

evaluate both external and internal exposures, with the goal being to minimize the total effective dose equivalent. An effective program to keep doses as low as reasonably achievable must also balance minimizing individual worker doses with minimizing the collective dose of workers in a group. For example, using many workers to perform small portions of a task would reduce the individual worker dose to low levels. However, frequent worker changes would make the work inefficient, resulting in a significantly higher collective dose to all the workers than if fewer had received slightly higher individual doses.

SRS worker doses have typically been well below Federal worker exposure limits. DOE sets administrative exposure guidelines at a fraction of the exposure limits to help enforce doses that are as low as reasonably achievable. For example, the current DOE worker exposure limit is 5,000 mrem per year, and the 1998 SRS as-low-as-reasonably-achievable administrative control level for the whole body was 500 mrem per year. Every year, DOE evaluates the SRS as-low-as-reasonably-achievable administrative control levels and adjusts them as needed.

Table 3-17 lists average individual doses and SRS collective doses from 1989 to 1998.

3.8.4 WORKER NONRADIOLOGICAL HEALTH

Industrial hygiene and occupational health programs at SRS deal with all aspects of worker health and the relationship of the worker to the work environment. The objective of an effective occupational health program is to protect employees from hazards in their work environments. To evaluate these hazards, DOE uses routine monitoring to determine employee exposure levels to hazardous chemicals.

Exposure limit values are the basis of most occupational health codes and standards. If an overexposure to a harmful agent does not exist, that agent generally does not create a health problem.

The Occupational Safety and Health Administration (OSHA) has established Permissible Exposure Limits to regulate worker exposure to hazardous chemicals. These limits refer to airborne concentrations of substances and represent conditions under which nearly all workers could receive repeated exposures day after day without adverse health effects.

Table 3-18 lists OSHA-regulated workplace pollutants likely to be generated by salt processing activities and the applicable OSHA limits.

A well-defined worker protection program is in place at SRS to protect the occupational health of DOE and contractor employees. To prevent occupational illnesses and injuries and to preserve the health of the SRS workforce, contractors involved in the construction and operations programs have implemented DOE-approved health and safety programs. Tables 3-19 and 3-20 display the results of these health and safety programs, which have resulted in lower incidences of injury and illness than in the general industry construction and manufacturing workforces.

3.9 Waste and Hazardous Materials Management

This section describes the waste generation baseline that DOE uses in Chapter 4 to gauge the relative impact of each salt processing alternative on the overall waste generation at SRS and on DOE's capability to manage such waste. In 1995, DOE prepared an EIS on the management of wastes projected to be generated by SRS for the next 30 years (DOE 1995b).

DOE generates six basic types of waste – HLW, low-level radioactive (LLW), hazardous, mixed (low-level radioactive and hazardous),

Table 3-17. SRS annual individual and collective radiation doses.

Year	Employees with measurable dose	Average individual worker dose (rem) ^a	Site worker collective dose (person-rem)
1989	12,363	0.070	863
1990	11,659	0.065	753
1991	8,391	0.055	459
1992	6,510	0.054	352
1993	5,202	0.051	264
1994	6,284	0.050	315
1995	4,846	0.053	256
1996	4,736	0.053	252
1997	3,327	0.050	165
1998	3,163	0.052	166

Sources: duPont (1989), Petty (1993), WSRC (1991, 1992, 1993, 1994, 1995b, 1996, 1997b, 1998e, 1999c).

a. The average dose includes only workers who received a measurable dose during the year.

Table 3-18. Potential occupational safety and health hazards and associated exposure limits.

Pollutant	OSHA PEL ^a (mg/m ³)	Time period
Benzene	3.1	8 hours
Carbon monoxide	55	8 hours
Nitrogen dioxide	9	Ceiling limit
Sulfur dioxide	13	8 hours
Particulate matter (<10 microns)	150	24 hours
	50	annual
Total particulates	15	8 hours

a. PEL = Permissible Exposure Limits. The OSHA PEL listed in Table Z-1-A or Z-2 of the OSHA General Industry Air Contaminants Standard (29 CFR 1910.1000) provided if appropriate. These limits, unless otherwise noted (e.g., ceiling), must not be exceeded during any 8-hour work shift of a 40-hour work week.

Table 3-19. Comparison of injury and illness incident rates for SRS construction to general industry construction.

Incident rate	SRS construction department ^a	Construction industry ^b
Total recordable cases per 200,000 hours worked ^c	5.11	9.70
Total lost workday cases per 200,000 hours worked ^c	2.41	4.45

a. Source: DOE (2000b). Data includes direct-hire and subcontract construction hours worked for the years 1995 through 1999.

b. Source: Bureau of Labor Statistics (2000). Industry average for the years 1995 through 1998. No data available for 1999.

c. 200,000 hours is the standard base for incidence rates, and represents the equivalent of 100 employees working 40 hours per week for 50 weeks.

Table 3-20. Comparison of injury and illness incident rates for SRS operations to private industry and manufacturing.

Incident rate	SRS operations ^a	Private industry ^b	Manufacturing ^b
Total recordable cases per 200,000 hours worked ^c	1.24	7.33	10.55
Total lost workday cases per 200,000 hours worked ^c	0.54	3.35	4.93

- a. Source: DOE (2000b). Data includes direct-hire and subcontract operations hours worked for the years 1995 through 1999.
- b. Source: Bureau of Labor Statistics (2000). Industry average for the years 1995 through 1998. No data available for 1999.
- c. 200,000 hours is the standard base for incidence rates, and represents the equivalent of 100 employees working 40 hours per week for 50 weeks.

transuranic (including alpha-contaminated), and sanitary (nonhazardous, nonradioactive) – which this SEIS considers because they are possible byproducts of the SRS salt processing activities. The following sections describe the waste types. Table 3-21 lists projected total waste generation volumes for a 30-year period that encompasses the expected duration of the salt processing activities addressed in this SEIS. The assumptions and uncertainties applicable to SRS waste management plans and waste generation estimates are described in Halverson (1999). These estimates do not include wastes that would be generated as a result of SRS salt processing activities evaluated in this SEIS.

Tables 3-22 through 3-24 provide an overview of the existing and planned facilities that DOE expects to use in the storage, treatment, and disposal of the various waste classes.

3.9.1 LOW-LEVEL RADIOACTIVE WASTE

DOE (1999b) defines LLW as radioactive waste that cannot be classified as HLW, spent nuclear fuel, transuranic waste, by-product material, or naturally occurring radioactive material.

At present, DOE uses a number of methods for treating and disposing of LLW at SRS, depending on the waste form and radioactivity level. DOE volume-reduces these wastes by incineration, compaction, supercompaction, smelting, or repackaging (DOE 1995b). After volume reduction, DOE packages the remaining low-activity waste and places it in either shallow land disposal or vault disposal in E Area.

DOE places LLW of intermediate activity and some tritiated LLW in E Area intermediate activity vaults, and will store long-lived LLW (e.g., spent deionizer resins) in the long-lived waste storage buildings in E Area, where they will remain until DOE determines their final disposition.

3.9.2 MIXED LOW-LEVEL WASTE

Mixed LLW is radioactive waste that contains material that is listed as hazardous waste under the Resource Conservation and Recovery Act (RCRA) or that exhibits one or more of the following hazardous waste characteristics: ignitability, corrosivity, reactivity, or toxicity. It includes such materials as tritiated mercury, tritiated oil contaminated with mercury, other mercury-contaminated compounds, radioactively-contaminated lead shielding, equipment from the tritium facilities in H Area, and filter paper takeup rolls from the M-Area Liquid ETF.

Table 3-21. Total waste generation forecast for SRS (cubic meters).^a

Inclusive dates	Waste class				
	Low-level	HLW	Hazardous	Mixed low-level	Transuranic and alpha
1998 to 2029	180,299	14,129	6,315	3,720	6,012

a. Derived from Halverson (1999). Projected quantities for hazardous and mixed low-level waste derived using ratio of expected waste forecasts for these waste types in DOE (1995b).

3.9.2 MIXED LOW-LEVEL WASTE

Mixed LLW is radioactive waste that contains material that is listed as hazardous waste under the Resource Conservation and Recovery Act (RCRA) or that exhibits one or more of the following hazardous waste characteristics: ignitability, corrosivity, reactivity, or toxicity. It includes such materials as tritiated mercury, tritiated oil contaminated with mercury, other mercury-contaminated compounds, radioactively-contaminated lead shielding, equipment from the tritium facilities in H Area, and filter paper takeup rolls from the M-Area Liquid ETF.

As described in the *Approved Site Treatment Plan* (WSRC 1999d), storage facilities for mixed low-level waste are in several different SRS areas. These facilities are dedicated to solid, containerized, or bulk liquid waste and all are approved for this storage under RCRA as interim status or permitted facilities or under the Clean Water Act as permitted tank systems. Several treatment processes described in WSRC (1999d) could be used for mixed LLW. These facilities, which are listed in Table 3-23, include the Consolidated Incineration Facility (CIF), the M-Area Vendor Treatment Facility, and the Hazardous Waste/Mixed Waste Containment Building.

CIF operations were suspended in October 2000. It was constructed primarily to incinerate benzene generated in the In-Tank Precipitation process. Additionally, it was scheduled to destroy plutonium uranium extraction (PUREX) wastes from Canyon operations,

some solid LLW from ongoing operations, and waste from decontamination and decommissioning (D&D) projects. The benzene stream and the D&D projects did not materialize, and LLW could be more cost-effectively compacted. If an effective alternative to PUREX disposal can be identified, CIF will not be necessary. DOE is expected to make a decision on CIF by April 2002.

Depending on the nature of the waste residues remaining after treatment, DOE plans to use either shallow land disposal or RCRA-permitted hazardous waste/mixed waste vaults for disposal.

3.9.3 HIGH-LEVEL WASTE

HLW is highly radioactive material resulting from the reprocessing of spent nuclear fuel that contains fission products in concentrations requiring permanent isolation. It includes both liquid waste produced by reprocessing and any solid waste derived from that liquid (DOE 1999b).

At present, DOE stores HLW in carbon steel and reinforced concrete underground tanks in the F- and H-Area Tank Farms. The HLW in the tanks consists of three physical forms: sludge, saltcake, and supernatant. The sludge is solid material that precipitates or settles to the bottom of a tank. The saltcake is comprised of salt compounds that have crystallized as a result of concentrating the salt component of HLW by evaporation. The salt supernatant is a highly concentrated liquid.

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Table 3-22. Planned and existing waste storage facilities.

Storage facility	Location	Capacity	Original waste stream ^a					Mixed Low-level	Status
			Low-level	HLW	Transuranic	Alpha ^b	Hazardous		
Long-lived waste storage buildings	E Area	140 m ³ / bldg	X						One exists; DOE plans to construct additional buildings, as necessary.
Containerized mixed waste storage	Buildings 645-2N, 643-29E, 643-43E, 316-M, and Pad 315-4M	4,237 m ³						X	DOE plans to construct additional storage buildings, similar to 643-43E, as necessary.
Liquid mixed waste storage	DWPF Organic Waste Storage Tank (S Area) SRTC Mixed Waste Tanks Liquid Waste Solvent Tanks (H Area) Process Waste Interim Treatment/Storage Facility Tanks (M Area)	9,586 m ³						X	The Process Waste Interim Treatment/Storage Facility ceased operation under RCRA in March 1996 and now operates under the Clean Water Act.
HLW Tank Farms	F and H Areas	(c)		X					51 underground tanks; one (16H) has been removed from service and two (17F, 20F) have been closed. ^d
Failed equipment storage vaults	Defense Waste Processing Facility (S Area)	300 m ³		X					Two exist; DOE plans approximately 12 additional vaults.
Glass waste storage buildings	Defense Waste Processing Facility (S Area)	2,286 canisters ^e		X					One exists and is expected to reach capacity in 2005; a second is planned to accommodate canister production from 2005 to 2015.
Hazardous waste storage facility	Building 710-B Building 645-N Building 645-4N Waste Pad 1 (between 645-2N and 645-4N) Waste Pad 2 (between 645-4N and 645-N) Waste Pad 3 (east of 645-N)	4,557 m ³						X	Currently in use. No additional facilities are planned, as existing space is expected to adequately support the short-term storage of hazardous wastes awaiting treatment and disposal.
Transuranic waste storage pads	E Area	(f)				X	X	X	19 pads exist; additional pads will be constructed as necessary.

Sources: DOE (1994; 1995b), WSRC (1999d).

- a. Sanitary waste is not stored at SRS; therefore, it is not addressed in this table.
 - b. Currently, alpha waste is handled and stored as transuranic waste. After it is surveyed and separated, most will be treated and disposed of as low-level or mixed low-level waste.
 - c. As of April 1998, there were approximately 660,000 gallons of space available in each of the HLW Tank Farms.
 - d. Twenty-four of these tanks do not meet secondary containment requirements and have been scheduled for closure.
 - e. Usable storage capacity of 2,159 canisters due to floor plug problems.
 - f. Transuranic waste storage capacities depend on the packaging of the waste and the configuration of packages on the pads.
- m³ = cubic meters, SRTC = Savannah River Technology Center.

Table 3-23. Planned and existing waste treatment processes and facilities.

Waste Treatment Facility	Waste Treatment Process	Waste type							Status
		Low-level	High-level	Transuranic	Alpha ^a	Hazardous	Mixed Low-level	Sanitary	
Consolidated Incineration Facility	Incineration	X				X	X		Operations suspended in 2000
Offsite facility	Incineration	X				X	X		Not currently operating
Offsite facility	Compaction	X							Not currently operating
Onsite facility	Supercompaction	X							Operating
Offsite facility	Smelting	X							Not currently operating
Onsite facility	Repackaging	X							Operating
Defense Waste Processing Facility	Vitrification		X						Operating (sludge only)
Saltstone Manufacturing and Disposal	Stabilization						X		Not currently operating
Replacement High-Level Waste Evaporator ^c	Volume Reduction		X						Began treating waste in December 1999
M-Area Vendor Treatment Facility	Vitrification						X		Treatment of design basis wastes completed in February 1999
Hazardous Waste/Mixed Waste Containment Building	Macroencapsulation					X	X		Plan to begin operations in 2006
Treatment at point of waste stream origin	Decontamination						X		As feasible, based on waste and location
Non-Alpha Vitrification Facility	Macroencapsulation						X		Under evaluation as a potential process
DOE Broad Spectrum Contractor ^b	Vitrification	X				X	X		DOE is considering use of the Broad Spectrum Contract
Offsite facility	Amalgamation/Stabilization/Macro encapsulation						X		Currently operational
Offsite facility	Offsite Treatment and Disposal					X			Currently operational
Offsite facility	Decontamination						X		Began treating waste onsite in December 1998. Plan to pursue treatment offsite in 2000, if necessary.
High-activity mixed transuranic waste facility	Repackaging/size reduction			X	X				Planned to begin operations in 2012
Low-activity mixed transuranic waste facility	Repackaging/size reduction/super compaction			X	X				Planned to begin operations in 2002
Various onsite and offsite facilities ^d	Recycle/Reuse	X				X	X	X	Currently operational
Existing DOE facilities	Repackaging/Treatment			X					Transuranic waste strategies are still being finalized
F- and H-Area Effluent Treatment Facility	Wastewater Treatment	X					X		Currently operational

Sources: DOE (1994, 1995b); WSRC (1999d,e; 2000b).

- Currently, alpha waste is handled as transuranic waste. After it is surveyed and separated, most will be treated and disposed of as low-level or mixed low-level waste.
- Evaporation precedes treatment at the DWPF and is used to maximize HLW storage capacity.
- Various waste streams have components (e.g., silver, lead, freon, paper) that might be recycled or reused. Some recycling activities might occur onsite, while other waste streams are directed offsite for recycling. Some of the recycled products are released for public sale, while others are reused onsite.

Table 3-24. Planned and existing waste disposal facilities.

Disposal facility	Location	Capacity (m ³)	Original waste stream ^a						Status
			Low-level	High-level	Transuranic	Hazardous	Mixed Low-level	Sanitary	
Shallow land disposal trenches	E Area	(b)	X						Four have been filled; up to 58 more may be constructed.
Low-activity vaults	E Area	30,500/vault	X						One vault exists and one additional is planned.
Intermediate-activity vaults	E Area	5,300/vault	X						Two vaults exist and five more may be constructed.
Hazardous waste/mixed waste vaults	NE of F Area	2,300/vault					X	X	RCRA permit application submitted for 10 vaults. At least 11 additional vaults may be needed.
Saltstone Manufacturing and Disposal	Z Area	80,000/vault ^c	X						Two vaults exist; future vault needs to be determined by SRS salt processing alternatives.
Three Rivers Landfill	Intersection of SC 125 and SRS Road 2	NA						X	Current destination for SRS sanitary waste.
Burma Road Cellulosic and Construction Waste Landfill	SRS Intersection of C Road and Burma Road	NA						X	Current destination for demolition/construction debris. DOE expects to reach permit capacity in 2008.
Waste Isolation Pilot Plant (WIPP)	New Mexico	175,600				X			Current destination for some SRS transuranic waste. ^d
Federal repository	See Status	NA		X					Proposed Yucca Mountain, Nevada, site is currently under investigation.

Sources: DOE (1994, 1995b, 1997c); WSRC (1999d,f; 2000b).

- a. After alpha waste is assayed and separated from the transuranic waste, DOE plans to dispose of it as low-level or mixed low-level waste, so it is not addressed separately here.
- b. Various types of trenches exist including engineered low-level trenches, greater confinement disposal boreholes and engineered trenches, and slit trenches. The different trenches are designed for different waste types, are constructed differently, and have different capacities.
- c. This is the approximate capacity of a double vault. One single vault and one double vault have been constructed. Future vault design would be based on the selected salt processing alternative.
- d. SRS received WIPP certification in April 2001 and shipped waste to WIPP in May 2001.

NA = not available, WIPP = Waste Isolation Pilot Plant.

The sludge portion of the HLW is currently being transferred to DWPF for immobilization in borosilicate glass. The treatment processes at DWPF are described in the *Final Supplemental Environmental Impact Statement for the Defense Waste Processing Facility* (DOE 1994). The salt portions of the HLW must be separated into high-radioactivity and low-radioactivity fractions before ultimate treatment. Alternatives for processing the salt portion of the SRS HLW is the subject of this SEIS.

DOE has committed to complete closure by 2022 of the 24 HLW tank systems that do not meet the secondary containment requirements in the Federal Facility Agreement (WSRC 2000b). During waste removal, DOE will retrieve as much of the stored HLW as can be removed using the existing waste transfer equipment. The sludge portion of the retrieved waste will be treated in treatment facilities and vitrified at DWPF, as discussed in the 1999 SEIS. Processing of the salt portion of the retrieved waste is the subject of this SEIS.

3.9.4 SANITARY WASTE

Sanitary waste is solid waste that is neither hazardous, as defined by RCRA, nor radioactive. It consists of salvageable material and material that is suitable for disposal in a municipal sanitary landfill. Sanitary wastes include such items as paper, glass, discarded office material, and construction debris (DOE 1994).

Sanitary waste volumes have declined due to recycling and the decreasing SRS workforce. DOE sends sanitary waste that is not recycled or reused to the Three Rivers Landfill on SRS. DOE also continues to operate the Burma Road Cellulosic and Construction Waste Landfill to dispose of demolition and construction debris.

3.9.5 HAZARDOUS WASTE

Hazardous waste is nonradioactive waste that SCDHEC regulates under RCRA and

corresponding state regulations. Waste is hazardous if the EPA lists it as such or if it exhibits any of the characteristic(s) of ignitability, corrosivity, reactivity, or toxicity. SRS hazardous waste streams consist of a variety of materials, including mercury, chromate, lead, paint solvents, and various laboratory chemicals.

At present, DOE stores hazardous wastes in three buildings and on three solid waste storage pads that have RCRA permits. Hazardous waste is sent to offsite treatment and disposal facilities. DOE also plans to continue to recycle, reuse, or recover certain hazardous wastes, including metals, excess chemicals, solvents, and chlorofluorocarbons. Wastes remaining after treatment might be suitable for either shallow land disposal or disposal in the Hazardous/Mixed Waste Disposal Vaults (DOE 1995b).

3.9.6 TRANSURANIC AND ALPHA WASTE

Transuranic waste contains alpha-emitting transuranic radionuclides (those with atomic numbers greater than 92) that have half-lives greater than 20 years at activities exceeding 100 nanocuries per gram (DOE 1999b). At present, DOE manages low-level alpha-emitting waste with activities between 10 and 100 nanocuries per gram (referred to as alpha waste) as transuranic waste at SRS.

Current SRS efforts for transuranic and alpha waste consist primarily of providing continued safe storage. After alpha waste is assayed and separated from the transuranic waste, DOE plans to dispose of the alpha waste onsite as low-level or mixed low-level waste. Eventually, DOE plans to ship the SRS transuranic and mixed transuranic waste to the Waste Isolation Pilot Plant in New Mexico for disposal.

3.9.7 HAZARDOUS CHEMICALS

The *Savannah River Site Tier II Emergency and Hazardous Chemical Inventory Report* for 1998 (WSRC 1999g) lists more than 79 hazardous chemicals that were present at SRS at some time during the year in amounts that exceeded the minimum reporting thresholds (generally 10,000

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pounds for hazardous chemicals and 500 pounds for extremely hazardous substances). Four of the 79 hazardous chemicals are considered extremely hazardous substances under the Emergency Planning and Community Right-to-Know Act of 1986. The actual number and quantity of hazardous chemicals present on and at individual facilities changes daily as a function of use and demand.

3.10 Energy and Utilities

Electricity. The South Carolina Electric and Gas Company (SCE&G) supplies SRS electric power needs via one 160-kilovolt and two 115-kilovolt-capacity transmission lines, with a combined available power of about 390 megawatts. The SRS D-Area Powerhouse, which was once operated by DOE to provide a portion of the Site's electricity needs, is now under lease to SCE&G, which in turn sells electricity to DOE. Current Site power demand is about 70 megawatts, with 30 percent of that total (about 22 megawatts) being delivered to H-Area facilities. The capacity of the H-Area power distribution network is 64 megawatts. A substation in H Area distributes electricity to S and Z Areas.

Steam. Steam production facilities at SRS include coal-fired powerhouses at A, D, and H Areas, and two package boilers, which use number 2 fuel oil, in K Area. DOE has privatized the D-Area Powerhouse, which provides most of the steam for SRS. SCE&G produces and sells steam to DOE. At present, steam generation occurs continuously at the A- and D-Area facilities (the H-Area powerhouse is maintained in a standby condition). The combined capacity of these steam production facilities is about 1.7 million pounds per hour, with the D-Area powerhouse representing 75 percent of that capacity (1.3 million pounds per hour).

Average daily steam use is about 150,000 pounds per hour (excluding 30,000 pounds per hour use during winter).

Domestic and Process Water. During 1998, groundwater withdrawals at SRS for domestic and process uses totaled 5,345 billion gallons, or a daily average of 14,634 million gallons (10,162 gallons per minute). This demand represents about 91 percent of the lowest estimated production capacity (16 million gallons per day) of the aquifer. The 1998 average consumption of water in H- and S-Area facilities was about 1.023 and 0.049 million gallons per day, respectively. This water demand represents almost 7 percent of the total Site demand. The average demand for water is about 960 gallons per minute; the water supply capacity is about 3,450 gallons per minute, which is about 30 percent of the lowest estimated production capacity (16 million gallons per day) of the aquifer. The water demand imposed by the operation of S- and Z-Area facilities averages 50 gallons per minute (about 5 percent of the total Site demand); the associated system capacity is 200 gallons per minute.

Originally built to supply water from the Savannah River to the five SRS production reactors, the River Water System includes three pumphouses, two (1G and 3G) on the Savannah River, and one (6G) on Par Pond. Pumphouse 5G is also on the Savannah River, but has a separate piping system that supplies cooling water to the D-Area Powerhouse. Pumphouses 1G and 6G are no longer operating, but DOE has maintained the 1G pumphouse and system. The total design capacity of the 1G and 3G pumphouses is 400,000 gallons per minute. In 1997, DOE installed a 5,000-gallon-per-minute pump in Pumphouse 3G to save energy and costs. At present, only Pumphouse 3G is in use, withdrawing 5,000 gallons per minute from the Savannah River to supply small cooling loads in K and L Areas.

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