2.8.4 COST

Based on the preconceptual designs prepared and used by the Salt Processing Systems Engineering Team, the cost through construction of the alternatives would range L6-47 from $900 million to $1.4 billion (WSRC 1998a). Based on this preliminary information, the Direct Disposal in Grout alternative would be the least costly. However, as designs are refined, the projected costs are subject to change and estimates for the alternatives could be higher or lower. Because the designs are preliminary, DOE does not consider the cost estimates to be reliable enough to be a discriminating factor. Cost estimates will, however, continue to be refined and evaluated in the ultimate selection of an alternative for implementation.

2.9 Comparison of Alternatives

This comparison is based on the information in Chapter 3 (Affected Environment), and analyses in Chapter 4 (Environmental Impacts). Its purpose is to present impacts of the alternatives in comparative form to provide a clear basis for choosing among the alternatives for the decisionmaker(s) and the public.

This section compares the impacts of the four action alternatives: Small Tank Precipitation, Ion Exchange, Solvent Extraction, and Direct Disposal in Grout. These action alternatives would involve very similar construction and operations activities that enable a sharply focused comparison of impacts on each environmental resource.

Because the No Action alternative is a continuation of current HLW management activities, very few changes to that baseline would occur if DOE decided to not select and implement a salt-processing alternative. However, should DOE determine that a salt processing facility would not be available by 2010, decisions about future tank space management would have to be made immediately. The course of action that DOE would follow cannot be predicted at this time, but available options may include the following, either individually or in combination:

- Identify additional ways to optimize of Tank Farm operations
- Reuse tanks scheduled to be closed by 2019
- Build tanks permitted under wastewater treatment regulations
- Build tanks permitted under RCRA regulations
- Suspend operations at DWPF.

HLW salt processing would affect the environment and human health and safety during the period of time when facilities are being constructed and are operating. For purposes of analysis in this SEIS, DOE has defined this life cycle to be from the year 2001 through about 2023, when salt processing would be complete. For the No Action alternative, short-term impacts are considered for the two periods, continuing tank space management (until 2010) and post tank space management. DOE expects the long-term impacts to be those that could result from the eventual release of residual waste from the Z-Area vaults to the environment. In this SEIS, DOE has used modeling to predict these long-term impacts.

Chapter 4 of this SEIS presents the potential short-term and long-term environmental impacts associated with each salt processing alternative and the No Action alternative.

2.9.1 SHORT-TERM IMPACTS

Section 4.1 presents the potential short-term impacts (those that would occur between the approximate years 2001 and 2023) for each of the action alternatives and No Action. Because potential impacts are presented for both the action alternatives and the No Action alternative, DOE has measured the impacts as incremental to the existing "baseline" conditions.

These potential impacts are compared among the four action alternatives in Table 2-6 for normal

Table 2-6. Summary comparison of incremental life-cycle impacts to the SRS baseline by salt processing alternative. Values in bold indicate greatest impact for a particular parameter.

Parameter	No Action[a] Continue Tank Space Management	No Action[a] Post Tank Space Management Scenarios	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Geologic Resources						
	Continuation of tank space management activities would increase the surveillance necessary to ensure safe and environmentally satisfactory performance of these tanks.	The reuse of existing HLW tanks would increase the risk of tank failure resulting in the release of HLW to soils. Any new HLW storage tanks would be built in previously disturbed industrial areas. Best management practices would be used to stabilize soils and control erosion during construction. The operation of any new HLW storage tanks would not disturb any landforms or surface soils.	Minimal	Minimal	Minimal	Minimal
Water Resources						
Surface Water	No Change	Construction of any new HLW tanks would be confined to previously disturbed industrial areas with established stormwater controls. Therefore, impacts would be minimal.	Minimal	Minimal	Minimal	Minimal
Groundwater	Continuation of tank space management activities would increase the surveillance necessary to ensure safe and environmentally satisfactory performance of these tanks.	The reuse of existing HLW tanks would increase the risk of tank failure resulting in the release of HLW to ground-water. Any release of HLW to groundwater would have a substantial adverse impact on the quality of the surficial aquifer. Construction of any new HLW tanks would be confined to previously disturbed industrial areas with a deep water table. The operation of any new HLW storage tanks would not involve discharges to groundwater.	Minimal	Minimal	Minimal	Minimal

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Table 2-6. (Continued).

Parameter	No Action[a] Continue Tank Space Management	No Action[a] Post Tank Space Management Scenarios	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Air Resources						
Nonradiological air emissions (tons/yr.):						
Sulfur dioxide (as SO_2) (PSD Standard - 40)	No Change	Minimal[b]	0.33	0.33	0.33	0.33
Total suspended particulates (PSD Standard - 25)	No Change	Minimal[b]	0.95	0.95	0.95	0.80
Particulate matter (≤10 µm) (PSD Standard - 15)	No Change	Minimal[b]	0.40	0.40	0.40	0.30
Carbon monoxide (PSD Standard - 100)	No Change	Minimal[b]	5.4	5.4	5.4	4.9
Volatile organic compounds (PSD Standard - 40)	No Change	Minimal[b]	**70**	1.6	40	1.5
Oxides of nitrogen (NO_x) (PSD Standard - 40)	No Change	Minimal[b]	21	21	21	19
Lead (PSD Standard - 0.6)	No Change	Minimal[b]	4.0×10^{-4}	4.0×10^{-4}	4.0×10^{-4}	3.5×10^{-4}
Beryllium (PSD Standard - 4.0×10^{-4})	No Change	Minimal[b]	1.0×10^{-4}	1.0×10^{-4}	1.0×10^{-4}	5.0×10^{-5}
Mercury (PSD Standard - 0.1)	No Change	Minimal[b]	0.0026	0.0026	0.0026	0.0025
Formic Acid (PSD Standard - NA)	No Change	Minimal[b]	**1.6**[c]	None	None	None
Benzene (PSD Standard - NA)	No Change	Minimal[b]	**53**	0.0085	0.0085	0.0085
Biphenyl (PSD Standard - NA)	No Change	Minimal[b]	**1.1**	None	None	None
Methanol (PSD Standard - NA)	No Change	Minimal[b]	0.42	0.42	0.42	0.42
n-Propanol (PSD Standard - NA)	No Change	Minimal[b]	0.42	0.42	0.42	0.42
Isopar®L (PSD Standard - NA)	None	None	None	None	**38**	None
Air pollutants at the SRS boundary (maximum concentrations-µg/m³):						
Sulfur dioxide (as SO_2) - 3 hr. (Standard - 1,300)	1240[d]	Minimal[b]	0.30	0.30	0.30	**0.40**
Total suspended particulates - annual (Standard - 75)	67[d]	Minimal[b]	0.0010	0.0010	0.0010	0.0010
Particulate matter (≤10 µm) - 24 hr. (Standard - 150)	130[d]	Minimal[b]	0.070	0.070	0.070	0.070

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Table 2-6. (Continued).

Parameter	No Action[a]: Continue Tank Space Management	No Action[a]: Post Tank Space Management Scenarios	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Carbon monoxide - 1 hr. (Standard - 40,000)	10,350[d]	Minimal[b]	15	15	15	18
Ozone - 1 hr. (Standard - 235)	216[d]	Minimal[b]	ND	ND	ND	ND
Nitrogen dioxide (NO_2) - annual (Standard -100)	26[d]	Minimal[b]	0.030	0.030	0.030	0.030
Lead - max. quarterly (Standard - 1.5)	0.03[d]	Minimal[b]	4.0×10^{-7}	4.0×10^{-7}	4.0×10^{-7}	4.0×10^{-7}
Beryllium - 24 hr. (Standard - 0.01)	0.0090[d]	Minimal[b]	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}
Mercury - 24 hr. (Standard - 0.25)	0.03[d]	Minimal[b]	3.0×10^{-5}	3.0×10^{-5}	3.0×10^{-5}	3.0×10^{-5}
Benzene - 24 hr. (Standard - 150)	5[d]	Minimal[b]	**4.0**	0.0010	0.0010	0.0010
Biphenyl - 24 hr. (Standard - 6)	0.02[d]	Minimal[b]	**0.45**	None	None	None
Methanol - 24 hr. (Standard - 1,310)	0.9[d]	Minimal[b]	0.32	0.32	0.32	0.53
Annual radionuclide emissions (curies/year): (Doses are reported in Worker and Public Health Section.)	No Change[e]	Minimal[b]	5.3	18.2	**25.4**	9.3[f]
Worker and Public Health						
Radiological dose and health impacts to the public:						
Maximally-exposed individual (mrem/yr.)	No Change[g]	Minimal[h]	0.20	0.049	**0.31**	0.086
MEI project-phase latent cancer fatality	No Change[g]	Minimal[h]	1.3×10^{-6}	3.2×10^{-7}	**2.0×10^{-6}**	5.6×10^{-7}
Offsite population dose (person-rem/yr.)	No Change[g]	Minimal[h]	12.0	2.9	**18.1**	4.0
Offsite population project-phase latent cancer fatality increase	No Change[g]	Minimal[h]	0.078	0.019	**0.12**	0.026

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Table 2-6. (Continued).

Parameter	No Action[a] Continue Tank Space Management	No Action[a] Post Tank Space Management Scenarios	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Nonradiological health impacts to the public:						
Maximally exposed offsite individual						
Latent cancer fatality from benzene	No Change[g]	Minimal[h]	**1.7×10^{-5}**	(c)	(c)	(c)
Latent cancer fatality from beryllium	No Change[g]	Minimal[h]	2.4×10^{-8}	2.4×10^{-8}	2.4×10^{-8}	2.4×10^{-8}
Radiological dose and health impacts to noninvolved workers:						
Noninvolved worker dose (mrem/yr.)	No Change[g]	Minimal[h]	3.3	0.8	**4.8**	1.7
Project-phase latent cancer fatality increase	No Change[g]	Minimal[h]	1.7×10^{-5}	4.2×10^{-6}	**2.5×10^{-5}**	8.6×10^{-6}
Nonradiological health impacts to noninvolved workers:						
Latent cancer fatality from benzene	No Change[g]	Minimal[h]	**0.0066**	(i)	(i)	(i)
Latent cancer fatality from beryllium	No Change[g]	Minimal[h]	7.2×10^{-5}	7.2×10^{-5}	7.2×10^{-5}	7.2×10^{-5}
Radiological dose and health impacts to involved workers:						
Involved worker dose (mrem/yr)	No Change[g]	Minimal[h]	16	3.9	**23**	10
Project-phase dose to population of involved workers (total person-rem)	No Change[g]	Minimal[h]	29	5.0	**47**	14
Project-phase latent cancer fatality increase	No Change[g]	Minimal[h]	0.012	0.0020	**0.019**	0.0056
OSHA-regulated nonradiological air pollutants at noninvolved worker location (max conc. in mg/m^3)[n]						
Sulfur dioxide (as SO_2) - 8 hr. (OSHA Standard -13)[j]	No Change[g]	Minimal[h]	0.01	0.01	0.01	0.01
Total suspended particulates - 8 hr (OSHA Standard -15)	No Change[g]	Minimal[h]	0.02	0.02	0.02	0.01

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Table 2-6. (Continued).

Parameter	No Action[a]: Continue Tank Space Management	No Action[a]: Post Tank Space Management Scenarios	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Particulate matter (≤10 μm) - 8 hr. (OSHA Standard - 5)	No Change[g]	Minimal[h]	0.02	0.02	0.02	0.01
Carbon monoxide - 8 hr. (OSHA Standard - 55)	No Change[g]	Minimal[h]	0.2	0.2	0.2	0.2
Oxides of nitrogen (as NO_x) - ceiling (OSHA Standard - 9)	No Change[g]	Minimal[h]	7.0	7.0	7.0	7.0
Lead - 8 hr. (OSHA Standard - 0.5)	No Change[g]	Minimal[h]	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}	1.0×10^{-5}
Beryllium - 8 hr. (OSHA Standard - 0.002)	No Change[g]	Minimal[h]	3.0×10^{-6}	3.0×10^{-6}	3.0×10^{-6}	3.0×10^{-6}
Beryllium - ceiling (OSHA Standard - 0.005)	No Change[g]	Minimal[h]	3.0×10^{-5}	3.0×10^{-5}	3.0×10^{-5}	3.0×10^{-5}
Mercury - ceiling (OSHA Standard - 0.1)	No Change[g]	Minimal[h]	3.0×10^{-5}	3.0×10^{-5}	3.0×10^{-5}	3.0×10^{-5}
Benzene - 8 hr. (OSHA Standard - 3.1)	No Change[g]	Minimal[h]	**0.1**	3.0×10^{-4}	3.0×10^{-4}	3.0×10^{-4}
Benzene - ceiling (OSHA Standard - 15.5 m^3)	No Change[g]	Minimal[h]	**0.8**	0.004	0.004	0.004
Formic Acid - 8 hr. (OSHA Standard - 9 m^3)	No Change[g]	Minimal[h]	**2.2×10^{-4}[c]**	None	None	None
Methyl alcohol - 8 hr. (OSHA Standard - 260)	No Change[g]	Minimal[h]	0.08	0.08	0.08	0.08
n-Propyl alcohol - 8 hr. (OSHA Standard - 500)	No Change[g]	Minimal[h]	0.08	0.08	0.08	0.08
Occupational Health and Safety						
Total recordable accidents per year	No Change	0.80[k]	2.2	1.7	**2.7**	1.8
Lost workdays per year	No Change	0.35[k]	1.0	0.72	1.2	0.77
Environmental Justice						
	None	None	None	None	None	None
Ecological Resources						
	Activity and noise could displace small numbers of wildlife	Activity and noise could displace small numbers of wildlife	Activity and noise could displace small numbers of wildlife.	Activity and noise could displace small numbers of wildlife.	Activity and noise could displace small numbers of wildlife.	Activity and noise could displace small numbers of wildlife.

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Table 2-6. (Continued).

Parameter	No Action[a] Continue Tank Space Management	No Action[a] Post Tank Space Management Scenarios	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Land Use						
	Zoned heavy industrial-no change in land use patterns. Land dedicated to HLW tanks could not be used for other purposes.	Zoned heavy industrial-no change in land use patterns. Land dedicated to HLW tanks could not be used for other purposes.	Zoned heavy industrial-no change in SRS land use patterns.	Zoned heavy industrial-no change in SRS land use patterns.	Zoned heavy industrial-no change in SRS land use patterns.	Zoned heavy industrial-no change in SRS land use patterns.
			Land dedicated to vaults for low-activity grout disposal could not be used for other purposes.	Land dedicated to vaults for low-activity grout disposal could not be used for other purposes.	Land dedicated to vaults for low-activity grout disposal could not be used for other purposes.	Land dedicated to vaults for low-activity grout disposal could not be used for other purposes.
Socioeconomics (employment - full time equivalents)						
Annual construction employment	None	500	500	500	500	500
Annual operational employment	No Change	65[j]	180	135	220	145
Cultural Resources						
	None	None	None	None	None	None
Transportation						
Construction:						
Material shipments	None	(k)	3,000	3,000	3,000	3,400
Accidents from material shipments	None	(k)	0.04	0.04	0.04	0.05
Construction worker accidents	None	(k)	95	**98**	95	91
Construction worker injuries	None	(k)	42	**43**	42	40
Construction worker fatalities	None	(k)	0.4	0.4	0.4	0.4
Operations:						
Material shipments	No Change	No Change	**26,000**	21,000	24,000	19,000
Accidents from material shipments	No Change	No Change	0.4	0.3	0.3	0.3
Operations worker accidents	No Change	39[l]	122	91	**148**	97
Operations worker injuries	No Change	17[l]	53	40	**65**	42
Operations worker fatalities	No Change	0.2[l]	0.5	0.4	**0.6**	0.4

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Table 2-6. (Continued).

Parameter	No Action[a] Continue Tank Space Management	No Action[a] Post Tank Space Management Scenarios	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Waste Generation						
Maximum annual waste generation:						
Radioactive liquid waste (gallons)	No Change	No Change	300,000	250,000	**900,000**	150,000
Nonradioactive liquid waste (million gallons)	No Change	No Change	Minimal	**34,000**	Minimal	Minimal
Transuranic waste (m^3)	No Change	No Change	Minimal	Minimal	Minimal	Minimal
Low-level waste (m^3)	No Change	No Change	71	71	71	71
Hazardous waste (m^3)	No Change	No Change	Startup - 23 Operations - 1	Startup - 23 Operations - 1	Startup - 23 Operations - 1	Startup - 23 Operations - 1
Mixed low-level waste (m^3)	No Change	No Change	1	1	1	1
Mixed low-level liquid waste (gallons)	No Change	No Change	**60,000**	None	1,000	None
Industrial waste (metric tons)	No Change	No Change	Startup - 30 Operations - 20	Startup - 30 Operations - 20	Startup - 30 Operations - 20	Startup - 30 Operations - 20
Sanitary waste (metric tons)	No Change	No Change	Startup - 62 Operations - 41	Startup - 62 Operations - 41	Startup - 62 Operations - 41	Startup - 62 Operations - 41
Total waste generation:						
Radioactive liquid waste (million gallons)	No Change	No Change	3.9	3.3	**12.0**	2.0
Nonradioactive liquid waste (million gallons)	No Change	No Change	Minimal	**0.49**	Minimal	Minimal
Transuranic waste (m^3)	No Change	No Change	Minimal	Minimal	Minimal	Minimal
Low-level waste (m^3)	No Change	No Change	920	920	920	920
Hazardous waste (m^3)	No Change	No Change	43	43	43	43
Mixed low-level waste (m^3)	No Change	No Change	13	13	13	13
Mixed low-level liquid waste (gallons)	No Change	No Change	**780,000**	None	13,000	None
Industrial waste (metric tons)	No Change	No Change	299	299	299	299
Sanitary waste (metric tons)	No Change	No Change	611	611	611	611
Utilities (total life cycle)						
Water (million gallons)			**435**	403	380	289
Construction	None	(m)	35	37	35	33
Operations	No Change	No Change	400	366	345	256

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Table 2-6. (Continued).

Parameter	No Action[a]		Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
	Continue Tank Space Management	Post Tank Space Management Scenarios				
Electricity (gigawatt-hours)			319	365	**391**	245
Construction	None	(m)	76	79	76	73
Operations	No Change	No Change	243	286	315	172
Steam (million pounds)			**2,548**	2,300	1,915	1,536
Construction	None	(m)	0	0	0	0
Operations	No Change	No Change	2,548	2,300	1,915	1,536
Fuel (million gallons)			8.7	**9.3**	8.7	8.2
Construction	None	(m)	8.4	9	8.4	8
Operations	No Change	No Change	0.3	0.3	0.3	0.2

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a. Under the No Action alternative, DOE would continue tank space management activities until approximately 2010, when the existing HLW tanks would reach capacity. Because the course of action that DOE would pursue after the initial period of tank space management has not been determined. For each resource evaluated, only those post tank management scenarios that would be expected to have an impact are included.
b. Air emissions under the No Action alternative would be similar to those from the existing HLW Tank Farm operations for all scenarios. Therefore, the No Action alternative is represented by slight increases above the baseline.
c. Formic acid emissions would shift from DWPF to the Small Tank Precipitation facility, resulting in no net increase in emissions.
d. SRS baseline concentration at the site boundary. Emissions from ongoing tank space management activities are included in this value.
e. Radionuclide emissions from ongoing tank space management activities are included in the site baseline. SRS baseline emissions are shown in Table 3-12.
f. Includes building stack and ground level vault emissions. Vaults for the other three action alternatives would have no measurable emissions because the saltstone produced by these action alternatives would have a much lower activity level and the vaults would not be ventilated.
g. Under No Action, air emissions during tank space management activities would remain at current levels; therefore, no change in worker and public health impacts would be expected.
h. For all scenarios under No Action, impacts to worker and pubic health would be expected to increase slightly above the current baseline.
i. Latent cancer fatalities from benzene from the other alternatives would be substantially less than that from Small Tank Precipitation.
j. Up to 65 new employees would be required for operation of any new HLW tanks constructed under No Action. Alternatively, DOE could suspend operations at the DWPF which, if prolonged, could result in a workforce reduction.
k. Material shipments and associated accident and injury rates for construction transportation of up to 10 new HLW tanks would be similar to those identified under the action alternatives. L6-7
l. Based on employment of 65 additional workers for operation of any new HLW tanks built under the No Action alternative.
m. DOE could build as many as 10 new HLW storage tanks under the No Action alternative. Utility and energy use during the construction period would be similar to usage rates under the action alternatives. L6-7
n. Under normal operating conditions, involved workers would not be exposed to any OSHA-regulated nonradiological air pollutants; therefore, impacts to involved worker health would be minimal for all alternatives, including No Action.

ND = Not Determined.

operations (bolded values in the table indicate the alternative that would have the greatest impact on selected parameters). Because the specific activities that would be pursued under the No Action alternative have not been determined, only those potential activities that would be expected to have an impact on a given resource area are discussed in this section.

Geologic and water resources – The sites proposed for salt processing facilities lie within areas of the SRS that are committed to industrial use and have been previously disturbed. Therefore, none of the salt processing action alternatives would have short-term impacts to the geology or groundwater, regardless of which alternative was selected. DOE anticipates small sedimentation impacts to McQueen Branch from construction activities, but these impacts would cease once construction was completed.

Under the No Action alternative reuse of old tanks would increase the risk for the release of radiological and nonradiological hazardous liquids with potential for substantial negative impact on soils and the quality of the surficial aquifer.

Nonradiological air quality – Construction activities and routine operations associated with salt processing activities would result in the re-lease of regulated nonradiological pollutants to the surrounding air. For any of the four action alternatives, the increases in pollutant concentrations resulting from construction activities would be small and would not exceed regulatory limits.

Nonradiological emissions from routine operations (with the exception of volatile organic compounds [VOCs]) would be below regulatory limits. The Small Tank Precipitation alternative would require additional permit review, whereas emissions from the other alternatives are either covered by the existing permit(s) or are below the threshold values.

All options under the No Action alternative would result in emissions similar to those at the existing HLW Tank Farms. Therefore, incremental increases in air emissions as a result of the No Action alternative would be minimal.

For all alternatives, air concentrations at the SRS boundary of the emitted pollutants would be well below South Carolina Department of Health and Environmental Control (SCDHEC) or Clean Air Act regulatory limits. Occupational Safety and Health Administration (OSHA) -regulated pollutant levels would be below regulatory limits at both the noninvolved and the involved worker locations.

Radiological air quality – Radiation dose to the maximally exposed individual (MEI) from air emissions associated with the salt processing alternatives would be highest (0.31 millirem per year) for the Solvent Extraction alternative, due to the higher emissions of radioactive cesium, which would account for 90 percent of the total dose to the MEI. Dose to the MEI from other alternatives would be lower: 0.20 millirem per year for the Small Tank Precipitation alternative, 0.049 millirem per year for the Ion Exchange alternative, and 0.086 millirem per year for the Direct Disposal in Grout alternative. Estimated dose to the offsite population would also be highest for the Solvent Extraction alternative (18.1 person-rem per year). For the Small Tank Precipitation alternative, the offsite population dose would be 12.0 person-rem per year; for the Ion Exchange alternative, the offsite population dose would be 2.9 person-rem per year; and for the Direct Disposal in Grout alternative, the offsite population dose would be 4.0 person-rem per year.

For doses to the noninvolved (onsite) worker, the involved worker, and the collective onsite population from the estimated annual radioactive emissions. The highest estimated dose would occur under the Solvent Extraction alternative, with the Small Tank Precipitation having similar results and the Ion Exchange and the Direct Disposal in Grout alternatives having lower doses. The maximum dose to the noninvolved and in volved worker would be 4.8 millirem per year and 22.8 millirem per year, respectively, with radioactive cesium emissions contributing about 98 percent of the total dose. The maximum estimated dose to the onsite population would be 6.5 person-rem per year, with 94 percent of this total dose due to radioactive cesium emissions. Under the No Action alternative, air emissions from all potential scenarios would be similar to those from ongoing operations at the HLW Tank Farms.

Impacts on radiological air quality are measured in terms of effects on occupational and public health and are reported in the *Worker and Public Health* section of Table 2-6.

Nonradiological pollutant concentrations at noninvolved worker locations would be well below the regulatory limits, except for oxides of nitrogen. Facility workers would be exposed to minimum levels of nonradiological air pollutants under all four alternatives. Worker exposure to chemicals in the workplace would be monitored in accordance with OSHA regulatory guidance.

Radiation Dose and Cancer Fatalities

Worker and public health impacts are expressed in terms of latent cancer fatalities. The primary health effect of radiation is an increased risk of cancer. A radiation dose to a population is believed to result in cancer fatalities at a certain rate, expressed as a dose-to-risk conversion factor. The National Council on Radiation Protection and Measurement has established dose-to-risk conversion factors of 0.0005 per person-rem for the general population and 0.0004 per person-rem for workers. The difference is due to the presence of children, who are believed to be more susceptible to radiation, in the general population.

DOE estimates the doses to the population and uses the conversion factor to estimate the number of cancer fatalities that might result from those doses. In most cases the result is a small fraction of one. For these cases, DOE concludes that no additional cancers would be expected in the exposed population.

Worker and public health impacts – Radiological air doses for the Solvent Extraction alternative translate into 0.12 additional project-phase latent cancer fatalities in the offsite population of approximately 620,000 people. Additional project-phase latent cancer fatalities in the offsite population from Small Tank Precipitation, Ion Exchange, and Direct Disposal in Grout radiological doses would be 0.078, 0.019, and 0.026, respectively. For the collective worker population at SRS, additional project phase latent cancer fatalities would be 0.022, 0.0055, 0.034, and 0.012 for the Small Tank Precipitation, Ion Exchange, Solvent Extraction, and Direct Disposal in Grout alternatives, respectively. Under all action alternatives, the potential for any cancer death as a result of salt processing activities is minimal. Air emissions from all potential scenarios under the No Action alternative are similar to those at the existing HLW Tank Farms and would result in slight increases above the baseline cancer risk.

Occupational Health and Safety – Based on historic SRS injury rates over a four-year period (1995 through 1999), estimated total recordable cases (TRCs) and lost workdays (LWDs) would be greatest for the Solvent Extraction alternative, with 2.7 TRCs and 1.2 LWDs on an annual basis. The Small Tank Precipitation, Ion Exchange, and Direct Disposal in Grout alternatives would generate fewer TRCs (2.2, 1.7, and 1.8, respectively) and LWDs (1.0, 0.72 and 0.77, respectively) because fewer employees are required for these alternatives. Under the No Action alternative, TRCs and LWCs would be expected to remain at current levels during ongoing tank space management activities. In the event that DOE would build new HLW tanks, the number of TRCs and LWCs would increase by approximately 0.80 and 0.35, respectively.

Environmental Justice – Because short-term impacts from salt processing activities would not significantly affect the surrounding population, and no means were identified for minority or low-income populations to be disproportionately affected, no disproportionately high and adverse impacts would be expected for minority or low-income populations under any of the salt processing alternatives.

Ecological resources – Construction-related disturbances under all alternatives, including No Action, would result in impacts to wildlife that are small, intermittent, and localized. Some individual animals could be displaced by construction noise and activity, but populations would not be affected. Operational impacts would be minimal.

Land use – Each of the four action alternatives would be constructed in areas (S and Z) that are zoned as heavy industrial. Under the No Action alternative, continuation of tank space management activities would have no impact on existing land use plans. Any tanks built under the No Action alternative would also be constructed in industrial areas. SRS land use patterns are not expected to change over the short term due to proposed salt processing activities.

Socioeconomics – Each of the salt processing alternatives, including No Action, would require approximately 500 construction workers annually. During operations, the number of workers for the action alternatives would range from 135 to 220, depending on the alternative chosen. None of the action alternatives is expected to have a measurable effect on regional employment or population trends.

Under the No Action alternative, DOE could suspend operations at DWPF. If the suspension of operations at these facilities is not temporary, it would result in a sizeable workforce reduction, which would have a substantial negative impact on the communities surrounding SRS. Alternatively, DOE could construct as many as 10 new HLW tanks. Operation of new HLW tanks would require up to 65 new employees. This small increase is not expected to have a measurable effect on regional employment or population trends.

Cultural resources – No impacts to cultural resources would occur under any of the alternatives, including No Action. The sites proposed for salt processing facilities and any tanks built under No Action all lie within areas of SRS that are committed to industrial use and have been previously disturbed by construction activities. There are no known archeological or historic resources on the proposed construction sites. Therefore, there are no expected cultural impacts.

Traffic and Transportation – Transportation by truck of materials to construct and operate the salt processing facilities over the duration of the project would require from 22,000 shipments (400,000 miles) for the Direct Disposal in Grout alternative to 29,000 shipments (525,000 miles) for the Small Tank Precipitation alternative. Construction of any tanks built under the No Action alternative would require a similar number of material shipments as the action alternatives. No vehicle accidents, occupant injuries, or fatalities would be expected for these miles driven.

Construction worker commutes to the site during the construction phase of the salt processing action alternatives would vary from 24 million miles for the Direct Disposal in Grout alternative to 26 million miles for the Ion Exchange alternative. Up to 98 accidents, 43 occupant injuries, and no fatalities would be expected for these total commuter miles. Commuter miles and impacts would be similar for construction of any tanks under the No Action alternative.

The increased traffic resulting from facility operations for any of the alternatives, including No Action, would be minimal.

Waste generation – Salt processing activities under the action alternatives would generate 150,000 to 900,000 gallons of radioactive liquid waste annually. This radioactive liquid waste consists of wastewater recycled from the treatment of the high-activity portion of the salt solutions at DWPF. Small amounts of waste (low-level radioactive, mixed low-level, hazardous, industrial, and sanitary) would be produced under each of the action alternatives and could be handled within the existing site capacity. The No Action alternative would not generate any waste beyond that which is included in the SRS baseline.

Utilities and energy consumption – Water use over the duration of the project would range from 290 million gallons for the Direct Disposal in Grout alternative to 435 million gallons for the Small Tank Precipitation alternative. Construction and operation phase water usages would be from 33 to 37 million gallons and 260 to 400 million gallons, respectively. At its highest average daily use, the water required would be 1.5 percent of the lowest estimated production capacity of the aquifer.

Electricity use over the duration of the project would range from 245 gigawatt-hours (with a peak power demand of 18 megawatts) for the Direct Disposal in Grout alternative to 391 gigawatt-hours (with a peak power demand of 32 megawatts) for the Solvent Extraction alternative. During the construction and operation phases, electricity use would be from 73 to 79 gigawatt-hours and 172 to 315 gigawatt-hours, respectively. This electricity use and peak power demand could be supported by the current power generation and distribution systems serving SRS.

Steam use over the duration of the project would range from 1.5 billion pounds for the Direct Disposal in Grout alternative to 2.5 billion pounds for the Small Tank Precipitation alternative. No steam would be used during the construction phase of the project.

Liquid fuel use over the duration of the project would range from 8.2 million gallons for the Direct Disposal in Grout alternative to 9.3 million gallons for the Ion Exchange alternative. Fuel use during the operation phase would not exceed 300,000 gallons under any alternative. This fuel use is well within the current regional fuel supply capacity.

Under the No Action alternative, utility and energy use would be similar to consumption rates at the existing tank farm and is therefore included in the SRS baseline.

Accidents – DOE evaluated the impacts of potential accidents related to each of the action alternatives (Table 2-7). Because the No Action alternative includes primarily current operations that have been evaluated in approved safety analysis reports (WSRC 1998h), only the radiological and nonradiological hazards associated with accidents under the four action alternatives were evaluated. For each action alternative, the accidents considered were: loss of confinement; earthquakes; fire in a process cell; loss of cooling; external events, such as aircraft and helicopter crashes; and explosions from benzene and radiation-generated hydrogen. Accidents for which the probability was calculated at less than 1 in 10,000,000 years were not considered credible and were dropped from further consideration.

For each remaining accident scenario involving radioactive materials, the radiation dose to the involved worker, the noninvolved worker, the onsite and offsite MEI, and the collective radiation dose to the onsite and offsite populations were calculated. The impacts of the alternatives, expressed as latent cancer fatalities to these receptors, were also calculated. A beyond-extremely-unlikely aircraft impact at the Ion Exchange facility would result in the highest potential dose to each of the receptor groups and the highest potential increase in latent cancer fatalities. On a latent cancer fatality per year basis (i.e., latent cancer fatality per accident times accident frequency), the beyond design-basis earthquake at the Small Tank Precipitation facility would result in the highest impact on each of the five receptors. In general, severe accident potential was highest for the Small Tank Precipitation alternative and lowest for the Direct Disposal in Grout alternative.

In general, accidents involving nonradiological hazardous materials would result in minimal impacts to onsite and offsite receptors. However, noninvolved workers exposed to atmospheric releases of benzene from two of the accidents evaluated under the Small Tank Precipitation alternative could experience serious or life-threatening health effects. Workers exposed to airborne benzene concentrations (950 mg/m^3)

Table 2-7. Comparison of accident impacts among alternatives.[a]

	Frequency	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Accidents Involving Radioactive Materials					
Loss of Confinement	Once in 30 years					L6-28
Maximally Exposed Offsite Individual					
Dose (rem)		0.0016	8.3×10^{-4}	8.3×10^{-4}	2.4×10^{-4}
LCF per accident[b]		8.2×10^{-7}	4.2×10^{-7}	4.2×10^{-7}	1.2×10^{-7}
LCF per year		2.8×10^{-8}	1.4×10^{-8}	1.4×10^{-8}	4.1×10^{-9}
Offsite population					
Dose (person-rem)		88	45	45	14
LCF per accident		0.044	0.022	0.022	0.0072
LCF per year		0.0015	7.6×10^{-4}	7.6×10^{-4}	2.4×10^{-4}
Involved Worker (100 m)					
Dose (rem)		3.2×10^{-6}	6.4×10^{-8}	6.4×10^{-8}	7.3×10^{-8}
LCF per accident[b]		1.3×10^{-9}	2.6×10^{-11}	2.6×10^{-11}	2.9×10^{-11}
LCF per year[b]		4.3×10^{-11}	8.7×10^{-13}	8.7×10^{-13}	9.8×10^{-13}
Noninvolved Worker (640 m)					
Dose (rem)		0.024	0.012	0.012	0.0036
LCF per accident[b]		9.5×10^{-6}	4.9×10^{-6}	4.9×10^{-6}	1.5×10^{-6}
LCF per year[b]		3.2×10^{-7}	1.6×10^{-7}	1.6×10^{-7}	4.9×10^{-8}
Onsite population					
Dose (person-rem)		39	20	20	4.2
LCF per accident		0.016	0.0080	0.0080	0.0017
LCF per year		5.3×10^{-4}	2.7×10^{-4}	2.7×10^{-4}	5.7×10^{-5}
Beyond Design Basis Earthquake	Less than once in 2,000 years					L6-28
Maximally Exposed Offsite Individual					
Dose (rem)		0.31	0.12	0.12	0.042
LCF per accident[b]		1.5×10^{-4}	5.9×10^{-5}	5.8×10^{-5}	2.1×10^{-5}
LCF per year[b]		7.6×10^{-8}	2.9×10^{-8}	2.9×10^{-8}	1.0×10^{-8}
Offsite population					
Dose (person-rem)		16,000	6,200	6,100	2,300
LCF per accident		8.0	3.1	3.0	1.1
LCF per year		0.0040	0.0016	0.0015	5.7×10^{-4}
Involved Worker (100 m)					
Dose (rem)		310[c]	120	120	42
LCF per accident[b]		0.12	0.047	0.046	0.017
LCF per year		6.1×10^{-5}	2.4×10^{-5}	2.3×10^{-5}	8.4×10^{-6}
Noninvolved Worker (640 m)					
Dose (rem)		9.6	3.7	3.6	1.3
LCF per accident[b]		0.0038	0.0015	0.0015	5.3×10^{-4}
LCF per year[b]		1.9×10^{-6}	7.4×10^{-7}	7.3×10^{-7}	2.6×10^{-7}
Onsite population					
Dose (person-rem)		9,000	3,500	3,400	1,000
LCF per accident		3.6	1.4	1.4	0.41
LCF per year		0.0018	6.9×10^{-4}	6.8×10^{-4}	2.1×10^{-4}

Table 2-7. (Continued).

	Frequency	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Loss of Cooling to Loaded Resin Hold Tanks	Once in 5,300 years				
Maximally Exposed Offsite Individual					
Dose (rem)		NA	9.4×10^{-7}	NA	NA
LCF per accident[b]		NA	4.7×10^{-10}	NA	NA
LCF per year[b]		NA	8.9×10^{-14}	NA	NA
Offsite population					
Dose (person-rem)		NA	0.052	NA	NA
LCF per accident		NA	2.6×10^{-5}	NA	NA
LCF per year		NA	5.0×10^{-9}	NA	NA
Involved Worker (100 m)					
Dose (rem)		NA	8.8×10^{-8}	NA	NA
LCF per accident[b]		NA	3.5×10^{-11}	NA	NA
LCF per year[b]		NA	6.7×10^{-15}	NA	NA
Noninvolved Worker (640 m)					
Dose (rem)		NA	1.4×10^{-5}	NA	NA
LCF per accident[b]		NA	5.7×10^{-9}	NA	NA
LCF per year[b]		NA	1.1×10^{-12}	NA	NA
Onsite population					
Dose (person-rem)		NA	0.023	NA	NA
LCF per accident		NA	9.0×10^{-6}	NA	NA
LCF per year		NA	1.7×10^{-9}	NA	NA
Fire in Process Cell	Once in 10,000 years				
Maximally Exposed Offsite Individual					
Dose (rem)		0.014	0.0094	0.0094	0.0027
LCF per accident[b]		7.2×10^{-6}	4.7×10^{-6}	4.7×10^{-6}	1.4×10^{-6}
LCF per year[b]		7.2×10^{-10}	4.7×10^{-10}	4.7×10^{-10}	1.4×10^{-10}
Offsite population					
Dose (person-rem)		780	500	500	160
LCF per accident		0.39	0.25	0.25	0.0081
LCF per year		3.9×10^{-5}	2.5×10^{-5}	2.5×10^{-5}	8.1×10^{-6}
Involved Worker (100 m)					
Dose (rem)		2.8×10^{-5}	9.1×10^{-7}	7.2×10^{-7}	8.2×10^{-7}
LCF per accident[b]		1.1×10^{-8}	3.6×10^{-10}	2.9×10^{-10}	3.3×10^{-10}
LCF per year[b]		1.1×10^{-12}	3.6×10^{-14}	2.9×10^{-14}	3.3×10^{-14}
Noninvolved Worker (640 m)					
Dose (rem)		0.21	0.14	0.14	0.041
LCF per accident[b]		8.5×10^{-5}	5.5×10^{-5}	5.5×10^{-5}	1.6×10^{-5}
LCF per year[b]		8.5×10^{-9}	5.5×10^{-9}	5.5×10^{-9}	1.6×10^{-9}
Onsite population					
Dose (person-rem)		340	220	220	48
LCF per accident		0.14	0.089	0.089	0.019
LCF per year		1.4×10^{-5}	8.9×10^{-6}	8.9×10^{-6}	1.9×10^{-6}

L6-28
L6-28

Table 2-7. (Continued).

	Frequency	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Benzene Explosion in PHC[d]	Once in 99,000 years				
Maximally Exposed Offsite Individual					
Dose (rem)		0.70	NA	NA	NA
LCF per accident[b]		3.5×10^{-4}	NA	NA	NA
LCF per year[b]		3.5×10^{-9}	NA	NA	NA
Offsite population					
Dose (person-rem)		38,000	NA	NA	NA
LCF per accident		19	NA	NA	NA
LCF per year		1.9×10^{-4}	NA	NA	NA
Involved Worker (100 m)					
Dose (rem)		0.0014	NA	NA	NA
LCF per accident[b]		5.5×10^{-7}	NA	NA	NA
LCF per year[b]		5.6×10^{-12}	NA	NA	NA
Noninvolved Worker (640 m)					
Dose (rem)		10	NA	NA	NA
LCF per accident[b]		0.0041	NA	NA	NA
LCF per year[b]		4.1×10^{-8}	NA	NA	NA
Onsite population					
Dose (person-rem)		17,000	NA	NA	NA
LCF per accident		6.7	NA	NA	NA
LCF per year		6.8×10^{-5}	NA	NA	NA
Hydrogen Explosion in Extraction Cell	Once in 1,300,000 years				
Maximally Exposed Offsite Individual					
Dose (rem)		NA	NA	0.0029	NA
LCF per accident[b]		NA	NA	1.4×10^{-6}	NA
LCF per year[b]		NA	NA	1.1×10^{-12}	NA
Offsite population					
Dose (person-rem)		NA	NA	160	NA
LCF per accident		NA	NA	0.081	NA
LCF per year		NA	NA	6.1×10^{-8}	NA
Involved Worker (100 m)					
Dose (rem)		NA	NA	2.7×10^{-4}	NA
LCF per accident[b]		NA	NA	1.1×10^{-7}	NA
LCF per year[b]		NA	NA	8.1×10^{-14}	NA
Noninvolved Worker (640 m)					
Dose (rem)		NA	NA	0.044	NA
LCF per accident[b]		NA	NA	1.8×10^{-5}	NA
LCF per year[b]		NA	NA	1.3×10^{-11}	NA
Onsite population					
Dose (person-rem)		NA	NA	70	NA
LCF per accident		NA	NA	0.028	NA
LCF per year		NA	NA	2.1×10^{-8}	NA

L6-28

L6-28

Table 2-7. (Continued).

	Frequency	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout	
Helicopter Impact	Once in 2,100,000 years					L6-28
Maximally Exposed Offsite Individual						
Dose (rem)		3.3	1.7	1.7	0.53	
LCF per accident[b]		0.0016	8.5×10^{-4}	8.5×10^{-4}	2.7×10^{-4}	
LCF per year		7.9×10^{-10}	4.1×10^{-10}	4.1×10^{-10}	1.3×10^{-10}	
Offsite population						
Dose (person-rem)		170,000	89,000	89,000	29,000	
LCF per accident		87	45	45	14	
LCF per year		4.2×10^{-5}	2.1×10^{-5}	2.1×10^{-5}	6.9×10^{-6}	
Involved Worker (100 m)						
Dose (rem)		3,300[c]	1,700[c]	1,700[c]	53	
LCF per accident[b]		1.3	0.68	0.68	0.21	
LCF per year[b]		6.3×10^{-7}	3.2×10^{-7}	3.3×10^{-7}	1.0×10^{-7}	
Noninvolved Worker (640 m)						
Dose (rem)		100	53	53	17	
LCF per accident[b]		0.041	0.021	0.021	0.0067	
LCF per year[b]		2.0×10^{-8}	1.0×10^{-8}	1.0×10^{-8}	3.2×10^{-9}	
Onsite population						
Dose (person-rem)		97,000	50,000	50,000	13,000	
LCF per accident		39	20	20	5.3	
LCF per year		1.9×10^{-5}	9.5×10^{-6}	9.6×10^{-6}	2.5×10^{-6}	
Aircraft Impact	Once in 2,700,000 years					L6-28
Maximally Exposed Offsite Individual						
Dose (rem)		5.4	2.0	2.0	0.74	
LCF per accident[b]		0.0027	0.0010	0.0010	3.7×10^{-4}	
LCF per year[b]		1.0×10^{-9}	3.7×10^{-10}	3.8×10^{-10}	1.4×10^{-10}	
Offsite population						
Dose (person-rem)		280,000	110,000	110,000	40,000	
LCF per accident		140	53	54	20	
LCF per year		5.3×10^{-5}	2.0×10^{-5}	2.0×10^{-5}	7.4×10^{-6}	
Involved Worker (100 m)						
Dose (rem)		5,400[c]	2,000[c]	2,000[c]	740[c]	
LCF per accident[b]		2.1	0.81	0.81	0.30	
LCF per year[b]		8.0×10^{-7}	3.0×10^{-7}	3.0×10^{-7}	1.1×10^{-7}	
Noninvolved Worker (640 m)						
Dose (rem)		170	63	64	23	
LCF per accident[b]		0.067	0.025	0.026	0.0093	
LCF per year[b]		2.5×10^{-8}	9.4×10^{-9}	9.5×10^{-9}	3.4×10^{-9}	
Onsite population						
Dose (person-rem)		160,000	59,000	60,000	18,000	
LCF per accident		63	24	24	7.3	
LCF per year		2.3×10^{-5}	8.8×10^{-6}	8.9×10^{-6}	2.7×10^{-6}	

Table 2-7. (Continued).

	Frequency	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Accidents Involving Nonradioactive Hazardous Materials					
Accidents Involving Sodium Hydroxide Releases					L6-28
Caustic Feed Tank Loss of Confinement	Once in 30 years				
Maximally Exposed Offsite Individual Dose (mg/m^3)		5.9×10^{-4}	5.9×10^{-4}	5.9×10^{-4}	5.9×10^{-4}
Noninvolved Worker (640 m) Dose (mg/m^3)		0.18	0.18	0.18	0.18
Caustic Dilution Tank Loss of Confinement	Once in 30 years				
Maximally Exposed Offsite Individual Dose (mg/m^3)		NA	NA	NA	0.0031
Noninvolved Worker (640 m) Dose (mg/m^3)		NA	NA	NA	0.93[e]
Accidents Involving Nitric Acid Releases					L6-28
Nitric Acid Feed Tank Loss of Confinement	Once in 30 years				
Maximally Exposed Offsite Individual Dose (mg/m^3)		NA	NA	8.8×10^{-5}	NA
Noninvolved Worker (640 m) Dose (mg/m^3)		NA	NA	0.026	NA
Accidents Involving Benzene Releases					L6-28
PHA Surge Tank Loss of Confinement	Once in 30 years				
Maximally Exposed Offsite Individual Dose (mg/m^3)		7.4×10^{-10}	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m^3)		2.2×10^{-8}	NA	NA	NA
TPB Tank Spill	Once in 30 years				
Maximally Exposed Offsite Individual Dose (mg/m^3)		0.060	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m^3)		18.7	NA	NA	NA
Organic Evaporator Loss of Confinement	Once in 30 years				
Maximally Exposed Offsite Individual Dose (mg/m^3)		0.45	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m^3)		130	NA	NA	NA
Beyond Design Basis Earthquake	Less than once in 2,000 years				
Maximally Exposed Offsite Individual Dose (mg/m^3)		0.0026	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m^3)		0.78	NA	NA	NA

Table 2-7. (Continued).

	Frequency	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
OWST Loss of Confinement	Once in 140,000 years				
Maximally Exposed Offsite Individual Dose (mg/m^3)		3.2	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m^3)		950[f]	NA	NA	NA
Loss of Cooling	Once in 170,000 years				
Maximally Exposed Offsite Individual Dose (mg/m^3)		0.0015	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m^3)		0.44	NA	NA	NA
Benzene Explosion in the OWST	Once in 770,000 years				
Maximally Exposed Offsite Individual Dose (mg/m^3)		30	NA	NA	NA
Noninvolved Worker (640 m) Dose (mg/m^3)		8,840[g]	NA	NA	NA

L6-28

NA = not applicable.
a. Accident impacts based on bounding case.
b. Probability of latent cancer fatality (LCF) to the exposed individual.
c. An acute dose to an individual over 300 rem would likely result in death.
d. PHC = precipitate hydrolysis cell.
e. Individuals exposed to sodium hydroxide concentrations above 0.5 mg/m^3 could experience mild transient health effects (headache, nausea, rash) or perception of a clearly defined objectionable odor.
f. Individuals exposed to benzene concentrations above 480 mg/m^3 could experience or develop irreversible kidney damage or other serious health effects (dizziness, confusion, impaired vision).
g. Individuals exposed to benzene concentrations above 3,190 mg/m^3 could experience or develop life-threatening health effects (loss of consciousness, cardiac dysrhythmia, respiratory arrest).

resulting from an Organic Waste Storage Tank (OWST) loss of confinement accident could develop irreversible (e.g., kidney damage) or other serious health effects that may impair their ability to take protective action (e.g., dizziness, confusion, impaired vision). Workers exposed to airborne benzene concentrations (8,840 mg/m^3) resulting from an explosion in the OWST could experience life-threatening health effects (e.g., loss of consciousness, cardiac dysrhythmia, respiratory arrest). Both of these accidents would occur less than once in 100,000 years and are in the extremely unlikely category.

Pilot Plant – Under the Small Tank Precipitation, Ion Exchange, and Solvent Extraction alternatives, DOE would design, construct, and operate 1/100 to 1/10 scale pilot plant to demonstrate the salt processing technology. No Pilot Plant is needed for the Direct Disposal in Grout alternative because the technology has already been demonstrated in the existing Saltstone Manufacturing and Disposal Facility. Because the Pilot Plant would be a scaled-down version of the salt processing facility, impact would typically be no more than 10 percent of that for the full-sized facility.

2.9.2 LONG-TERM IMPACTS

Section 4.2 of the Draft SEIS discusses the long-term impacts associated with disposing of fractions of the salt solutions as a saltstone grout in Z-Area vaults. DOE estimated long-term impacts by doing a performance assessment that included fate and transport modeling to determine when certain impacts (e.g., radiation dose) could reach a maximum value. DOE used the *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility* (Martin Marietta 1992) as the basis for analysis of the long-term water resource and human health impacts. This performance assessment was based on the original saltstone that would have resulted from the ITP process.

Analytical results, particularly those attempting to predict impacts over a long period of time, always have some uncertainties. Uncertainties could be associated with assumptions used, the complexity and variability of the process being analyzed, or incomplete or unavailable information. The uncertainties involved in estimating the long-term impacts analyzed in this SEIS are described in Appendix D.

This section presents estimates of long-term impacts of the four salt processing action alternatives and the No Action alternatives. For all the action alternatives, the major source of long-term impacts would be the saltstone that would result from each of the four alternatives. As discussed in Chapter 2, the saltstone vaults would be located in Z Area, regardless of the selected alternative. Therefore, this SEIS analyzes impacts only from the placement of saltstone in Z Area. Short-term impacts of manufacturing the saltstone are included in Section 4.1.

L3-2 L6-4 L7-3 L8-5 L8-6

For NEPA analysis of long-term impacts of the action alternatives, DOE assumed that institutional control would be maintained for 100 years post-closure, during which the land encompassing the saltstone vaults would be managed to prevent erosion or other conditions that would lead to early degradation of the vaults. DOE also assumed that the public would not have access to Z Area during this time to set up residence. DOE estimated long-term impacts by doing a performance evaluation that included fate and transport modeling to determine when certain impacts (e.g., radiation dose) could peak. DOE used the *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility* (WSRC 1992) (RPA) as the basis for the water resources and human health analyses. This performance assessment was done for the original saltstone that would have resulted from the In-Tank Precipitation process. For this SEIS, DOE modified the source terms for each of the action alternatives. See Appendix D for details of the analysis.

For NEPA analysis of long-term impacts of the No Action alternative, DOE assumes that the sludge in the HLW tanks would be processed to the extent practicable so that only salt waste would be left in the tanks, and the tanks would be nearly full. It is also assumed that DOE would take no further action to stabilize the waste remaining in the tanks or to stabilize the tank systems themselves but would maintain institutional control and would maintain the tanks for 100 years. Following this 100-year period of institutional control, the HLW tanks would begin to fail. Failed tanks could create physical hazards to humans and wildlife in the area. Waste contaminants could be released from tanks into groundwater and the contaminants would eventually migrate to surface water. Precipitation could infiltrate into failed tanks, causing them to overflow and spill dissolved salt onto the ground surface. Salt solutions spilled onto the ground surface could contaminante the soil, vegetation, and groundwater, and could flow overland to surface streams (Upper Three Runs, Fourmile Branch, and the Savannah River). People who intruded into the site vicinity could receive radiation exposure by external exposure to contaminated soil or by consuming contaminated surface water, groundwater, or vegetation, or eating meat or dairy products from animals that had consumed such water or vegetation.

In the Draft SEIS, DOE did not model the eventual release of salt waste to the environment under the No Action alternative. Instead, DOE provided a comparison to the modeling results from the No Action alternative in the *High-Level Waste Tank Closure Draft Environmental Impact Statement* (DOE 2000). In the Tank Closure Draft EIS No Action scenario, most of the waste would be removed

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from the HLW tanks (i.e., approximately 10,000 gallons would remain as residual waste in a 1.3-million-gallon tank). After a period of several hundred years, the remaining waste, 200 curies of long half-life isotopes and 9,900 curies of cesium-137 (which has a relatively short half-life of 30 years), would be released to groundwater and eventually migrate to surface water. The Tank Closure Draft EIS modeling showed that an adult resident in the F-Area Tank Farm could receive a lifetime dose of 430 millirem (primarily from groundwater) and incur an incremental risk of 0.0022 of contracting a fatal cancer. For comparison, in the No Action alternative in the Salt Processing Alternatives Draft SEIS, DOE assumed that HLW would be left in the tanks and the tanks would be nearly full and that 160,000,000 curies (primarily cesium-137) in the salt component and 290,000,000 curies (primarily long half-life isotopes) in the sludge component of the HLW in the storage tanks would be released to groundwater and eventually enter surface water. This analysis did not take credit for any decay of the short half-life radionuclides, particularly cesium-137. Because the activity under this scenario (450,000,000 curies) would be much greater than the activity (10,000 curies) modeled in the Tank Closure Draft EIS, the Salt Processing Alternatives Draft SEIS stated that long-term impacts to human health resulting from the radiation dose under the No Action alternatives would be catastrophic.

During the public comment period, DOE received several comments from the public (See Appendix C, Letters L3, L6, L7, and L8) questioning the description of the No Action alternative and its impacts. The commenters generally expressed the opinion that the long-term impacts of No Action would be more severe than portrayed qualitatively in the Salt Processing Alternatives Draft SEIS and requested that the No Action alternative be modified and the long-term impacts analyzed quantitatively. One commenter suggested that, to be consistent with the short-term No Action scenario described in Section 2.3, the long-term No Action scenario should contain the consequences of removing all the sludge and leaving the salt waste containing 160,000,000 curies of activity (primarily cesium-137) in the tanks. In addition, several commenters suggested that, by assuming all radionuclides would reach the public through groundwater, the Salt Processing Alternatives Draft SEIS missed the largest long-term risk to the public and that DOE should consider the release of HLW to surface run-off.

L6-5

In response to these comments, for this Final Salt Processing Alternatives SEIS, DOE modeled the potential impacts of a scenario in which precipitation leaks into the tanks, causing them to overflow and spill their contents onto the ground surface, from which contaminants migrate to surface streams.

DOE estimated that the salt waste in the HLW tanks now contains about 160,000,000 curies, approximately 500 curies of long half-life isotopes (e.g., technetium-99, iodine-129, and plutonium-239), and the balance short half-life isotopes, primarily cesium-137, which has a half-life of 30 years. Radioactive decay during the 100-year period of institutional control would reduce the activity level to around 16,000,000 curies.

To conservatively estimate the consequences of this scenario for water users, DOE modeled the eventual release of the salt waste to surface water at SRS, assuming no loss of contaminants during overland flow. The modeling showed that an individual consuming 2 liters per day of water from Fourmile Branch would receive a dose of 640 millirem per year. This dose is more than 160 times the drinking water regulatory limit of 4 millirem per year and would result in a 2.2 percent increase in the probability of contracting a latent cancer fatality from a 70-year lifetime exposure. While a 2.2 percent increase is low, the probability of contracting a latent cancer fatality under the No Action alternative is about 13,000 times greater than that of any of the action alternatives. Similarly, an individual consuming the same amount of water from Upper Three Runs would receive a dose of 295 millirem per year, and an individual consuming the same amount of water from the Savannah River would receive a dose of 14.5 millirem per year. These doses also exceed the drinking water limit and would incrementally increase the probability of contracting a latent cancer fatality from a 70-year lifetime exposure by 1.0 percent and 0.051 percent, respectively.

L6-5

For the No Action alternative, DOE also considered potential external radiation exposure from the tank overflow scenario described above for a resident in the tank farm area conservatively assuming that all contamination is deposited on the ground surface rather than flowing to streams or entering the underlying soil. The modeling showed that an individual living in the tank farm would receive an external dose of about 2,320 rem in the first year following the event, which would result in a prompt fatality.

DOE expects that those two scenarios bound the potential impacts of the No Action alternative. This is consistent with results of a multipathway exposure analysis for the Z-Area vaults which showed that the external radiation dose an individual would receive from cesium-137 is considerably greater than doses an individual would receive from other exposure pathways (e.g., drinking water).

Because of the assumption that, in the long term, DOE would not be active at the Site, there would be no long-term impacts to socioeconomics, utilities and energy, worker health, traffic and transportation, or waste generation. Air and accident impacts would be very small and would not differ substantially among alternatives. Section 4.2 does not analyze or discuss long-term impacts to these resources. The following impact areas are analyzed: geologic resources, water resources (groundwater and surface water), ecological resources, land use, and public health. Table 2-8 summarizes the long-term impacts to these resources.

Geologic resources – No detrimental effect on topography or on the structural or load-bearing properties of the geologic deposits would occur as a result of saltstone manufactured by any of the analyzed action alternatives.

Under the No Action alternative, DOE assumed that only salt waste would be left in the HLW tanks. Failure of the HLW tanks would allow precipitation to collect in the tanks and eventually salt solution could overflow and contaminate surface soils. No detrimental effect on topography or load-bearing properties of geologic deposits would result from release of contaminants from the HLW tanks. The contaminants would contaminate nearby soils, but would not alter their physical structure.

Surface water – Based on modeling results, the saltstone manufactured under all action alternatives would be effective in limiting the long-term movement of residual contaminants from Z Area to nearby streams via groundwater. Radiological doses at the seeplines of Upper Three Runs and McQueen Branch would be orders of magnitude below the drinking water standard of 4 millirem per year. Concentrations of nonradiological contaminants (primarily **nitrate**) moving to Upper Three Runs via McQueen Branch or the Upper Three Runs seepline would be very low; in most cases, they would be several times below applicable standards. For all action alternatives, predicted long-term concentrations of nonradiological contaminants would be well below applicable water quality standards.

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Under the No Action alternative, after failure of the HLW tanks, salt solution could overflow and run off to onsite streams (Upper Three Runs, Fourmile Branch, and the Savannah River). The runoff would mix with the stream flow. Assuming that the upstream concentration of all contaminants would be zero and no groundwater infiltration occurred, the radioactivity in Fourmile Branch would be 4.95×10^{-6} curies per liter resulting in a drinking water dose to an individual of 640 millirem per year. Similarly, Upper Three Runs radioactivity would be 2.28×10^{-6} curies per liter and Savannah River radioactivity would be 1.12×10^{-7} curies per liter, respectively.

Table 2-8. Summary comparison of long-term impacts by salt processing alternative. Bolded values indicate greatest impacts for a particular parameter.

Parameter	No Action	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Geologic Resources					
	After tank failure soils could become contaminated.	After saltstone degradation, soil could become contaminated.	After saltstone degradation, soil could become contaminated.	After saltstone degradation, soil could become contaminated.	After saltstone degradation, soil could become contaminated.
Surface Water					
	Contaminants could be transported overland to surface water.	Contaminants in groundwater could be transported to downgradient surface waters, but concentrations would be very low.	Contaminants in groundwater could be transported to down-gradient surface waters but concentrations would be very low.	Contaminants in groundwater could be transported to down-gradient surface waters but concentrations would be very low.	Contaminants in groundwater could be transported to down-gradient surface waters, but concentrations would be very low.
Groundwater					
Maximum radiation dose (mrem/yr) 1 meter downgradient of vaults	NA	0.49	**0.58**	0.45	0.57
Maximum radiation dose (mrem/yr) 100 meters downgradient of vaults	**640**[a]	0.042	0.044	0.038	0.048
Maximum radiation dose (mrem/yr) at seepline	NA	0.0029	0.0028	0.0025	**0.0032**
Maximum nitrate concentration (mg/L) 1 meter downgradient of vaults	NA	338	**395**	307	394

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Table 2-8. (Continued).

Parameter	No Action	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout
Maximum nitrate concentration (mg/L) 100 meters downgradient of vaults	NA	29	31	26	**33**
Maximum nitrate concentration at seepline (mg/L)	NA	2.2	2.1	1.9	**2.4**
Ecological Resources					
	Ecological receptors could encounter severe adverse impacts.	Minimal impacts from nitrate and radionuclides for ecological receptors in and near McQueen Branch and Upper Three Runs.	Minimal impacts from nitrate and radionuclides for ecological receptors in and near McQueen Branch and Upper Three Runs.	Minimal impacts from nitrate and radionuclides for ecological receptors in and near McQueen Branch and Upper Three Runs.	Minimal impacts from nitrate and radionuclides for ecological receptors in and near McQueen Branch and Upper Three Runs.
Land Use					
	The area around the tank farms would be too contaminated to support human or ecological habitats.	Z Area zoned heavy industrial; no residential areas allowed on SRS. Vaults would preclude other uses.	Z Area zoned heavy industrial; no residential areas allowed on SRS. Vaults would preclude other uses.	Z Area zoned heavy industrial; no residential areas allowed on SRS. Vaults would preclude other uses.	Z Area zoned heavy industrial; no residential areas allowed on SRS. Vaults would preclude other uses.
Radiation dose from Agricultural Scenario (mrem/yr)	NA	110	130	110	**140**
Latent Cancer Fatalities from Agricultural Scenario[b]	NA	0.0018	0 0.0046	0.0039	**0.0049**
Radiation dose from Residential Scenario at 100 years post-closure (mrem/yr)[d]	**2,320,000**[b,c]	0.11	0.13	0.1	1,200

L6-28

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L6-32

Table 2-8. (Continued).

Parameter	No Action	Small Tank Precipitation	Ion Exchange	Solvent Extraction	Direct Disposal in Grout	
Latent Cancer Fatalities from Residential Scenario at 100 years post-closure[b,d]	**1.16**[e]	3.9×10^{-6}	4.6×10^{-6}	3.5×10^{-6}	0.042	L6-28
Radiation dose from Residential Scenario at 1,000 years post-closure (mrem/yr)[d]	NA	69	80	65	**85**	L6-32
Latent Cancer Fatalities from Residential Scenario at 1,000 years post-closure[b,d]	NA	0.0024	0.0028	0.0023	**0.0030**	L6-33

a. Based on consumption of contaminated surface water in Fourmile Branch.
b. Health effects are expressed as lifetime (70-year) individual probability of an LCF.
c. Based on external radiation in the area of the tank farm. L4-10
d. External radiation doses and latent cancer fatalities at 1,000 years post-closure are higher than doses 100 years post-closure because a layer of soil to provide adequate shielding is assumed to be present in the 100-year scenario, but is assumed to be absent in the 1,000-year scenario.
e. Probability of an LCF provided for comparison. The external radiation dose from the No Action alternative would result in prompt fatalities.

mrem/yr = millirem per year.
mg/L = milligram per liter.
LCF = latent cancer fatalities.

Groundwater – Long-term impacts to the groundwater of the Upper Three Runs Aquifer and the Gordon Aquifer could occur as the saltstone degrades and releases additional contaminants to the aquifers. Based on groundwater modeling, no constituents would occur in concentrations that exceed drinking water standards in wells 100 meters from the vaults. However, for all alternatives, maximum nitrate concentrations in a well 1 meter downgradient from the vaults would exceed the established maximum contaminant level in both aquifers.

Ecological resources – The potential risk is very low to biota in Upper Three Runs or McQueen Branch from long-term effects of saltstone.

TC The No Action alternative would have severe adverse impacts on the ecological resources in the area of the tank farms.

Land use – Long-term impacts to land use at Z Area would occur. The placement of 13 to 16 additional vaults that will contain radioactive cementitious grout for up to 10,000 years would limit other uses of the land in Z Area.

L6-60 Because of the contamination under the No Action alternative, future land use at SRS tank farms would not support human or ecological habitats.

Public health – Although the vaults would contain radioactive cementitious grout for up to 10,000 years, DOE evaluated the long-term impacts to public health, using the methods developed in the original radiological performance assessment prepared for the Z-Area Saltstone Manufacturing and Disposal Facility. This included determining concentrations in groundwater and radiological doses from those concentrations, radiological doses from crops grown on the vaults, doses from living in a home constructed on the vaults 100 years after closure, and doses from living in a home on the vault site 1,000 years after closure.

The differences in calculated concentrations and doses among the alternatives are a function primarily of the differences in composition of the saltstone by alternative. The Small Tank Precipitation alternative would produce a saltstone that is very similar to that originally planned for the ITP process. The Ion Exchange alternative would result in a saltstone with slightly more concentrated contaminants, thus causing greater impacts. The Solvent Extraction alternative would produce a saltstone with slightly lower contaminant concentrations, resulting in smaller impacts. The Direct Disposal in Grout alternative would produce saltstone with radioactive cesium concentrations many times higher than the other alternatives, but with only slightly higher concentrations of other contaminants.

As shown in Table 2-8, the Direct Disposal in Grout alternative results in higher doses and greater health effects over the long term than the other action alternatives. However, for all action alternatives the projected number of latent cancer fatalities is very much less than one and DOE does not therefore expect any alternative to result in adverse health effects over the long term.

As discussed above for the No Action alternative, an individual consuming 2 liters per day of water from Fourmile Branch would receive a dose of 640 millirem per year. This dose is more than 160 times the drinking water regulatory limit of 4 millirem per year and would result in a 2.2 percent increase in the probability of contracting a latent cancer fatality from a 70-year lifetime exposure. While a 2.2 percent increase is low, the probability of contracting a latent cancer fatality under the No Action alternative is about 13,000 times greater than that of any of the action alternatives. L6-5 L6-51

For the No Action alternative, an individual living in the tank farm area would receive an external dose of about 2,320,000 millirem in the first year following the event, which would result in a prompt fatality. L6-5 L6-51

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