential events involving hazardous materials at M-Area facilities. Using the methodology described in Section F.4.2 for M-Area facilities, it was determined that the inventory of sulfuric acid located in the Dilute Effluent Treatment Facility (341-M) would be the only chemical present in sufficient quantities to warrant further evaluation. This accident scenario assumed an unmitigated liquid spill of the entire inventory of sulfuric acid at 341-M, with a resulting pool covering 77 square meters (829 square feet) at a depth of 1 centimeter (0.39 inch). The evaporation rate for this liquid spill was estimated to be 2.01E-05 grams per second at standard pressure and
TE temperature. The results of this chemical analysis are presented in Table F-19.

TE **Table F-19.** Chemical hazards analysis results for the 341-M facility.

Chemical	Inventory (kilograms)[a]	100-meter concentration (mg/ m)[b]	640-meter concentration (mg/ m)[b]	Offsite concentration (mg/ m)[b]	ERPG-1[c] (mg/ m)[b]	ERPG-2[c] (mg/ m)[b]	ERPG-3[c] (mg/ m)[b]
Sulfuric acid	1.52E+04	9.10E-06	7.70E-07	2.70E-07	2.00E+00	1.00E+01	3.00E+01

a. To convert to pounds, multiply by 2.2046.
b. Milligrams per cubic meter of air.
c. Emergency Response Planning Guideline. See Table F-3.

F.5.5 TRANSURANIC AND ALPHA WASTE

The following sections address the impacts of postulated accidents associated with the alternatives considered in this EIS for the management of transuranic and alpha waste.

F.5.5.1 Facilities and Accidents: Transuranic and Alpha Waste

The accident analyses considered all facilities and processes involved in the management of transuranic and alpha waste. The facilities were identified from the transuranic waste information provided in Chapter 2. Table F-20 lists the facilities associated with each of the alternatives. Descriptions of these facilities are provided in Appendix B. For each facility, a list of postulated accident scenarios was developed to support the accident analysis for transuranic waste for each alternative. | TE

Table F-20. Transuranic and alpha waste facilities identified by alternative. | TE

List of facilities area	No-action alternative	Alternative A (limited treatment configuration)	Alternative C (extensive treatment configuration)	Alternative B (moderate treatment configuration)	
Low-activity waste vaults	X	X	X	X	TC
Transuranic and alpha waste storage pads	X	X	X	X	
Experimental Transuranic Waste Assay Facility/ Waste Certification Facility	X				
RCRA disposal[a]		X	X	X	
Alpha vitrification facility[b]			X	X	
Consolidated Incineration Facility			X		TC
Transuranic waste characterization/certification facility[b,c]		X	X	X	

a. Accidents for Resource Conservation and Recovery Act (RCRA) disposal are assumed to be bounded by the accident scenarios associated with the transuranic waste storage pads.
b. Proposed facility.
c. Accidents for the transuranic waste characterization/certification facility are assumed to be the same as the accident scenarios described in the Transuranic Waste Facility Preliminary Safety Analysis Report identified in the WSRC technical report presenting accident analyses for solid wastes (WSRC 1994c). | TE

Table F-21 lists potential accidents. This information was extracted from the technical reports supporting this EIS (WSRC 1994b, c, and e). While all the accidents listed in Table F-21 are supported by quantitative analyses, accident impacts for proposed facilities are not listed in the table because they are mainly qualitative. | TE

TE **Table F-21.** List of potential accidents associated with the management of transuranic waste.

No.	Accident description	Annual frequency	Dose[a] (rem)	Risk (rem/yr)
1	Deflagration in culvert during TRU[b] retrieval activities	1.00E-02	4.56E-01	4.56E-03
TC 2	Fire at the EAV/LAWV[c]	8.30E-02	3.55E-02	2.95E-03
3	Fire in culvert - TRU[b] storage pads	8.10E-04	1.94E+00	1.57E-03
4	Drum breach due to culvert overturn during TRU retrieval activities	4.00E-02	2.28E-02	9.12E-04
5	Container breach at the EAV/LAWV[c]	2.00E-02	4.00E-02	8.00E-04
6	Fire from all causes - TRU[b] storage pads	2.60E-03	7.52E-02	1.96E-04
7	Vehicular crash - TRU[b] storage pads	2.60E-03	6.84E-02	1.78E-04
8	Drum rupture on the TRU[b] storage pads (internally induced)	2.10E-02	5.70E-03	1.20E-04
9	Drum breach/fall of unlined drums during TRU[b] retrieval activities	7.20E-02	1.10E-01	7.92E-05
10	Fire in the TRU[b] waste characterization/certification facility w/o HEPA[d] bypass	6.00E-03	9.50E-03	5.70E-05
11	Drum breach/fall during TRU[b] retrieval activities	4.00E-02	1.10E-03	4.40E-05
12	Multiple drum deflagration during TRU[b] retrieval activities	1.50E-04	2.30E-02	3.45E-06
13	Vehicle crash/fire on the TRU[b] storage pads	6.50E-05	3.51E-01	2.28E-05
14	Explosion with fire in the TRU[b] waste characterization/ certification facility	4.20E-03	9.10E-04	3.82E-06
15	Large fire for entire CIF[e]	2.34E-04	1.07E-02	2.50E-06
16	Vehicle crash during TRU[b] retrieval activities	2.00E-04	4.60E-03	9.20E-07
17	Earthquake at CIF[e]	1.00E-03	2.65E-04	2.65E-07
18	Explosion at CIF[e] - rotary kiln	1.50E-04	1.57E-03	2.36E-07
19	High winds - TRU[b] storage pads	3.80E-03	5.50E-05	2.10E-07
20	Drum fire due to vehicle crash during TRU[b] retrieval activities	5.00E-06	2.30E-02	1.15E-07
21	High velocity straight winds at CIF[e]	2.00E-02	5.23E-06	1.05E-07
22	Tornado at the EAV/LAWV[c]	2.00E-05	4.90E-03	9.80E-08
TC 23	Earthquake - TRU[b] storage pads	2.00E-04	2.28E-04	4.56E-08
24	F2 tornado on TRU[b] storage pads	4.50E-05	7.00E-04	3.20E-08
25	Explosion at CIF[e] - backhoe housing	4.00E-04	5.64E-05	2.26E-08
26	Earthquake at the TRU[b] waste characterization/certification facility	2.00E-04	8.10E-05	1.62E-08
27	High wind at the EAV/LAWV[c]	1.00E-03	1.50E-05	1.50E-08
28	F3 tornado on TRU[b] storage pads	8.00E-06	1.50E-03	1.20E-08
29	Fire in the TRU[b] waste characterization/certification facility w/ HEPA[d] bypass	6.00E-06	6.52E-04	3.91E-09
30	High winds on the TRU[b] storage pads	4.00E-05	7.20E-05	2.90E-09
31	Explosion at CIF[e] - tank farm tank	3.40E-07	5.36E-03	1.82E-09
32	Explosion at CIF[e] - tank farm sump and dike area	1.90E-07	6.85E-03	1.30E-09
33	Criticality in the TRU[b] waste characterization/certification facility	1.00E-06	1.29E-03	1.29E-09
34	HEPA[d] filter bypass in the TRU[b] waste characterization/certification facility	2.00E-03	1.00E-09	2.00E-12

a. The dose given is for the offsite maximally exposed individual using 99.5 percentile meteorology.
b. Transuranic.
c. E-Area Vaults low-activity waste vault.
d. High efficiency particulate air.
TE e. Consolidated Incineration Facility.

F.5.5.2 Accident Analysis for Transuranic and Alpha Waste No-Action Alternative

This section addresses the effects of postulated accidents associated with the no-action alternative considered for transuranic wastes. The postulated accidents provide a baseline for comparison of the effects of the postulated accidents associated with the other alternatives. TE

F.5.5.2.1 Impacts from Postulated Radiological Accidents

From the list of potential radiological accidents presented in Table F-21, the representative bounding accident scenarios were identified for the no-action alternative. Figure F-7 shows the highest-risk accident scenarios for the four frequency ranges. As shown in Figure F-7, the accidents associated with the transuranic waste storage pads and the low-activity waste vaults are scattered over the three highest accident frequency ranges. However, there are no accidents identified in the technical reports for the beyond-extremely-unlikely accident range. Table F-22 lists the representative bounding accidents, accident consequences, and latent fatal cancers for exposed workers and the public. TE TC TE

Accident Scenario 1 – Deflagration in culvert during transuranic drum handling activities: The culverts are concrete containers used to store up to 14 transuranic waste drums. Transuranic waste drum handling activities would require the movement of some culverts and other waste containers to gain access to the waste drums. Because the drums inside a culvert are not vented, a flammable mixture of hydrogen and air could exist (due to the radiolysis of the polyethylene wrappings inside the drum). Ignition of this flammable gas mixture would most likely occur due to a shift in the material while moving the culverts. Although the curie content of the drums inside the culverts is much higher than that in drums stored directly on transuranic waste storage pads, it is assumed that the amount of curies released to the atmosphere due to a drum deflagration inside a culvert would be mitigated somewhat by the culvert. This accident scenario is considered the representative bounding accident for the anticipated accident range. TC

Accident Scenario 3 – Fire in a culvert at the transuranic and alpha waste storage pads (one drum): Culverts are concrete containers used to store up to 14 transuranic 55-gallon drums. Transuranic drums stored in concrete culverts potentially generate hydrogen gas through radiolytic decomposition of organics that could be in the drums. As a consequence, a fire hazard is associated with the storage of transuranic and alpha waste in drums. A postulated fire in a concrete culvert is assumed to involve only one drum, since other drums are sealed with gaskets and the lids are secured with metal ring clamps.

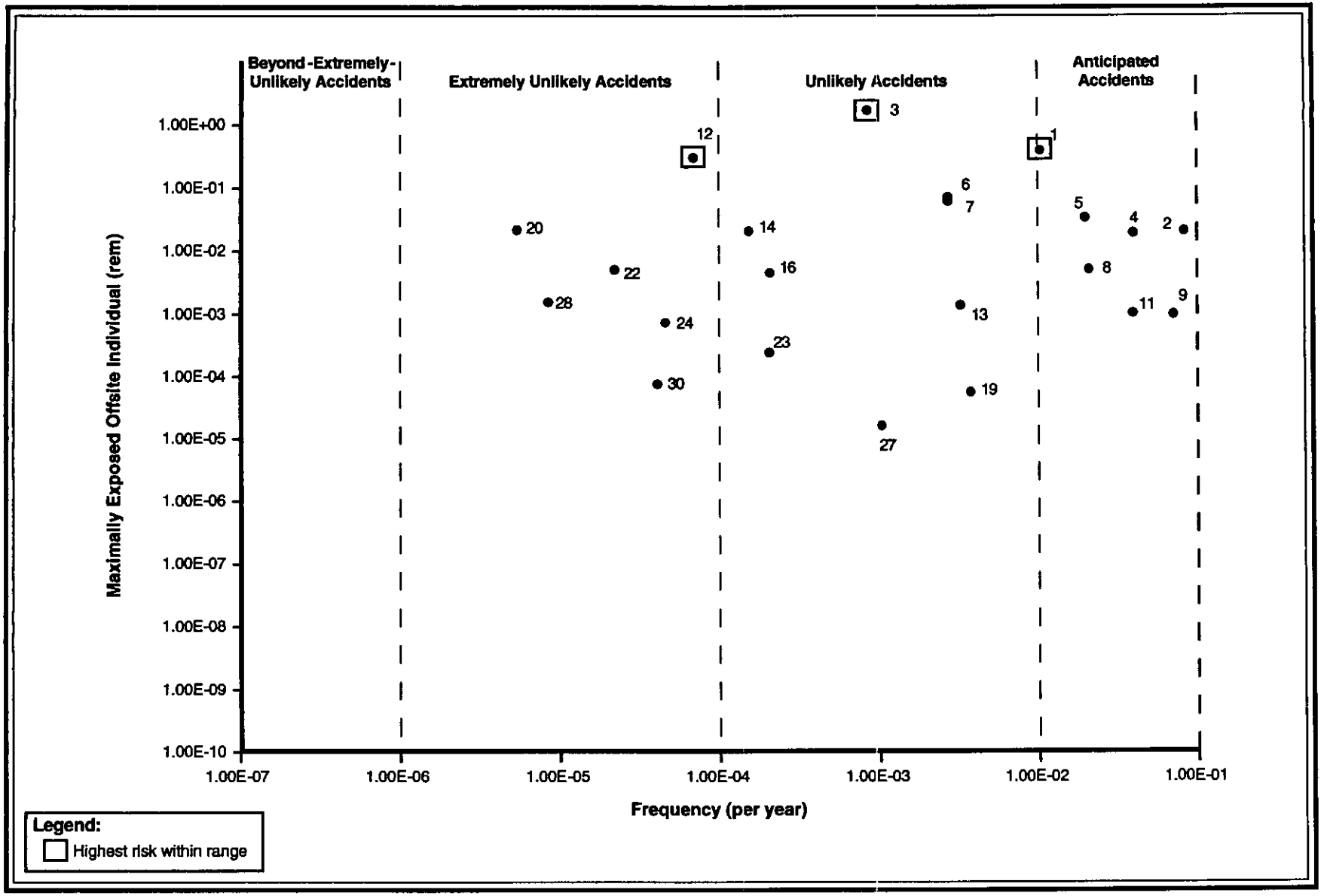


Figure F-7. Accidents that were analyzed for the no-action alternative for transuranic waste facilities.

Table F-22. Representative bounding radiological accidents for transuranic waste under the no-action alternative. TE

No.	Accident description	Frequency (per year)	Accident consequences: Uninvolved worker at 100 meters (rem)	Accident consequences: Uninvolved worker at 640 meters (rem)	Accident consequences: Offsite maximally exposed individual (rem)	Accident consequences: Population within 80 kilometers[c] (person-rem)	Point estimate of increased risk per year[a] (increased risk of fatal cancers per occurrence)[b]: Latent fatal cancers: Uninvolved worker at 100 meters	Latent fatal cancers: Uninvolved worker at 640 meters	Latent fatal cancers: Offsite maximally exposed individual	Latent fatal cancers: Population within 80 kilometers
1	Deflagration in culvert during TRU[d] drum retrieval activities	1.00E-02 (anticipated)	1.12E+02	3.97E+00	5.72E-02	2.90E+03	8.96E-04 (8.96E-02)	1.59E-05 (1.59E-03)	2.86E-07 (2.86E-05)	1.45E-02 (1.45E+00)
3	Fire in culvert at the TRU[d] waste storage pads (one TRU drum in culvert)	8.10E-04 (unlikely)	4.74E+02	1.69E+01	2.43E-01	1.23E+04	3.07E-04 (3.79E-01)	5.48E-06 (6.76E-03)	9.84E-08 (1.22E-04)	4.98E-03 (6.15E+00)
13	Vehicle crash with resulting fire at the TRU[d] waste storage pads	6.50E-05 (extremely unlikely)	8.59E+01	3.06E+00	4.40E-02	2.23E+03	4.47E-06 (6.87E-02)	7.96E-08 (1.22E-03)	1.43E-09 (2.20E-05)	7.25E-05 (1.12E+00)

TE

a. Point estimate of increased risk per year is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor ¥ annual frequency.
b. Increased risk of fatal cancers per occurrence is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor.
c. A conservative assumption of 99.5 percentile meteorology was assumed for determining accident consequences for the exposed population within 80 kilometers. A less conservative meteorology (50 percentile) was used to determine the accident consequences for exposed individuals.
d. Transuranic.

TE Accident Scenario 12 – Vehicle crash with resulting fire at the transuranic waste storage pads: The frequency of a vehicle crash into a transuranic pad impacting waste containers is estimated as
TE 2.60E-03 event per year. Approximately 2.5 percent of vehicle crashes result in fires. Therefore, the frequency of a vehicle crashing into a transuranic pad and causing a fire is estimated to be 6.50E-05
TE event per year. It is estimated that a vehicle crash into a transuranic pad followed by a fire would affect 7 pallets (28 drums) of transuranic waste.

F.5.5.2.2 Impacts from New or Proposed Facilities

Table F-20 identifies no new or proposed facilities under the no-action alternative for transuranic waste.

F.5.5.3 Accident Analysis for the Transuranic and Alpha Waste Under Alternative B

This section addresses the impacts of postulated accidents associated with alternative B considered for the transuranic waste stream.

F.5.5.3.1 Impacts from Postulated Radiological Accidents

This section presents potential effects from postulated radiological accidents at facilities identified in
TE Table F-20 for alternative B. Figure F-8 shows the highest-risk accident scenarios for the four frequency ranges. As shown in Figure F-8, this alternative consists of many more accident scenarios than the no-action alternative. There are no accidents listed in the technical reports for the beyond-extremely-unlikely accident range. Table F-23 lists the representative bounding accidents, accident consequences, and latent fatal cancers for exposed workers and the public. Although alternative B has additional
TC facilities associated with it, the representative bounding radiological accident scenarios are the same as those for the no-action alternative (Table F-23). However, DOE assumes that the conclusions regarding the representative bounding accident scenarios could be affected by alternative B minimum, maximum, and expected waste forecasts. The accident analyses for the accident scenarios are based on a conservative assumption of peak utilization of facilities, [i.e., the minimum, maximum, and expected waste forecasts would only affect how long the facilities (e.g., the Experimental Transuranic Waste Assay Facility/Waste Certification Facility), would operate]. Therefore, while consequences or
TE frequencies for postulated accidents do not change, the expected duration of risk from a facility-specific accident scenario could be longer or shorter, depending on the case. However, the number of new facilities needed to meet the transuranic waste management requirements could be affected by the

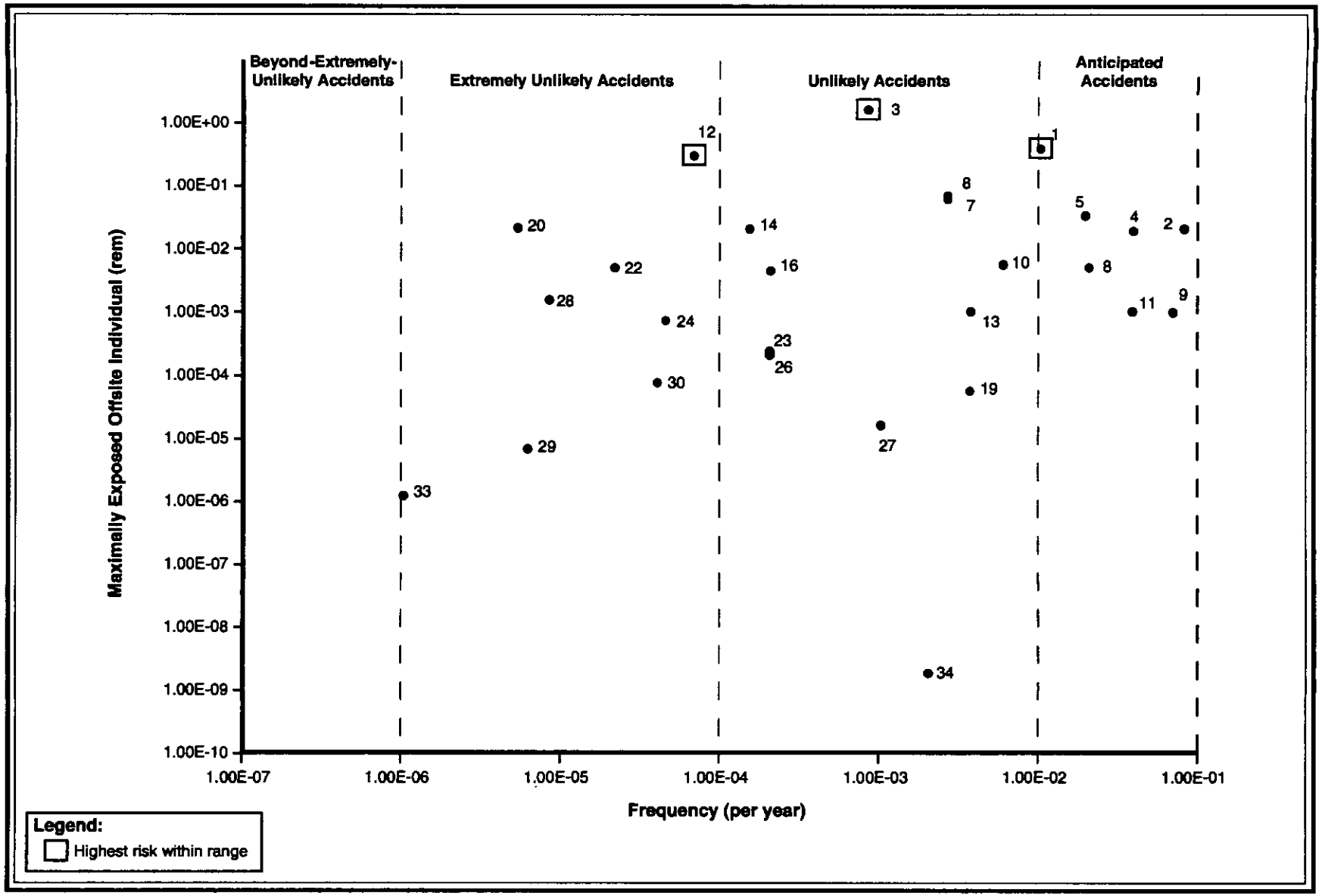


Figure F-8. Accidents that were analyzed for alternative B and alternative A for transuranic waste facilities.

TE | **Table F-23.** Representative bounding radiological accidents for transuranic waste under alternative B.

No.	Accident description	Frequency (per year)	Accident consequences: Uninvolved worker at 100 meters (rem)	Accident consequences: Uninvolved worker at 640 meters (rem)	Accident consequences: Offsite maximally exposed individual (rem)	Accident consequences: Population within 80 kilometers[c] (person-rem)	Point estimate of increased risk per year[a] (increased risk of fatal cancers per occurrence)[b]: Latent fatal cancers: Uninvolved worker at 100 meters	Uninvolved worker at 640 meters	Offsite maximally exposed individual	Population within 80 kilometers
1	Deflagration in culvert during TRU[d] drum retrieval activities	1.00E-02 (anticipated)	1.12E+02	3.97E+00	5.72E-02	2.90E+03	8.96E-04 (8.96E-02)	1.59E-05 (1.59E-03)	2.86E-07 (2.86E-05)	1.45E-02 (1.45E+00)
3	Fire in culvert at the TRU[d] waste storage pads (one TRU drum in culvert)	8.10E-04 (unlikely)	4.74E+02	1.69E+01	2.43E-01	1.23E+04	3.07E-04 (3.79E-01)	5.48E-06 (6.76E-03)	9.84E-08 (1.22E-04)	4.98E-03 (6.15E+00)
TE 13	Vehicle crash with resulting fire at the TRU[d] waste storage pads	6.50E-05 (extremely unlikely)	8.59E+01	3.06E+00	4.40E-02	2.23E+03	4.47E-06 (6.87E-02)	7.96E-08 (1.22E-03)	1.43E-09 (2.20E-05)	7.25E-05 (1.12E+00)

a. Point estimate of increased risk per year is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor ¥ annual frequency.
b. Increased risk of fatal cancers per occurrence is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor.
c. A conservative assumption of 99.5 percentile meteorology was assumed for determining accident consequences for the exposed population within 80 kilometers. A less conservative meteorology (50 percentile) was used to determine the accident consequences for exposed individuals.
d. Transuranic.

minimum, maximum, and expected waste forecasts. Thus, the consequences or frequencies for specific accident scenarios could be increased or decreased, depending on the case. Impacts for these cases are addressed in the representative bounding accident descriptions in Section F.5.5.2.1. TE TE

Under the expected waste forecast, 14 additional transuranic and alpha waste storage pads would be required. However, for the minimum waste forecast (6 additional transuranic and alpha waste storage pads), it could be assumed that the frequency of this accident scenario occurring would be less than the expected waste forecast, because fewer containers are at risk due to a deflagration. For the maximum waste forecast (1,173 additional transuranic and alpha waste storage pads), it could be assumed that the frequency of this accident scenario occurring would be much greater than the expected waste forecast, because a great many more containers are at risk due to a deflagration. TE

Accident Scenario 3 – Fire in transuranic culvert at the transuranic and alpha waste storage pads (one transuranic drum): This accident scenario is detailed in Section F.5.5.2.1 and is considered the representative bounding accident for the unlikely accident range.

Accident Scenario 12 – Vehicle crash with resulting fire at the transuranic and alpha waste storage pads: This accident scenario is detailed in Section F.5.5.2.1 and is considered the representative bounding accident for the extremely unlikely accident range. Impacts regarding the alternative B minimum, maximum, and expected waste forecasts would be similar in terms of decreasing and increasing risk, as discussed in the preceding representative bounding accident description. TC

F.5.5.3.2 Impacts from New or Proposed Facilities

Table F-20 identifies one proposed facility for which quantitative or qualitative accident analyses do not exist. This facility is described below. Because the facility is proposed and its design is not complete, quantitative analyses at this point would provide non-meaningful risk information (because the design could be changed) that could be compared to the risk information available for existing facilities. However, DOE will perform quantitative analyses throughout the design, construction, and operation phases of proposed facilities in accordance with requirements, and DOE will ensure that the risks associated with operating these facilities are within established regulatory guidelines. TE

Alpha vitrification facility – The alpha vitrification facility would prepare waste for vitrification, vitrify it, and treat the secondary waste gases and liquids generated by the vitrification process. The waste would include newly generated alpha-contaminated waste and mixed waste, alpha-contaminated waste and mixed waste in storage, and some mixed waste soils. This waste would fall in the following

treatability groups: 10 to 100 nanocuries per gram nonmixed; 10 to 100 nanocuries per gram mixed; and greater than 100 nanocuries per gram transuranic waste. All waste would enter this facility in drums transported from the transuranic waste characterization/certification facility. The final vitrified and low-temperature stabilized waste forms would be sent back through the transuranic waste characterization/ certification facility for final certification. The vitrification facility would consist of a thermal pretreatment unit, a melter, an afterburner, and an offgas treatment unit. The afterburner would enhance destruction of any remaining hazardous organic compounds prior to treatment in the offgas system. The offgas system would scrub the gases and minimize the release of any hazardous materials or particulates to the atmosphere. It can be assumed that the accidents initiated by the alpha vitrification facility would be similar to those for the Defense Waste Processing Facility vitrification facility. However, the releases would be minor in comparison. It is also assumed that the offgas treatment unit accidents would be similar to those for the F/H-Area Effluent Treatment Facility.

F.5.5.4 Accident Analysis for Transuranic and Alpha Waste Under Alternative A

The facilities under alternative A are identical to the facilities identified to support alternative B, except that alternative A does not include the alpha vitrification facility. Because the alpha vitrification facility is a proposed facility and as such did not contribute to the representative bounding accidents, it is assumed that the impacts from the postulated radiological scenarios for alternative A are the same as described in Section F.5.5.3.

F.5.5.5 Accident Analysis for Transuranic and Alpha Waste Under Alternative C

This section addresses the impacts of the postulated accidents associated with alternative C considered for the transuranic waste stream.

This section presents potential effects from postulated radiological accidents at facilities identified in Table F-20 for alternative C. Figure F-9 shows the highest risk accident scenarios for the four frequency ranges. As shown in Figure F-9, this alternative consists of many more accident scenarios than the no-
TC action alternative, with a substantial addition of accidents in the unlikely and beyond-extremely-unlikely accident frequency ranges. Table F-24 lists the representative bounding accidents, accident consequences, and latent fatal cancers for exposed workers and the public. DOE assumes that the conclusions regarding the representative bounding accident scenarios could be affected by alternative C minimum, maximum, and expected waste forecasts. The accident analyses for the accident scenarios are based on the conservative assumption of peak utilization of facilities [i.e., the minimum, maximum, and expected waste forecasts would only affect how long the facilities (e.g., Experimental Transuranic Waste

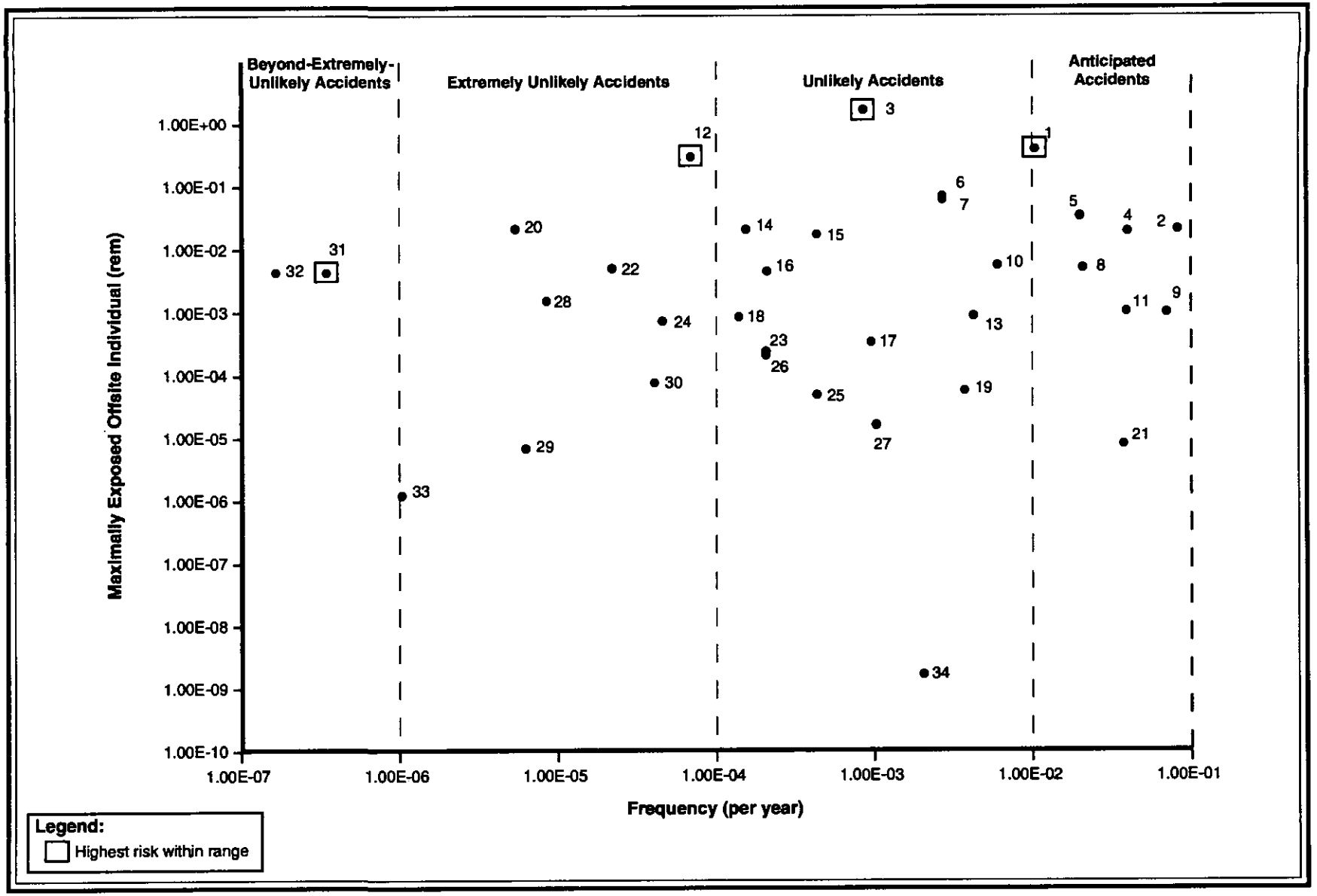


Figure F-9. Accidents that were analyzed for alternative C for transuranic waste facilities.

TC

Table F-24. Representative bounding radiological accidents for transuranic waste under alternative C.

No.	Accident description	Frequency per year (accident range)	Accident consequences: Uninvolved worker at 100 meters (rem)	Accident consequences: Uninvolved worker at 640 meters (rem)	Accident consequences: Offsite maximally exposed individual (rem)	Accident consequences: Population within 80 kilometers[c] (person-rem)	Point estimate of increased risk per year[a] (increased risk of fatal cancers per occurrence)[b]: Latent fatal cancers: Uninvolved worker at 100 meters	Uninvolved worker at 640 meters	Offsite maximally exposed individual	Population within 80 kilometers
1	Deflagration in culvert during TRU[d] drum retrieval activities	1.00E-02 (anticipated)	1.12E+02	3.97E+00	5.72E-02	2.90E+03	8.96E-04 (8.96E-02)	1.59E-05 (1.59E-03)	2.86E-07 (2.86E-05)	1.45E-02 (1.45E+00)
3	Fire in culvert at the TRU[d] waste storage pads (one TRU drum in culvert)	8.10E-04 (unlikely)	4.74E+02	1.69E+01	2.43E-01	1.23E+04	3.07E-04 (3.79E-01)	5.48E-06 (6.76E-03)	9.84E-08 (1.22E-04)	4.98E-03 (6.15E+00)
12	Vehicle crash with resulting fire at the TRU[d] waste storage pads	6.50E-05 (extremely unlikely)	8.59E+01	3.06E+00	4.40E-02	2.23E+03	4.47E-06 (6.87E-02)	7.96E-08 (1.22E-03)	1.43E-09 (2.20E-05)	7.25E-05 (1.12E+00)
	Explosion at CIF[e] - tank farm	3.40E-07 (beyond-extremely-unlikely)	1.28E+00	4.07E-02	7.01E-04	4.79E+01	1.74E-10 (5.12E-04)	5.54E-12 (1.63E-05)	1.19E-13 (3.51E-07)	8.14E-09 (2.40E-02)

a. Point estimate of increased risk per year is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor ¥ annual frequency.
b. Increased risk of fatal cancers per occurrence is calculated by multiplying the consequence (dose) ¥ latent cancer conversion factor.
c. A conservative assumption of 99.5 percentile meteorology was assumed for determining accident consequences for the exposed population within 80 kilometers. A less conservative meteorology (50 percentile) was used to determine the accident consequences for exposed individuals.
d. Transuranic.
e. Consolidated Incineration Facility.

TC

Assay Facility/Waste Certification Facility) would operate]. Therefore, while consequences or frequencies for postulated accidents do not change, the expected duration of risk from a facility-specific accident scenario could be longer or shorter, depending on the case. However, the number of new facilities needed to meet the transuranic waste management requirements could be affected by the minimum, maximum, and expected waste forecasts. Impacts for these cases are addressed in the representative bounding accident descriptions.

Accident Scenario 1 – Deflagration in culvert during drum handling activities. This accident scenario is detailed in Section F.5.5.3.1 and is considered the representative bounding accident for the anticipated accident range.

Accident Scenario 3 – Fire in transuranic culvert at the transuranic and alpha waste storage pads (one transuranic drum): This accident scenario is detailed in Section F.5.5.2.1 and is considered the representative bounding accident for the unlikely accident range. TC

Accident Scenario 12 – Vehicle crash with resulting fire at the transuranic and alpha waste storage pads: This accident scenario is detailed in Section F.5.5.2.1 and is considered the representative bounding accident for the extremely unlikely accident range. Impacts regarding alternative B minimum, maximum, and expected waste forecasts would be similar in terms of decreasing and increasing risk, as discussed in the preceding representative bounding accident description.

Accident Scenario 31 – Explosion of tanks associated with the Consolidated Incineration Facility: This accident scenario is detailed in Section F.5.2.3.1 and is considered the representative bounding accident for the beyond extremely unlikely accident range.

F.5.5.6 Impacts to Involved Workers from Accidents Involving Transuranic and Alpha Waste

While it is not a representative bounding accident in this analysis, a criticality in the transuranic waste characterization/certification facility could be the most dangerous accident scenario for the involved worker. Direct radiation could affect personnel in the facility, depending on their proximity to the accident location and the degree of shielding in place. Potentially lethal radiation doses (approximately 400 rem) could be received by a person about 7 meters (23 feet) from an unshielded event producing 2.0E+17 fissions. Because 2.0E+18 fissions are assumed for a criticality in the transuranic waste characterization/certification facility, it is estimated that the dose at 7 meters (23 feet) would be approximately 4,000 rad. The 12-inch-thick concrete walls of the waste preparation cell would reduce

the radiation dose by a factor of approximately 10, although cell windows would probably provide less protection. Personnel adjacent to the walls of the waste preparation cell could receive fatal doses.

If the high efficiency particulate air filters were bypassed, as assumed in the transuranic waste characterization/certification facility fire scenario, the combustion products would be exhausted to the atmosphere via the sand filter. Thus, DOE assumes no fatalities to workers from radiological consequences. Additionally, operators in the waste preparation cell of the transuranic waste characterization/certification facility would be equipped with respiratory protection and would follow facility-specific and SRS safety procedures.

Accident scenarios involving transuranic waste drum retrieval operations are not expected to result in serious injury or fatalities to involved workers due to radiological consequences. There would be a containment structure for the vent and purge station to protect workers from injury due to a deflagration in a waste drum. Portable air monitors would be required for this operation, in addition to a contamination control hut with a carbon high efficiency particulate air filter exhaust, which would prevent serious injury to adjacent workers due to exposure. Workers inside the contamination hut would be required to wear protective equipment, including respirators, when there is a potential for an airborne contamination.

F.5.5.7 Impacts from Transuranic and Alpha Waste Chemical Accidents

A chemical hazards analysis was performed for the transuranic and alpha waste storage pads. For a discussion of the hazard analysis methodology, refer to Section F.4.2. In the hazards assessment document prepared for the transuranic waste storage pads, specific accidents were not analyzed. Instead, the entire quantity of chemicals in each segment was assumed to be released. Table F-25 lists the results of this chemical assessment. Because the concentrations do not exceed the ERPG-1 limits, no further analyses were performed. The preliminary chemical hazards analysis performed in conjunction with the initial hazard categorization of the transuranic and alpha waste storage pads provides a bounding chemical analysis for the transuranic and alpha waste. The transuranic waste storage pads are representative of the entire transuranic and alpha waste inventory contained in E-Area. Other facilities such as the transuranic waste characterization/certification facility, alpha vitrification facility, and transuranic waste retrieval activities involve the manipulation of the transuranic and alpha waste inventory, including chemicals contained on the transuranic and alpha waste storage pads.

Table F-25. Transuranic and alpha waste storage pads chemical hazards analysis results.[a]

Chemical	Quantity (kg)[b]	Onsite concentration 100 meters (328 feet) (mg/m^3)[c]	Offsite concentration (mg/m^3)[c]	ERPG-1[d] (mg/m^3)[c]	ERPG-2[d] (mg/m^3)[c]	ERPG-3[d] (mg/m^3)[c]
Beryllium	3.74E+04	1.67E+01	8.23E-03	5.00E-03	1.00E-02	1.00E+01
Cadmium	7.50E+05	3.33E+02	1.65E-01	1.50E-01	2.50E-01	5.00E+01
Chloroform	3.75E+04	8.33E+03	4.11E+00	1.47E+02	4.88E+02	4.88E+03
Chromium	3.75E+04	1.67E+01	8.23E-03	1.50E-01	2.50E+00	(e)
Copper	1.50E+05	6.67E+01	3.29E-02	3.00E+00	5.00E+00	(e)
Lead	1.50E+06	6.67E+02	3.29E-01	1.50E-01	2.50E-01	7.00E+02
Lead nitrate	3.75E+04	1.67E+01	8.23E-03	1.50E-01	2.50E-01	7.00E+02
Mercuric nitrate	3.75E+04	1.67E+01	8.23E-03	1.50E-01	2.00E-01	2.80E+01
Mercury	3.75E+04	1.67E+01	8.23E-03	1.50E-01	2.00E-01	2.80E+01
Methyl isobutyl ketone	3.75E+04	1.67E+02	8.23E-02	3.07E+02	1.02E+03	1.23E+04
Nickel nitrate	3.75E+04	1.67E+01	8.23E-03	3.00E+00	5.00E+00	(e)
Silver nitrate	3.75E+04	1.67E+01	8.23E-03	3.00E-01	5.00E-01	(e)
Sodium chromate	3.75E+04	1.67E+01	8.23E-03	1.50E-01	2.50E-01	3.00E+01
Toluene	3.75E+04	8.33E+03	4.11E+00	3.77E+02	7.54E+02	7.54E+03
Trichlorotrifluoro-ethane	3.75E+04	1.67E+01	8.23E-03	9.58E+03	1.15E+04	3.45E+04
Uranyl nitrate	3.75E+04	1.67E+01	8.23E-03	1.50E-01	2.50E-01	3.00E+01
Xylene	3.75E+04	1.67E+02	8.23E-02	4.34E+02	8.69E+02	4.34E+03
Zinc	3.75E+04	1.67E+01	8.23E-03	3.00E+01	5.00E+01	(e)
Zinc nitrate	3.75E+04	1.67E+01	8.23E-03	3.00E+01	5.00E+01	(e)

a. The chemicals presented in this table are those for which concentration guidelines were available.
b. Kilograms. To convert to pounds, multiply by 2.2046.
c. Milligrams per cubic meter of air.
d. Emergency Response Planning Guideline. See Table F-3.
e. No equivalent value found.

While the chemical analysis did not address frequencies associated with chemical releases, some qualitative statements concerning the frequency of chemical releases can be made. Because the chemical inventory contained on the transuranic and alpha waste storage pads is widely dispersed, it is difficult to identify a credible accident scenario that could liberate the entire or even a large portion of the chemical inventory. More probable are the accident scenarios identified in Section F.5.3, which would release small amounts of hazardous chemicals along with radionuclides.

TE A chemical hazards analysis was performed for the Consolidated Incineration Facility. The results of this analysis are described in Section F.5.4.7.

F.6 Cumulative Impacts from Postulated Accidents

A severe seismic event was identified as the only reasonably foreseeable accident that has the potential to initiate simultaneous releases of radioactive or toxic materials from multiple facilities at SRS. A design-basis earthquake, which has an estimated ground acceleration of 0.2 times the acceleration of gravity (0.2*g*) potentially could impact multiple facilities. An earthquake of this magnitude is estimated to have TC TE a 2.0×10^{-4} annual probability of occurrence (1 in 5,000 years). Analyses estimating the cumulative impacts from multiple facility releases caused by a severe earthquake at SRS have not been included in TE the list of potential accidents (Tables F-4, F-9, F-14, and F-21). Such analyses would be based on the assumption that the earthquake breaches all of the buildings and their materials are released. Even accounting for release fractions and taking credit for existing facility design parameters, this type of analysis is considered too conservative because it is not expected that an earthquake of 0.2*g* would cause equivalent amounts of damage at multiple locations. Trying to realistically estimate impacts from multiple facilities at different locations would inherently include a margin of error of sufficient magnitude to compromise the confidence in the resulting estimate.

The illustration below is based on the unlikely assumption that an earthquake would cause each postulated accident scenario initiated by an earthquake to occur simultaneously. However, the analysis TC shows that the cumulative risk of these simultaneous accidents would be less than the highest-risk accident (Table F-26). Table F-26 lists the risk of each earthquake-initiated accident and the sum of TC those risks. The highest-risk event is more than 10 times the cumulative seismic-event risk for each corresponding waste type.

The synergistic effects of chemical hazards from simultaneous releases from a common accident initiator were not evaluated due to the scarcity of information about the effects of concurrent exposure to various chemical combinations. DOE is not aware of synergistic effects resulting from simultaneous exposures to radiation and a carcinogenic chemical, such as benzene, each of which is known to result in an increased incidence of cancer. Indeed, synergistic effects of radiation and other agents have been identified in only a few instances, most notably the combined effects of radiation exposure and smoking causing lung cancer among uranium miners. Radioactivity released simultaneously with hazardous chemicals could affect the clean-up or mitigation of the resulting hazard that could have a greater impact than if the releases were separate.

Table F-26. Conservative estimate of risk from seismic accidents.

	High-level waste[a]		Hazardous and mixed waste[b]		Low-level waste[c]		Transuranic waste[d]		
	Accident number	Risk (rem/yr)	Accident number	Risk (rem/yr)	Accident number	Risk (rem/yr)	Accident number	Risk (rem/yr)	
	3	1.63 E-05	6	9.30E-05	14	2.65E-07	17	2.65E-07	TC
	13	6.82E-07	11	1.17E-05			23	4.56E-08	
	27	6.76E-09	13	3.30E-06			26	1.62E-08	
	28	5.54E-09	20	2.65E-07					
	33	1.88E-09	26	3.08E-08					
	34	1.54E-09	36	5.54E-09					
	40	5.00E-10	37	1.88E-09					
	56	7.71E-11	39	1.54E-09					
	66	1.38E-11	41	5.00E-10					
			48	7.71E-11					
			53	2.34E-11					
			56	1.38E-11					
Total seismic risk		1.70E-05		1.08E-04		2.65E-07		3.27E-07	TC
Highest risk accident		1.91E-04		5.26E-03		5.20E-03		4.56E-03	

a. See Table F-4.
b. See Table F-14.
c. See Table F-9.
d. See Table F-21.

F.7 Secondary Impacts from Postulated Accidents

The primary focus of accident analyses performed to support the operation of a facility is to determine the magnitude of the consequences of postulated-accident scenarios on public and worker health and safety. DOE recognizes that accidents involving releases of materials can also adversely affect the surrounding environment. To determine the greatest impact that could occur to the environment from the postulated accidents, DOE evaluated each radiological accident scenario to determine potential secondary impacts.

F.7.1 BIOTIC RESOURCES

The consequences of a postulated accident on biotic resources have not been studied. DOE believes that the area of contamination from the postulated-accident scenarios would be localized. Terrestrial biota in or near the contaminated area could be exposed to small quantities of radioactive materials and ionizing radiation until the affected areas could be decontaminated. Effects on aquatic biota would be minor, since no waste management facilities are near any major bodies of water.

F.7.2 WATER RESOURCES

No adverse impacts on water quality from the postulated-accident scenarios are considered likely. Contamination of the groundwater or surface water due to the postulated releases would be minor. Contamination would migrate slowly to the groundwater, so the clean-up efforts that would follow a release incident would capture the contaminants before they reached groundwater.

F.7.3 ECONOMIC IMPACTS

With the exception of the economic effects generated by severe-accident scenarios, such as those initiated by severe earthquakes, limited economic effects would occur as a result of accident scenarios postulated in this appendix. Clean-up of contamination would be localized at the facility where the accident occurred, and DOE expects that the current workforce could perform the clean-up activities. In addition, DOE expects that offsite contamination would be limited or nonexistent.

F.7.4 NATIONAL DEFENSE

The postulated-accident scenarios considered for SRS waste management facilities would not affect national defense.

F.7.5 ENVIRONMENTAL CONTAMINATION

Contamination of the environment from the postulated accidents for SRS waste management facilities would be limited to the immediate area surrounding the facility where the accident occurred. It is unlikely that the postulated accidents would result in offsite contamination.

F.7.6 THREATENED AND ENDANGERED SPECIES

Habitats of Federally listed threatened or endangered species have not been identified in the immediate vicinity of the SRS waste management facilities. Because the accident scenarios postulated in this appendix would result only in localized contamination, DOE does not expect these accidents to affect threatened or endangered species.

F.7.7 LAND USE

Because the accidents postulated in this appendix would result in only localized contamination around the facility where an accident occurred, and no measurable offsite contamination is likely, DOE expects no impacts on land use.

F.7.8 TREATY RIGHTS

The environmental impacts of accidents postulated in this appendix would be within the SRS boundaries. Because there are no Native American lands within SRS boundaries, treaty rights would not be affected. | TE

F.8 Accident Mitigation

An important part of the accident analysis process is to identify actions that can mitigate consequences from accidents if they occur.[3] This section summarizes the SRS emergency plan, which governs responses to accident situations that affect SRS employees or the offsite population. | TE

The *Savannah River Site Emergency Plan* defines appropriate response measures for the management of site emergencies (e.g., radiological or hazardous material accidents). It incorporates into one document a | TE

[3]It should be noted that no credit was taken for accident response under the SRS emergency plan in determining the potential consequences and risks to workers or members of the public presented in earlier sections of this appendix.

description of the entire process designed to respond to and mitigate the consequences of an accident. For example, protective actions guidelines are established for accidents involving chemical releases to keep onsite and offsite exposures as low as possible. Exposure is minimized or prevented by limiting the time spent in the vicinity of the hazard or the release plume, keeping personnel as far from the hazard or plume as possible (e.g., physical barricades and evacuation), and taking advantage of available shelter. Emergencies that could cause activation of this plan or part of it include the following:

- Events (operational, transportation, etc.) with the potential to cause releases above allowable limits of radiological or hazardous materials.

- Events such as fires, explosions, tornadoes, hurricanes, earthquakes, dam failures, etc., that affect or could affect safety systems designed to protect SRS and offsite populations and the environment.

- Events such as bomb threats, hostage situations, etc., that threaten the security of SRS.

- Events created by proximity to other facilities, such as the Vogtle Electric Generating Plant (a commercial nuclear power plant across the Savannah River from SRS) or nearby commercial chemical facilities.

Depending on the types of accidents and the potential impacts, emergencies are classified into one of several categories in accordance with requirements defined in the DOE 5500 series of orders. Incidents classified as "alerts" are expected to be confined within the affected facility boundary. Measurable impacts to workers outside the facility boundary or members of the public would be expected from incidents classified as alerts. Incidents classified as "Site Area Emergencies" represent events that are in progress or have occurred and involve actual or likely major failures of facility safety or safeguards systems needed for the protection of onsite personnel, the public, the environment, or national security. Because Site Area Emergencies have the potential to impact workers at nearby facilities or members of the public in the vicinity of SRS, these emergency situations require notification of and coordination of responses with the appropriate local authorities. Incidents classified as "General Emergencies" are events expected to produce consequences that require protective actions to minimize impacts to both workers and the public. Under General Emergencies, full mobilization of available onsite and offsite resources is usually required to deal with the event and its consequences.

In accordance with the *Savannah River Site Emergency Plan*, drills and exercises are conducted frequently at SRS to develop, maintain, and test response capabilities and validate the adequacy of

emergency facilities, equipment, communications, procedures, and training. For example, drills for the following accident scenarios are conducted periodically in the facilities or facility areas: facility/area evacuations; shelter protection; toxic gas releases; nuclear incident monitor alarms (which activate following an inadvertent nuclear criticality); fire alarms; medical emergencies; and personnel accountability (to ensure that all personnel have safely evacuated a facility or area following an emergency). Periodic drills are also conducted with the following organizations or groups and independently evaluated by the operating contractor and DOE to ensure that they continue to maintain (from both a personnel and equipment standpoint) the capability to adequately respond to emergency situations: first aid teams; rescue teams; fire wardens and fire-fighting teams; SRS medical and health protection personnel, as well as personnel from the nearby Eisenhower Army Medical Center; SRS and local communications personnel and systems; SRS security forces; and SRS health protection agencies.

F.9 References

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APPENDIX G

SRS FEDERAL FACILITY AGREEMENT APPENDIXES

G.1 Introduction

This appendix provides a list of Resource Conservation and Recovery Act (RCRA) facilities, units, and sites referred to in the EIS. Section G.1 lists the RCRA/ Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) units identified in Appendix C "RCRA/CERCLA Units List" of the Savannah River Site (SRS) Federal Facility Agreement (EPA 1993). Section G.2 lists the RCRA-regulated units identified in Appendix H "RCRA-Regulated Units List" of the SRS Federal Facility Agreement. Section G.3 lists the Site Evaluation units identified in Appendix G "Site Evaluation List" of the SRS Federal Facility Agreement. DOE is required to conduct RCRA Facility Investigation/Remedial Investigations for the units listed in Section G.1 and remedial or removal evaluations for the sites listed in Section G.3. Section G.4 lists references. The EIS waste forecasts were developed based on the May 11, 1992, version of the SRS Federal Facility Agreement's Appendixes. TE TE TE TE

This section lists the RCRA/CERCLA units identified in Appendix C, "RCRA/CERCLA Units List," of the SRS Federal Facility Agreement.

108-4R Overflow Basin
211-FB Pu-239 Release
716-A Motor Shop Seepage Basin
A-Area Burning/Rubble Pits
A-Area Coal Pile Runoff Basin
A-Area Miscellaneous Rubble Pile
A-Area Rubble Pit
Burial Ground Complex
Burma Road Rubble Pit
C-Area Burning/Rubble Pit
C-Area Coal Pile Runoff Basin
C-Area Reactor Seepage Basins
Central Shops Burning/Rubble Pit (631-6G)
Central Shops Burning/Rubble Pit (631-5G)
Central Shops Burning/Rubble Pit (631-1G, 3G)
Central Shops Sludge Lagoon
CMP Pits
D-Area Ash Basin
D-Area Burning/Rubble Pits
D-Area Coal Pile Runoff Basin

D-Area Oil Seepage Basin

D-Area Waste Oil Facility

F-Area Burning/Rubble Pits

F-Area Coal Pile Runoff Basin

F-Area Inactive Process Sewer Lines from Building to the Security Fence

F-Area Retention Basin

Fire Department Hose Training Facility

Ford Building Seepage Basin

Ford Building Waste Site

G-Area Oil Seepage Basin

Gas Cylinder Disposal Facility

Grace Road Site

Gunsite 113 Access Road

Gunsite 218 Rubble Pile

Gunsite 720 Rubble Pit

H-Area Coal Pile Runoff Basin

H-Area Inactive Process Sewer Lines from Building to the Security Fence

H-Area Retention Basin

Hydrofluoric Acid Spill

K-Area Bingham Pump Outage Pits

K-Area Burning/Rubble Pit

K-Area Coal Pile Runoff Basin

K-Area Reactor Seepage Basin

K-Area Rubble Pile

K-Area Sludge Land Application Site

L-Area Bingham Pump Outage Pits

L-Area Burning/Rubble Pit

L-Area Hot Shop

L-Area Oil/Chemical Basin and L-Area Acid/Caustic Basin

L-Area Rubble Pit (131-1L)

L-Area Rubble Pit (131-3L)

M-Area Settling Basin Inactive Process Sewers to Manhole 1

M-Area West

Miscellaneous Chemical Basin/Metals Burning Pits

New TNX Seepage Basin

Old F-Area Seepage Basin

Old TNX Seepage Basin

P-Area Bingham Pump Outage Pits

P-Area Burning/Rubble Pit

P-Area Coal Pile Runoff Basin

Par Pond

Par Pond Sludge Land Application Site

R-Area Acid/Caustic Basin

R-Area Bingham Pump Outage Pits

R-Area Burning/Rubble Pits

R-Area Reactor Seepage Basins

Road A Chemical Basin

Silverton Road Waste Site

SRL 904-A Process Trench

SRL Oil Test Site

SRL Seepage Basins

Tank 16

Tank 37 CTS Line Leak

TNX Burying Ground

TNX Groundwater

Warner's Pond

West of SREL "Georgia Fields" Site

G.2

This section lists the RCRA-regulated units identified in Appendix H, "RCRA-Regulated Units List," of the SRS Federal Facility Agreement.

Met Lab Basin/Carolina Bay
Acid/Caustic Basins, F-, H-, K-, and P-Areas (4 units)
Burial Ground Solvent Tanks (S23 - S30) (8 units)
DWPF Organic Storage Tank
F-Area Hazardous Waste Management Facility (3 units)
H-Area Hazardous Waste Management Facility (4 units)
Hazardous Waste Storage Buildings (including Solid Waste Storage Pads) (4 units)
Low Level Radioactive Waste Disposal Facility (RCRA regulated portions)
M-Area Hazardous Waste Management Facility (2 units)
M-Area Interim Treatment/Storage Facility
Mixed Waste Management Facility
Mixed Waste Storage Building (643-29E)
Mixed Waste Storage Building (643-43E)
Mixed Waste Storage Tank (S-32)
New TNX Seepage Basin
Sanitary Landfill
SRL Mixed Waste Storage Tanks
SRL Seepage Basins (4 units)
TRU Waste Storage Pads 1 through 6 (6 units)
TRU Waste Storage Pads 7 through 17 (11 units)

G.3

This section lists the Site Evaluation units identified in Appendix G, "Site Evaluation List," of the SRS Federal Facility Agreement.

R-Area Asbestos Pit
D-Area Asbestos Pit
C-Area Asbestos Pit (080-21G)
C-Area Asbestos Pit (080-22G)
H-Area Erosion Control Site
L-Area Erosion Control Site
Substation 51 Erosion Control Site
F-Area Erosion Control Site
Gunsite 051 Rubble Pile
Gunsite 102 Rubble Pile
Gunsite 072 Rubble Pile
C-Area Disassembly Basin
K-Area Disassembly Basin
L-Area Disassembly Basin
P-Area Disassembly Basin
R-Area Disassembly Basin
Cooling Water Effluent Sump
Purge Water Storage Basin
C-Area Erosion Control Site
P-Area Erosion Control Site
Gas Cylinder Disposal Facility
R-Area Rubble Pit
L-Area Rubble Pit
Concrete Lake (R-Area)
C-Area Reactor Cooling Water System
K-Area Reactor Cooling Water System
L-Area Reactor Cooling Water System
P-Area Reactor Cooling Water System
C-Area Ash Pile
K-Area Ash Basin
L-Area Ash Basin

P-Area Ash Basin

R-Area Ash Basin

C-Area Ash Pile (188-1C)

C-Area Ash Pile (188-2C)

F-Area Separations Facilities and Associated Spills

H-Area Separations Facilities and Associated Spills

F-Area Scrap Lumber Pile

F-Area Tank Farm

H-Area Tank Farm (except Tank 16)

RBOF (Receiving Basin for Offsite Fuels)

H-Area Retention Basin (281-1H)

H-Area Retention Basin (281-2H)

F-Area Retention Basin

H-Area Retention Basin (281-8H)

F-Area Ash Basin (288-0F)

H-Area Ash Basin

F-Area Ash Basin (288-1F)

Underground Sump 321-M #001

Underground Sump 321-M #002

D-Area Rubble Pit

D-Area Waste Oil Facility

D-Area Ash Basin (488-1D)

D-Area Ash Basin (488-2D)

Rubble Pile - Cemetery Road

Rubble Pile - Bragg Bay Road and Cemetery Road

Rubble Pile - Road 781.1

Rubble Pile - Bragg Bay Road

Gunsite 113 Rubble Pile

Risher Road Open Metal Pit

Scrap Metal Pile

R-Area Rubble Pile

L-Area Rubble Pile

Central Shops Scrap Lumber Pile

Miscellaneous Rubble Pile

3G Pumphouse Erosion Control Site

SRFS Rubble Pile

Neutralization Sump
L-Area Hot Shop
Salvage Yard
New Salvage Yard
40-Acre Hardwood Site
Lower Kato Road Site
Orangeburg Site
Lucy Site
Kato Road Site
Road F Site
Second Par Pond Site
SREL Rubble Pile
Spill on 4/24/91 of 0.11 Ci of Pu-239
Low Level Radioactive Drain Lines
A-Area Ash Pile (788-0A)
A-Area Ash Pile (788-2A)
P-Area Reactor Seepage Basin (904-061G)
P-Area Reactor Seepage Basin (904-062G)
P-Area Reactor Seepage Basin (904-063G)
L-Area Reactor Seepage Basin
C-Area Reactor Seepage Basin (904-066G)
C-Area Reactor Seepage Basin (904-067G)
C-Area Reactor Seepage Basin (904-068G)
K-Area Containment Basin
Fire Department Hose Training Facility
313-M and 320-M Inactive Clay Process Sewers to Tims Branch
Advanced Tactical Training Area (ATTA) Firing Ranges
Arsenic Treated Wood Storage Area
B-Area Sanitary Treatment Plant Rubble Pile
B-Area Tower Foundation
Beaver Dam Creek
Central Shops Area of Concern
D-F Steamline Erosion Control Site
Ditch to Outfall H-12 (Tributary to Four Mile Creek)
Diversion Box - Radioactivity from 907-1H
DWPF Concrete Batch Plant

F-Area Railroad Crosstie Pile

F-Area Sanitary Sludge Land Application Site

Fire Training Pit at 709-1F

Four Mile Branch

Groundwater, F-, H-, K-, P-Area Acid/Caustic Basin

Groundwater, R-Area

Gun Emplacement 407A and 407B Rubble Pile

Gunsite 012 Rubble Pile

H-Area Burning Pit

H-Area Sanitary Sludge Land Application Site

IMHOFF Tank Rubble Pile

Indian Grave Branch

K-Area Area of Concern

L-Area Scrap Metal and Wood

L-Lake

Lower Three Runs Creek

Meyers Mill Siding Rubble Pile

Miscellaneous Rubble at Dunbarton

Miscellaneous Trash at Snapp

Old Ellenton Rubble Pile

Old R-Area Discharge Canal

Parking Lot Type Lights on Wilson Road

Patterson Mill Road Rubble Pile

Pen Branch

Pile of Telephone/Light Poles

Pond B Dam Rubble Pile

Potential Release of Caustic/HNO_3 from 312-M

Potential Release of Diesel Fuel and Benzene from 730-M

Potential Release of $NaOH/H_2SO_4$ from 183-2L

Potential Release of $NaOH/H_2SO_4$ from 183-2R

Potential Release of $NaOH/H_2SO_4$ from 280-1F

Potential Release of TCT, TET CE, HNO_3, U, Heavy Metals from 321-M Abandoned Sewer Line

Process and Sewer Lines as Abandoned

Reactor Areas Cask Car Railroad Tracks as Abandoned

Recreation Area #002 Rubble Pile

Risher Road Rubble Pile

Risher Road Rubble Pile #2
Road 3 Foundation Rubble Pile
Road 9 at Gate 23 Rubble Pile
Road 9 Rubble Pile
Robbins Station Road Rubble Pile
Rubble Pile Across from Gunsite 012
Rubble Pile Near Junction U.S. 278 and GE Road 103
Rubble Pile North of SRL
S-Area Erosion Control Site
Sandblast Areas
Savannah River
Savannah River Swamp
Silverton Road Waste Tank Plugs
Small Arms Training Area (SATA)
Stadia Lights with Poles
Steed Pond
Steel Creek
Steel Creek Swamp
Stormwater Outfall A-002
Stormwater Outfall A-024
Stormwater Outfall H-013
Stormwater Outfall K-011
Stormwater Outfall L-012
Stormwater Outfall P-010
TCU Rubble Pile
Tims Branch
TNX Rubble Pile
Unnamed Tributary of Four Mile Branch South of C-Area
Unnumbered Gun Emplacement Rubble Pile
Upper Three Runs Creek
Warners Pond (Spill on 9/24/56 of Beta-Gamma)
Combined Spills from 105-C, 106-C, and 109-C
Combined Spills from 105-K, 106-K, and 109-K
Combined Spills from 105-P, 106-P, and 109-P
Combined Spills from 105-R, 106-R, and 109-R
Combined Spills from 183-2

Combined Spills from 183-2K

Combined Spills from 183-2P

Combined Spills from 211-H

Combined Spills from 241-84H

Combined Spills from 241-H (H-Area Tank Farm)

Combined Spills from 242-F

Combined Spills from 242-H

Combined Spills from 483-D and Associated Areas

Combined Spills from 643-G

Combined Spills from 672-T

Combined Spills from 674-T (Boneyard)

Combined Spills from 679-T

Combined Spills from 701-1T

Spill of Mercury Adjacent to Building 780-2A

Spill of Mercury in Building 232-H

Spill of Uranyl Nitrate (1/2 Ton)

Spill of Pu-239 from 221-FB

Spill of Retention Basin Pipe Leak

Spill of Beta-Gamma (<1 Ci)

Spill of Beta-Gamma (<1 Ci)

Spill of Seepage Basin Pipe Leak from 904-44G

Spill of Rad Liquid from Solvent Trailer

Spill of Seepage Basin Pipe Leak Between 904-42G and 904-43G

Spill of Segregated Solvent from 211-F

Spill of Flush Water - Rad (500 square feet)

Spill of Waste Tank Spill

Spill of Seepage Basin Pipe Leak

Spill of Flush Water - Rad (100 square feet)

Spill of Rad Water from 773-A

Spill of Waste Water - Rad (50 gallons)

Spill of Waste Water - Rad (3 gallons)

Spill of Rad Contaminated Soil

Spill of PCE

Spill of 50% Nitric Acid (200 gallons)

Spill of 50% Sodium Hydroxide (600 pounds)

Spill of 50% Sodium Hydroxide (50 gallons)

Spill of H-Area Process Sewer Line Cave-In
Spill of Seepage Basin Pipe Leak in H-Area Seepage Basin
Spill of Sump Overflow
Spill of Diversion Box Overflow from 281-1H
Spill of Contaminated Water
Spill of Contaminated Liquid
Spill of Acid in D-Area
Spill of 50% Nitric Acid (5,600 pounds)
Spill of Waste Water - Rad (less than 5 gallons)
Spill of Chromated Water from H-Area Pump House
Spill of Nitric Acid (3 gallons)
Spill of Chromated Water from Valve House 3
Spill of 34% Aluminum Nitrate
Spill of Uranyl Nitrate (100 pounds)
Spill of Contaminated Flush Water
Spill of Hydrogen Sulfide
Spill of Chromated Water
Spill of Low Level Waste from Trailer
Spill of Chromated Water from 243-H
Spill of Hydrogen Sulfide
Spill of Acid Solution
Spill of 31.5% Hydrochloric Acid from 183-P
Spill of Radioactive Spill
Spill of Oil - Rad
Spill of Fine-Organic #101 from 8307Z
Spill of Low Level Water Near 105-C
Spill of Tritiated Water in C-Area
Spill of Sodium Hydroxide
Spill of Simulated Salt Solution, Pizzolith 122R in 643-7G
Spill of Chromated Water from 221-F
Spill of Chilled Water
Spill of Process Solution
Spill of Water - Rad (200 gallons)
Spill of 6% Potassium Permanganate
Spill of Aluminum Nitrate
Spill of Caustic (50 gallons)

Spill of Acid Mixture from S-Area Trailer S-16

Spill of Water Vapor - Rad

Spill of 64% Nitric Acid from 221-F

Spill of Sulfuric Acid (25 milliliters)

Spill of Alcohol from 779-A

Spill of Cooling Water from Tank Farm

Spill of Process Water from 106-P

Spill of Mercury Near 284-F

Spill of Hydrochloric Acid From S-Area

Spill of Uranyl Nitrate (500 gm)

Spill of Mercury from 748-A

Spill of Nitric Acid (1 1/2 gallons)

Spill of Nitric Acid at Barricade 10

Spill of Aropol from 690-G

Spill of Chromated Water from Between 702-A and 708-A

Spill of Phosphoric Acid

Spill of 50% Sodium Hydroxide (2 gal)

Spill of Plating Solution

Spill of Water - Rad from 106-1C

Spill of 50% NaOH from 341-M

Spill of Acid (10 gallons)

Spill of Caustic (6 gallons)

Spill of Nitric Acid (10 gallons)

Spill of Water - Rad (1/2 pint)

Spill of Water - Rad (less than 1 gallon)

Spill of 50% Sodium Hydroxide (2 gal)

Spill of Nitric Acid (2 gallons)

Spill of Neutralization System Water

Spill of Tritiated Waste Oil from 110-P

Spill of Water - Rad (20 gallons)

Spill of Water - Rad (1 gallon)

Spill of 50% Sodium Hydroxide (5 gal) 01/01/87

Spill of Potassium Permanganate

Spill of Caustic (20 gallons)

Spill of Mercury North of 211-H

Spill of Sulfuric Acid Between 704-8F and 703-F Parking Lot

Caustic (1 gallon)

Chromated Water from 241-24H

Acidic Water (15 gallons)

Cr III Ligno - Sulfonate

Chromated Water from 772-F

Water - Rad (15 gallons)

Water from 300-M

Caustic from 295-H

50% Sodium Hydroxide

Water - Rad (~1 gallon)

Bromocide Solution from 607-14D

Water - Rad

Bromocide Solution from 607-22P

KOH, SMBS, $NaPO_4$ from 784-A

64% Nitric Acid at Barricade 1

Sulfuric Acid (less than 1 gallon)

Acidic Water (15 gallons)

Ethylene Glycol-Rad from 772-F

64% Nitric Acid in F-Area

Cs-137 from 254-8H

G.4 Reference

EPA (U.S. Environmental Protection Agency), 1993, Federal Facility Agreement between the U.S. Environmental Protection Agency, Region IV, the U.S. Department of Energy, and the South Carolina Department of Health and Environmental Control, Docket No. 89-05-FF, August 16.

APPENDIX H

ALTERNATIVE APPROACHES TO LOW-LEVEL WASTE REGULATION

APPENDIX H
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APPENDIX H
ALTERNATIVE APPROACHES TO LOW-LEVEL WASTE REGULATION

The U.S. Department of Energy (DOE) received comments during the scoping process requesting several analyses and comparisons of potential alternative regulatory regimes for low-level radioactive wastes. Among these was the suggestion that DOE consider the regulation of its low-level radioactive waste disposal activities by an independent organization, presumably the Nuclear Regulatory Commission, which regulates disposal of low-level radioactive wastes from their licensees. Comparison of current DOE low-level radioactive waste vault designs with a vault designed to meet the U.S. Environmental Protection Agency's (EPA) Resource Conservation and Recovery Act (RCRA) requirement and the Nuclear Regulatory Commission's commercial low-level radioactive waste disposal standards, and comparison of DOE's current low-level radioactive waste vault design with its current methods for shallow land disposal were also requested. DOE is bound by existing law (Atomic Energy Act) to regulate its low-level radioactive waste disposal activities. A change in regulatory authority for these activities would constitute a major change in approach, including changes in legislation. Such considerations are well beyond the scope of this EIS and are not discussed further. This appendix focuses instead on the comparison of alternative regulatory regimes as requested by the commentor.

The first analysis identifies the similarities and differences in the requirements established by DOE and the Nuclear Regulatory Commission for the disposal of low-level radioactive waste. This comparison permits an assessment of the potential for substantive differences in the impacts of such disposal operations. This section also presents a description of the RCRA hazardous waste landfill design requirements (40 CFR 264.301) to which Savannah River Site (SRS) vault designs can be compared. Comparisons of the performance of existing shallow land disposal at SRS with alternative engineered disposal systems were presented in an earlier EIS [*Waste Management Activities for Groundwater Protection, Savannah River Plant* (DOE 1987)] and are not repeated here. TE

H.1 DOE and Nuclear Regulatory Commission Technical Regulatory Requirements for Low-Level Radioactive Waste

The basic DOE requirements for low-level radioactive waste management are established in DOE Order 5820.2A (9/26/88), and those of the Nuclear Regulatory Commission in 10 CFR 61 (12/27/82). Several basic factors shape the nature and extent of the respective sets of requirements:

- DOE is a major generator of low-level radioactive waste at a number of its operating facilities and has substantial technical and research and development resources and expertise in its staff and those of its operating contractor/waste generator organizations. DOE's requirements extend to the waste generator as well as to the operator of disposal facilities which, for its major sites, are staffed by the same contractor organization and are under DOE's direction.

- DOE's requirements implicitly recognize that its major waste-generating sites tend to be diverse in the scope of their activities, materials handled, and wastes produced. DOE's requirements also recognize that these sites tend to be large in size and relatively isolated in location (compared to typical commercial, industrial, or academic licensees of the Nuclear Regulatory Commission). As a result, DOE's policy explicitly requires that low-level radioactive waste be disposed of at its site of origin to the extent possible.

- Nuclear Regulatory Commission regulations are more detailed, prescriptive, and process-oriented than those of DOE, consistent with the legal role of the agency as a purely regulatory organization, and the adversarial nature of its licensing and hearing processes. The regulations are also supported by such other documents as Regulatory Guides, Standard Review Plans, and Technical Positions that further expand the direction of and guidance to applicants and licensees.

- Nuclear Regulatory Commission regulations recognize the responsibility of the States for disposal of low-level radioactive waste under the Low Level Radioactive Waste Policy Act, their likely role as site owners and landlords of the operating licensees, and eventual responsibility for institutional control. Thus, the Nuclear Regulatory Commission regulations provide a role for the host and affected States in the licensing process.

A side-by-side comparison of the requirements of DOE Order 5820.2A and the corresponding requirements of the Nuclear Regulatory Commission in Part 61 is presented in Table H-1. Selecting this basis for comparison has eliminated from the table the substantial portions of Part 61 that deal with

Table H-1. Low-level radioactive waste regulations: DOE and Nuclear Regulatory Commission requirements.

DOE citation	DOE requirement	NRC citation	NRC requirement	
Order 5820.2A (9/26/88)	Establishes policies, guidelines, and minimum requirements for management of radioactive wastes, including low-level radioactive wastes	10 CFR 61 12/27/82	Licensing requirements for land disposal of radioactive wastes; procedures, criteria, and terms and conditions for licensing of disposal of wastes received from others. Does not apply to (1) high-level waste, (2) uranium or thorium tailings, or (3) disposal of licensed material by licensees under Part 20	
Attachment 2 Definitions:	Low-Level Waste. Radioactive waste not classified as high-level waste, transuranic waste, or spent nuclear fuel, or uranium or thorium tailings and waste Transuranic Waste. Waste contaminated with alpha-emitting nuclides with atomic number greater than 92, half-life greater than 20 years, and concentrations greater than 100 nanocuries per gram	§ 61.2 Definitions	"Low-level radioactive wastes containing source, special nuclear, or byproduct material that are acceptable for disposal in a land disposal facility...not classified as high-level waste, transuranic waste, spent nuclear fuel, or...uranium or thorium tailings and waste."	TE
III. Management of low-level waste: 3. Requirements a. Performance objectives	(1) Protect public health and safety in accordance with other Environment, Safety and Health and DOE Orders	Subpart C-Performance objectives § 61.40 General Requirement	Land disposal facilities to be sited, designed, operated, closed, and controlled after closure to provide reasonable assurance that human exposures are within the limits established in the performance objectives.	
	(2) Limit effective dose equivalent resulting from external exposure to the waste and concentrations in water, soil, plants, and animals resulting from releases to less than or equal to 25 millirem per year; atmospheric releases to meet 40 CFR 61 requirements; reasonable effort to maintain releases as low as reasonably achievable	§ 61.41 Protection of the general population from releases of radioactivity	Concentrations of radioactive material which may be released...in...water, air, soil, plants or animals...less than or equal to 25 millirem per year to whole body, less than or equal to 75 millirem per year to thyroid, and less than or equal to 25 millirem per year to any other organ. Reasonable effort to maintain releases as low as reasonably achievable to the environment in general.	TE
	(3) Committed effective dose equivalent to inadvertent intruders after loss of institutional control (100 years) of less than or equal to 100 millirem per year (continuous exposure) or less than or equal to 500 millirem (single acute exposure)	§ 61.42 Protection of individuals from inadvertent intrusion	"Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into...the site or contacting the waste at any time after institutional controls...are removed."	
		§ 61.7(4) Concepts	Institutional control of access to the site is required for up to 100 years; permits disposal of Class A and Class B waste without special provisions for intruder protection.	
		§ 61.7(5)	"Waste that will not decay to levels which present an acceptable hazard to an intruder within 100 years is designated as Class C waste." Disposed of at greater depth or with intruder barriers with an effective life of 500 years. Maximum concentrations of radionuclides are specified (§ 61.55) to ensure no unacceptable intruder hazard after 500 years.	

Table H-1. (continued).

DOE citation	DOE requirement	NRC citation	NRC requirement
a. Performance objectives (cont.)	(4) Protect groundwater resources, consistent with Federal, State and local requirements.		No specific parallel in Part 61
b. Performance assessment	(1) ...Prepare and maintain a site-specific radiological performance assessment for disposal of waste to demonstrate compliance with 3.a.	§ 61.13 Technical Analyses	...Analyses to demonstrate performance objectives of Subpart C will be met, including: (a) pathways to general population must include air, soil, ground- and surface water, plant uptake, and exhumation by burrowing animals, identifying differentiated roles played by natural site characteristics and design features; (b) protection of intruders afforded by meeting segregation requirements and barriers; (c) protection of individuals during operations, including likely accidents; and (d) analyses of long-term site stability
	(2) ...For each DOE reservation, prepare and maintain an overall waste management systems performance assessment supporting combination of waste management practices used in generation reduction, segregation, treatment, packaging, storage and disposal.		No specific parallel - not applicable
	(3) ...Where practical, make monitoring measurements to evaluate actual and prospective performance within and outside each facility and disposal site.	§ 61.53 Environmental Monitoring	...Requires an environmental monitoring program to evaluate potential health and environmental impacts during construction, operation and after closure, and capable of providing early warning, if migration is indicated, before it leaves the site
c. Waste generation	(1) ...Controls shall be directed to reducing the gross volume of waste generated and/or the amount of radioactivity requiring disposal.		No specific parallel - not applicable
	(2) Generation Reduction...low-level waste generators shall establish auditable programs to assure minimization of the amount of low-level waste generated and/or shipped for disposal.		No specific parallel - not applicable
	(3) Segregation...low-level waste generators shall separate uncontaminated waste from low-level waste.		No specific parallel - not applicable
	(4) Minimization...new process or process change designs shall incorporate principles to minimize generation of low-level waste.		No specific parallel - not applicable

Table H-1. (continued).

DOE citation	DOE requirement	NRC citation	NRC requirement
d. Waste characterization	(1) Low-level waste shall be characterized...to permit proper segregation, treatment, storage and disposal...characterization shall ensure that actual physical and chemical characteristics and major radionuclide content are recorded and known during the entire waste management process.	§ 61.55(a) Waste Classification	(1) *Considerations.* Wastes are to be classified for near-surface disposal to permit consideration of, first, limiting concentrations of long-lived radionuclides with hazards persisting after institutional controls, improved waste form, and deeper disposal are no longer effective; and, second, concentrations of shorter-lived radionuclides for which those protective measures are effective. (2) *Classes of waste.* Defines Class A, Class B and Class C wastes in terms of nuclide concentrations and stability requirements
	(2) Waste characterization data to be recorded on a waste manifest include (a) physical and chemical characteristics; (b) volume; (c) weight; (d) major radionuclides and concentrations; (e) packaging date, weight, volume.	Appendix F to §20.1001-20.2401 Requirements for Low-Level-Waste Transfer for Disposal at Land Disposal Facilities and Manifests	*I. Manifest*...requires physical description of waste, volume, radionuclide identity and quantity, total radioactivity, and principal chemical form; solidification agent to be specified; waste with greater than or equal to 0.1 percent chelating agents by weight to be identified and the agent estimated
	(3) Radionuclide concentration determined by direct or correlatable indirect methods (i.e., scaling factors)		No specific parallel - not applicable
e. Waste acceptance criteria	(1) Waste shipped to a site for treatment, storage or disposal shall meet the requirements of the receiving site.		No specific parallel - not applicable
	(2) Waste acceptance criteria shall be established for each low-level waste treatment, storage, and disposal facility.		No specific parallel - not applicable
	(3) Generators shall implement low-level waste certification program to ensure waste acceptance criteria are met; generators and receiving facilities jointly responsible for compliance with waste acceptance criteria	Appendix F to §20.1001-20.2401	*II. Certification*...requires generator to include with shipment, certification of proper waste classification and packaging.
	(4) Generator low-level waste certification programs shall be audited periodically.		No specific parallel - not applicable

Table H-1. (continued).

DOE citation	DOE requirement	NRC citation	NRC requirement
e. Waste acceptance *criteria* (cont.)	(5) Waste acceptance criteria for storage, treatment, or disposal facilities shall address: (a) allowable quantities/concentrations of specific radionuclides to be handled; (b) criticality safety requirements; (c) restrictions for classified low-level waste; (d) external radiation and internal heat generation; (e) restrictions on generation of harmful gases, vapors or liquids in waste; (f) chemical and structural stability of waste packages, radiation effects, microbial activity, chemical reactions, and moisture; (g) restrictions for chelating and complexing agents; and (h) quantity of free liquids.	§ 61.56 Waste Characteristics	(a) Establishes minimum requirements for all waste classes, including (1) no cardboard or fiberboard box packaging for disposal; (2) liquid waste to be solidified, or packaged with adequate absorbent material; (3) restrictions on free liquid to less than 1 percent of volume; (4) not readily capable of detonation or explosive reactions at normal temperature and pressure; (5) restrictions on generation of toxic gases, vapors, or fumes harmful to personnel; (6) not pyrophoric; (7) gaseous waste to be packaged at less than 1.5 atmospheres at normal temperature and pressure and total less than 100 curies per container; and (8) waste containing chemically or biologically hazardous material to be treated to reduce hazard to the extent practical. (b) Requires structural stability of waste by (1) a stable waste form and/or container; (2) limiting free-standing and corrosive liquids to less than 1 percent of waste volume in a stable container, or 0.5 percent of volume for waste processed to a stable form; and (3) minimize void spaces within the waste and its package
f. Waste treatment	(1) Waste shall be treated by appropriate methods to enable disposal site to meet performance objectives.		No specific parallel - not applicable
	(2) ...Methods such as incineration, shredding, and compaction to reduce volume and increase form stability shall be implemented as necessary to meet performance criteria. Use to increase life of disposal facility and improve performance to the extent it is cost effective.		No specific parallel - not applicable
	(3) Large scale waste treatment facility development requires support by National Environmental Policy Act documentation plus (a) site waste stream analysis and treatment process evaluation; (b) construction design report; and (c) a Safety Analysis Report.		No specific parallel - not applicable
	(4) Operation of treatment facilities requires support by (a) operations and management procedures; (b) personnel training and qualification procedures; (c) monitoring and emergency response plans; and (d) records of each low-level waste package entering and leaving the facility.		No specific parallel - not applicable
g. Shipment	Offsite shipment of low-level waste shall comply with DOE 1540.1.	10 CFR 71 and DOT 49 CFR 173	Define transport requirements for radioactive materials

Table H-1. (continued).

DOE citation	DOE requirement	NRC citation	NRC requirement
h. Long-term storage	(1) Shall be stored by appropriate methods to achieve performance objectives of 3.a.		No specific parallel - not applicable
	(2) Records shall be maintained for all low-level waste that enters and leaves the facility.		No specific parallel - not applicable
	(3) Documentation requirements include (a) needs analysis; (b) construction design report; (c) Safety Analysis Report and NEPA documentation; and (d) operational procedures and plans.		No specific parallel - not applicable
	(4) Storage to allow decay and to await disposal by approved methods are acceptable	§ 20.2001(a)(2)	A licensee shall dispose of licensed material...by any one of four methods including decay in storage.
i. Disposal	(1) Low-level waste shall be disposed of to meet the performance objectives of 3.a., consistent with the site radiological performance assessment in 3.b.	Part 61	...Establishes requirements to assure compliance with Subpart C Performance Objectives
	(2) "Engineered modifications (stabilization, packaging, burial depth, barriers) for specific waste types and for specific waste compositions (fission products; induced radioactivity; uranium, thorium, radium) for each disposal site shall be developed through the performance assessment model." ...in the process, site specific waste classification limits may also be developed if operationally useful for specific wastes.	§ 61.51 Disposal site design for land disposal	(1) Site design features for near-surface disposal to focus on long-term isolation and avoidance of need for continuing maintenance; (2) design to be compatible with closure and stabilization plan; (3) design to complement and improve natural site features; (4) covers designed to minimize water infiltration, diverting percolation and surface water from waste and resist degradation; (5) diverted water not to produce erosion requiring maintenance; and (6) minimize contact between water and waste during storage, disposal or post-disposal
	(3) Establishes an Oversight and Peer Review Panel of DOE, contractor and other specialists in performance assessment to ensure consistency and quality		No specific parallel - not applicable
	(4) Disposition of waste designated as greater-than-class C (10 CFR 61.55) must be handled as special case, including special performance assessment through the NEPA process.	§ 61.55(2)(iv) Waste classification	Waste for which form and disposal methods must be more stringent than those specified for Class C waste are not generally acceptable for near-surface disposal.
		§ 61.7(b)(5) Concepts	There may be some instances where waste with concentrations greater than permitted for Class C would be acceptable for near-surface disposal with special processing or design. These would be evaluated on a case-by-case basis.

Table H-1. (continued).

DOE citation	DOE requirement	NRC citation	NRC requirement
i. Disposal (cont.)	(5) Additional disposal requirements include: (a) no cardboard or fiberboard boxes not meeting Department of Transportation *requirements with stabilized waste and minimum voids*; (b) no liquid exceeding 1 percent of waste volume in disposal container, or 0.5 percent of waste processed to stable form; (c) waste not readily capable of detonation or explosive decomposition or reaction at normal temperature and pressure, or explosive reaction with water; (d) waste not contain or generate quantities of toxic gases, vapors, or fumes harmful to workers; (e) gaseous waste packaged at pressure less than or equal to 1.5 atmospheres at 20°C; and (f) no pyrophoric waste.	§ 61.56 Waste characteristics	See previous entry for this Section (page H-6)
TE |	(6) Wastes containing amounts of radionuclides below regulatory concern, as defined by Federal regulations, can be disposed without regard to radioactivity.	§ 20.2005 Disposal of specific wastes	Identifies specific licensed material that may be disposed of "as if it were not radioactive"
	(7) Disposal Site Selection shall (a) have criteria developed for new low-level waste disposal sites, based on planned confinement technology; (b) be based on evaluation of site and confinement technology in accordance with NEPA process; (c) provide a site with hydrogeologic characteristics which, with confinement technology, will protect groundwater resource; (d) consider natural hazards; and (e) have criteria which address impacts on populations, land use, resource development plans and public facilities, transport and utility accessibility, and location of waste generation.	§ 61.50 Disposal site suitability for near-surface disposal	(1) ...Specifies minimum acceptable site characteristics with primary emphasis on isolation of wastes; (2) capable of being characterized, modeled, analyzed and monitored; (3) consider projected population growth relative to performance objectives; (4) avoid natural resource areas whose exploitation might compromise achievement of performance objectives; (5) avoid flooding and poorly drained areas; (6) minimize upstream drainage area; (7) provide sufficient depth to water table; (8) hydrogeologic disposal unit shall not discharge groundwater to the surface within the site; (9) avoid areas with sufficient tectonic activity to challenge the performance objectives; (10) avoid areas where surface geologic processes may adversely affect performance or modeling and prediction; and (11) avoid areas where nearby activities could impact performance objective achievement or mask the ability to monitor that performance.
		§ 61.7(a)(2) Concepts	...Site characteristics should be considered in terms of the indefinite future and evaluated for at least a 500 year time frame.
	(8) Disposal Facility and Site Design (a) require design criteria based on analyses of physiographic, environmental and hydrogeological data, as well as assessments of projected waste volumes and characteristics to assure Order policy and requirements can be met; and (b) disposal units shall be designed in accordance with criteria and NEPA process	§ 61.51 Disposal site design for land disposal	See previous entry for this Section (page H-7)

Table H-1. (continued).

DOE citation	DOE requirement	NRC citation	NRC requirement
i. Disposal (cont.)	(9) Disposal Facility Operations (a) requires operating procedures that protect the environment, health and safety of the public and facility personnel; ensure facility security; minimize need for long-term control; and meet closure/post-closure plan requirements; (b) emplacement of permanent markers; (c) training requirements, emergency plans and the unusual occurrence reporting system; (d) minimize voids in disposal units between waste containers; and (e) conduct operations such that active disposal operations will not adversely affect filled disposal units	§ 61.52 Land disposal facility operation and disposal site closure	(a)(1) requires segregation of Class A wastes; (2) requires disposal of Class C wastes greater than or equal to 5 meters below top surface of cover or with intruder barriers designed to resist inadvertent intrusion for greater than or equal to 500 years; (3)-(11) provides specific requirements on maintenance of package integrity, void minimization, cover placement to minimize surface radiation dose rate, marking of boundaries of disposal units, maintenance of buffer zone, closure and stabilization of units as they are filled, prevent adverse effects of active disposal operations on closed units, and no disposal of non-radioactive materials
j. Disposal site closure/post-closure	(1) Requires development of site-specific closure plans for new and existing sites addressing closure within a 5-year period after filling, and conformance with NEPA process. Performance objectives for existing disposal sites developed on a case-by-case basis as part of NEPA process.	§ 61.12(g) Specific technical information (license application)	Requires a description of the disposal site closure plan, including design features intended to facilitate disposal site closure and to eliminate the need for ongoing maintenance
	(2) During closure/post closure, residual radioactivity levels for surface soils shall comply with existing DOE decommissioning guidelines.		No specific parallel - not applicable
	(3) Corrective measures shall be applied to new sites or individual units if conditions occur or are forecast that jeopardize attainment of performance objectives.	§ 61.12(l) Specific technical information (license application)	Requires a description of the plan for taking corrective measures if migration of radionuclides is indicated by monitoring program
	(4) Manage inactive sites in conformance with Resource Conservation and Recovery Act, Comprehensive Environmental Response, Compensation, and Liability Act and Superfund Amendment and Reauthorization Act; or if mixed waste, may be included in permit applications for operation of contiguous disposal facilities.		No specific parallel - not applicable
	(5) Closure plans to be reviewed and approved by appropriate field organization		No specific parallel - not applicable
	(6) Termination of monitoring and maintenance activities to be based on analysis of site performance at end of institutional control period	§ 61.29 Post-closure observation and maintenance	Responsibility for the disposal site, including observing, monitoring and necessary maintenance and repairs, shall be maintained for five years; a shorter or longer period for post-closure observation and maintenance may be established.

Table H-1. (continued).

	DOE citation	DOE requirement	NRC citation	NRC requirement
k.	Environmental monitoring	(1) Each low-level waste treatment, storage and disposal facility (operational or not) to be monitored by a program conforming with DOE 5484.1 and k(2) and k(3)	§ 61.53(c) Environmental monitoring	See previous entry for this Section (Page 4)
		(2) Program shall measure (a) operational effluent releases; (b) migration of radionuclides; (c) disposal unit subsidence; and (d) changes in facility and site parameters that may affect long-term site performance		See previous entry
		(3) Based on facility characteristics, program may include surface soil, air, surface water, and subsurface soil and water both in the saturated and unsaturated zones		See previous entry
		(4) Program shall be capable of detecting trends in performance far enough in advance to permit any needed corrective action, and able to ascertain compliance with Environment, Safety and Health Orders		See previous entry
TC | l.	Quality assurance	Consistent with DOE 5700.6C, conduct in accordance with American National Standards Institute/American Society of Mechanical Engineers Nuclear Quality Assurance-1 and other appropriate consensus standards	§ 61.12(j) Specific technical information	Requires a description of the quality assurance program during site qualification, design, construction, operation and closure of the facility
m.	Records and Reports	(1) Defines record-keeping requirements for field organizations based on waste manifest data	§ 61.80 Maintenance of records, reports and transfers	Establishes requirements for maintenance of records and their transfer to State and local governmental agencies, and other agencies as designated by the Commission at license termination
		(2) Waste Manifest records shall contain data specified in 3.d.(2) and be kept as permanent records.		See previous entry

the licensing process requirements (e.g., the contents of the license application, financial responsibility, etc.) that are judged not to affect the substantive requirements that determine waste disposal impacts. TE
The two sets of requirements were divided for comparison into eight major categories: performance objectives; performance assessment; waste characterization and acceptance criteria; disposal site selection; facility and site design; disposal facility operation; disposal site closure/post-closure; and environmental monitoring.

H.2 DOE - Nuclear Regulatory Commission Requirement Comparisons

H.2.1 PERFORMANCE OBJECTIVES

The basic performance objectives for the protection of the general public in DOE and Nuclear Regulatory Commission regulations are essentially identical: requiring maintenance of releases as low as reasonably achievable, and setting a limit of 25 millirem/year to any individual from all exposure pathways as a consequence of releases from the disposal site. In addition, the DOE Order limits atmospheric releases of radioactivity from a site to no more than 10 millirem/year as stipulated in the EPA National Emission Standards for Hazardous Air Pollutants regulation, 40 CFR 61.

An apparent difference exists in the approaches specified for protection of a hypothetical future inadvertent intruder by each of the agencies. Nuclear Regulatory Commission requirements for intruder protection are to be met by a combination of defined concentration limits on those wastes that will not decay to acceptable levels within 100 years (Class C wastes) and emplacement at depths greater than 5 meters or with 500-year-effective intruder barriers. DOE requires assurance that the specified dose limits will not be exceeded after the 100-year institutional control period and requires the specification of the quantities/concentrations of wastes in waste acceptance criteria for each treatment, storage and disposal facility.

The Nuclear Regulatory Commission initially proposed a rule that included both a 500-millirem intruder dose limit and concentration limits conservatively calculated to achieve that dose. In the final rule, the Nuclear Regulatory Commission removed the dose limit as a requirement for future performance TE
because a licensee could not demonstrate compliance or monitor that future performance; however, that dose value was used as the basis for calculating the concentration limits for Class C wastes. Thus, the apparent difference between the requirements is only superficial and more a consequence of the formal nature of the Nuclear Regulatory Commission regulatory process than a substantive difference in protection afforded the hypothetical future inadvertent intruder, since both agencies use the same dose as a basis for protection features.

H.2.2 PERFORMANCE ASSESSMENT

Both agencies require a radiological performance assessment to demonstrate the compliance of proposed disposal activities with the performance objectives. DOE also requires a performance assessment for the overall waste management system at each site covering activities from the reduction of wastes generated through treatment to their disposal. In keeping with their nature as licensing requirements, Nuclear Regulatory Commission regulations are more explicit in the details of the performance assessment to be provided. Both DOE and the Nuclear Regulatory Commission require monitoring to assess actual and prospective performance.

H.2.3 WASTE CHARACTERIZATION AND ACCEPTANCE CRITERIA

Nuclear Regulatory Commission waste characterization and classifications apply only to the wastes delivered to the disposal site, whereas DOE characterization applies to all aspects of waste management, from its initial segregation at the waste generator, through treatment and interim storage, to its final disposal. The transfer documents, or manifests, specified by each agency (by the Nuclear Regulatory Commission in Appendix F to Part 20) require essentially the same information.

Characteristics of waste packages acceptable for disposal are essentially the same for the two agencies, although the requirements set by the Nuclear Regulatory Commission in 10 CFR 61 Part 56 are specified
TE | by DOE in two parts of DOE 5820.2A [3.e.(5) Waste Characterization and 3.i.(5) Disposal]. Because of the nature of the materials handled by DOE in the course of its diverse missions, DOE also requires waste acceptance criteria for criticality safety and for (security) classified low-level radioactive waste not applicable to Nuclear Regulatory Commission licensees.

H.2.4 DISPOSAL SITE SELECTION

For new disposal sites, DOE requires the development of selection criteria that recognize the intended confinement technology, and the selection of a site considering both site and confinement technology characteristics. DOE requirements include consideration of natural hazards and of environmental impacts as well as protection of groundwater resources. Nuclear Regulatory Commission site-selection requirements focus exclusively on site characteristics and require their evaluation for at least a 500-year time frame, reflecting the greater reliance for protection placed by the Nuclear Regulatory Commission on site (as opposed to facility design) features.

H.2.5 FACILITY AND SITE DESIGN

DOE requires facility and site design criteria, the specifications for which (including such factors as stabilization, packaging, burial depth, and barriers) are left for definition by each disposal site [3.i.(2)]; design criteria are to be based on site features as well as expected waste volumes and characteristics [3.i.(8)]. Nuclear Regulatory Commission site design requirements are general with respect to their objectives, except for the specification of the effective life of intruder barriers as 500 years where Class C wastes cannot be buried at depths greater than 5 meters. In addition to the fundamental site specifications common to both DOE and Nuclear Regulatory Commission requirements, the latter also identifies as requirements the ability of a site to be characterized, modeled, analyzed, and monitored, and the avoidance of areas where nearby activities could adversely impact achievement of performance objectives or substantially mask the monitoring program.

H.2.6 DISPOSAL FACILITY OPERATION

DOE requirements under this title are similar to but less specific than those of the Nuclear Regulatory Commission, particularly with respect to the segregation of Class A wastes (determined by concentration of short- and long-lived radionuclides) and the Nuclear Regulatory Commission requirement for deeper disposal of Class C wastes or the use of a 500-year effective intruder barrier. Both are intended to limit worker and public exposures to those specified in the performance objectives (identical for both agencies) and to promote long-term site stability. TE

H.2.7 DISPOSAL SITE CLOSURE/POST-CLOSURE

DOE and the Nuclear Regulatory Commission requirements for closure and post/closure activities are similar. Both require site-specific closure plans; the Nuclear Regulatory Commission requires plans for corrective measures, while the DOE requirement is for their application if the attainment of performance objectives is threatened or occurs. TE

H.2.8 ENVIRONMENTAL MONITORING

DOE and the Nuclear Regulatory Commission requirements for environmental monitoring are quite similar in substance and objectives; both require programs that will demonstrate compliance with public health and safety standards and provide early warning of migration of radioactivity from the disposal sites. TE

H.3 Nuclear Regulatory Commission - DOE Comparison Summary

Apart from the licensing procedural elements of the Nuclear Regulatory Commission regulations, the most substantial distinctions between the requirements of the Nuclear Regulatory Commission and DOE affecting the disposal of low-level radioactive waste are in the specificity of the Nuclear Regulatory Commission regulations in 10 CFR 61, which are not reflected in DOE Order 5820.2A. To a considerable extent that is the result of the formal regulatory process prescribed for the Nuclear Regulatory Commission and its licensees. Additionally, the more general nature of the DOE Order reflects the greater flexibility required to manage the diversity of waste materials and forms which are produced by the wide variety of missions and activities carried out by and for DOE, as well as the broad range of existing DOE site characteristics that are not reflected at likely licensed disposal sites.

Despite these distinctions, the performance objectives specified for the protection of the public and workers from the operation of low-level radioactive waste disposal facilities are essentially identical, and the means specified for demonstrating compliance (i.e., performance assessments) are also essentially identical in approach. Accordingly, there are no substantive differences in the degree of protection afforded public health and safety inherent in the different agency regulations.

H.4 EPA Hazardous Waste Landfill Requirements

As indicated in the previous discussion, Nuclear Regulatory Commission and DOE design requirements for low-level radioactive waste disposal facilities are prescribed in terms of their performance requirements (i.e., basically their ability to limit radiological dose to meet the respective regulations). In contrast, the EPA regulations governing landfill facilities for hazardous wastes under RCRA (40 CFR 264.301), although not applicable to low-level radioactive waste disposal, prescribe facility design features themselves. These include, for example:

- Each new landfill must have two or more liners and a leachate collection and removal system between the liners. The liners must be designed and constructed to prevent migration of wastes out of the landfill to the adjacent subsurface soil or groundwater or surface water during the active period of the landfill (including the closure period).

- The liners must be constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure, be placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients, and must be installed to cover surrounding earth likely to be in contact with the waste or leachate.

- The liner system must include a top and bottom liner. The bottom liner must include two components, the lower of which must be constructed of at least 90 cm (3 feet) of compacted soil material with a hydraulic conductivity of no more than 1×10^{-7} cm/sec (2×10^{-7} ft/min).

- The leachate collection and removal system immediately above the top liner must be designed, constructed, operated, and maintained to collect and remove leachate from the landfill during the active life and post-closure care period to ensure the leachate depth over the liner does not exceed 30 cm (1 foot).

- The leachate collection and removal system between the liners is also a leak detection system. The requirements for a leak detection system include: constructed of granular drainage materials with a hydraulic conductivity of 1×10^{-2} cm/sec (2×10^{-2} ft/min) or more and a thickness of 30 cm (1 foot) or constructed of synthetic or geonet drainage materials with a transmissivity of 3×10^{-5} m^2/sec (2×10^{-2} ft^2/min); constructed of materials that are chemically resistant to the waste and leachate and of expected strength and thickness to prevent collapse; and designed and operated to minimize clogging; constructed with sumps and liquid removal methods. TE TE

- A run-on control system capable of preventing flow into the active portion of the landfill during peak discharge from at least a 25-year storm, and a runoff management system to collect and control at least the water volume resulting from a 24-hour, 25-year storm must be in place.

Thus, the EPA requirements for a hazardous waste landfill do not specify or require "vaults" as such, nor do they specify performance requirements (e.g., environmental exposure or concentration limits), or appear to contemplate that such landfills would consist of more than a trench excavated in the earth with relatively sophisticated engineered systems for leachate collection and infiltration protection. The vaults proposed for disposal of low-level radioactive waste at SRS, as described in Appendix B, greatly surpass the EPA hazardous waste landfill requirements described above.

H.5 Reference

DOE (U.S. Department of Energy), 1987, *Waste Management Activities for Groundwater Protection, Savannah River Plant*, DOE/EIS-0120, Savannah River Operations Office, Aiken, South Carolina, December.

APPENDIX I

PUBLIC COMMENTS AND DOE RESPONSES

APPENDIX I
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APPENDIX I. PUBLIC COMMENTS AND DOE RESPONSES

I.1 Introduction

DOE completed the draft Environmental Impact Statement (EIS) for Waste Management at the Savannah River Site (SRS) in January 1995, and on January 27, 1995, the U.S. Environmental Protection Agency (EPA) published a Notice of Availability for the document in the Federal Register (60 FR 5386). EPA's notice started the public comment period on the draft EIS and announced an ending date of March 13, 1995. At a request from the public, DOE extended the comment period through March 31, 1995. This appendix presents the comments received from government agencies and the public during the comment period and DOE's responses to those comments.

Comments by letter, telephone (voice mail), facsimile, and in formal statements made at public hearings were accepted. The hearings, which included the opportunity for informal discussions with SRS personnel involved with waste management, were held in Barnwell, South Carolina on February 21, 1995; Columbia, South Carolina on February 22, 1995; North Augusta, South Carolina on February 23, 1995; Savannah, Georgia on February 28, 1995; Beaufort, South Carolina on March 1, 1995; and Hilton Head, South Carolina on March 2, 1995. DOE received comments from a total of 15 individuals, government agencies, or other organizations including five written or oral statements at the hearing sessions. Ten letters were received. No one submitted comments by facsimile or voice mail. The statements made at the hearings were documented in official transcripts. Each of these comments were assigned unique number codes as follows for reference in this Final EIS:

Hearings	HH001 through HH002 (Statements made at the Hilton Head meeting)
	NA001 (Statement made at the North Augusta meeting)
	S001 through S002 (Statements made at one of the Savannah meetings)
Letters	L001 through L010

Specific comments by each commentor were numbered sequentially (i.e., 001, 002, etc.) to provide unique identifiers. The individuals, government agencies, and other organizations that submitted comments and their unique identifiers are provided in Table I-1.

The comments DOE received reflect a broad range of concerns and opinions about topics addressed in this EIS. The topics most frequently raised by commentors were concerns about specific facilities, including the Consolidated Incineration Facility; the various waste types this EIS addresses; public participation; and potential impacts on human health. Comments received from government agencies

consisted primarily of statements of no conflict or requests for clarification. The EPA endorsed the proposed action in their response and gave the Draft EIS a rating of EC-2. This rating indicated that the agency has environmental concerns about the project and that EPA needs more information to fully assess the impacts.

DOE also received numerous comments that raised issues outside the scope of this EIS; many of them involved proposed actions that are being evaluated in other National Environmental Policy Act (NEPA) reviews. DOE considered those comments it received during the comment period that were within the scope of this EIS in the preparation of the final EIS. Individual comments received and DOE's responses, identified by the numbering system described above, are provided in Parts 1, 2, and 3 of this appendix. Where appropriate, DOE revised the EIS in response to these comments. In such cases, the revision is indicated in the margin of the page with a change bar and the number of the comment that prompted the revision.

Table I-1. Public Comments on the Draft Environmental Impact Statement.

Statements Made at the Public Hearings

Comment Source No.	Commentor	Page No.
NA	**North Augusta, SC, February 23, 1995**	
NA001	Bob Overman	I-5
S	**Savannah, GA, February 28, 1995**	
S001	Jean O. Brown	I-9
S002	Fred Nadelman Coastal Citizens for a Cleaner Environment	I-11
HH	**Hilton Head, SC, March 2, 1995**	
HH001	George Minot	I-14
HH002	Charlotte Marsala	I-18

Correspondence Received from Government Agencies and the Public

Comment Source No.	Commentor	Page No.
L001	James E. Bolen	I-22
L002	W. F. Lawless Citizens Advisory Board	I-24
L003	Andreas Mager, Jr. National Marine Fisheries Service	I-26
L004	Kenneth W. Holt Dept. Of Health and Human Services	I-29
L005	Shirley Dennis	I-37
L006	Robert H. Wilcox	I-39
L007	Debra K. Hasan Citizens for Environmental Justice	I-42
L008	Heinz J. Mueller U.S. Environmental Protection Agency, Region IV	I-53
L009	Mary T. Kelly League of Women Voters	I-57
L010	W. F. Lawless Citizens Advisory Board	I-59

I.2 Statements Made at the Public Hearings

PUBLIC CITIZEN-2: Can I make a formal comment?

MR. POPE: Yes, sir. You bet.

PUBLIC CITIZEN-2: Okay. My name is Bob Overman. I'm not representing any company. As I said before, I contributed to all this stuff. I don't like the idea of leaving this low-level waste buried. That's not being disposed of. I don't want my great-grandchildren pointing a finger at me and saying why didn't you take care of that garbage. It's bad enough that my grandchildren are saying that now.

In my opinion, the only satisfactory way of disposing of waste is to reduce it to the least chemically active form. That means all of your organic material, lab coats and shoes, that's going to decompose. That's going to give trouble in the burial ground. Let's get that stuff out of there, put it in the incinerator, and then get an agreement on what you're going to do with the ash. NA-001-01

The ash is not the most stable form. It can migrate. Vitrification seems to be acknowledged as the one way to stabilize low-level waste for any activity. You're talking about a vitrifier for M-Area. Wonderful. Let's get some vitrifiers in there.

As you dig up that stuff, take care of it, vitrify it after you incinerate, if you have to incinerate, but let's don't do another halfway job and expect our grandchildren to have to come back, dig up what we left, and do it again. I shudder to hear that you're not planning on digging up all of the lab coats that I helped put in there. I didn't bury them, but I sure got some dirty.

Compactors, only temporary. They do absolutely no good. The organics were decomposed in these little boxes. You get gas formation, you may get leaks, but that's not a final way to store them. So I was glad to hear that you're talking about vitrifying it, you're talking

PK56-40

Comment NA-001. (page 1 of 3)

about smelters. We have an awful lot of contaminated metal stored -- buried out there, old mixer settlers, old tanks. Chop those things up, melt them, get them into ingots or billets, and if you can't sell it, bury the stuff.

NA001-01 (cont.)

The thing about a billet, the activity inside there is going to be exposed as the billet rusts. But the rust on the surface of the billet will also capture the radioactivity, the elements that are radioactive, the cesium and all the rest of that. Rust is a very good scavenger for that stuff, so if you have released any activity, that rust will keep it from migrating into the soil.

So think in terms vitrifying and smelting. Let's stabilize this stuff. I won't be around another 100 years, but maybe my great-grandchildren will. Thank you.

MR. POPE: Thank you.

PUBLIC CITIZEN-2: The minimum is Alternate C.

MR. POPE: Well, there's a minimum waste forecast for each of the alternatives.

PUBLIC CITIZEN-2: No, I meant the minimum thing you do with that is C.

MR. POPE: Yes, sir?

PUBLIC CITIZEN-1: You are not including the spent fuel you're receiving from the European reactors and temporarily storing that? That's not part of this; is that right?

MR. POPE: No, that is the subject of another environmental impact statement that's going on.

PUBLIC CITIZEN-2: You have to get rid of that before you do the basin water, though.

PK56-40

Comment NA-001. (page 2 of 3)

MR. POPE: Yeah. Any other questions or would someone else like to stand up and make a comment?

(No response.)

MR. POPE: Well, thank you so much for coming. If you'd like to come up and talk with any of the crew here afterwards, please feel free to. Thank you.

(Meeting adjourned at 2:02 p.m.)

PK56-40

Comment NA-001. (page 3 of 3)

Response to Comment NA001-1

The comment suggests that DOE should address the hazards of the decomposition of organic materials present in low-level wastes previously sent to shallow land disposal at SRS by excavating these wastes and treating them to destroy the organic fraction by incineration. Additionally, the commentor recommended that the incinerator ash be vitrified, and that buried contaminated metals be retrieved and processed by smelting before sale or reburial. These techniques are generally consistent with the extensive treatment configuration described in alternative C. However, the Waste Management EIS does not establish what type of environmental restoration activities should be implemented for the various waste sites at SRS. The SRS low-level waste disposal facilities are being investigated in accordance with the SRS Federal Facility Agreement. A formal risk assessment and remedial investigation will be performed for the Burial Ground Complex under Resource Conservation and Recovery Act (RCRA) Section 3004(u)/Comprehensive Environmental Response, Compensation, and Liability Act Section 120(e) to determine the facility's closure and post-closure performance objectives and requirements. These analyses will consider the hazards presented by the wastes, including the potential for gas formation as a result of the decomposition of organic materials and the potential for migration of contaminants on buried organic and metal wastes, to establish appropriate remediation requirements. These hazards will be weighed against the risks posed by the remediation alternatives, including worker exposure during excavation of the wastes and the emissions associated with any treatment performed on the excavated materials.

Comment Sheet

Savannah River Site Waste Management Draft Environmental Impact Statement

Please use this sheet if you wish to provide written comments on potential environmental issues concerning the Draft Environmental Impact Statement.

B.S.

Why should we believe your charts?

You get my vote of NO CONFIDENCE

S001-01

Your Name Jean E. Brown

Address 443 Tattnall St.

Company, Agency, or Organization

Street Address Savannah, GA 31401

City / State / Zip Code

IMPORTANT: Please fold and tape bottom edge before mailing. *Thank you.*

PK56-37

Letter S001.

Response to Comment S001-01

DOE believes that the charts and other technical information that were presented at the public hearings on the SRS Waste Management Draft EIS accurately describe the waste management alternatives and their impacts. Because the alternatives in the EIS include new facilities that have not been operated at SRS, DOE studied similar existing facilities and used validated analytical techniques and models to estimate impacts. In their review of the EIS, federal and state agencies examined the results of DOE analyses and provided their comments as presented in this Appendix and Appendix J. The EIS has also been subject to independent peer review, as discussed in the response to comment L002-02. The analytical procedures and models used to determine the impacts presented on the charts are discussed in the EIS. For example, refer to Section 4.1.3 for groundwater resources, Section 4.1.5 for air resources, Section 4.1.12 for health effects, and Section 4.1.13 and Appendix F for further detail on accidents.

The fallacy of the Safe Waste Management of Nuclear Materials

by Fred Nadelman

Can nuclear materials, namely. Plutonium, the deadliest of all such materials be stored safely? Definitely not. Not only are we, the taxpayers, being asked to subsidize an overage nuclear weapons plant, a relic of the cold war, that leaks radioactive gas into the air and poisons the ground water serving Savannah and South Georgia with leaks from its cooling system, but we are now asked to institutionalize those inadequacies by allowing Westinghouse and the Department of Energy to store those materials in the ground--until these agencies find a way to store the materials somewhere else in pieces of glass. S002-01

The fact remains that any storage of nuclear materials--anywhere and under any of the proposed circumstances is unreliable. For this reason we should not accept the storage of any such materials in this area. The question of how to "permanently" store such materials safely has not been solved. What is the answer? That is still a good question. We have such recent accidents as Three-Mile-Island, Chernobyl, and the December 1992 Plutonium leaks at the Savannah River Site as guides. S002-02

Can any deadly material going into "cold storage" in the ground be invulnerable to changes resulting from natural ground movement as well as disasters such as floods and earthquakes. Remember--the Savannah River Site is located over a fault in the earth. Thus the devastation resulting from an earthquake is too horrendous for anyone to conceive--given the haunting factor of the release of nuclear waste throughout the Georgia and South Carolina countryside and cities. S002-03

Fellow Savannahians! Do not accept the false proposition that you are not in danger from the DOE proposal. Until we adequately solve the problem of nuclear waste we should not lull ourselves into believing that our lives are not being risked under the current proposed solution.

PK56-37

Letter S002.

Response to Comment S002-01

Plutonium storage is out of the scope of this EIS. The response to comment L007-07 provides additional information on the storage of transuranic waste, which may contain plutonium. DOE addresses plutonium storage and storage of other weapons materials in other National Environmental Policy Act documentation including the *Stockpile Stewardship and Management Programs Programmatic EIS* (DOE/EIS-0236), the *Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs EIS* (DOE/EIS-0203), the *F-Canyon Plutonium Solutions EIS* (DOE/EIS-0219), the *Interim Management of Nuclear Materials EIS* (DOE/EIS-0220), the *Long-Term Storage and Disposition of Weapons - Useable Fissile Materials Programmatic EIS* (DOE/EIS-0229), the *Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components EIS* (DOE/EIS-0225), and the *Environmental Assessment for Operation of the HB-Line Facility and Frame Waste Recovery Process for the Production of Pu-238 Oxide at the SRS* (DOE/EIS-0948).

Response to Comment S002-02

The Department of Energy Savannah River Operations Office is committed to the safe storage and disposal of all nuclear and other hazardous materials for which it is responsible. Standards for the storage and disposal of radioactive material are set forth in the Atomic Energy Act of 1954 (42 USC §201 *et seq.*) and implemented through DOE Orders. The DOE Orders establish an extensive system of standards and requirements that protect human health and minimize dangers to life or property from radioactive material management activities under DOE's jurisdiction. DOE Order 5820.2A, "Radioactive Waste Management," establishes performance criteria for the storage of high-level and transuranic wastes and for the storage and disposal of low-level wastes. The performance criteria for low-level waste disposal facilities require that a radiological performance assessment be developed that projects the migration of radionuclides from the disposed waste to the environment and estimates the resulting dose to people. The performance assessment is used to establish the combination of waste inventory and proposed disposal method that provides reasonable assurance that the performance objectives will be met. Engineered structures, such as the low-level waste disposal vaults, and enhanced waste forms, such as the stabilized waste forms to be achieved by the Consolidated Incineration Facility or the proposed vitrification facilities, evaluated in this EIS are designed to provide containment of the radioactive materials in accordance with applicable requirements.

Further, the Atomic Energy Act, as amended, and other related statutes give EPA responsibility and authority for developing generally applicable standards for protection of the environment from radioactive material. EPA has promulgated several regulations under this authority including the "Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes" (40 CFR 191). DOE must manage its radioactive wastes in accordance with applicable EPA regulations. In addition, the management of radioactive waste that also contains hazardous waste components, known as mixed waste, is also subject to regulation under RCRA, which is coadministered by the state of South Carolina.

Response to Comment S002-03

DOE analyzes accident scenarios associated with existing and proposed waste processing, storage, and disposal facilities in Appendix F, "Accident Analysis," of this EIS. Accident analysis methodology included natural phenomena initiators such as floods, tornadoes, and earthquakes. DOE considers the potential for flood damage in the design of SRS facilities.

Both above-grade and below-grade storage and disposal facilities would be located in E-Area, which is centered over the drainage divide between Upper Three Runs and Fourmile Branch and is approximately 30 meters (100 feet) above their floodplains (as shown in Figure 3-7 of the EIS). Sites of new construction would be graded to direct stormwater away from the storage and disposal facilities. In addition, facility design would include sumps to remove water that entered underground disposal areas. Therefore, flooding would not damage above- or below-grade storage and disposal facilities.

As shown in Figure 3-4 of the EIS, no earthquake fault underlies E-Area, where SRS waste management activities are carried out. A design-basis earthquake, which has an estimated ground acceleration of 0.2 times the acceleration of gravity (0.2*g*), is (as stated in Section 3.2.3 of the EIS) estimated to have a 2.0×10^{-4} annual probability of occurrence (1 in 5,000 years) at SRS. Appendix F analyzed 24 potential accidents that would be initiated by earthquakes. The analysis shows that the risk of these accidents (probability × consequences), both individually and cumulatively, is not the highest risk event for any waste type. The highest risk accident to a storage or disposal facility initiated by an earthquake would increase the likelihood of a fatal cancer to the offsite maximally exposed individual by 4 chances in 1 million which would not be detectable, given the individual likelihood of fatal cancer from all causes of about 1 in 4. As stated in Section F.7, Secondary Impacts from Postulated Accidents, no adverse impacts on water quality from postulated accidents are considered likely. Contamination would migrate slowly to the groundwater, so clean-up efforts that would follow a release incident would capture the contaminants before they reach the groundwater, and it is unlikely that the postulated accidents would result in offsite contamination.

MR. MINOT: I have in my hand here something that -- from Oak Ridge about in situ vitrification that they've apparently been very successful in. Is that part of your plan?

MR. THOMAS: In situ -- this is the Waste Management EIS for solid waste streams. Now --

MR. MINOT: Well, that's exactly what they're talking about. They're talking about taking the contaminated dirt and putting electrodes in it and melting it down and forming a solid glass form.

MR. THOMAS: That isn't processing. That is in the environmental restoration we're in for in situ, and the environmental restoration folks are evaluating in situ vitrification as potential treatment for remediation sites. Does that make sense?

HH001-01

MR. MINOT: What the hell difference does it make? You want to contain it. Why dig it up and carry it off to a glass-making facility even though it's across the way?

MR. THOMAS: We didn't, in this EIS, want to make policies for particular environmental restoration sites. What we wanted to do was to try to determine how much waste would be coming out of those and then set up the facilities to treat it. Those individual environmental restoration sites are the subject of other NEPA actions which will be done as those sites come about.

PK56-40

Comment HH-001. (page 1 of 3)

MR. MINOT: I don't know a NEPA action from anything.

MR. THOMAS: National Environmental Policy Act, which an environmental impact statement is a NEPA action. So there's a separate process for evaluating and the cleanup and technologies for environmental restoration sites as dictated by --

MR. MINOT: That's bureaucratic gobbledegook. What I'm talking about, if I have a problem and it consists of contaminated soil, which you indicated that a large majority of this, at least the mixed waste, was a contaminated soil problem, some of the high-level waste is -- you know, has to be reduced out of a liquid form, and certainly we want it out of the groundwater and out of the aquifers. But contaminated soils, it seems that this seems to be a viable or at least something to be considered. We're not going to be selling that land -- DOE is not going to sell that land for residential property sites in the next 1,000 years.

HH001-01 (cont.)

MS. MARSALA: It may. It may.

MR. MINOT: Not -- no. No. No.

MS. MARSALA: They have a plan for it.

MR. MINOT: No, they don't. No they don't. That's the Mickey Mouse that they're talking about. Let's be realistic. The question was, have you considered this?

MR. THOMAS: The environmental restoration folks are considering that.

MR. MINOT: I'm talking about in your program to handle waste.

MR. THOMAS: No, we are not.

MR. MINOT: Why not?

PK56-40

Comment HH-001. (page 2 of 3)

MR. THOMAS: Because we take that results from other facilities, all right, that we project to come to us and have a centralized treatment facility. Now, if I was remediating --

MR. MINOT: No, that's not -- that wasn't my understanding of it. The problem was to look at the waste as it exists and what might be coming in.

MR. THOMAS: Right.

MR. MINOT: And if the best answer is to freeze it in place and move on, you know.

MR NOLL: Not taking the soil out of the ground and doing something with it is -- one of the projections would be the minimum case.

HH001-01 (cont.)

MR. THOMAS: Right.

MR. NOLL: And if they leave the soil there, there's several things they can do. It is between negotiations between the State who gives us the permit.

MR. MINOT: You're asking for comment. My comment would be, why not consider this? And don't give me the -- you know, well, we have to take it from them, whoever them are. That a viable solution to solving the waste management problem at SRS might be, for its contaminated soil, the least expensive, the least exposure to people, and more equipment that has to be trashed later on because it was digging in this dirt. It may be a consideration. And why can't we propose that as a comment to this particular --

MR. POPE: You can. You can.

MR. MINOT: So moved.

PK56-40

Comment HH-001. (page 3 of 3)

Response to Comment HH001-01

Although specific alternatives for environmental restoration (i.e., cleaning up contaminants released into the environment in the past) would be subject to separate NEPA review, if appropriate, DOE has included in this EIS the waste volumes that could be generated from environmental restoration activities. As the discussions at the hearing indicated, DOE-Savannah River Operations Office is evaluating the feasibility of in-place vitrification of contaminated soil as well as other in-place treatments. In-place vitrification is addressed in Appendix D, Section D.7.15 of the EIS as an emerging treatment technology which may well be employed for the treatment of some or much of the contaminated soil at SRS. Sections 2.1.3, 2.1.4, and 2.1.5 of the EIS show that the expected, minimum, and maximum waste volumes resulting from environmental restoration activities depend on whether in-place treatment is viable (as assumed for most of the units in the minimum waste forecast) or the waste must be removed for treatment (as assumed for most of the units in the maximum waste forecast).

As indicated in Section 2.1, the environmental restoration program is regulated by the *Federal Facility Agreement for SRS*, an agreement between EPA, the South Carolina Department of Health and Environmental Control (SCDHEC), and DOE. Characterization of the environmental restoration units (identified in Appendix G) is in its early stages. Therefore, DOE believes it would be premature to consider site-specific environmental restoration alternatives in this EIS. DOE-Savannah River Operations Office has established a land use planning group to develop a comprehensive land use plan and land use options for the SRS.

MS. MARSALA: Number one, you don't have to be told by me that DOE has a credibility gap with the public. Okay? You have done, inadvertently, no intention, no intentional doing, created an economic hardship on the city of Savannah and will be created and imposed on Hilton Head if this continues and we go to the river as a water source -- drinking water source. I resent it very, very much.

I think since you created this tritium problem -- because of the unknowns of 50 years ago there's no finger of blame being pointed -- you should subsidize the scintillating monitors that's been being used in the city of Savannah ever since that 1991 spill. Since nobody trusts DOE in letting the public know as quickly as the public would like to know, even if we let our hair stand on end for a couple of days, I think you should underwrite that and let it continue to be an independent testing but funded by DOE.

HH002-01

I further think you should offer Beaufort-Jasper Water Sewer Association a new scintillating monitor which is very sensitive to tritium readings. The maximum cost of the monitor is $25,000. The ultimate goal that they use to monitor it is the only one out of three that doesn't produce more hazardous waste in the testing of it. And you should supply the manpower that is needed to test it, and place it at least an hour/an hour and a half riverwise up the Savannah River so that an alarm could be sent for the Beaufort-Jasper to close our canal if the readings are higher than what we anticipate or hope that they're going to be.

And this is the message that I have sent to Hazel O'Leary and I restate it here. I think you should at least subsidize that. That's not going to break the bank as far as I'm concerned.

PK56-40

Comment HH-002. (page 1 of 2)

Secondly, there was -- from the Lawrence Livermore National Laboratory in California a new technology was developed for desalinating not only brackish water but soiled seawater. I would hope that the Department of Energy, which funds that particular program, would consider using that at the Savannah River Plant so that you don't have to lay off a bunch of people, just convert the mass plowshare, so to speak, and use the facility for something productive.

And if you can get the cooperation of Secretary Baggett from the Department of the Interior, because his reclamation group has already sent me a letter in response to my sending him that information that they think it's a very viable method, that they would develop and are considering developing it for commercial use if they had enough funding. So possibly in this country Macy's could help Macy's, instead of being separate entities being cooperative and to develop that technology. That's about it.

HH002-02 (cont.)

MR. WILLIAMS: Okay. Any other comments, questions, observations?

PK56-40

Comment HH-002. (page 2 of 2)

Response to Comment HH002-01

Subsidizing or providing additional scintillation monitors for Savannah River water users is outside the scope of the Waste Management EIS. However, this suggestion was forwarded to the DOE Savannah River Environmental Compliance Division for review.

After detailed review of DOE's and the state's monitoring program, DOE believes that additional monitoring is not necessary because of the following reasons:

- DOE presently monitors the tritium concentrations at a number of locations upstream of Savannah, GA including Highway 301, and the Beaufort Jasper and the Port Wentworth water treatment plant intakes. DOE presents the results of its monitoring program for public review in the *SRS Annual Environmental Monitoring Reports*. The 1994 annual dose to an individual who drank two liters of water per day from either of the Savannah River water intakes (0.06 millirem) is well below a level that would cause concern. DOE encourages public participation in its environmental monitoring program through review of the *SRS Annual Environmental Monitoring Reports*.
- River water at Highway 301 is routinely sampled by SCDHEC to independently verify that there are no health concerns presented by the Savannah River due to contaminants released from SRS.

We also wish to note that the SRS reactors, which in the past presented the greatest risk of an unplanned release, are presently shutdown. Only the K-Reactor is being maintained for possible future missions. Before K-Reactor was shutdown, the component that caused the release in December 1991 was replaced and successfully tested. That component has been drained and deactivated for over 2 years.

Response to Comment HH002-02

Lawrence Livermore Laboratories is currently bench-scale testing a less energy-intensive water desalination technology. The technology works on the principle of deionization. Deionization is simply the stabilization of the electrical charge on an atom, group of atoms, or molecule by maintaining or restoring its electrical configuration. The deionization unit would contain charged ion plates (i.e., positive and negative) that would be used to attract the salt molecules from saltwater. To purge the system the charge on the plates would be reversed and a concentrated brine (i.e., salt) solution would be removed. The plates would then be reversed again and the system would be ready to treat more saltwater. There is no application of this technology for desalination purposes at SRS, however, in theory the technology could be applied to the treatment of wastewater with inorganic contaminants.

Since this technology is being developed by DOE through the Office of Technology Development (OTD), its applications to SRS would be evaluated and applied through the DOE complex-wide focus areas which include: plumes (i.e., groundwater plumes), landfills, stabilization (i.e., materials and waste), high level waste, and mixed waste. OTD communicates the potential application of emerging and developing technologies to SRS.

In response to the comment about layoffs, in this EIS DOE evaluated the manpower needed to construct and operate the treatment, storage and disposal facilities. This includes retraining personnel to perform waste management activities.

I.3 Correspondence Received from Government Agencies and the Public

A.B. Gould, Director
Environmental Compliance Division
NEPA Compliance Officer
U.S. Department of Energy
Savannah River Operations Office
P.O. Box 5031
Aiken, South Carolina 29804-5031
Attention WMEIS

RE: Comments regarding the "Savannah River Site (SRS) Waste Management Draft Environmental Impact Statement"

Mr. Gould:

The subject document is well written, user friendly, and thorough in every respect.

1. The draft environmental impact statement (EIS) addresses options for treatment of polychlorinated biphenyl substances (PCBs). Shipment of PCBs to offsite locations from the Site is an option SRS should consider only after doing the following:

Proposing a blending plan to SCDHEC (and receiving approval of same) which allows SRS to blend PCBs and PCB contaminated media to below TSCA or waste acceptance limits with the waste streams already approved for burning in the Consolidated Incineration Facility (CIF).

L001-01

It is recognized the CIF is not licensed to incinerate TSCA substances, however, the State of South Carolina (SCDHEC) could be doing a dis-service to its residents of the State by forbidding on-site treatment and thereby requiring SRS to transport incinerable PCBs across local highways for treatment and disposal, when SRS could treat (by incineration) blended-down (or diluted) concentrations of this waste volume. While the RCRA Permitted incinerator at SRS may not be designed to achieve the destruction efficiency of a TSCA Licensed incinerator, blending waste PCB oils and residues (particularly with high heat value wastes) may result in more than adequate destruction, and hence reduce the need for offsite shipments.

2. This document (WMEIS) describes different operating lifespans for the CIF (in years). Depending on the different alternatives considered, the CIF would operate until other facilities could be constructed (the Alpha and/or Non-Alpha Vitrification Facilities).

L001-02

Because of the substantial demand for process steam in the immediate area of the CIF construction site (the CIF itself requires steam in its operation) SRS would better spend its financial resources by developing steam (or even electrical power) generating capabilities at the CIF if enough high-heat value waste is available. If SRS is chosen to receive incinerable waste from the DOE Complex (i.e. outside of SRS) then special consideration for producing steam and power should be given to this. If the existing incinerator can (without drastic engineering and construction changes) be modified to support steam production (i.e. reheating of condensate or other) in some way, then this concept should be considered as well.

James E. Bolen
Aiken, South Carolina - Resident

PK56-34

Letter L001.

Response to Comment L001-01

EPA has established regulations under the Toxic Substances Control Act that specify standards for the incineration of polychlorinated biphenyl materials (PCBs). As noted in the comment, these standards are generally more restrictive than those imposed on the incineration of hazardous wastes under RCRA. For example, a destruction and removal efficiency of 99.9999 percent is specified for the incineration of PCBs as opposed to the efficiency of 99.99 percent generally required by RCRA regulations. Certification of an incinerator under the Toxic Substances Control Act requires extensive testing in addition to that required for RCRA permitting. Furthermore, the EPA regulations under the Toxic Substances Control Act prohibit generators of PCB materials from avoiding, by dilution, requirements applicable to materials contaminated in excess of specified PCB concentrations. It would not be cost-effective to obtain permits under the Toxic Substances Control Act for the small amount of PCB wastes that could be treated at the Consolidated Incineration Facility, and it would not be legal to circumvent the Toxic Substances Control Act regulations by diluting PCB wastes.

Response to Comment L001-02

Implementation of steam or electrical power generation by recovering waste energy from the Consolidated Incineration Facility was considered at the time the process was being designed. Energy recovery was not adopted because the economic benefits were marginal. The small thermal capacity of the Consolidated Incineration Facility design limits the amount of recoverable energy. Additionally, energy recovery would increase the complexity of operations and maintenance and require that the combustion offgas be held at a temperature range known to promote the formation of undesired combustion products such as dioxins and furans. The costs to enhance the air pollution control system to counter this increased pollutant generation and maintain emissions at safe levels would offset any cost benefits of energy recovery. Retrofitting an energy recovery system into the Consolidated Incineration Facility at this time would significantly impact design of the downstream air pollution control system. Substantial costs would also be incurred to modify various environmental permits and to repeat emissions tests such as the trial burn required by RCRA.

PAINE COLLEGE

Division of Natural Sciences and Mathematics 1235 Fifteenth Street Augusta, Georgia 30901-3182 (706) 821-8200

A.B. Gould, Director, ECD
U.S. Department of Energy
Savannah River Operations Office
P.O. Box 5031
Aiken, SC 29804-5031

Dear Director Gould: 2.10.95

Re: WMEIS

Thank you for sending me a copy of the WMEIS (i.e., DOE/EIS-0217-D, January, 1995). Because our CAB meets formally only once every two months and its next scheduled meeting is not until after DOE has planned to close the comment period, as Co-Chair of the SRS CAB's ER & Waste Management Subcommittee, I request that you extend the public comment period for the WMEIS. L002-01

The reason for this request is that the working group for our Subcommittee has begun to draft for the CAB's approval three motions on the WMEIS: a motion on the treatment of transuranic wastes (primarily pu-238); another on incinerable low level wastes; and the third on contaminated soils. If approved by the CAB, these three motions will be forwarded to DOE SRS, EPA, and DHEC (note that in addition to members of the public, the working group includes representatives of DOE, EPA, and DHEC).

Because work just began on the motions last night, at this time, little can be said of what issues they will eventually address. But whatever is included in them, they will at least recommend that, in keeping with DOE's implementation of the first motion of the CAB (letter M. Fiori, DOE SRS Manager, January 20, 1995), the WMEIS be submitted to independent scientific peer review. L002-02

Thank you for your attention to this request.

Sincerely,

W.F. Lawless

cc: M. Fiori; R.H. Slay (Co-Chair, CAB); M. McClain (Co-Chair, CAB)

A College of The United Methodist Church and the Christian Methodist Episcopal Church

PK56-36

Letter L002.

Response to Comment L002-01

On March 3, 1995, the Manager, DOE-SR, extended the public comment period through March 31, 1995, to allow the Citizens Advisory Board time to consider and present comments. On March 13, 1995, DOE issued a press release announcing the extension of the public comment period; the announcement was published in local newspapers.

Response to Comment L002-02

DOE retained nationally recognized experts in waste management to provide independent review before issuing the Draft EIS. Four individuals participated, three of whom also provided independent review of the *SRS Proposed Site Treatment Plan* prepared in response to the Federal Facility Compliance Act of 1992. The reviewers were required to sign a "no conflict of interest" statement stating that they have no financial, contractual, personal, or organizational interests in decisions reached through the EIS that could affect their ability to render impartial advice. Their reviews included reading the documents, extensive discussion meetings at SRS, and submittal of written review comments. Their recommendations were incorporated into the draft EIS.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive N.
St. Petersburg, Florida 33702

February 14, 1995

Mr. Arthur B. Gould, Jr.
NEPA Compliance Officer
U.S. Department of Energy
Savannah River Operations Office
P.O. Box 5031
Aiken, South Carolina 29804-5031 Attn: WM EIS

Dear Mr. Gould:

The National Marine Fisheries Service (NMFS) has reviewed the Draft Environmental Impact Statement (DEIS) for Waste Management, Savannah River Site, Aiken, South Carolina. The document addresses the environmental effects of various alternatives for nuclear and related waste management at the Savannah River Site (SRS). The alternatives include an evaluation of storage and disposal of five types of waste including liquid high-level radioactive, low-level radioactive, hazardous, mixed (radioactive and hazardous combined), and transuranic wastes.

The DEIS advises that waste management could affect a land area of about 100 to 1,000 acres in size. The final amount of land needed will be determined by the final volume of the waste and the processing technique utilized. Impacts involving areas in the 1,000-acre range are associated with the "maximum waste forecast" and are not anticipated. Direct elimination or degradation to aquatic resources is not anticipated.

L003-01

Considering the location and size of the area to be affected, even under the "minimal waste forecast" it is possible that tributary waters of the Savannah River could be adversely affected. Since work in wetlands is not called for, likely impacts to wetlands and other aquatic resources are limited to those associated with the discharge of degraded surface water from converted forest or other vegetated uplands. Several agencies, including the NMFS, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and the States of Georgia and South Carolina are jointly and individually examining aquatic resource protection and restoration needs in the Savannah River. These efforts have been initiated as a result of increasing concern over the river's environmental quality and growing recognition of its enormous fishery, natural aesthetic, recreational, power production, and other public interest features. Of particular interest to the NMFS and other agencies is the river's function as a spawning and nursery site for anadromous fishes including American shad (Alosa sapidissima),

PK56-36

Letter L003 (page 1 of 2).

blueback herring (Alosa aestivalis), striped bass (Morone saxatilis), Atlantic sturgeon (Acipenser oxyrhynchus) and shortnose sturgeon (Acipenser brevirostrum). Because of their migratory nature, these species utilize significant portions of the river including sections that would be impacted by discharges from the Savannah River Site.

Based on the preceding, the final environmental document should fully address changes in the physical, chemical, and biological character of surface waters entering the Savannah River and its tributaries. Additionally, the final document should identify all measures that will be implemented to ensure adverse impact avoidance and mitigation and those measures that will be employed if significant adverse effects are realized. L003-01

Finally, in accordance with the Endangered Species Act of 1973, as amended, it is the responsibility of the appropriate federal regulatory agency to review its activities and programs and to identify any activity or programs that may affect endangered or threatened species or their habitat. If it is determined that these activities may adversely affect any species listed as endangered or threatened, formal consultation with our Protected Species Management Branch must be initiated. The appropriate contact person for matters pertaining to protected species is Mr. Charles Oravetz who may be contacted at the letterhead address. L003-02

We appreciate the opportunity to provide these comments.

Sincerely,

Andreas Mager, Jr.
Assistant Regional Director
Habitat Conservation Division

PK36-36

Letter L003 (page 2 of 2).

Response to Comment L003-01

As described in the respective sections on surface water impacts in Chapter 4, no substantive changes in the physical, chemical, or biological characteristics of the surface waters feeding the Savannah River are expected to result from implementing any of the alternatives evaluated in the EIS. This is due to the essential similarity of the very low concentrations in the projected discharges to those currently being released in accordance with the conditions of the current National Pollutant Discharge Elimination System Permit, and the very small volumetric addition of a few percent, relative to the natural stream flows, at the maximum.

Discharges from SRS treatment systems and outfalls are monitored for the constituents included on the National Pollutant Discharge Elimination System permit on a schedule prescribed by the permit. If a discharge is found to exceed the permit limits, DOE determines the cause of the exceedance and corrects the problem. Most of the treatment systems can be shut down and the wastewater stored until the problem is corrected. Both the M-Area Dilute Effluent Treatment Facility and the F/H-Area Effluent Treatment Facility can be operated in a batch treatment mode. The M-Area Air Stripper can be shut down (the wells supplying the groundwater would cease pumping) until any problem could be corrected. Also, SRS has an ongoing stream monitoring program (not part of the National Pollutant Discharge Elimination System program) for the collection and analysis of samples. Thus, any changes in constituent concentrations would be noted and steps taken to locate the source of the changes. It should be noted that tables in Section 1.0 of Appendix E indicate that the radionuclides in the aqueous discharges will be very low as was explained in Section 4.1.4 of the EIS.

As discussed in Section 4.1.4, measures would be taken to control the impact of stormwater runoff during both construction and operation activities. SRS must meet criteria of National Pollutant Discharge Elimination System permits issued by SCDHEC for both activities. Pollution prevention plans have been prepared which detail the steps to be taken to control suspended solids, debris, and oil/grease that may be in the runoff and impact the streams (WSRC 1994). Facilities or measures taken to control these impacts would be regularly inspected. Additionally, immediately following major rain events, the facilities would be inspected. If problems are found during these inspections, DOE would take corrective actions to mitigate the problems.

Response to Comment L003-02

A protected species survey of the uncleared part of E-Area has been completed and submitted to U.S. Fish and Wildlife Service and the National Marine Fisheries Service. This survey, dated February 3, 1995, initiated informal consultation as required by Section 7 of the Endangered Species Act of 1973. The survey concluded that activities proposed for E-Area north of F-Area and south of the M-Line Railroad will not affect any Federally protected animal or plant species. The revised survey of April 1995 is included in this EIS as Appendix J.

The survey does not address impacts to threatened and endangered species on additional land outside the boundary of E-Area that would be needed if SRS is required to manage the maximum waste forecast. If land outside E-Area is needed, additional surveys for threatened and endangered species would be required and another Section 7 consultation would be initiated with U.S. Fish and Wildlife Service. Until decisions are made on the facilities that are needed and the amount of waste that would be handled at SRS, the selection of additional land would be premature.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
Atlanta GA 30341-3724

February 24, 1995

Arthur B. Gould, Jr.
Savannah River Operations Office
NEPA Compliance Officer
U.S. Department of Energy
P.O. Box 5031
Aiken, South Carolina 29804-5031

Dear Mr. Gould:

We have completed our review of the Draft Environmental Impact Statement (DEIS) for Waste Management, Savannah River Site, Aiken, South Carolina. Technical assistance for this review was provided by the Radiation Studies Branch , Division of Environmental Hazards and Health Effects, National Center for Environmental Health. We are responding on behalf of the U.S. Public Health Service.

This review focused on the public health consequences associated with several proposed waste management alternatives. The attached pages offer general and specific comments that should be considered when preparing the Final EIS. If you have questions regarding these comments, you may contact Mr. Robert Whitcomb at (404) 488-7634, or me at (404) 488-7074.

Thank you for the opportunity to review this draft document. Please ensure that we are included on your list to receive a copy of the Final EIS, and future EIS's which may indicate potential public health impact and are developed under the National Environmental Policy Act (NEPA).

Sincerely yours,

Kenneth W. Holt

Kenneth W. Holt, M.S.E.H.
Special Programs Group (F29)
National Center for Environmental Health

Attachment

PK56-37

Letter L004. (page 1 of 6)

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service
Centers for Disease Control

Memorandum

Date February 16, 1995

From Robert C. Whitcomb, Jr., Physical Scientist, National Center for Environmental Health, Division of Environmental Hazards and Health Effects, Radiation Studies Branch (F35)

Subject Review of 'Savannah River Site Waste Management Draft Environmental Impact Statement'

To Ken Holt, Environmental Health Scientist, Special Programs Office, National Center for Environmental Health

This review focuses on the public health consequences associated with several proposed alternatives for the management of waste at the Savannah River Site. Comments have been separated into two categories; general and specific. This page considers the general comments and subsequent pages provide specific comments. There are some minor changes that would improve the document as discussed below.

General Comments

L004-01 Populations are listed by pathway of exposure; 620,100 for the atmospheric pathway and 65,000 for the aqueous pathway. It may be that the population exposed by the aqueous pathway extends beyond the 80 kilometer (50 mile) atmospheric pathway. If this is the case, then it is possible for some 'downstreamers' to receive their dose only from the river. The question therefore is as follows; is the population exposed to the aqueous pathway (65,000) a subset of the 620,100 included in the atmospheric pathway? This clarification would be helpful for interpreting the collective doses and risk.

L004-02 There are several tables or figures in the beginning sections presented without numbering (e.g., page 2-4, page 2-23, page 2-24, etc..). They are also not included in the List of Tables or the List of Figures. All tables and figures should be numbered and included in the list of tables and in the list of figures respectively.

L004-03 All terms used within the text and tables should be included in the glossary. For example; collective dose is used but not defined in the glossary.

PK56-37

Letter L004. (page 2 of 6)

Specific Comments

1) Section 3.12.1.2 Radiation Levels in the Vicinity of SRS, page 3-65, paragraph 3,

'A dose of this magnitude would result in an annual probability of contracting a latent fatal cancer of 6.5×10^{-7}.'

The question here is why provide a risk for this activity and not the previous activity of a hunter who had a higher estimated dose. Also, the risk is given with no reference to the risk factor used. The risk factor used is 5×10^{-4} risk of fatal cancer per person rem referenced to ICRP 60. L004-04

2) Section 3.12.1.3, Radiation Levels in E-, F-, H-, S-, and Z-Areas, page 3-66,

Table 3.12-1 presents gamma radiation levels measured in these areas except N-Area. In the previous section, N-Area had the maximum measured gamma radiation level of 506 millirem per year. In Figure S-3, SRS areas and facilities, N-Area is described as 'Site services and waste storage'. Therefore N-Area should be included in the table and in the discussion. L004-05

3) Section 4.1.11.2 Transportation, page 4-37, first paragraph,

'...by the risk factors of 0.0004 (for occupational health) and 0.0005 (for the general public) excess latent cancer fatalities per person-rem (ICRP 1991).

later in section 4.1.12 Occupational and Public Health, page 4-43, second paragraph,

'Dose-to-risk conversion factors for nonfatal cancers and genetic effects (0.0001 per person-rem and 0.00013 per person-rem, respectively; NCRP 1993) are ...'

and finally in section 4.1.12.2.1 Radiological Impacts, page 4-47, first paragraph,

'...the conversion factor of 0.0005 latent cancer fatality per rem for the general population (DOE 1993c).'

It is unnecessary to provide multiple references for this L004-06

PK56-38

L004-06 (cont.)

information. The original source of these values is ICRP 1991. The NCRP and DOE have concurred with and adopted limits and values set by the International Commission on Radiological Protection. The reference source should be the same in both cases ICRP 1991 and not NCRP 1993 or DOE 1993c.

4) Section 4.1.11.2.2 Radiological Transportation Accident Impacts, page 4-41, Table 4.1.11-4, second to last column on right,

The value for the Offsite MEI, minimum dose, high probability accident, excess latent cancer fatality of 1.4×10^{-10}

L004-07

This value should be 1.9×10^{-13} based on the calculation $3.7 \times 10^{-10} \times 5 \times 10^{-4}$ risk per person rem for the offsite population. The current (incorrect) value is based on the calculation of $2.8 \times 10^{-7} \times 5 \times 10^{-4}$.

5) Section 4.1.12.2.1 Radiological Impacts, page 4-50, last paragraph,

'In the population of 620,100 people living within 80 kilometers (50 miles) of SRS and exposed to its atmospheric releases, the number of people expected to die of cancer is 145,700. In the population of 65,000 people using the Savannah River and exposed to the aqueous releases, the number of people expected to die of cancer is 15,275.'

L004-08

The way this paragraph is written it sounds like 145,700 are getting cancer as a result of atmospheric releases and 15,275 from aqueous releases. These are actually the normal expected incidence of cancer in populations this size. Please reword this paragraph for clarity.

6) Figure 4.1.12-2. Dose to individuals in communities within 80 kilometers (50 miles) of SRS under the no-action alternative, page 4-55,

L004-09

There is a typographical error on the Dose axis 1.0×10^{7} should be 1.0×10^{-7}.

PK56-38

Letter L004. (page 4 of 6)

Savannah River Site Waste Management
Draft Environmental Impact Statement
Page 4 of 5

7) Section 4.2.11.2.3 Transportation Maximum Waste Forecast, page 4-109, Table 4.2.11-9, second to last column on right,

The value for the Remote MEI, excess latent cancer fatality of 4.1×10^{-10c}

This value should be 4.1×10^{-11} based on the calculation 8.2×10^{-8} x 5×10^{-4} risk per person rem for the offsite population. L004-10

8) Section 4.3.12.3.2 Public Health and Safety, Radiological Impacts, page 4-181, second paragraph, first sentence,

'The health effects associated with the maximum waste forecast are included in Table 4.3.12-3.'

This should read Table 4.3.12-2. L004-11

9) Section 4.3.12.3.2 Public Health and Safety, Radiological Impacts, page 4-181, second paragraph,

'..and the number of fatal cancers in the regional population could be 3.6 (effectively 4). This probability of a fatal cancer is much smaller than the one chance in four (23.5 percent) ...'

Then in Section 4.4.12.3.2 Public Health and Safety, Radiological Impacts, page 4-242,

'The number of additional fatal cancers in the regional population could be 0.20 (effectively zero).'

Change the sentence from Section 4.3.12.3.2 Public Health and Safety, Radiological Impacts, page 4-181, second paragraph, to read; '..and the number of <u>additional</u> fatal cancers in the regional population could be 3.6 (effectively 4). L004-12

10) Section 4.4.5.1.2 Operational Impacts, page 4-208,

'The two radioisotopes contributing most of the radiation dose would be cesium-137 and plutonium-239.'

How was this determined? Were screening or sensitivity analyses performed? How much of the dose do these represent? Please describe the process. L004-13

PK56-39

Letter L004. (page 5 of 6)

11) Section 4.4.11.2.2 Transportation Minimum Waste Forecast, Table 4.4.11-7, page 228

L004-14 **The value (2.2×10^{-4d}) at the bottom right hand column of Table 4.4.11-7 refers to footnote d. Footnote d uses the risk factor for occupational (0.0004) rather than population (0.0005). The value is correct but the reference should be 2.2×10^{-4c} and footnote c should read 'c. Additional probability of an excess latent fatal cancer. Value equals the total dose times the risk factor (0.0005 excess fatal cancers per person-rem).'**

12) Section 4.4.12.2.2, Radiological Impacts, page 239,

'Table 4.3.12-3 includes...'

L004-15 **This should read Table 4.3.12-2.**

PK56-39

Letter L004. (page 6 of 6)

Response to Comment L004-01

The downstream population which uses the Savannah River as the source of its drinking water is not considered part of the population within 80 kilometers (50 miles) of SRS. The text in Section 3.8.5 has been modified to clarify this point. In addition, a map locating all the communities within the 80-kilometer (50-mile) radius has been added to that section.

Response to Comment L004-02

All tables and figures in the document have been numbered.

Response to Comment L004-03

The term "collective dose" has been added to the glossary. Figures and tables were searched and other words have been included in the glossary.

Response to Comment L004-04

Because this probability of contracting a latent fatal cancer is not related to the waste management alternatives considered in the EIS, DOE believes that it is inappropriate to include a discussion of health impacts in Chapter 3, which only describes the affected environment. The sentence discussing the probability of contracting a fatal cancer has been deleted to make the discussion in question consistent with others in this chapter.

Response to Comment L004-05

N-Area data was inadvertently omitted from the discussion of gamma radiation levels. The data are now included in the table in Section 3.12.1.3. In addition, the level for N-Area given in the text of Section 3.12.1.2 was incorrect. The correct value is 460 millirem per year. The text has been corrected.

Response to Comment L004-06

DOE agrees with the comment. All citations dealing with risk conversion factors have been changed to reflect the original reference found in ICRP (1991).

Response to Comment L004-07

Table 4-8 (originally Table 4.1.11-4) has been revised and no longer presents low consequence accidents.

Response to Comment L004-08

DOE has revised the paragraph to clarify that the number of cancer deaths expected is not specific to the population in the vicinity of SRS but to any population of comparable size.

Response to Comment L004-09

The entry in the figure has been corrected.

Response to Comment L004-10

The entry in Table 4-31 (formerly Table 4.2.11-9) has been corrected to 4.1×10^{-11}.

Response to Comment L004-11

The table reference has been corrected.

Response to Comment L004-12

The word "additional" has been added to the sentence to make the statement correct.

Response to Comment L004-13

Contributions of various isotopes to the offsite maximally exposed individual and population doses were determined by developing isotope-specific emission factors for each facility. These factors, when coupled with facility throughput data based on the alternative and the waste forecast, yielded total quantities of each isotope released from each facility. The release values were then used with facility-specific unit-activity isotopic dose conversion factors to determine the isotope-specific doses. Calculated isotopic-specific doses are reported in Section E.4 (Appendix E). A detailed description of the calculations can be found in Chesney (1995). The text of the EIS has been revised to refer the reader to Appendix E and to Chesney (1995) for additional information.

In addition, the text in the no-action alternative section has been changed. In the no-action alternative (Section 4.1.5.2.2) the F-Area tank farm and the M-Area Vendor Treatment Facility have been added to the list of facilities that contribute to offsite doses.

Response to Comment L004-14

Reference to the footnote in the table has been corrected and the footnote has been modified to explain how the value is calculated.

Response to Comment L004-15

The table reference has been corrected.

SHIRLEY O. DENNIS
11 WING SHELL LANE • HILTON HEAD ISLAND, SOUTH CAROLINA 29926

7 March 1995

Arthur B. Gould, Jr., Dir.
NEPA Compliance Officer
U.S. Dept. of Energy
Savannah River Operations Office
P.O. Box 5031, Code IS
Aiken, SC 29804-5031

I could not attend the recent local meeting for public comment on the waste management environmental impact statement. However, I want to let you know of my support. Also, I am very concerned that the project might suffer because of insufficient funding — this project should not be neglected nor abandoned. L005-01

Another important issue — there has been no permanent depository site designated in the U.S. — SRS should not become that permanent site. L005-02

Sincerely,
Shirley Dennis

PK56-40

Letter L005.

Response to Comment L005-01

DOE intends to pursue funding to support the initiatives developed on the basis of this EIS and the obligations imposed under the Federal Facilities Compliance Act. DOE-Savannah River prioritizes and requests funding for various projects through DOE-Headquarters (HQ). DOE-HQ requests funding from the U.S. Congress, which either approves or disapproves the request.

Response to Comment L005-02

DOE is investigating two sites for the permanent disposal of transuranic and high-level wastes. If approved, permanent repositories for transuranic waste in Carlsbad, New Mexico, and for high-level waste in Yucca Mountain, Nevada, would dispose of these wastes. However, as described in this EIS, SRS would contain permanent disposal sites for certain low-level and mixed/hazardous wastes.

INTER-OFFICE MEMORANDUM
Savannah River Site

09-Mar-1995 01:25pm EST

To: Arthur B. Gould, Jr.

From: Robert H. Wilcox
Dept: EP&RFSPD - Project Management

Draft EIS on SRS Waste Management

Thank you for sending me the two volume report DOE/EIS-0217D, "Savannah River Site Waste Management Draft Environmental Impact Statement". I appreciate the opportunity to review the report, and I do wish to offer the following comments which are intended to be constructive in the broad sense.

1. General. Once again, I must question the interpretation of the NEPA which calls for the creation of documents such as this and of this one in particular. Managing wastes at the SRS as elsewhere is an ongoing multi-faceted program with a myriad of necessary policy and business-type decisions needed by the U.S. Government. Such decisions have been needed since the early days of operating SRS through the enactment of NEPA, the end of the Cold War, and will be needed well beyond into the future. When, oh when, with whatever changes in federal policy and even laws are appropriate, will we stop devoting scarce resources to processes and volumes like this and get on with an orderly, cost-effective management of the business of necessary cleanup of such sites. L006-01

2. This Draft EIS. Nothing in 1 above is intended to question the accuracy of what has been put together by the authors of this report. To the limited extent that I have been able to review it, I have found no errors in what has been prepared.

3. Cleanup Philosophy. In the interest of minimizing future federal outlays, would it not make sense to take a fresh look at the many environmental requirements enacted during the last 25 years, especially as they pertain to large federally-owned sites like SRS. Such a look should focus on identified real and potential dangers and lay out a long-range approach capable of achieving bipartisan buy-in and support over the long haul. This draft EIS can be a most important reference in any such effort. My suggestion is not to imply that much planning has not already been done. It should be taken instead to suggest that what is needed now is less of an emphasis on compliance with present regulations and more of an open attitude toward reducing (or making exceptions to) them for sites such as SRS. L006-02

4. Environmental Consequences of SRS Waste Management. It is appropriate to emphasize what the report points out (e.g. in Section 5.7) that the differences among the various "management alternatives" would generally be minor for the same waste forecast. Impacts will be more dependent on the amount of waste managed, and that, in turn, depends largely on the government decisions on the extent of environmental restoration and decontamination/decommissioning. In any case, if I read the report right, environmental impacts are very small. (Once again this raises the question

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Letter L006. (page 1 of 2)

L006-03

of why such important decisions are more keyed to the NEPA process than to a businesslike cost-benefit approach of spending federal dollars.)

5. The Consolidated Incineration Facility (CIF). If I understand it right, this document is intended to analyze alternative approaches to operating the CIF and the environmental impacts of each. This would appear to be the most significant specific purpose of the report, along with some analyses of potential future facilities. The report appears to indicate that CIF's impact would vary depending on amount and type of waste and on the duration of its operation. The conclusion seems to be, however, that none of the cases analyzed result in an impact which would affect decisions on how best to operate CIF.

L006-04

6. Overall SRS Waste Picture. Treatment or not of the kind of wastes analyzed in this report is, of course, a trivial decision compared with the management of the site's high level wastes and spent nuclear fuel. As these appear to be outside the scope of this EIS, I offer no comments now, though I have done so on other opportunities.

7. Recommendation. DOE should conclude this EIS process as soon as possible, give the report a respected place on the bookshelf, and get on with the waste management job consistent with the real drivers of actual and potential risk to public health and the need to maximize the cleanup benefit for the cost to the federal taxpayer.

L006-05

PK56-41

Letter L006. (page 2 of 2)

Response to Comment L006-01

NEPA requires agencies to prepare a detailed statement (i.e., an EIS) on proposals for major Federal actions significantly affecting the quality of the human environment. DOE determined that the actions proposed in this EIS are major and may significantly affect the environment. Simply stated, DOE supports NEPA and its goal to ensure that environmental amenities and values are considered in decisionmaking along with economic and technical considerations.

Response to Comment L006-02

DOE is required and fully intends to comply with current, applicable regulations. This EIS considers three reasonable alternatives (alternatives A, B, and C) that would comply with applicable waste management requirements. However, the suggested "fresh look" at environmental requirements is not only outside the scope of this EIS, but is also beyond the authority of DOE to implement.

Response to Comment L006-03

The NEPA process includes the formulation of reasonable alternatives that are feasible from a common sense, technical, and economic standpoint. As paraphrased from the Summary and Chapter 2, the factors used to identify the most desirable technologies include process efficiency and effectiveness, engineering feasibility, costs, and environmental attributes. Because the environmental impacts of the candidate technologies are very small, the values of the other criteria are expected to weigh heavily in the decisionmaking process.

Response to Comment L006-04

DOE agrees that the impacts resulting from any of the operating scenarios for the Consolidated Incineration Facility evaluated in this EIS are very small. DOE evaluated a wide range of alternative operating scenarios for this facility to aid in establishing the appropriate role of incineration in an integrated waste management system for SRS. Different waste types (including hazardous, mixed, and low-level wastes) and volumes were proposed for treatment at the Consolidated Incineration Facility. The operating scenarios considered ranged from modifying the facility to include solid waste feed and ash handling systems capable of accommodating large volumes of soils and sludges to operating the incinerator for only a limited time until a non-alpha vitrification facility could be designed and constructed. The emissions and exposures associated with the operation of the Consolidated Incineration Facility vary with the waste volumes proposed for treatment under each alternative; however, under all alternatives, the impacts would be very small. DOE will consider the environmental consequences evaluated in this environmental impact statement along with costs, schedule, and regulatory requirements in reaching a decision regarding the operation of the Consolidated Incineration Facility. DOE will document its decision in the Record of Decision for this EIS.

Response to Comment L006-05

DOE believes that the responses to comments L006-01 and -03 address this concern. Part of the process is to identify the real and potential issues and to implement the actions required to establish a safe and cost-effective mix of treatment, storage, and disposal facilities.

Commentary on the Draft EIS Waste Management (Savannah River Site)

"Should SRS/DOE continue with waste management practices currently in place or continue practices with specifics modifications?"

Contrast the quantity (volume) of waste generated through the no-action plan with that generated through the other three options, alternatives a,b, and c.
The limited treatment practice meets regulatory requirements. Are there specific
L007-01 regulatory requirements for the extensive, agressive treatments of sitewide strategy C?
Or will these regulatory requirements be made with public involvement?
L007-02 PEIS has Class C waste and DEIS doesn't have Class C waste. Explain here.
L007-03 Shallow land disposal of low-level waste will stop in March for unstablilized waste forms, where will the low level waste be disposed of then? Does there
L007-04 exist currently the technology for the characterization of TRU waste?

Making sure that the decisions made around the management and interim storage of nuclear materials is in no way detrimental to the citizens living near the cleanup sites is of grave concern. The health effects of radioactive pollutants is still largely an unknown one. However, it has been scientifically recognized that high-energy radiation in low doses over long exposure periods is far more serious than was previously believed since the discovery of radiation. The production of nuclear weapons on the DOE sites around the nation imposed risks on human life and health without the knowledge of such nuclear weapons production, and subsequently, also without their consent. In addition to
L007-05 safeguarding the health of the citizens residing and working in and around these nuclear facilities, there must be a serious regard for these radioactive nuclides and their escape into the environment. Special care in handling even minute quantities of radioactive subtances must be required to protect the health and safety of the workers and the public health.

In addition to the radioactive waste now stored at the SRS, the DOE also stores
L007-06 tons of this highly radioactive spent nuclear fuel at other sites around the country. The threat of "criticality" or the risk of a natural nuclear explosion from a chain reaction is a real one These spontaneous explosions will lead to major releases of radioactivity.

L007-07 In interim storage with inadequate protection from natural and human events, there is more than 500,000 55 gallon drums of radioactive transuranic waste.

In light of these and many similar facts about the nature of radionuclides, we
L007-08 propose that hasty cleanup action just for the sake of saying that a site is cleanup is not recommended

PK56-42

Letter L007. (page 1 of 4)

Placing the by products of plutonium production in the most stable form possible will prove to be costly and time consuming, but it seems to be a more viable decision than transferring these by products to a final disposal site that has not yet been proven technically acceptable L007-09

The eventual genetic and immune system effects from chronic radiation exposure are not fully understood, nor are the biological interactions among radioactive and toxic pollutants. Given the clear health and environmental risks, steps taken now to minimize the spread of contamination will be a much better investment than assuming that spilled waste can be cleaned up later. L007-10

There must be a consensus between government and the public about which of the technologies used are the most reliable and feasible ones. The technology must be developed to separate, characterize, and identify the kinds of nuclear waste that is now being stored at DOE sites. These wastes must be taken out of the environment by stabilizing and containing them as quickly as possible. It is strongly urged that these wastes be contained and stored at the sites at which they presently are stored to avoid the costs of transport; and, the threat of releases and theft; and, the possibility of having to clean up another area of contamination if such an accident did occur. L007-11 L007-12

Submitted by

Debra Hasan
Citizens for Environmental Justice
Savannah, Georgia
March 13, 1995

PK56-42

Public Comments from February 25, CFEJ, "A Community Look at Look at Management," workshop on Savannah River Site Waste Management Draft Environmental Impact Statement.

L007-13 L007-14 "The DOE needs to educate the communities of how dangerous these wastes are. The waste should be neutralized instead of storing it in containers which will only be temporarily safe."

Participant, WM EIS workshop

L007-15 "Include that all waste is harmful , specifically what types of waste. Also include that all waste is harmful to a certain degree, whether it be low-level, high-level, etc. Also, include both shortterm and longterm effects concerning waste management."

Participant, WM EIS workshop

L007-16 "We, the community need to be educated about what DOE is doing in managing waste."

Participant, WM EIS workshop

L007-17 "Based on our understanding, we believe that nuclear waste should be converted to glass and stored in uninhabited areas."

Participant, WM EIS workshop

L007-18 "Use more graphic pictures, utilizing serious comedy. Include agencies, organizations who participated."

Participant, WM EIS workshop

L007-19 L007-20 "Change management now. Answer the following questions. How does the waste affect my community? What type of physical affects will the waste have on the human body?"

PK56-42

Letter L007. (page 3 of 4)

"More information on how it can effect a person's health and community. Also, maybe there could be more public announcements."
Participant, WM EIS workshop

L007-21

"This was one of the most informative, workshops that I have attended since becoming involved with CFEJ. It was very explicit, and I understood and learned more about environmental pollution."
Participant, WM EIS workshop

L007-22

PK56-42

Letter L007. (page 4 of 4)

Response to Comment L007-01

The three action alternatives (alternatives A, B, and C) examined in the Waste Management EIS represent treatment, storage, and disposal configurations that would provide the capability to manage all SRS wastes in accordance with applicable regulatory requirements. The alternatives represent different strategies (limited, moderate, and extensive treatment) for meeting regulatory objectives. The extensive treatment scenario of alternative C is not prescribed by regulation.

Some of the regulations applicable to SRS waste management prescribe the technology to be used to manage a particular type of waste, whereas other regulations establish a level of performance that the management technology must achieve. For wastes for which regulations prescribe a particular technology, the prescribed technology is included in all three action alternatives. For example, EPA regulations under RCRA specify that all mixed high-level radioactive wastes be treated by vitrification, and DOE would use vitrification to treat its mixed high-level waste under any of the three action alternatives. Where the regulations establish performance criteria but do not prescribe a method of treatment, DOE considered a range of management technologies in this EIS. This analysis allowed DOE to compare the benefits afforded by each technology (e.g., volume reduction, migration resistance of the final waste form) and the corresponding impacts of implementation (e.g., worker and public health, cost, safety) as part of the basis for selecting a waste management configuration.

Public involvement in the NEPA process does not establish or alter regulatory policy. Agencies responsible for establishing regulations provide the regulations for public review during their development. For example, EPA provides for public involvement in the development of new RCRA regulations. The text of the proposed regulation is published in the *Federal Register* and supporting information used by EPA to develop the proposal is available for public review in the RCRA docket. EPA considers any comments received on the proposed regulation in developing the final regulation.

Response to Comment L007-02

This comment refers to the category of low-level waste known as "class C" waste. This waste classification is defined in 10 CFR 61.55 (U.S. Nuclear Regulatory Commission) as waste that must meet rigorous requirements on its waste form to ensure stability; it also requires additional measures at the disposal facility to protect against inadvertent intrusion. This classification is generally reserved for waste containing high concentrations of long-lived radioisotopes such as carbon-14 and iodine-129 (half-lives of 5,730 and 17,000,000 years respectively). Waste containing concentrations of long-lived radionuclides in excess of the class C criterion is referred to as "greater-than-class C" waste and is generally not acceptable for near-surface disposal. These wastes would normally be disposed of in a geologic repository as defined in 10 CFR 60.

DOE classifies waste differently from the 10 CFR 61 waste classification system; however, DOE discusses the disposition of greater-than-class C waste in DOE Order 5820.2A, "Radioactive Waste Management." The Order requires that disposal systems for such waste be justified by specific performance assessments through the NEPA process.

Though not specifically discussed in the WMEIS, small quantities of waste meeting the greater-than-class C criteria of 10 CFR 61.55 have been identified at SRS. This waste, consisting primarily of spent-deionizer resins from reactor moderator purification systems, has been included in the long-lived low-level waste category. Section 2.2.3.3 of the WMEIS states that DOE plans to store this long-lived waste in the long-lived waste storage buildings in E-Area. The Waste Management

Programmatic EIS evaluates a regionalization alternative under which a very small amount (less than 1 cubic meter) of greater-than-class C waste would be transferred to SRS. Receipt of this very small amount of additional low-level waste would not affect the alternatives considered or the environmental consequences evaluated in the EIS; DOE would manage this waste as long-lived low-level waste.

Response to Comment L007-03

In the absence of a site-specific radiological performance assessment, the existing disposal units in the Low-Level Radioactive Waste Disposal Facility cannot demonstrate conformance with the performance objectives and assessment requirements of DOE Order 5820.2A. DOE determined that disposal of low-level wastes that have not been certified as conforming to the DOE Order 5820.2A requirements should cease as of March 31, 1995. Shallow land disposal of uncertified wastes at the Low-Level Radioactive Waste Disposal Facility concluded March 31, 1995 with limited exceptions (such as the continued use of suspect soils to backfill the existing disposal units). DOE will continue to dispose of wastes that have been certified to comply with waste acceptance criteria based on radiological performance assessments. Such disposal will occur at the E-Area vaults (for most low-level waste) and shallow land disposal (for suspect soils only) in the area adjacent to the Low-Level Radioactive Waste Disposal Facility for which a radiological performance assessment has been completed. DOE assumes that radiological performance assessments to be developed in the future will support shallow land disposal of additional low-level wastes such as the stabilized ash and blowdown wastes from the Consolidated Incineration Facility.

Response to Comment L007-04

Although the technology exists, SRS does not have a facility to completely characterize radiological properties of transuranic waste (waste contaminated with greater than 100 nanocuries per gram). SRS conservatively manages alpha waste (material in the activity range from 10 to 100 nanocuries per gram) as transuranic waste. SRS plans to ship its transuranic waste to the DOE Waste Isolation Pilot Plant when that facility becomes operational. Once the Waste Isolation Pilot Plant Waste Acceptance Criteria are finalized, SRS plans to develop the transuranic waste characterization/certification facility to characterize and repackage its transuranic waste for shipment to the Waste Isolation Pilot Plant. The alpha waste would be certified as mixed low-level waste or low-level waste for disposal at SRS. The characterization of hazardous constituents would continue to be based on the process knowledge of the generator and the waste would be packaged to meet the Waste Isolation Pilot Plant No-Migration Petition requirements once approved.

Response to Comment L007-05

As stated in Section 3.12.2.2 the current SRS radiological control program implements the Radiation Protection Guidance to the Federal Agencies for Occupational Exposure approved by President Reagan on January 20, 1987, and issued to all Federal agencies. This guidance has been subsequently codified (10 CFR 835) as a Federal Regulation governing all DOE activities (58 FR 238). Policies and program requirements formulated to ensure the protection of SRS workers and visitors are documented in the *SRS Radiological Control Procedure Manual, WSRC 5Q.*

The safety of the public and the well-being of the environment is ensured by conduct of the effluent monitoring and environmental surveillance programs at SRS; the programs are based on current scientific understanding of radiation effects, which is reflected in DOE orders. DOE Order 5400.1, "General Environmental Protection Program," requires the submission of an environmental report that

documents the impact of facility operations on the environment and on public health. These annual reports demonstrate compliance with requirements of DOE Order 5400.5, "Radiation Protection of the Public and the Environment."

DOE is firmly committed to operating a Radiological Control Program of the highest quality. This commitment applies to all DOE activities that manage radiation and radioactive materials and that may potentially result in radiation exposure to workers, the public, and the environment. Performance excellence has been demonstrated by maintaining radiation exposures to SRS workers and the public, at values which are well below regulatory limits.

Response to Comment L007-06

The disposition of spent nuclear fuel at SRS and other sites in the nuclear weapons complex is not within the scope of this EIS. DOE exercises strict control over all fissionable material for which it is responsible because of the potential risks associated with these materials. DOE is preparing other EISs which address these issues; please refer to Table 1-1 in this EIS.

Response to Comment L007-07

SRS performs storage of its transuranic waste in accordance with its RCRA Part A Permit and DOE orders. SRS utilizes containers and storage pads in accordance with detailed procedures to protect human health and the environment. Depending on the size of the waste material, transuranic waste is packaged in 55-gallon drums or carbon steel boxes. For drums with greater than 0.5 curies of alpha activity, up to 14 drums are placed inside a concrete culvert which is sealed to protect against potential radiological exposure.

As indicated in Section 2.2.6 and Section B.30 of Appendix B, the SRS procedures for transuranic waste address requirements for packaging and segregating waste, labeling and assaying containers, recordkeeping of container contents, onsite transportation, storage of containers and inspection of storage facilities. The storage facility consists of 19 reinforced concrete pads roughly 80 ft. by 150 ft. in size known as "TRU pads." The transuranic waste pads are all located in an area with controlled access in the central portion of SRS. TRU Pads 1-17 operate under RCRA interim status which requires a contingency plan for emergencies and maintenance of inspection records and facility personnel training records. TRU Pads 1-6 are full of containers and in accordance with past interim storage practices are covered with soil until their retrieval. This interim storage practice provides added radiological protection to humans and the environment from the transuranic waste and protection of the containers from the weather. TRU Pads 7-13 are uncovered pads that store primary carbon steel boxes and concrete culverts. TRU Pads 14-17, where 55-gallon drums are stored, are covered with plastic enclosures, and resemble greenhouses. TRU Pads 18-19 operate under DOE orders since they store only nonhazardous transuranic waste. These two uncovered pads contain only carbon steel boxes. Through years of study and management of transuranic waste, SRS has utilized the above mentioned interim storage practices to protect humans and the environment and provide safe retrievable storage of transuranic waste.

The SRS RCRA Part A Permit for TRU Pads 1-17 allows a maximum of 84,200 55-gallon drums, although this number will not be reached due to the other storage containers on the pads and packing of higher activity drums inside concrete culverts. Based on the current volume estimate for transuranic waste in storage of 10,053 cubic meters (2,656,000 gallons), it has been conservatively estimated that no more than 48,000 55-gallon drums are presently in storage at the transuranic waste facility.

Response to Comment L007-08

Remedial decisionmaking is regulated by the *Federal Facility Agreement for SRS*, an agreement between the U.S. Environmental Protection Agency, the South Carolina Department of Health and Environmental Control, and DOE. Characterization of the environmental restoration units (identified in Appendix G) is in its early stages. DOE believes it would be premature to consider site-specific environmental restoration alternatives in this EIS, and therefore does not include site cleanup in the scope of this EIS.

Response to Comment L007-09

The placement of all wastes in the most stable form possible is consistent with the extensive treatment configuration alternative (alternative C). The waste that would be transported to geologic repositories (high-level and transuranic waste) requires permanent isolation from the environment. DOE is investigating two sites for the permanent disposal of transuranic and high-level wastes. If approved, permanent repositories in Carlsbad, New Mexico, and Yucca Mountain, Nevada, would dispose of these wastes. The design and operation of these sites is not in the scope of this EIS. SRS high-level waste would be processed in the Defense Waste Processing Facility and the vitrified product would be enclosed in stainless steel canisters and transferred to the Yucca Mountain repository for permanent disposal. DOE recently issued a Supplemental EIS on this facility (DOE 1994) and a Record of Decision (DOE 1995).

Response to Comment L007-10

Pollution prevention, including minimizing the spread of waste, is an integral part of SRS's pollution prevention program under the *Department of Energy, Savannah River Site Waste Minimization and Pollution Prevention Awareness Plan, FY 1995*. The waste minimization program has identified source reduction, through administrative controls and good housekeeping practices, as an essential element to achieve waste volume reduction. The source reduction program includes administrative controls that reduce the likelihood of spills and minimize the spread of contamination. Section 2.2.1.3 presents the 1994 waste minimization goals. These goals are reviewed at least annually and progress reports, which are prepared quarterly, show substantial and continuing achievement of its goals.

Response to Comment L007-11

DOE agrees. DOE-SR has established a Citizens Advisory Board to help achieve this objective. Public and state government involvement is a significant component of the Federal Facility Compliance Act, which involves selection of the technology for the management of mixed waste.

Response to Comment L007-12

DOE agrees that certain waste in storage requires characterization and separation; this EIS analyzes a proposal to construct and operate the transuranic waste characterization/certification facility and a soil sort facility for these purposes. All of the action alternatives considered in the EIS have the objective of isolating wastes from the environment. Among these alternatives, alternative C would achieve the most stabilization, while alternative A could be implemented most quickly.

The comment regarding onsite management versus transport of waste is a DOE complex-wide issue. The final EIS includes an offsite low-level waste volume reduction initiative that has several advantages

over the supercompactor described in the draft EIS (Section 2.6.3). The analysis indicates that transportation impacts are very small.

In general, strategies for the management of DOE nuclear weapons complex waste are beyond the scope of this EIS but are being addressed in the Waste Management Programmatic EIS. The minimization of waste transport by onsite treatment, storage, and disposal is consistent with the decentralization alternative that is under consideration in the programmatic EIS.

Response to Comment L007-13

DOE has attempted in this EIS, and in other documents over the years, to inform the public about the risks associated with the wastes which result from its operations. It is difficult to convey this important information in a manner which is accurate and understandable, and yet does not raise undue and unfounded fears among members of the public. DOE welcomes any suggestions for means to share this information with the public.

Response to Comment L007-14

DOE agrees that prolonged storage is not an acceptable substitute for proper treatment and disposal. The alternatives considered by DOE include waste storage only until the required treatment and disposal technologies can be developed and implemented. When prolonged storage may be required pending a disposal determination, DOE proposes that treatment be provided that will minimize hazards associated with such storage.

Response to Comment L007-15

The EIS has identified in Chapter 4, as well as in Appendices E and F, the magnitudes of the chemical and radioactive risks from both normal operations and accidents for each of the waste types to be managed at SRS.

Response to Comment L007-16

See the response to Comment L007-13. DOE continually informs the public and provides opportunities for their involvement. After announcing its intent to prepare this EIS, DOE held three workshops and three scoping meetings in combination with two other related EISs. After issuing the draft EIS, DOE conducted hearings at six locations to inform the public of its plans and receive comments.

Response to Comment L007-17

The encapsulation of waste in glass by vitrification is a technology that will be used extensively at SRS. Two facilities, the Defense Waste Processing Facility and the M-Area Vendor Treatment Facility, will vitrify high-level and certain mixed low-level wastes, respectively. Vitrified high-level waste would be sent to a geologic repository for permanent disposal when such a facility is available (see response to Comment L007-09). In addition, this EIS analyzes the impacts of constructing and operating two vitrification facilities, one for non-alpha waste (mixed low-level and possibly low-level and hazardous waste) and one for transuranic and other alpha-emitting waste. Alternative C relies heavily on vitrification to create a highly migration-resistant waste form.

Response to Comment L007-18

Agencies, organizations, and individuals who participated in the preparation of this EIS are identified in the List of Preparers. DOE has attempted to use graphics where it believes they are useful and appropriate, and has examined other possible applications for graphics in the Final EIS.

Response to Comment L007-19

Generally speaking, the EIS shows that offsite effects, if any, to individuals or communities due to the waste management actions discussed in the EIS would be very small. These effects would be the result of radiation exposure, which is calculated to result from the various alternatives analyzed in the EIS. The estimated dose received by the population in any specific region or community, as well as the dose to an average individual in that region or community can be determined for each of the alternatives discussed in the EIS. The harm to a community or individual would be the risk of contracting cancer. The following paragraphs describe the process for determining that risk or harm.

Figure 4-6 identifies annular sectors around the SRS within which communities of interest to the reader can be located. For each of these sectors, Table E.5-1 provides two sets of fractional values: the first is the fraction of the total population dose resulting from a particular alternative which is received by the population in that sector, and the second, is the fraction of the total population dose which is received by the average person in that annular sector. Offsite (i.e., public) population doses, expressed as "person-rem" over the 30-year period, are presented for each of the alternatives in their respective sections of Chapter 4, and are summarized in Table 2-38 of the EIS.

Thus, a community can be located within a specific annular sector on the map in Figure 4-6, and the dose fraction for that sector determined from Table E.5-1 for either population dose or for the average individual dose. If the community comprises most or all of that annular sector, multiplying the particular population dose in the appropriate section of Chapter 4 (or from Summary Table 2-38) by the population dose fraction will give an approximate value of the community population dose. If the community is a smaller part of the annular sector, multiplying the particular alternative's population dose by the average individual dose fraction will provide the dose to the average individual in that community, and multiplying again by the community's population will give an estimate of the population dose for that community.

Multiplying the population dose to the community of interest by the cancer risk factor of 0.0005 per person-rem provides an estimated number of fatal cancers that would be expected to occur in that community due to the radiation dose received over the thirty-year period analyzed in this EIS.

Response to Comment L007-20

The effects on members of the public from managing these wastes would result from very small amounts of radioactive materials and perhaps hazardous chemicals that might escape during the handling, treatment, and disposal of these wastes. The most likely effect of exposure to these radioactive materials and chemicals is an increase in the risk of contracting cancer, which is small but which increases as the exposure increases. Therefore, impacts to offsite populations have been evaluated and determined to be very small. Impacts to offsite populations have been presented as an incremental increase in the risk of developing a fatal cancer and the number of additional cancer deaths for individuals and populations, respectively. These impacts have been included in the Summary Section and Chapter 4 of the EIS.

Response to Comment L007-21

Please see the responses to comments L007-19 and L007-20. Also, DOE endeavors to keep the public informed of activities and provides opportunities for public involvement. See the response to Comment L007-16.

Response to Comment L007-22

DOE appreciates the efforts of the Citizens for Environmental Justice and their presentation of the workshop on February 25, 1995. It was a valuable precursor to the hearings that DOE presented in Savannah on February 28.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

MAR 31 1995

4PAB/EPS-mh

A. B. Gould, Director
Environmental Compliance Division
U.S. Department of Energy
Savannah River Operations Office
P.O. Box 5031
Aiken, SC 29804-5031
Attention: WMEIS

SUBJECT: Draft Environmental Impact Statement (DEIS), Savannah River Site (SRS) Waste Management, Aiken, South Carolina

Dear Mr. Gould:

We have reviewed the subject document in accordance with Section 102(2)(C) of the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act. The DEIS discusses minimizing, treating, storing, and disposing of liquid high-level radioactive, low-level radioactive, hazardous, mixed (radioactive and hazardous), and transuranic wastes at SRS. Alternatives considered include No Action, Limited Treatment (A), Moderate Treatment (B), and Extensive Treatment (C). For each of the action alternatives, the DEIS presents three forecasts of waste volume based on the expected, minimum and maximum amounts of wastes SRS might need to manage.

In general, the DEIS does a good job dealing with a very complex issue. While our review identified no major technical deficiencies, we offer the following comments and observations.

ENVIRONMENTAL JUSTICE

We wish to commend DOE on their assessment of environmental justice (Section 4.1.12.2.3). The DEIS concludes that "none of the alternative strategies would have disproportionate adverse effects on minority populations or low-income communities" (page 4-52).

WASTE MINIMIZATION

According to the DEIS, the determining factor of potential impacts is the amount of waste SRS would be called upon to manage (expected, minimum or maximum forecast) rather than the management strategy used (Alternative A, B, or C). The ultimate amount of waste managed is expected to depend in large part on the extent of environmental restoration (ER) and facility decontamination and decommissioning (D/D) undertaken at SRS in the future (page S-14).

PK56-43

Letter L008. (page 1 of 3)

This being the case, we expect that every effort will be made to minimize waste generated by ER and D/D activities. The DEIS states that D/D methods have not yet been identified for most SRS facilities and that the selection process would be subject to separate review under NEPA (page 3-92). We recognize that, in many cases at SRS, D/D activities present new challenges for DOE and that starting on small-scale projects will provide experience for larger ones (Section 3.14.1). What experience can be drawn from commercial applications of D/D activities?

L008-01

If Alternative C is chosen, additional treatment variances should be sought to minimize storage requirements. Section 2.5.3, Low Level Waste, for the expected waste forecast, indicates that 24 additional buildings will eventually be needed for storage of spent deionizers. DOE should look at technologies currently planned with the idea of stabilizing or destroying deionizers.

L008-02

Also, under Alternative C, DOE should minimize containerized storage. DOE should consider using technologies that will be available for destruction or stabilization of radioactive oil and mercury-contaminated tritiated oils rather than planning for 30 year storage capacity.

L008-03

It is notable that Pollution Prevention/Waste Minimization is discussed at the beginning of each alternative description in Chapter 2. We salute the efforts of the SRS waste minimization program and encourage continuous development and improvement of these efforts.

SENSITIVE RESOURCE IMPACTS

Under the maximum waste forecast, the DEIS states that it is probable that any site selected for expansion of the various waste management facilities could contain wetlands, steep slopes, threatened and endangered species habitat, and cultural resources (page 4-92, 4-154, and 4-214). As mentioned, additional biological and wetlands assessments would be required as part of the site(s) selection process. What criteria will be used in site selection? Avoidance of sensitive resources should be given top consideration.

L008-04

SUMMARY

Although we have no major objections to any of the action alternatives, we tend to favor the Extensive Treatment Configuration (Alternative C). While this alternative may increase short-term impacts, the long-term benefits (e.g., reducing volume and toxicity and creating stable, migration-resistant waste forms) are attractive. In addition, the cost-benefit analyses performed shows this alternative to be competitive with the others.

PK56-43

Letter L008. (page 2 of 3)

Page Three

We agree that the No Action Alternative is not a preferable option as it could cause DOE to violate some regulatory requirements and agreements. For any alternative chosen, we wish to emphasize that pollution prevention and waste minimization should be considered processes of continuous improvement that are integrated into every waste management activity.

Based on our comments given above, we rate this DEIS "EC-2." That is, we have environmental concerns about the project and more information is needed to fully assess the impacts. If you have any questions concerning our comments, you may contact Marion Hopkins of my staff at 404/347-3776.

Sincerely,

Heinz J. Mueller, Chief
Environmental Policy Section

PK56-43

Letter L008. (page 3 of 3)

Response to Comment L008-01

Since DOE is experienced with decontamination and decommissioning is limited to date, DOE relies on commercial experience. This includes using private companies with previous decontamination and decommissioning experience and using the same methodologies for waste treatment and minimization developed by and for private industry. The lessons learned from previous DOE and commercial activities have been compiled into the *Decommissioning Handbook*, (DOE/EM-0142P, March 1994) which serves as a reference when determining the means for achieving the appropriate level of cleanup of SRS facilities.

Response to Comment L008-02

DOE agrees that long-term storage of spent deionizers is not desirable; however, treatments for these waste streams are not completely developed at this time. DOE is aggressively pursuing several emerging technologies described in Appendix D of this EIS that may prove suitable for treating these wastes. The primary technologies being considered are quantum catalytic extraction, polyethylene encapsulation, and vinyl ester styrene solidification, which stabilizes and encapsulates spent deionizers. These technologies are rapidly approaching commercial availability and, if they prove feasible, will be used to reduce or eliminate the storage of these wastes.

Response to Comment L008-03

DOE is utilizing available treatment for radioactive oils and mercury-contaminated tritiated oils where the radioactivity level is low and does not pose an environmental risk. The wastes in question, however, are small in volume but have very high concentrations of tritium. Treatment by conventional means would release this tritium into the environment. DOE is investigating emerging technologies which may be suitable for disposal of these wastes. One such technology is a packed bed reactor (described in Appendix D, Section D.7.10) which would have the ability to capture the tritium and mercury in the offgas system, preventing release to the environment.

Response to Comment L008-04

Should the maximum waste forecast become reality, DOE would employ a site selection process similar to the one employed for the area adjacent to F- and E-Areas to identify sites for additional waste management facilities. In response to consultation requirements under NEPA, DOE described this selection process in the Protected Species Survey, dated April 1995 and completed pursuant to Section 7 of the Endangered Species Act. The initial effort to site new facilities near existing waste management facilities resulted in the selection of land near F- and E-Areas. In order to minimize impacts to biodiversity, wetlands, threatened and endangered species, and cultural resources, every effort was made to site facilities in existing cleared areas. Under the alternatives and forecasts for this EIS, varying number of facilities could not be accommodated in these cleared areas and undeveloped land was required. Every effort was made to site potential facilities that could not be accommodated in existing cleared areas on level, upland pine forest that had been previously farmed. This avoided wetlands, threatened and endangered species habitat, areas of high diversity, and archaeological sites. Undeveloped wetlands and steep upland areas that had never been farmed were considered only when their use could not be avoided due to their proximity to preferred sites (e.g., some upland hardwood sites would be required for sediment ponds). The values of these areas to wildlife and the biodiversity of the region was a consideration in the final selection. It is anticipated that any construction needed to accommodate the amount of waste anticipated by the maximum waste forecast would employ a similar site selection process documented through correspondence and site visits, if necessary, with U.S. Fish

and Wildlife Service and National Marine Fisheries Service, the U.S. Army Corps of Engineers, and the State Historic Preservation Officer.

Arthur B. Gould, Jr., Director
NEPA Compliance Officer
U.S. Dept. of Energy
SRS Operations Office
Aiken, SC 29804-5031

I appreciate the opportunity to have participated in the informational meeting held in Columbia and to have this further opportunity to comment in writing concerning the SRS Waste Management Draft EIS. On the understanding that the comment period has been extended until March 30, I am submitting these comments which are of a generalized character.

A serious concern, which you point out, and which makes much of the planning you are doing a gesture of hope over experience is the tremendous uncertainty about future waste burdens to be undertaken by SRS, whether through such possibles as the temporary(?) storage of spent fuel rods, the handling of foreign nuclear materials, the handling of decommissioning waste, civilian and governmental and the handling of new wastes to be generated by new initiatives being suggested by congressional leaders and others. We in South Carolina have a great concern about how much and what kinds of waste, imported or yet-to-be-generated, that will almost inevitably be treated/stored at SRS. As this and other documents so clearly point out there is already a heavy burden of on-site generated waste still awaiting treatment and various forms of processing for which true permanent storage seems to be always a plan and never a certainty. L009-0

We ask that in making decisions about further waste to be stored, treated, incinerated, etc. at SRS, which has not been generated on site, you take into account the fact that you have already heavilly impacted this state. This is a new era of considering environmental justice. Where is the justice in so heavily impacted this one small state?

We continue to be concerned over the long delays in solidifying the 36 million gallons of high level liquid waste and the uncertainties about the DWPF. L009-0

Thank you for the opportunity to comment,

Sincerely yours,

Mary T. Kelly

Mary T. Kelly, Ph.D., Natural Resources Specialist, League of Women Voters SC
4018 Sandwood Drive
Columbia, S.C. 29206
803-782-8410

PK56-43

Letter L009.

Response to Comment L009-01

The EIS presents, in Section 2.1 and Appendix A, DOE's range of forecasts of the waste it may manage at SRS, including the relatively small volumes from other sites. As indicated in that material, the major determinant of waste volume is the extent of onsite restoration activities, rather than the receipt of offsite waste.

DOE will issue a programmatic EIS on waste management that will provide the basis for decisions on alternative treatment and disposal options for the entire DOE complex. The programmatic EIS will detail the types and quantities of waste that might be managed at SRS and at other DOE facilities. The public will have a chance to comment on the proposals during the public comment period. There are a number of equity issues that will have to be worked out between states concerning how much and what types of waste each will allow to be managed within its borders to ensure no state is overburdened.

Response to Comment L009-02

DOE completed a detailed supplemental EIS for the Defense Waste Processing Facility in November 1994 to assist in determining how to proceed with the Defense Waste Processing Facility. On April 12, 1995, DOE published its Record of Decision for the Defense Waste Processing Facility in the *Federal Register* (60 FR 18589). The Record of Decision documents DOE's decision to continue construction and to operate the Defense Waste Processing Facility as currently designed using the In-Tank Precipitation process. DOE has also decided to implement additional safety modifications to the Defense Waste Processing Facility prior to operating the facility with radioactive waste. As noted in the Record of Decision, DOE currently proposes to vitrify only the high-level radioactive waste currently in tanks at SRS, plus any small increments produced as a result of ongoing SRS activities. DOE would undertake additional NEPA reviews if other wastes are proposed for treatment at the Defense Waste Processing Facility.

The Defense Waste Processing Facility is presently being tested with simulated waste. As of mid-April-1995, 24 canisters of vitrified simulated waste had been produced. DOE is presently on schedule for radioactive testing to begin in December 1995. Processing of SRS high-level radioactive waste is scheduled to begin in mid-February 1996. DOE believes that the existing and future inventories of high-level waste can be processed by 2018.

PAINE COLLEGE

Division of Natural Sciences and Mathematics 1235 Fifteenth Street Augusta, Georgia 30901-3182 (706) 821-8200

NEPA Compliance Officer
Department of Energy--Savannah River Operations Office
P.O. Box A
Aiken, SC 29802

Dear Dr. Fiori: March 31, 1995

Re: Waste Management Environmental Impact Statement (WM-EIS)

Please accept the attached material as my personal comments on the Waste Management Environmental Impact Statement (WM-EIS). This material regards three draft motions from this past Monday, March 27, 1995, that were presented to and approved by the Environmental Restoration and Waste Management Subcommittee of the Savannah River Citizens Advisory Board, of which I am the Subcommittee Co-Chair. All three motions had been reviewed by me with the members of the Subcommittee and later with Brian Costner, Energy Research Foundation and CAB member--the attached version of the Soil motion had even been revised at Costner's request in preparation for consideration by the full Board at its meeting held on Tuesday, March 28th.

The first motion, on Pu-238 and Transuranic Waste Treatment, was approved by the full Board and has already been forwarded to Dr. Mario P. Fiori, Manager, SRS. However, due to time constraints, the other two motions, Combustible Low Activity Waste Treatment and Hazardous and Mixed Soil Treatment, were not voted on by the CAB. I anticipate that these two motions will be brought before the full CAB at the next opportunity (presently, they are scheduled for the July meeting).

But in order to meet the March 31, 1995, cutoff for public input, the attached comments concerning the second and third motions, including the presentation materials (i.e., slides), supporting information on the motions, and the motions, are being submitted as my personal comments without the endorsement of the full CAB at this time. In addition, please include the minutes of the Subcommittee meeting (they are available from Dawn Haygood, 1-800-603-0970).

If you should have any questions concerning these comments, please contact me at your earliest convenience.

Sincerely,

W.F Lawless, Ph.D.
Associate Professor of Mathematics and Psychology

PK56-44

Letter L010. (page 1 of 18)

Attachment 1

Savannah River Site
Citizens Advisory Board
Environmental Remediation and Waste Management Subcommittee
Motion on Pu-238 Combustible Waste Management

In response to the Transuranic Waste Treatment Plan in the Waste Management Environmental Impact Statement, because of uncertainty associated with the start-up of the Waste Isolation Pilot Plant (WIPP), because of danger created by the serious consequences of a high activity Pu-238 or Pu-239 accident during storage or treatment at SRS, and because of he likelihood of the long term storage of transuranic waste at SRS after waste treatment, the CAB recommends that DOE:

L010-01 1. Categorize the SRS High Activity Transuranic waste as an urgent problem.

L010-02 2. Expedite the selection of an appropriate organic treatment (e.g. destruction/stabilization) for SRS transuranic waste by year's end to help make this selection. DOE should commission an independent "Blue Ribbon" panel of experts to review the treatment and waste-form options in a report to DOE and a presentation before the CAB at its November 1995 meeting; and,

L010-03 3. Assign the highest priority to obtain funding no later than the FY97 budget for a capital line-item project to treat transuranic wastes and convert them into a stabilized waste for (e.g., vitrified).

L010-04 4. Further, because of the increased probability of an accident during the scheduled repackaging of the Pu-238/239 wastes on 5 of the TRU pads (storing approximately 400,000 total curies), to eliminate the need to handle these wastes twice, he CAB recommends that DOE reconsider its repackaging plan carefully, possibly including a review by ISPR, to determine if SRS can wait until a treatment option is available without incurring undue risk.

PK56-44

Attachment 2

Savannah River Site
Citizens Advisory Board
Environmental Remediation and Waste Management Subcommittee
Motion on the Consolidated Incineration Facility

In response to the Combustible Low Level Waste Treatment Plan in the Waste Management Environmental Impact Statement, the Citizens Advisory Board recommends that:

1: Because of the insignificant differences in the air emissions from supercompaction and incineration, similar volume reduction ratios, and the additional advantage of a stabilized waste form resulting in lower disposal cost, DOE expeditiously process the SRS combustible low-level wastes in the CIF; and, L010

2. Because the stabilized waste form resulting from the Consolidated Incineration Facility can significantly affect long-term groundwater impacts, DOE determine, and evaluate in a cost-based analysis (CBA) by independent scientific peer review (ISPR), the best means to stabilize the ash waste concurrent with on-going schedule, activities and start-up. L010

PK56-44

Letter L010. (page 3 of 18)

Attachment 3

Savannah River Site
Citizens Advisory Board
Environmental Remediation and Waste Management Subcommittee
Motion on SRS Soils

In response to the Hazardous and Mixed Waste Soil Treatment Plan in the Waste Management Environmental Impact Statement, the CAB recommends that:

L010-07 1. Because of uncertainty of the waste volume and characterization of hazardous and mixed waste soils resulting from the lack of an SRS Future Use Plan, developed cleanup standards, sufficient site characterization data and cost effective treatment options, DOE defer the non-alpha vitrification facility for treating soils; and,

L010-08 2. In order to be able to treat the wide range of contaminated soils at SRS (D&D, seepage basin soils, etc.), and the uncertainty associated with the loss of institutional control of SRS in 100 years, DOE fund soils treatment research and development at a high level of priority.

L010-09 3. DOE and the regulators work with the public to develop an appropriate plan for determining how to safely categorize and manage contaminated and suspect soils.

PK56-44

ER & WM Subcommittee Motions:

1. ISPR (status: passed & accepted)
2. Zoning (status: passed & pending)
3. F&H-GW pump & treat (Mar. 28th)
4. Combustible Pu-238 (Mar. 28th)
5. Incinerable LLW (Mar. 28th)
6. Contaminated Soils (Mar. 28th)
7. Feasibility Study (RI/FS) (July??)
8. Market Based Plan (July)
9. Tritium-DNA health RFP (July)
10. Path Forward: DWPF initiatives (i.e., automated procedures; new canister storage; benzene; emptied waste tanks); FFA implementation plan

---

The Savannah River Site Waste Management Environmental Impact Statement was developed to evaluate the treatment, storage, and disposal options for five waste types:

High Level Waste (HLW)
Low Level Waste (LLW)
Transuranic Waste (TRU)
Hazardous Waste (HW)
Mixed Waste (MW)

The ER & WM Subcommittee of the Savannah River Citizens Advisory Board selected three focus areas to provide input for the final WMEIS:

- **Transuranic Waste Treatment**
- **Combustible Low Activity Waste Treatment**
- **Hazardous and Mixed Waste Soils Treatment**

PK56-44

Waste Management Environmental Impact Statement

Notice of Intent	April 1, 1994
Public Comment Period	April 6 - May 31, 1994
Public Scoping Meetings	May 1994
Implementation Plan	June 23, 1994
Draft EIS	January 20, 1995
Public Comment Period	January 27 - March 31, 1995
Final EIS	June 16, 1995
Record of Decision	July 26, 1995

EIS Options

A: Limited treatment and storage, lowest costs and releases to workers, highest long-term impact on the public.

B: Intermediate between A and C.

C: Extensive treatment and least storage impacts, highest costs and most short-term releases to workers and the public, least long-term impact on the public.

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Letter L010. (page 6 of 18)

TRANSURANIC WASTE

- Description
- Hazards
- Inventory
- Treatment Options
- Motion

Transuranic Waste

Description

- Waste contaminated with alpha-emitting transuranic radionuclides having an atomic number greater than 92, half-lives greater than 20 years, and concentrations greater than 100 nanocuries per gram
- TRU waste generated and sorted at SRS is composed primarily of Pu238 and Pu239
- Examples: *job control waste, sludges, resins, and filters*

PK56-44

Transuranic Waste

Hazards

- Transuranic isotopes are extremely toxic due to long retention time in the body. Although alpha particles cannot penetrate skin, they may be harmful if entered the body through a cut, through breathing air, or through food or water.
- Most of the hazards associated with transuranic waste are in the handling of the waste by the worker or potential releases to the environment through accidents or natural disasters. Accidental fire in a Transuranic storage facility has one of the highest consequences to offsite public of any SRS scenario.
- Some transuranic wastes also have hazardous constituents making them mixed wastes. However, they are managed primarily on the radiological hazard.

Transuranic Waste

Current Inventory and expected Generation

- 10,034 cubic meters in storage
  - High activity - 5920 cubic meters; 700,000 curies
  - Low activity - 4114 cubic meters; 2100 curies
- Expected thirty-year forecasted generation -- 12,564 cubic meters
- Significant increase could be generated by ER and D&D.

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Transuranic Waste Options

- Continued storage without treatment
  - Least expensive but does not mitigate risk or provide long term solution
  - Container degradation
  - Significant offsite consequences from an accident - fire
- High temperature organic destruction/Stabilization
  - High cost
  - Offers complete solution for low and high activity
  - Inhalation potential eliminated when combined with superior waste form
  - Organic destruction virtually eliminates offsite consequences and hydrogen gas generation which limits shipment to final repository
  - Hybrid thermal units such as plasma hearth have advantage of eliminating need for pre-characterization which is high cost

Transuranic Waste Options
(Continued)

- Acid Digestion
  - Moderate to high cost
  - Destroys organics but requires additional treatment to produce stable waste form
- Sorting, Characterization, and Repackaging
  - High cost
  - Could configure low activity waste for shipment to repository
  - Could not configure high activity waste for repository. High activity requires organic destruction

PK56-44

Pu-238 Background

1. At SRS, Tru wastes: job control waste, sludges, resins, and filters.

2. DOE complex-wide, SRS has 8% volume, 69% curies (mostly in a combustible waste matrix).

3. At SRS, 1/2 of its volume is certifiable to WIPP-WAC (mostly low activity Pu-239, less than 1% of total curies).

4. Pu-238 vitrification => high exposure and high danger; plasma hearth => low exposure and low danger.

5. Repackaging @$2-3 M for 5-6 of 22 pads.

6. xxx% gas generators; xxx% liquid; XXX% number of Pu-238 drums.

Combustible Low Activity Waste

- **Definition**
- **Categories**
- **Low Level Radioactive Waste**
- **Combustible Low Activity Waste Options**
- **Motion**

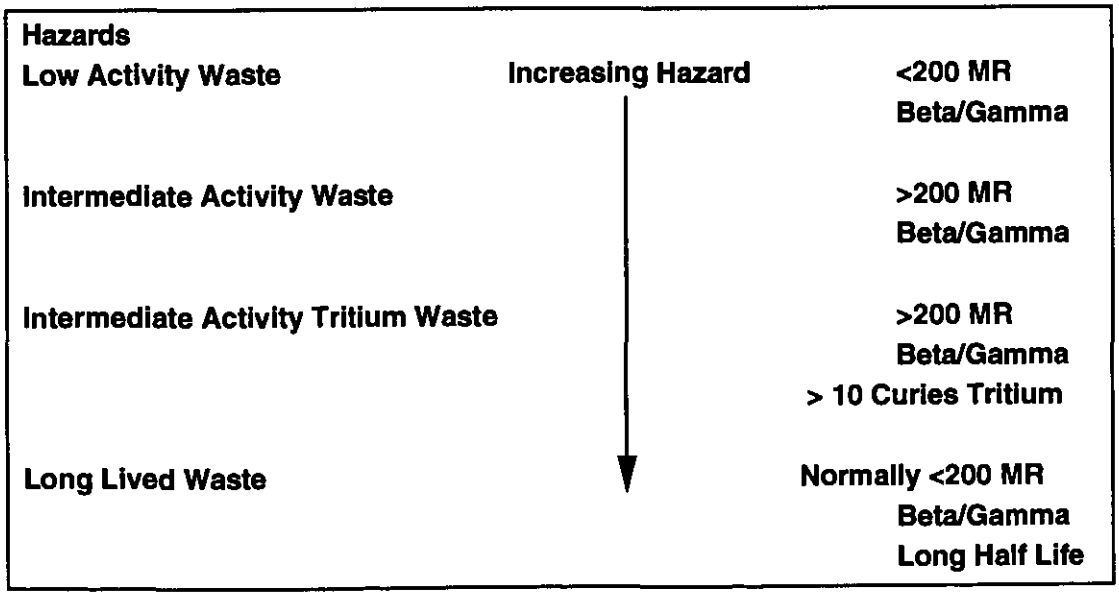
PK56-44

LOW LEVEL RADIOACTIVE WASTE

Definition - Radioactive waste that does not meet the definition of high level or transuranic waste and does not contain materials designated as hazardous by RCRA

- Five Main Categories
  - Low Activity
  - Intermediate Activity
  - intermediate Activity Tritium
  - Long Lived Waste
  - Suspect Soils

LOW LEVEL RADIOACTIVE WASTE



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Combustible Low Activity Waste Options

- **Direct Disposal**
  - **High cost due to lack of volume reduction and require construction disposal vault**
- **Supercompaction**
  - **Treatment cost justified by 12 to 1 volume reduction**
  - **Waste form unstabilized requiring high cost vault disposal**
  - **Air Emissions - Extremely low**
- **Consolidated Incineration Facility**
  - **Treatment cost justified due to 10 to 1 volume reduction**
  - **Facility available and designed to treat mixed and low activity waste**
  - **Provides waste form which has superior radiation containment and is better suited for less expensive shallow land disposal**
  - **Air Emissions - Slightly higher than supercompaction yet still extremely low**

CIF Background

1. Supercompactor product storage @$50/cu m; CIF ashcrete @$7/cu m.

2. Georgia Tech ISPR concluded that the differences in air emissions from the supercompactor and the CIF were very low and about equivalent.

Treatment costs:

CIF	**$1500 per cubic meter**
Supercompactor	**$1600 per cubic meter**

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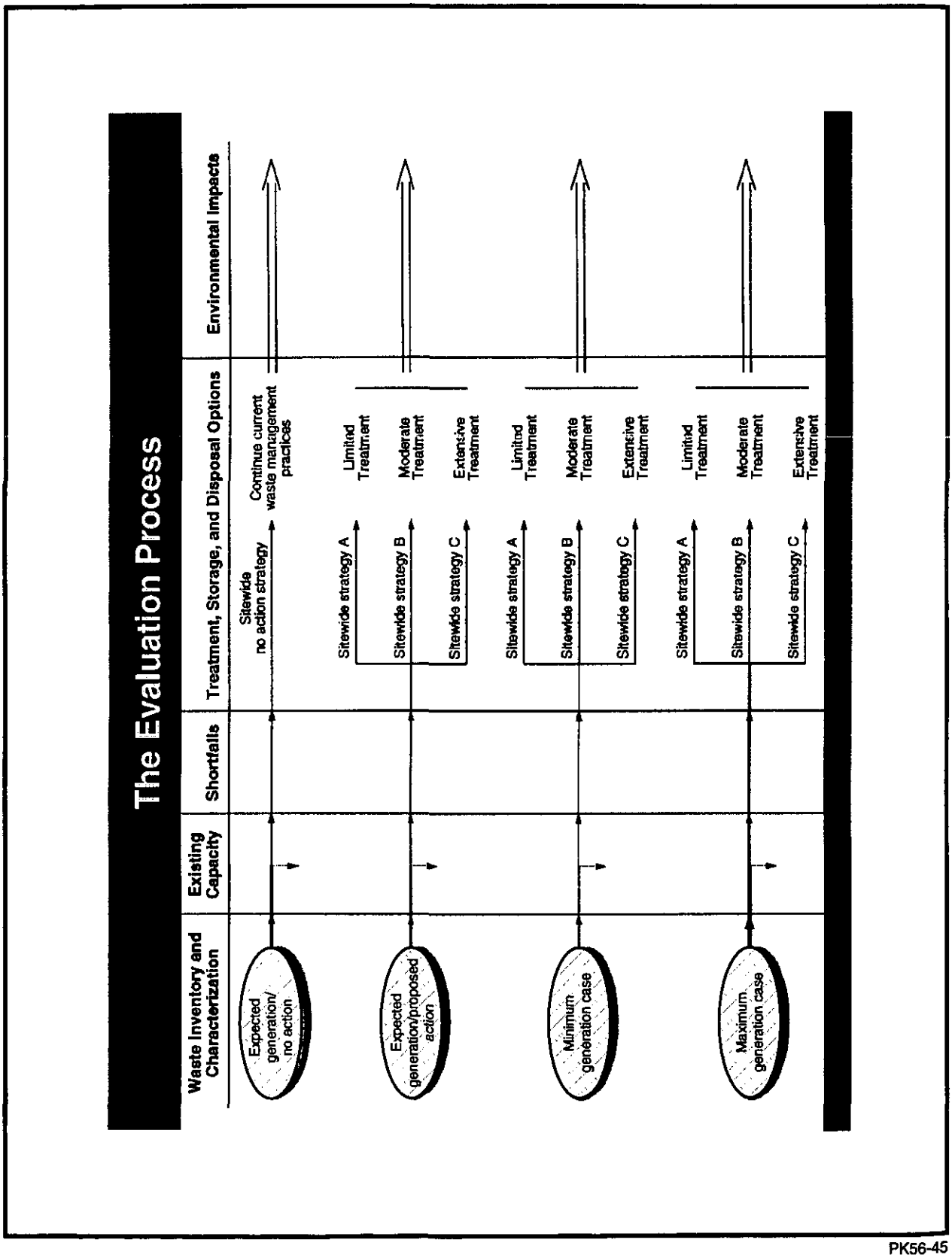

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Savannah River Site
Citizens Advisory Board
Environmental Remediation and Waste Management Subcommittee
Motion on the Consolidated Incineration Facility

In response to the Combustible Low Level Waste Treatment Plan in the Waste Management Environmental Impact Statement, the Citizens Advisory Board recommends that:

1. Because of the insignificant differences in the air emissions from supercompaction and incineration, similar volume reduction ratios, and the additional advantage of a stabilized waste form resulting in lower disposal cost, DOE expeditiously process the SRS combustible low-level wastes in the CIF; and,

2. Because the stabilized waste form resulting from the Consolidated Incineration Facility can significantly affect long-term groundwater impacts, DOE determine, and evaluate in a cost-based analysis (CBA) by independent scientific peer review (ISPR), the best means to stabilize the ash waste concurrent with on-going schedule, activities and start-up.

Hazardous & Mixed Waste Soils

- **Description**
- **Hazards**
- **Inventory**
- **Treatment Options**
- **Motion**

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Letter L010. (page 14 of 18)

Hazardous and Mixed Waste Soils

Description

- Regulated by Resource Conservation and Recovery Act
- Classified as either "characteristic" or "listed"
- Examples: freon, lead, paint solvents, pesticides
- Includes Seepage Basin soils

Hazards

- Mixed wastes contain hazardous and radioactive constituents
- Hazardous constituents are flammable, toxic, corrosive, or reactive
- Radioactive constituents range from low dose and concentrations to high

Current inventory and Annual Generation

- Approximately 6000 cubic meters in storage
- 30 year forecast ranges from 250,000 cubic meters to 800,000 cubic meters

Hazardous and Mixed Soils Treatment

- Soil Washing
  - High cost due to waste water treatment capacity required
  - High volume capacity
  - Processes organic and metals contaminated soils
- Consolidated Incineration Facility
  - Moderate incremental cost
  - Limited capacity to process large volumes
  - Primarily for organic destruction but ash stabilization could treat metals content
- Non-alpha vitrification
  - High cost
  - Highly flexible-suitable for all soils types
  - Superior waste form to meet leaching requirements

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Hazardous and Mixed Soils Treatment
(Continued)

- **Low Temperature Thermal Treatment**
  - **Low cost**
  - **High volume treatment**
  - **Removes organic from soil but does not destroy organics**
  - **Suitable for organic contaminated soil only**
- **Bioremediation**
  - **Low cost**
  - **High volume treatment**
  - **Suitable for organic contaminated soil only**

Savannah River Site
Citizens Advisory Board
Environmental Remediation and Waste Management Subcommittee
Motion on SRS Soils

In response to the Hazardous and Mixed Waste Soil Treatment Plan in the Waste Management Environmental Impact Statement, the CAB recommends that:

1. Because of uncertainty of the waste volume and characterization of hazardous and mixed waste soils resulting from the lack of an SRS Future Use Plan, developed cleanup standards, sufficient site characterization data and cost effective treatment options, DOE defer the non-alpha vitrification facility for treating soils; and,

2. In order to be able to treat the wide range of contaminated soils at SRS (D&D, seepage basin soils, etc.), and the uncertainty associated with the loss of institutional control of SRS in 100 years, DOE fund soils treatment research and development at a high level of priority.

3. DOE and the regulators work with the public to develop an appropriate plan for determining how to safely categorize and manage contaminated and suspect soils.

PK56-44

MOTION: SRS Soils

In response to the Hazardous and Mixed Waste Soil Treatment Plan in the Waste Management Environmental Impact Statement, the CAB recommends that:

1. Because of the uncertainty of the waste volume and characterization of hazardous and mixed waste soils resulting from the lack of an SRS Future Use Plan, developed cleanup standards, sufficient site characterization data, and cost effective treatment options, DOE defer the non-alpha vitrification facility for treating soils; and,

2. In order to be able to treat the wide range of contaminated soils at SRS (D&D, seepage-basin soils, etc.), and the uncertainty associated with the loss of institutional control of SRS in 100 years, DOE fund soils treatment research and development at a high level of priority.

Fact Sheet for backup discussions

- **2 million curies of Pu 238/239 in High Level Waste system**
  700,000 curies of Pu 238/239 on Transuranic Waste pads

- **Fiberglass containers subject**
  1 container leaked on Pad 3
  There were 14 fiberglass containers total
  After the leak, all were packaged in secondary containment (concrete culvert)
  Fiberglass was discontinued after the leak

- **Curie content on TRU pads 1-6 is 400,000 curies**

PK56-44

Savannah River Site Citizens Advisory Board
Environmental Remediation &
Waste Management Program Subcommittee
Meeting Summary
March 27, 1995

The Environmental Remediation (ER) Program Subcommittee met on Monday, March 27, 1995 from 7:30 p.m. to 9:00 p.m. at the Hyatt Regency Hotel in Savannah. Bill Lawless presided over the meeting. Other subcommittee members present were Anne Brown, Ann Loadholt, Kathryn May, Joanne Nestor, and P.K. Smith. Camilla Warren of the Environmental Protection Agency Region IV office attended. Ann Ragan from the South Carolina Department of Health and Environmental Control, (SCDHEC), also attended. Hunter Weiler attended for the Department of Energy's Headquarters office. Gerri El and Brian Hennessey of the Department of Energy's Savannah River Operations Office also attended. Attendees from Westinghouse Savannah River Company (WSRC) were Clay Jones, Cliff Thomas, Leslie Huber, Mary Flora, Ken Crase, and Walt Loring.

The meeting covered draft presentations and four draft motions; with detailed discussions followed by a vote. The four motions were: 1) Independent Scientific Peer Review of current and proposed ground water remediation projects; 2) To categorize the SRS High Activity Transuranic waste as urgent and assign high priority to funding/treatment; 3) Recommend use of the Consolidated Incineration Facility for low level activity wastes; 4) Delay treatment of contaminated soils. After detailed discussions of the motions, all four motions were passed unanimously (by all subcommittee members present) to recommend the motions for consideration by the Citizen's Advisory Board, at the March 28 CAB meeting.

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Letter L010. (page 18 of 18)

Response to Comment L010-01

DOE agrees, in principal, that the treatment of high activity transuranic waste should be pursued with a sense of urgency. However, the categorization of any waste as an urgent problem would require, at the outset, evidence of an imminent threat to the health and safety of the public or the work force. The accident analysis for high activity transuranic wastes indicates that, in a fire, the offsite population dose can be high but that the expected frequency of such an event is low, making its occurrence unlikely and its risk very low. While this situation does not pose an imminent threat that warrants classification as an urgent problem, the likelihood of a serious accident increases the longer these wastes remain untreated in storage. For this reason, DOE agrees that long-term storage of untreated waste is not desirable and has assigned a high priority to addressing transuranic waste treatment.

Response to Comment L010-02

DOE agrees with the recommendation to expedite the treatment selection for high activity transuranic wastes. DOE has conducted and continues extensive research and development on organic destruction treatment options for transuranic wastes. The Office of Technology Development has identified waste focus areas for research including transuranic wastes, and is funding ongoing activities at various DOE sites. The goal of this research is to have a selected technology completely developed and available for site implementation by November 1997. As part of the Office of Technology Development technology selection process, the DOE National Environmental Science and Technology Council performs independent technical reviews and evaluations of priorities. The DOE National Environmental Science and Technology Council is comprised of scientists and engineers with national and international reputations in their fields of expertise. DOE will make every effort to select a technology for treatment of transuranic waste by year's end and will present a status report at the November 1995 Citizens Advisory Board meeting.

Response to Comment L010-03

As a result of SRS developing the proposed site treatment plan as required by the Federal Facility Compliance Act, preferred technologies have been identified to allow treatment of SRS mixed waste streams including transuranic waste. To support this effort, funding has been targeted in fiscal year 1997 specifically for the Federal Facilities Compliance Act related activities. In the case of transuranic waste treatment, funding has been targeted for two specific activities. The first activity is to begin development of a transuranic waste treatment facility. In fiscal year 1997 it is envisioned that pre-engineering activities would be performed to support development of a capital line-item to treat transuranic wastes. A second activity that would be performed in fiscal year 1997 would be to initiate a direct support contract for transuranic waste characterization and certification. At present, these funds are targeted to support transuranic waste treatment; however, actual funds are not guaranteed at this time. It should be noted that arc melter studies and hybrid plasma induction activities are currently being performed in the research and development arena to address transuranic waste treatment.

Response to Comment L010-04

The retrieval activities planned for transuranic waste stored on TRU Pads 2 to 5 include "overpacking" and not "repackaging." With overpacking, an existing 55-gallon drum will be placed inside an 83-gallon overpack drum for continued safe storage. It should be understood that waste will not be removed from the existing 55-gallon drum and repackaged into a new drum. The primary objective of the retrieval project is the safety of continued transuranic waste storage. These drums were first placed in storage in

the mid 1970s; they have a minimum design life of 20 years. Since the drums are under earthen cover, monitoring their condition is not possible. The storage and retrieval hazards of the covered drums will increase with time from corrosion, and are enhanced because the drums cannot be routinely monitored. The covered drums to be retrieved are the lowest risk containers on these pads based on curie loading, but if these drums are left stored under earthen cover until significant deterioration occurs, the hazards associated with handling the drums during retrieval can increase by 300 percent. With regard to worker safety, an environmental assessment performed in 1988 (DOE 1988) showed that routine transuranic waste retrieval operations would result in insignificant amounts of radiation exposure to operating personnel. It also showed that retrieval and subsequent overpacking of these drums reduces the immediate environmental hazards.

The buried drums on TRU Pads 2 to 5 must be retrieved for disposal at the Waste Isolation Pilot Plant. The plan is to retrieve the drums without further delay, vent and purge them of any accumulated flammable gases, and overpack them with a new, vented 83-gallon drum. The overpacked and vented drums will then be re-stored on a weather-protected storage pad in a safe condition. The waste would not be repackaged until a suitable facility is constructed in the future.

Response to Comment L010-05

DOE proposes to incinerate combustible low-level waste and to use supercompaction to treat noncombustible low-level waste. As indicated in Appendix B, Section B.5 the Consolidated Incineration Facility was originally intended for the processing of solid and liquid hazardous and mixed wastes for which incineration is the preferred treatment. However, Appendix B.5 confirms that Consolidated Incineration Facility capacity is expected to be adequate for the incineration of combustible low-level wastes as well.

Response to Comment L010-06

DOE has completed the evaluation of stabilization alternatives for the Consolidated Incineration Facility residue and blowdown (Burns et al. 1993). Several studies on ash stabilization and blowdown have been completed. DOE is continuing to evaluate treatment technologies. The selected means of stabilization is cementation since it represents the most cost-effective alternative, is compatible with ash and blowdown chemistry, and will minimize groundwater impacts. DOE welcomes review of the data and will convene an independent scientific peer review team to evaluate the data. DOE will attempt to arrange this review promptly so that the results can be presented at the July 1995 Citizens Advisory Board meeting.

Response to Comment L010-07

DOE agrees that uncertainties exist in the nature of the final cleanup standards, as well as in the completed definition of areas to be decontaminated and restored. The range of waste forecasts presented in the EIS is intended to bound the effects of those uncertainties on the resulting waste volumes.

The non-alpha vitrification facility is an appropriate and flexible technology for treating soils. However, DOE will continue to evaluate alternative treatment activities based on further soil characterization and on new technologies. If waste volumes meet or exceed the expected (best estimate) waste forecasts, the non-alpha vitrification facility would be required to treat liquid, soil, and sludge wastes generally resulting from environmental restoration and/or decontamination and decommissioning activities.

Response to Comment L010-08

DOE agrees that research and development on the treatment of contaminated soils warrants (and is receiving) a high priority to ensure that areas containing such soils can be processed both effectively and economically. It should be noted, however, that there is no statutory or regulatory requirement that DOE relinquish control over all or parts of SRS in 100 years. It is possible that areas not economically or technically feasible to decontaminate or restore to acceptable levels may remain under the control of DOE or another government agency for an indefinite period.

Response to Comment L010-09

At the request of the Citizens Advisory Board, DOE will work with them to develop an appropriate plan for determining how to safely categorize and manage contaminated and suspect soils.

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APPENDIX J

PROTECTED SPECIES CONSULTATION

The information presented in this Protected Species Survey, published in April 1995, is based on the configuration of the alternatives presented in the draft EIS. This configuration has changed since the draft EIS with respect to the number of facilities and the land area required (Table 2-28 and Figures 4-13, 4-14, 4-22, 4-23, 4-31, 4-32). Changes in acreages range from a decrease of 33 acres between the draft and final in alternative B – maximum waste forecast, to an increase of 17 acres between the draft and final in alternative A – maximum waste forecast. These changes fall within the scope of the alternatives and within the areas surveyed and do not represent major modifications to land requirements. The survey concluded that DOE's plans to construct and operate additional waste management facilities within the uncleared portions of E-Area should not affect any Federally threatened or endangered species.

The amount of waste SRS would be required to treat has not been determined so the need for additional land beyond the uncleared parts of E-Area has not been identified. As stated in the survey, DOE will continue to consult informally with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service as waste management decisions are made.

Information presented in the Protected Species Survey was collected over a 3-year period. Rare plant surveys were conducted in 1992 and 1994 by a private consultant to the U.S. Forest Service. Surveys were done periodically from late March through August of each year along transects established through the area. In 1993, the U.S. Forest Service surveyed the area for red-cockaded woodpeckers, activity, or nest trees by walking through the area along compass lines 20 meters (66 feet) apart.

DOE/EIS-0217
July 1995

PROTECTED SPECIES SURVEY

PROPOSED
WASTE MANAGEMENT EXPANSION
IN THE UNCLEARED PORTION
OF E-AREA

APRIL 1995

U.S. Department of Energy
Savannah River Site
Aiken, SC 29802

DOE/EIS-0217
July 1995

PROTECTED SPECIES SURVEY

PROPOSED WASTE MANAGEMENT EXPANSION IN THE UNCLEARED PORTION OF E-AREA

Publication Date: April 1995

U.S. Department of Energy
Savannah River Site
Aiken, SC 29802

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INTRODUCTION

This report documents the results of a protected species survey conducted in support of the proposed U.S. Department of Energy (DOE) plan to construct and operate additional waste management treatment, storage, and disposal facilities within the uncleared portion of E-Area at the Savannah River Site (SRS) located near Aiken, South Carolina (Figure 1).

Approximately 600 acres of undeveloped woodland adjacent to E-Area were investigated as potential sites for the proposed waste management treatment, storage, and disposal facilities. Approximately 61 acres of currently graded, fenced, and partially developed land and 115 acres of undeveloped land would be required to develop the additional facilities.

Plant and animal surveys conducted by the Savannah River Forest Station (SRFS) during 1992, 1993, and 1994 located no protected species within or adjacent to areas that would be affected (LeMaster 1994a, b, and c).

The term "protected species" as used in the context of this report encompasses both plant and animal species that have been designated by the Federal government as endangered or threatened as defined in the Endangered Species Act and identified in the U.S. Fish and Wildlife Service (USFWS) list of endangered and threatened wildlife and plants (50 CFR Parts 17.11 and 17.12).

DESCRIPTION OF PROPOSED PROJECT

This protected species survey evaluated approximately 600 acres of undeveloped woodland adjacent to approximately 100 acres of previously cleared, fenced, and partially developed land within E-Area (Figures 2 and 3). Dominant cover types are shown in Figure 2. The proposed project is to treat, store and dispose of radioactive, mixed, and hazardous wastes generated during 40 years of operations at the SRS. DOE proposes to construct the following treatment, storage, and disposal facilities:

- 24 long-lived waste storage buildings (size 50' x 50')
- 18 Resource Conservation and Recovery Act (RCRA)-permitted disposal vaults (size 200' x 50')
- 4 low-activity waste vaults (size 650' x 150')
- 4 intermediate-level waste vaults (size 250' x 50')
- 56 shallow land disposal trenches (size 100' x 20')
- 14 transuranic waste storage pads (size 150' x 50')
- 80 mixed waste storage buildings (size 160' x 60')
- 1 supercompactor
- 1 alpha vitrification facility
- 1 non-alpha vitrification facility
- 1 containment building
- 1 transuranic waste characterization/certification facility

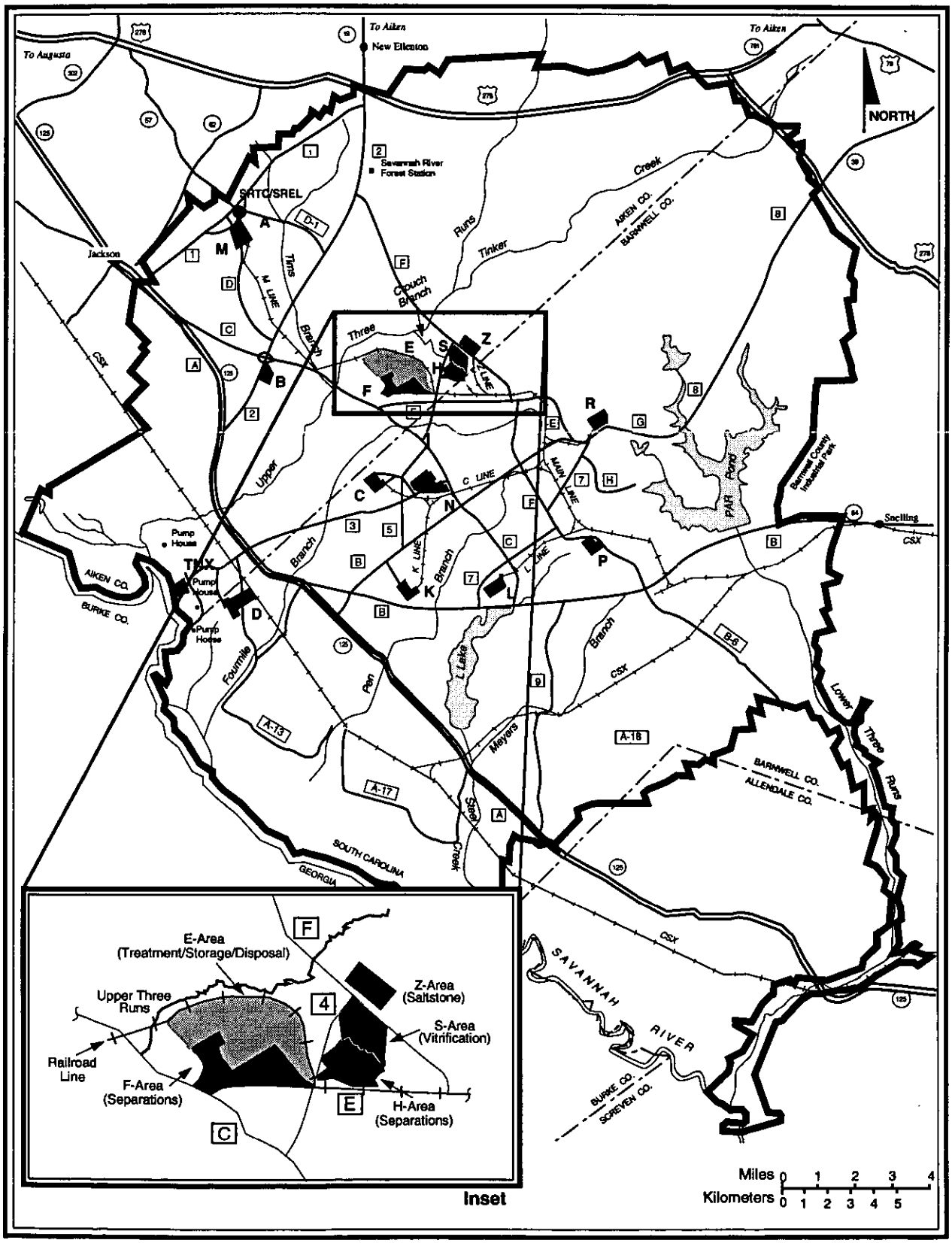

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Figure 1. General location of the proposed waste management expansion in E-Area at the Savannah River Site, South Carolina. Refer to Figure 2 for details on the proposed project area .

Construction of the treatment facilities that are proposed to be located northwest of F-Area will require approximately 10 years. Until the treatment facilities are available, all waste will be stored within the developed portion of E-Area, a loblolly pine (*Pinus taeda*) plantation planted in 1987 (3 acres), and a recently harvested mixed pine hardwood stand (4 acres) (Figure 2). When treatment of the waste begins in 2008, waste stored in the developed portion of E-Area will be treated, consolidated, and disposed in RCRA vaults to be constructed in a 9-acre loblolly pine plantation established in 1987 (Figure 3).

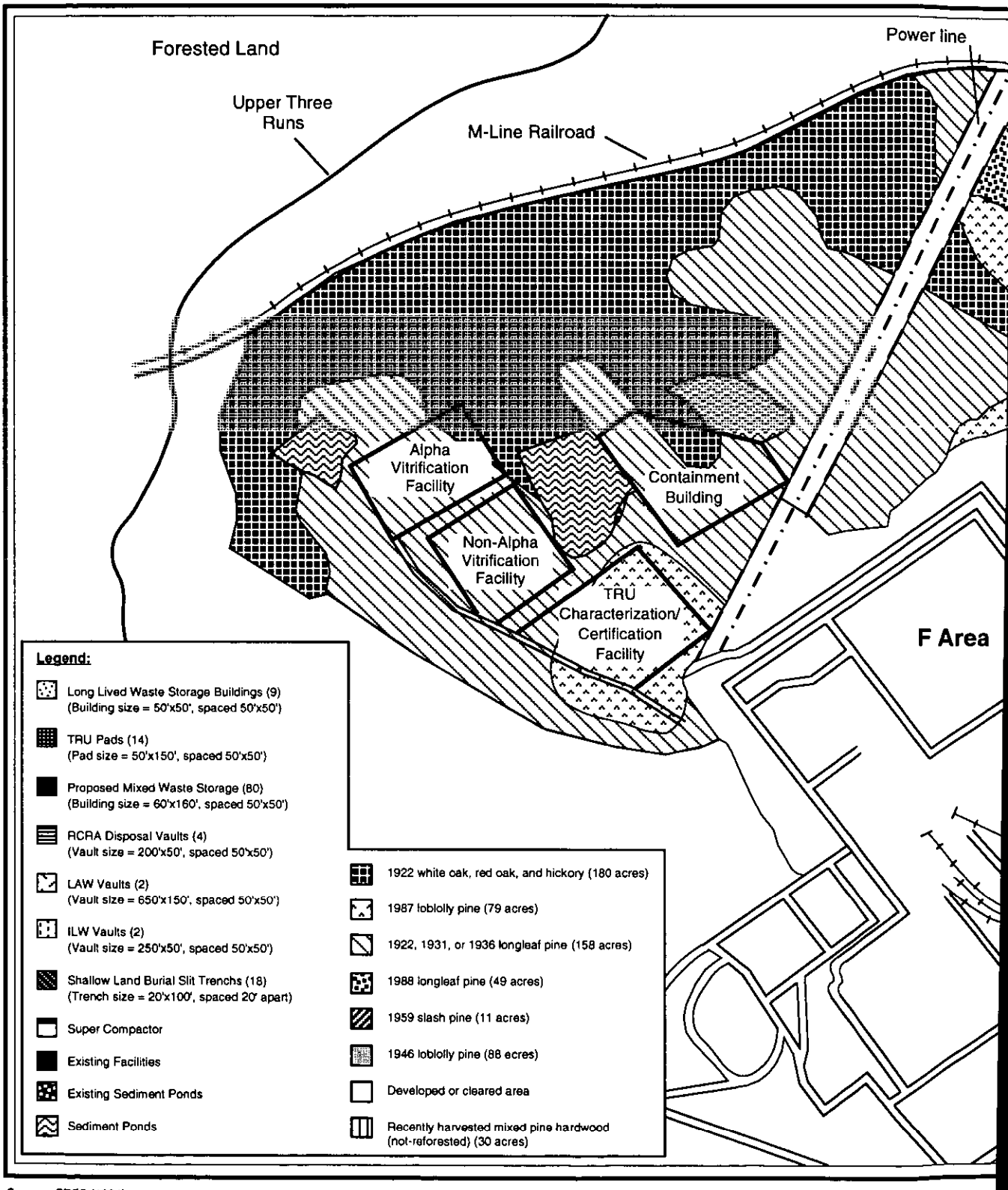
Efforts will be implemented to avoid problems before performing activities that would disturb surface soils and cause potential impacts. Erosion control will be established in accordance with the SRS Project Storm Water Management and Sedimentation Reduction Plan (WSRC 1993) as required by law. Management practices such as silt fences, hay bales, and rip-rap will be installed during construction to prevent erosion and avoid impacts to the wetlands located downgradient from the proposed project. Marketable timber would be harvested from the proposed project area.

To minimize impacts to the biodiversity, wetlands, and archaeological resources of SRS and to protect threatened and endangered species, the proposed facilities would be located adjacent to existing cleared and developed land in E-Area. All disposal facilities except the RCRA disposal vaults would be located in a 100-acre cleared, graded, and currently developed portion of E-Area. Additional land requirements for the treatment facilities would encompass approximately 34 acres of loblolly pine established in 1987; 57 acres of longleaf pine (*P. palustris*) established in 1922, 1931, and 1936; and 20 acres of white oak (*Quercus alba*), red oak (*Q. rubra*), and hickory (*Carya sp.*) established in 1922.

Three waste management alternatives have been analyzed in a draft environmental impact statement published in March 1995. If SRS were required to treat the maximum amount of waste it could handle, new facility construction could affect as much as 184 acres of undeveloped land north of E-Area. An additional 789 acres outside the surveyed area would also be required under the maximum waste forecast. Should SRS have to treat the maximum amount of waste, additional threatened and endangered species surveys, wetlands assessments, and archaeological resource surveys would be required. The amount of waste SRS would be required to treat has not been determined so no siting studies to identify any additional land have been initiated.

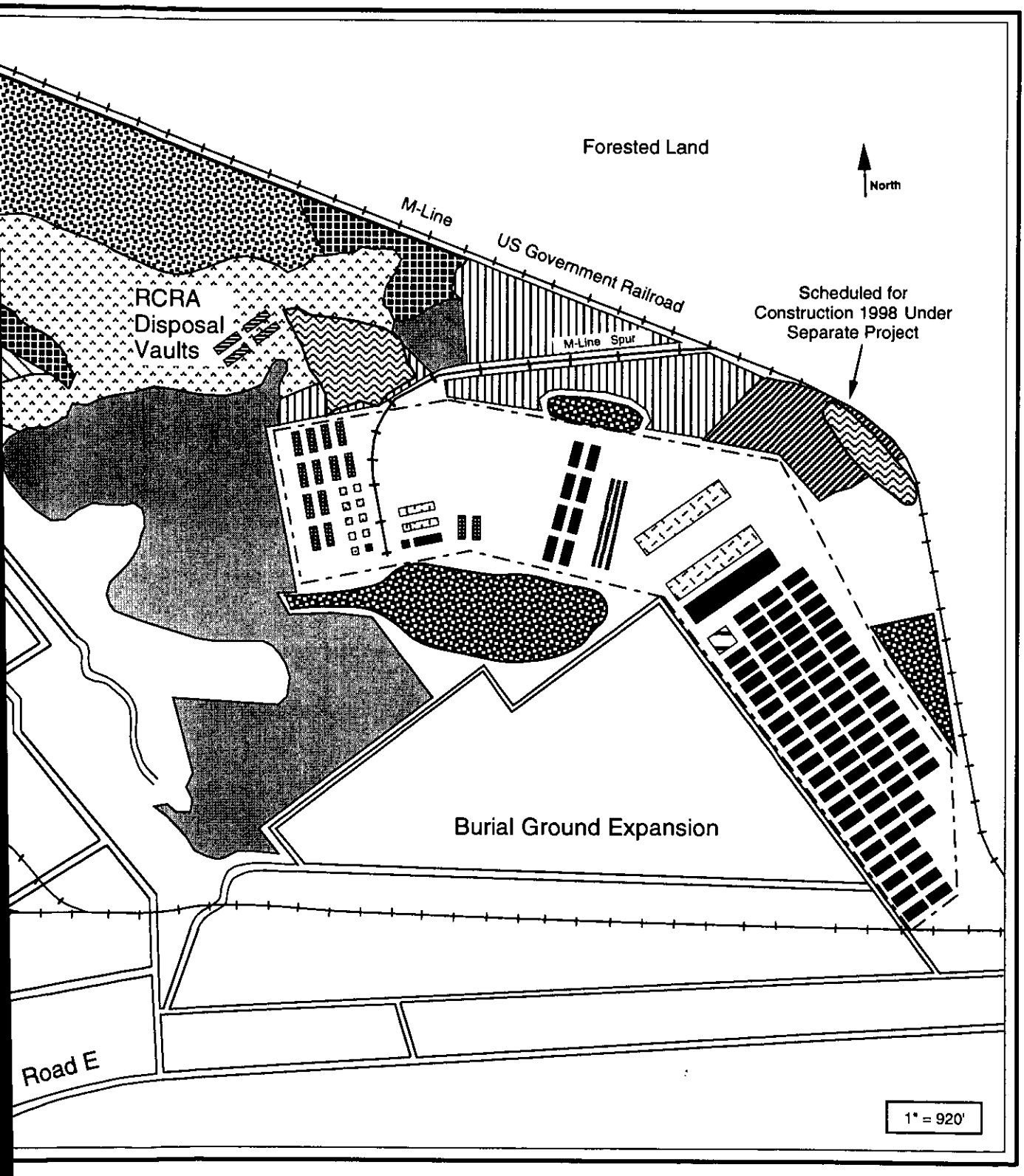
DESCRIPTION OF PROJECT AND SURROUNDING AREA

The proposed waste management area is located north of the developed portion of E-Area and south of Upper Three Runs and M-Line railroad. The majority of the site is a relatively level upland area dominated by Ailey sand (2-6 percent slopes), Lakeland sand (0-6 percent slopes), Troup sand (0-6 percent slopes), and Blanton sand (0-6 percent slopes). These level upland areas end abruptly along distinct bluffs overlooking the floodplain of Upper Three Runs and several small unnamed tributaries. These steep slopes are composed of Troup and Lucy sands



Source: SRFS (1994)

Figure 2. Map depicting the major plant communities/habitat types in and around the part of E-Area scheduled for expansion by 2008 and general footprints of the facilities that will be constructed.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Burial Ground Expansion
Road E
1" = 920'

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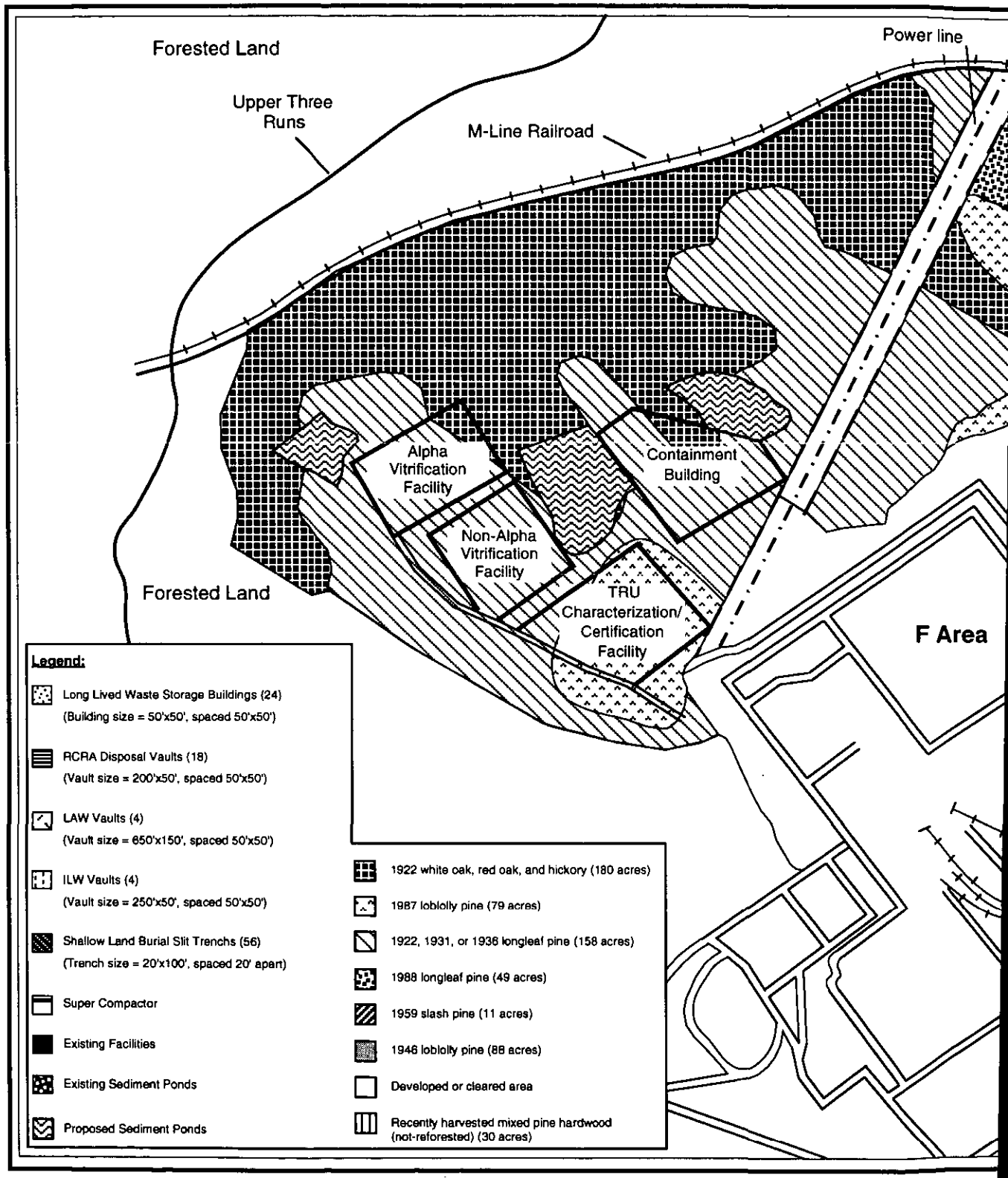
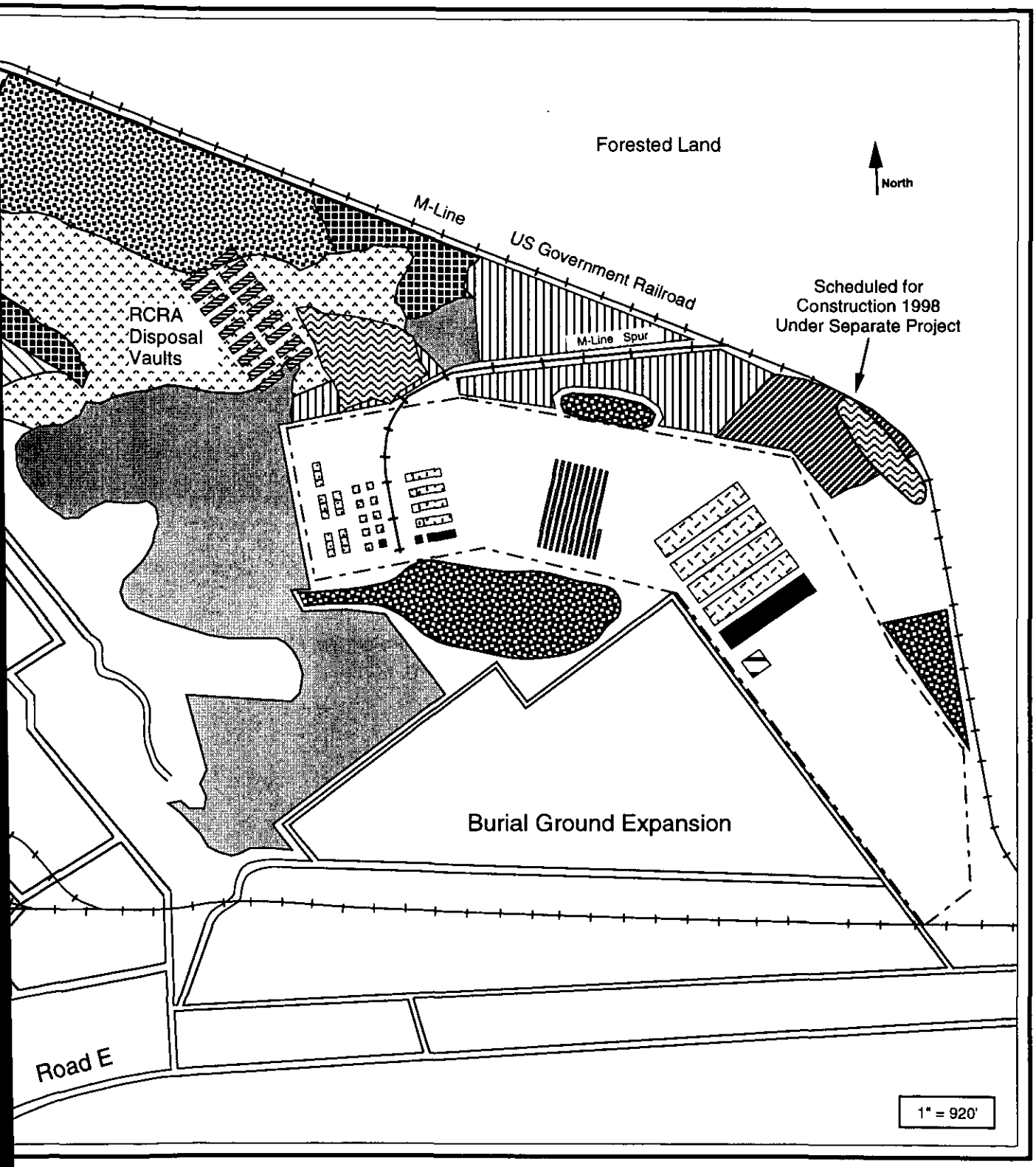


Source: SRFS (1994)

Figure 3. Map depicting the major plant communities/habitat types in and around the part of E-Area scheduled for expansion by 2024 and general footprints of the facilities that will be constructed.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(25-40 percent slopes and 15-25 percent slopes). The wetland floodplain of Upper Three Runs is composed of Ogeechee sandy loam ponded, fluvaquents, frequently flooded, and Pickney sand, frequently flooded (Rogers 1990). Contour elevations range from 130 feet above sea level along Upper Three Runs to 300 feet on the hilltops.

The sandy upland portions of the survey area are composed of approximately 11 acres of slash pine (*P. elliottii*) planted in 1959; 79 acres of loblolly pine planted in 1987; 88 acres of loblolly pine planted in 1946; 49 acres of longleaf pine planted in 1988; 158 acres of longleaf pine established in 1922, 1931, or 1936; and 30 acres of recently harvested mixed pine hardwood. The slopes are dominated by 180 acres of an upland hardwood community established in 1922. These steep slopes contain a closed canopy of mature white oak, red oak, and hickory. The wetlands adjacent to Upper Three Runs are dominated by tulip poplar (*Liriodendron tulipifera*) and sweet gum (*Liquidambar styraciflua*) (SRFS 1994).

PROTECTED SPECIES REVIEWED

Based on the protected species accounts provided in 50 Code of Federal Regulations 17.11 and 17.12 and the lists provided in Hyatt (1994), a list of protected species potentially occurring in the proposed project area was compiled (Table 1). Table 1 also provides a brief description of the preferred habitat for each of these species.

SURVEY RESULTS

Surveys of the proposed project area were conducted during 1992, 1993, and 1994 by SRFS for evidence of any of the protected species listed in Table 1.

IMPACT IDENTIFICATION

Based on the results of the aforementioned surveys, potential impacts which were identified are listed below:

Bald Eagle (*Haliaeetus leucocephalus*) - Records of the presence of this species on the SRS date back to the late 1950s (Mayer et al. 1985, 1986). Two bald eagle nesting territories have been established on SRS (Mayer et al. 1988; Wike et al. 1994). The nearest of these nest sites to the proposed project area is located approximately 7 miles to the south. There have been no documented records of bald eagles using the proposed project area (Mayer et al. 1985, 1986). In addition, the proposed project area has no preferable forage or nesting habitat available. The project area provides only marginal roosting habitat. Based on SRS records, use of the project site by bald eagles would be incidental at best. No evidence indicating the presence of this species was encountered during the surveys. The proposed project should have little to no impact on this endangered species. However, there is the potential that suitable habitat could become inhabited during the 30-year life of the project. As new facilities are planned, additional surveys will be initiated as needed and consultation with the USFWS will continue.

Table 1. Plant and animal species that potentially occur on the SRS and are protected under the Endangered Species Act of 1973 (Hyatt 1994).

Common Name	Scientific Name	Federal Status[a]	Preferred Habitat
		ANIMALS	
Bald Eagle	*Haliaeetus leucocephalus*	Endangered[b]	Suitable open wetland areas for hunting, and undisturbed lakeshore or coastal regions with large trees for roosting and nesting
Wood Stork	*Mycteria americana*	Endangered	Freshwater and brackish wetlands, primarily nesting in cypress or mangrove swamps, and feeding in freshwater marshes, flooded pastures and flooded ditches
Red-Cockaded Woodpecker	*Picoides borealis*	Endangered	Overmature pine trees; prefers understory vegetation less than 5 feet tall
American Alligator	*Alligator mississippiensis*	Threatened (due to similarity of appearance)	River swamps, lakes, bayous, and marshes in the southeastern states
Shortnose Sturgeon	*Acipenser brevirostrum*	Endangered	Atlantic seaboard rivers
		PLANTS	
Smooth Purple Coneflower	*Echinacea laevigata*	Endangered	Meadows and woodlands on basic or circumneutral soils

a. Endangered - a species that is in danger of extinction throughout all or significant portion of its range and has protection under the Endangered Species Act.
Threatened (due to similarity of appearance) - species not listed pursuant to Section 4 of the Endangered Species Act, but given special consideration because it closely resembles a listed taxa; or special treatment of the unlisted species will further the policy and enforcement of the Endangered Species Act.

b. The Bald Eagle has been proposed to be downlisted to threatened (59 FR 35584).

Wood Stork (*Mycteria americana*) - The breeding colony of wood storks from Birdsville, Georgia, continues to sporadically use wetland areas of the SRS for foraging (Wike et al. 1994). Documented wood stork use of SRS dates back to the late 1950s (Norris 1963). However, the proposed project area provides neither forage nor nesting habitat for this endangered species. In addition, there are no documented records of any previous use of the project site by wood storks (Coulter 1993). No evidence of this species was found during the surveys. The proposed project should not have any impact on this endangered species. However, as new facilities are planned, surveys will be initiated as needed and consultation with the USFWS will continue.

Red-Cockaded Woodpecker (*Picoides borealis*) - Seventy-seven red-cockaded woodpeckers lived on SRS at the end of 1994 (LeMaster 1994b). Red-cockaded woodpeckers prefer to nest in pines more than 60 years old and forage in pine forests more than 40 years old. Although the proposed project site is within the interior portion of SRS that is not intensively managed for the birds, the age of several stands of pines on the site make them appropriate for nesting and foraging. Due to the suitability of the habitat and the proximity of active colonies (7 miles to the north) and managed recruitment stands (1.5 miles to the north), an intensive survey was conducted in 1993. One hundred and fifty eight acres of longleaf pine established in 1922, 1931, or 1936 were surveyed. No evidence of red-cockaded woodpeckers was found during the survey (LeMaster 1994c). While the proposed project should have no impact on this endangered species, there is the potential that suitable habitat could become inhabited during the 30-year life of the project. No land clearing or facility construction is currently planned until at least after the year 2000. As new facilities are planned, additional surveys will be initiated as needed and consultation with USFWS will continue.

American Alligator (*Alligator mississippiensis*) - The SRS supports a population of approximately 200 to 250 American alligators (Gibbons and Semlitsch, 1991). The proposed project area does not provide any suitable habitat for this protected species. In addition, there are no documented records of any previous use of the project site by alligators. The closest known areas used by alligators are the wetlands present in the Upper Three Runs drainage corridor, located adjacent to the project site. No evidence of this species was found during the surveys. The proposed project should not have any impact on the threatened species. However, as new facilities are planned, surveys will be initiated as needed and consultation with the USFWS will continue.

Shortnose Sturgeon (*Acipenser brevirostrum*) - The proposed project has been designed utilizing Best Management Practices to eliminate or minimize impacts from any discharges that could impact tributaries to the Savannah River. In addition, the proposed project site is an upland area, and the project boundary is over 1,000 feet from the nearest stream (Upper Three Runs), which at that point is 15 kilometers from the river. The shortnose sturgeon occurs in the river along the southwestern boundary of SRS (Wike et al. 1994). The proposed project area does not provide any suitable habitat for this species. Furthermore, no evidence of this species was found during the surveys.

Therefore, the proposed project should not have any impact on this endangered species. As new facilities are planned, additional surveys will be initiated and consultation with the National Marine Fisheries Service (NMFS) will continue.

Smooth Purple Coneflower (*Echinacea laevigata*) - Two populations of this species are known to occur on the SRS (Knox and Sharitz 1990; Hyatt 1994). The first, a small dwindling population located adjacent to Burma Road, includes approximately 200 individuals (SRFS 1992). This population is approximately 4.5 miles southwest of the proposed project area. The second population, composed of approximately 500 individuals, is located 7.2 miles southeast of the project area (LeMaster 1994b). The proposed project area could provide habitat for the smooth purple coneflower. However, no evidence of this species was found during the 1992 and 1994 botanical surveys. The proposed project should not have any impact on this endangered species. While the proposed project should have no impact on this endangered species, there is the potential that suitable habitat could become inhabited during the 30-year life of the project. As new facilities are planned, additional surveys will be initiated as needed and consultation with USFWS will continue.

MITIGATION PLANS

No mitigation plans are necessary to minimize or prevent potential impacts to any of the protected species listed in Table 1.

SUMMARY

The proposed project should not affect any Federally protected animal or plant species. DOE will continue to consult informally with the USFWS and the NMFS as new facilities are planned and National Environmental Policy Act reviews continue over the 30-year life of the project.

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50 CFR 17.11 and 17.12. August 23, 1993. Endangered and Threatened Wildlife and Plants. Code of Federal Regulations.

59 FR 35584. **Endangered and Threatened Wildlife and Plants; Reclassify the Bald Eagle from Endangered to Threatened in Most of the Lower 48 States.** 50 CFR Part 17. *Federal Register* Vol. 59. No. 132. Tuesday, July 12, 1994. Pages 35584-35594.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive N.
St. Petersburg, FL 33702

May 22, 1995 F/SEO13:JEB

Stephen A. Danker
Environmental Scientist
Environmental Compliance Division
Savannah River Operations Office
U.S. Department of Energy
P.O. Box A
Aiken, SC 29802

Dear Mr. Danker:

This responds to your letter of April 13, 1995 which included a copy of the Protected Species Survey for the proposed waste management expansion in the uncleared portion of E-Area for the Savannah River Site (SRS), Aiken, South Carolina. The survey states that shortnose sturgeon would not be affected by the waste management expansion because shortnose sturgeon do not occur in the vicinity of the project area and because the nearest tributary to the Savannah River is over 1.5 kilometers from the project area.

We have reviewed the information provided and concur that the proposed project to more safely store and dispose of radioactive wastes at the SRS are not likely to adversely impact threatened or endangered species under our jurisdiction.

This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified, or critical habitat is determined that may be affected by the proposed activity.

If you have any questions please contact Jeffrey Brown, Fishery Biologist, at (813) 570-5312.

Sincerely,

Andrew J. Kemmerer
Regional Director

cc: F/PR8
F/SEO2

file name: SEC7\SRSEAREA.LET
file: 1514-22 m

United States Department of the Interior

FISH AND WILDLIFE SERVICE
P.O. Box 12559
217 Fort Johnson Road
Charleston, South Carolina 29422-2559

May 24, 1995

Mr. Stephen A. Danker
Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

Re: Additional Waste Management Facilities at SRS
Uncleared Portion of E-Area at SRS
FWS Log No. 4-6-95-242

Dear Mr. Danker:

We have reviewed the revised Protected Species Survey received April 18, 1995 concerning the above-referenced project in Aiken County, South Carolina. The proposed project includes construction and operation of additional waste management treatment, storage, and disposal facilities to support past and future operations and activities at SRS. The following comments are provided in accordance with the Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661-667e), and Section 7 of the Endangered Species Act, as amended (16 U.S.C. 1531-1543).

Based on the information received, we will concur with a determination that this action is not likely to adversely affect federally listed or proposed endangered and threatened species. In view of this, we believe that the requirements of Section 7 of the Endangered Species Act have been satisfied. However, obligations under Section 7 of the Act must be reconsidered if (1) new information reveals impacts of this identified action that may affect listed species or critical habitat in a manner not previously considered, (2) this action is subsequently modified in a manner which was not considered in this assessment, or (3) a new species is listed or critical habitat is determined that may be affected by the identified action.

Your interest in ensuring the protection of endangered and threatened species is appreciated. If you have any questions please contact Ms. Lori Duncan of my staff at (803) 727-4707. In future correspondence concerning the project, please reference FWS Log No. 4-6-95-242.

Sincerely yours,

Catherine D. Duncan
Acting Field Supervisor

CDD/LWD/km

INDEX FOR VOLUME II