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"Defense Waste Processing Facility"

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Final Supplemental Environmental Impact Statement Defense Waste Processing Facility

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Final Supplemental Environmental Impact Statement Defense Waste Processing Facility
DOE/EIS-0082-S

Final
Supplemental Environmental
Impact Statement

Defense Waste Processing Facility

November 1994
Department of Energy
Savannah River Site
Aiken, South Carolina

COVER SHEET

RESPONSIBLE AGENCY: U.S. Department of Energy (DOE)

TITLE: Supplemental Environmental Impact Statement, Defense Waste Processing Facility, Savannah River Site, Aiken, South Carolina (DOE/EIS-0082-S).

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ABSTRACT: This document supplements the Final Environmental Impact Statement (EIS) DOE issued in 1982 (DOE/EIS-0082) to construct and operate the Defense Waste Processing Facility (DWPF) at the Savannah River Site (SRS), a major DOE installation in southwestern South Carolina. That EIS supported the decision to construct and operate the DWPF to immobilize high-level waste generated as a result of nuclear materials processing at SRS. The DWPF would use a vitrification process to incorporate the radioactive waste into borosilicate glass and seal it in stainless steel canisters for eventual disposal at a permanent geologic repository. The DWPF is now mostly constructed and nearly ready for full operation. However, DOE has made design changes to the DWPF since the 1982 EIS to improve efficiency and safety of the facility. Each of these modifications was subjected to appropriate NEPA review. The purpose of this Supplemental EIS is to assist DOE in deciding whether and how to proceed with operation of the DWPF as modified since 1982 while ensuring appropriate consideration of potential environmental effects. In this document, DOE assesses the potential environmental impacts of completing and operating the DWPF in light of these design changes, examines the impact of alternatives, and identifies potential actions to be taken to reduce adverse impacts. Evaluations of impacts on water quality, air quality, ecological systems, land use, geologic resources, cultural resources, socioeconomics, and health and safety of onsite workers and the public are included in the assessment.

PUBLIC COMMENTS: In its preparation of this Final EIS, DOE considered comments received by letter and voice mail, and formal statements given at public hearings in Aiken, South Carolina (September 13, 1994); Hilton Head, South Carolina (September 14, 1994); Beaufort and Hardeeville, South Carolina (September 15, 1994); Savannah, Georgia (September 15 and 16, 1994); and Allendale, Barnwell, and Columbia, South Carolina (September 20, 1994).

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FOREWORD

This document supplements the Final Environmental Impact Statement (EIS) that DOE issued in 1982 (DOE/EIS-0082) to construct and operate the Defense Waste Processing Facility (DWPF), a major system for treatment of high-level radioactive waste at the Savannah River Site (SRS). DWPF, as used in this document, refers to high-level waste pre-treatment processes, the Vitrification Facility, Saltstone Manufacturing and Disposal, radioactive glass waste storage facilities, and associated support facilities. The 1982 EIS, its Record of Decision, and a subsequent Environmental Assessment, Waste Form Selection for Savannah River Plant High-Level Waste (DOE/EA-0179), supported the decision to construct and operate the DWPF to immobilize high-level waste generated as a result of nuclear materials processing at SRS.

DOE's primary mission at the SRS since the 1950s has included the production and processing of nuclear materials to support the defense, research, and medical programs of the United States. These activities have resulted in the generation of liquid high-level radioactive waste that continues to be stored in large underground tanks near the center of the 800-square-kilometer (300-square-mile) site. This high-level waste must be managed to protect people, now and in the future, from potential hazards. DOE responded to this need in 1982 with its decision to build and operate the DWPF. This facility is designed to incorporate the highly radioactive waste constituents into borosilicate glass by a process called vitrification and seal the radioactive glass in stainless steel canisters for eventual disposal at a permanent geologic repository.

The DWPF is nearly ready to operate. However, DOE has made design changes to the DWPF since the 1982 EIS to improve efficiency and safety of the facility. Among these changes are modifications to processes for pre-treating sludge and salt components of the high-level waste before vitrification and for disposing of the low radioactivity waste fraction resulting from salt pre-treatment. Each of these modifications was subjected to appropriate National Environmental Policy Act (NEPA) review.

The purpose of this Supplemental EIS is to address the cumulative environmental impacts of the modifications, and to assist DOE in deciding whether and how to proceed with operation of the DWPF as modified since 1982 while ensuring appropriate consideration of potential environmental effects. In this document, DOE assesses the environmental impacts of completing and operating the DWPF in light of these design changes, examines the impact of alternatives, and identifies potential actions to be taken to reduce adverse impacts.

DOE's proposed action (the preferred alternative) considered in this Supplemental EIS is to continue construction and begin operation of the DWPF as currently designed. This design includes the use of an in-tank precipitation (ITP) process for removal of radionuclides from the highly radioactive salt fraction of the waste. DOE also considers the use of an ion exchange system in place of ITP for removal of radionuclides from the salt fraction as a major alternative in this Supplemental EIS. In accordance with NEPA regulations, DOE examines the potential impacts of a no-action alternative in which the high-level waste would continue to be stored in the high-level waste tanks.

DOE published a Notice of Intent to prepare this Supplemental EIS in the Federal Register on April 6, 1994 (59 FR 16499). This notice solicited comments and suggestions for DOE to consider in its determination of the scope of the Supplemental EIS and announced a public scoping period that ended on

May 31, 1994. DOE held scoping meetings during this period in Savannah, Georgia, North Augusta, South Carolina, and Columbia, South Carolina, on May 12, 17, and 19, 1994, respectively. During the scoping period, 77 comments considered applicable to DWPF were received from individuals, organizations, and government agencies. Comments received during the scoping period and the DOE responses were used to develop the scope and the approach for this Supplemental EIS in an Implementation Plan, issued by DOE in June 1994.

DOE completed the Draft of this Supplemental EIS in August 1994, and on August 26, 1994, DOE and the U.S. Environmental Protection Agency (EPA) published Notices of Availability of the document in the Federal Register (59 FR 44137 and 59 FR 44143, respectively). EPA's notice officially started the public comment period on the Draft Supplemental EIS, which extended through October 11, 1994.

DOE has considered comments it received during the public comment period in the preparation of this Final Supplemental EIS. These comments were received by letter, telephone, and formal statements made at public hearings held in Aiken, South Carolina on September 13; Hilton Head, South Carolina on September 14; Beaufort and Hardeeville, South Carolina on September 15; Savannah, Georgia on September 15 and 16; and Allendale, Barnwell, and Columbia, South Carolina on September 20, 1994.

Revisions from the Draft Supplemental EIS are indicated in this Final Supplemental EIS by vertical change bars in the margin. The change bars are marked TC for technical changes, TE for editorial changes or, if the change was made in response to a public comment, the designated comment number as listed in Appendix C. Many of the technical changes were the result of the issuance of updated information (e.g., the 1993 SRS Environmental Report) since publication of the draft Supplemental EIS.

Transcripts of public testimony received during the scoping period, copies of scoping letters, scoping comments, the Implementation Plan, and reference materials cited in this Supplemental EIS are available for review in the DOE Public Reading Room, located at the University of South Carolina-Aiken Campus, Gregg-Graniteville Library, 2nd Floor, University Parkway, Aiken, South Carolina, (803) 648-6851 and the Freedom of Information Reading Room, Room 1E-190, Forrestal Building, 1000 Independence Avenue, Washington, D.C., (202) 586-6020.

DOE has prepared this Supplemental EIS in accordance with the NEPA regulations of the Council on Environmental Quality (40 CFR Parts 1500-1508) and the DOE NEPA Implementing Procedures (10 CFR Part 1021). The Supplemental EIS identifies the methods used and the scientific and other sources of information consulted. In addition, it incorporates, directly or by reference, available results of ongoing studies. The document is structured as follows:

Chapter 1 provides background information, describes the purpose and need for the proposed action, and describes related DOE actions being considered in other NEPA documents.

Chapter 2 describes the proposed action and its alternatives and provides a summary comparison of environmental impacts.

Chapter 3 describes the current potentially affected SRS environment as it relates to the alternatives addressed.

Chapter 4 provides a detailed assessment of environmental consequences of the construction and operation of the proposed action and its alternatives. The chapter also provides an assessment of unavoidable adverse impacts, irreversible or irretrievable commitment of resources, and cumulative impacts.

Appendix A provides supplemental technical data related to the description of the proposed action and alternatives and their impacts.

Appendix B provides technical information and discussion supporting the accident analysis results presented in Chapter 4.

Appendix C contains public and agency comments on the Draft Supplemental EIS and DOE responses to these comments with an indication of sections revised as a result of the comments.

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SUMMARY

Introduction

The U.S. Department of Energy (DOE) has prepared this Supplemental Environmental Impact Statement (EIS) for the Defense Waste Processing Facility (DWPF), a major system for treatment of high-level radioactive waste at the Savannah River Site (SRS) (Figure S-1). DWPF, as used in this document, refers to high-level waste pre-treatment processes, the Vitrification Facility, Saltstone Manufacturing and Disposal, radioactive glass waste storage facilities, and associated support facilities. This document supplements the Final EIS for the DWPF that DOE issued in 1982 (DOE/EIS-0082). That EIS, its Record of Decision, and a subsequent Environmental Assessment, Waste Form Selection for Savannah River Plant High-Level Waste (DOE/EA-0179) completed in 1982, supported the decision to construct and operate the DWPF to immobilize in borosilicate glass the high-level waste generated from nuclear materials processing at SRS (Photo S-1).

In preparing this Supplemental EIS, DOE considered the comments it received from organizations and individuals during a scoping period that extended from April 6 through May 31, 1994. Results of the scoping process and plans for development of this Supplemental EIS are described in an Implementation Plan issued by DOE in June 1994. DOE also considered comments its received from agencies, organizations, and individuals on the Draft of the Supplemental EIS issued in August 1994 during a public comment period that extended from August 26 to October 11, 1994.

DOE considers this Supplemental EIS to be timely and appropriate because of several changes that have occurred in the DWPF design since the 1982 EIS. This Supplemental EIS provides an analysis of the environmental impacts of the DWPF in light of these changes. It also includes analyses of the environmental impacts of reasonable alternatives to the present plans for the DWPF, in particular alternative ways of pre-treating part of the high-level waste before it is incorporated into glass.

The Supplemental EIS was prepared in accordance with provisions of the National Environmental Policy Act (NEPA) of 1969, as amended, which requires Federal agencies to assess the environmental impacts associated with their actions. DOE's policy is to follow the letter and spirit of NEPA and to comply fully with the regulation of the Council on Environmental Quality (40 CFR Parts 1500-1508). This policy is carried out in accordance with DOE's NEPA Implementing Procedures (10 CFR Part 1021).

Figure Figure S-1.
Figure S-1. Savannah River Site.

Figure Photo S-1.
Photo S-1. DWPF Vitrification Facility.

Background

When established in the early 1950s, SRS's primary mission was to produce nuclear materials to support the defense, research, and medical programs of the United States. SRS's present mission emphasizes waste management, environmental restoration, and decontamination and decommissioning of facilities that are no longer needed for SRS's traditional defense mission. The process used in the past to recover uranium and plutonium from production

reactor fuel and target assemblies in the chemical separations areas at SRS resulted in liquid high-level radioactive waste. This waste, which now amounts to approximately 129 million liters (34 million gallons), is stored in underground tanks in the F- and H-Areas near the center of the Site. After its introduction into the tanks, the high-level waste settles, separating into a sludge layer at the bottom of the tanks and an upper layer of soluble sats dissolved in water (supernatant). The evaporation of the supernatant creates a third waste form, crystallized saltcake, in the tanks.

In 1982, DOE prepared an EIS and issued a Record of Decision to continue a research and development program to develop technology for removing these wastes from the tanks and immobilizing the highly radioactive constituents in a form suitable for disposal. In its Record of Decision, DOE indicated that immobilization was the process most likely to ensure that the waste would remain contained in a form that would not pose a threat to human health or the environment.

After completing the 1982 DWPF EIS, DOE decided to build and operate the DWPF. This facility is designed to incorporate the highly radioactive waste constituents into borosilicate glass in a process called vitrification and seal the radioactive glass in stainless steel canisters for eventual disposal at a permanent Federal repository located deep within a stable geologic (e.g., rock) formation.

The DWPF is now mostly constructed, and the major high-level waste pre-treatment processes and the vitrification process are nearly ready to operate. However, DOE has made design changes to the DWPF since the 1982 EIS to improve efficiency and safety of the facility. Among these changes are modifications to processes for pre-treatment of the salt (i.e., supernatant and saltcake) and sludge components of the high-level waste before vitrification, and modifications to onsite disposal of the low radioactivity waste fraction resulting from salt pretreatment. The potential environmental impacts of these modifications have been considered individually, but not cumulatively, in prior NEPA documentation.

Purpose and Need for Agency Action

DOE must now decide whether and how to proceed with the DWPF system as modified since 1982 while ensuring appropriate consideration of potential environmental effects. DOE believes it can make the best decision by reassessing the potential environmental impacts, including cumulative impacts, of completing and operating the DWPF in light of these design changes by evaluating the potential impacts of alternatives, and by identifying viable measures for reducing adverse impacts. This Supplemental EIS is intended to provide this information.

Proposed Action and Alternatives

DOE's proposed action and preferred alternative considered in this Supplemental EIS is to continue construction and begin operation oft he DWPF system as currently designed. This design includes the use of and in-tank precipitation (ITP) process for separation of radionuclides from the highly radioactive salt fraction of the waste to enhance their stabilization in borosilicate glass in the Vitrification Facility. DOE's alternative action is the use of an ion exchange system as a pre-treatment alternative to ITP for removal of radionuclides form the salt fraction. Two options for implementing this alternative are evaluated. The first is to develop an construct an ion exchange system while operating the ITP, then replace ITP with the ion exchange process (phased replacement). The second is to develop and ion exchange process and construct a facility while continuing to store the waste in tanks until the facility is available (immediate replacement). Ion exchange is considered because technology developments have enhanced its

feasibility. As required by Council on Environmental Quality regulations, DOE also analyzes a no-action alternative in this Supplemental EIS.

PROPOSED ACTION

DOE proposes to continue construction and begin operation of the DWPF as currently designed to immobilize liquid high-level radioactive waste. DOE would continue the DWPF process and facility modifications that are currently underway, complete startup testing activities, and operate the facility upon completion of testing. Base on current operating plans and projected funding, high-level waste processing would be completed in about 24 years.

The DWPF system as currently designed (Figure S-2) includes processes and associated facilities and structures located in H-, S-, and Z-Areas near the center of the site. The major parts of the DWPF system as designed are listed below:

Figure Figure S-2.
Figure S-2. Current DWPF system design (simplified).

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

- Extended Sludge Processing - a washing process, carried out in selected H-Area high-level waste tanks, to remove aluminum hydroxide and soluble salts form the high-level waste sludge. The facility is built, and the process is presently being tested.
- In-Tank Precipitation - a process in H-Area to remove (through precipitation) dissolved radioactive constituents (strontium, cesium, and plutonium) from the highly radioactive salt solution. The precipitate would be sent to Late Wash; the low radioactivity salt solution that remains would be sent to Saltstone Manufacturing and Disposal. The facility is constructed, and testing is nearly complete.
- Late Wash - a process to wash the highly radioactive precipitate resulting from ITP to remove a chemical (sodium nitrite) that could potentially interfere with operations in the Vitrification Facility. This H-Area facility is presently being designed and constructed.

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

- Vitrification Facility - a large building that contains processing equipment to immobilize the highly radioactive sludge and precipitate portions of the high-level waste in borosilicate glass. The sludge and precipitate are treated chemically, mixed with frit (finely ground glass), melted, and poured into stainless steel canisters that are then welded shut. The facility is presently constructed and undergoing startup testing.
- Glass Waste Storage Buildings - buildings for interim storage of the radioactive glass waste canisters in highly shielded concrete vaults located below ground level. One building is completed; one building is in the planning stage.
- Chemical Waste Treatment Facility - an industrial waste treatment facility that neutralizes nonradioactive wastewater from bulk chemical storage areas and nonradioactive process areas of the Vitrification Facility. This facility is constructed and in operation.

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

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

Saltstone Manufacturing and Disposal (Z-Area) - Facilities to treat and dispose of the low radioactivity salt solution resulting from the in-tank precipitation process, including:

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

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

Under this alternative, DOE could begin Vitrification Facility operations before the high-level waste salt pre-treatment process was available by treating the sludge in Extended Sludge Processing and vitrifying only the sludge fraction.

THE NO-ACTION ALTERNATIVE

Under the no-action alternative for this Supplemental EIS, DOE would continue to manage SRS high-level waste in the F- and H-Area Tank Farms for an indefinite period until an alternative to DWPF can be developed to effectively immobilize the high-level radioactive waste. DOE would not operate the Vitrification Facility an associated facilities and structures, ITP, or Extended Sludge Processing. DOE would continue current Saltstone Manufacturing and Disposal operation to treat waste residuals from the F- and H-Area Effluent Treatment Facility. DOE would "mothball" the Vitrification Facility for an indefinite period and reduce DWPF operations staff accordingly. At least two additional Saltstone Disposal Vaults would be constructed for disposal of F- and H-Area Effluent Treatment Facility waste

residuals.

THE ION EXCHANGE ALTERNATIVE

In addition to the proposed action and the no-action alternative, DOE analyzed replacement of the ITP process with an ion exchange process for high-level waste pre-treatment. With use of the ion exchange system, the DWPF organic waste stream (primarily benzene) and associated hazards would be eliminated. The ion exchange resin has not been demonstrated on a large scale, but laboratory-scale tests of the resin have encouraged DOE to consider large-scale mockup testing. The total estimated cost of implementing ion exchange is about $500 million.

Ion exchange for waste pre-treatment could be implemented in two ways: (1) phased replacement and (2) immediate replacement. In phased replacement, ITP would operate until the ion exchange facility had been designed, constructed tested and was available to replace it, in approximately 14 years. In immediate replacement, ITP would not operate and salt pre-treatment would not begin until the ion exchange facility was operational, in approximately 10 years. Under the immediate replacement alternative, ITP would not operate to empty the high-level waste tanks. Therefore, DOE would design, construct, and test an ion exchange facility on an accelerated schedule so that the ion exchange facility would be available 4 years earlier.

Under the immediate replacement alternative, not operating the Vitrification Facility and maintaining it in a standby state would cost approximately $15-30 million per year. In addition, funds would be required to shut down and restart the Vitrification Facility. Saltstone production and disposal would continue at the present reduced rate until ion exchange begins operation.

Under this alternative, DOE could begin Vitrification Facility operations before the high-level waste salt pre-treatment process was available by treating the sludge in Extended Sludge Processing and vitrifying only the sludge fraction.

Affected Environment

The SRS encompasses approximately 800 square kilometers (300 square miles) within the Atlantic Coastal Plain and includes portions of Aiken, Allendale, and Barnwell counties in South Carolina. Four population centers - Augusta, Georgia; and Aiken Barnwell, and North Augusta, South Carolina - are within 40 kilometers (25 miles) of the Site. Three small South Carolina towns - Jackson, New Ellenton, and Snelling - are immediately next to the SRS boundary to the northwest, north, and east, respectively (Figure S-1). Land on the SRS falls into three broad categories: forested, water and wetlands, and developed. Approximately 82 percent of this land is forested; approximately 9 percent is water and wetlands; and approximately 9 percent is classified as developed.

Land use within the H-, S-, and S-Areas, where the facilities addressed by this Supplemental EIS are located, is classified as developed. H-Area occupies approximately 172 hectares (400 acres). S- and Z-Areas encompass approximately 110 hectares (270 acres) and approximately 73 hectares (180 acres), respectively. Land within a 8-kilometer (5-mile) radius of these areas lies entirely within the SRS boundaries.

This supplemental EIS addresses environmental resources, characteristics, and SRS activities that the proposed action or alternatives might affect.

Environmental Consequences

The potential environmental consequences associated with the proposed action, the no-action alternative, and the ion exchange alternative are summarized in Table S-1. For many resource categories, existing environmental conditions would remain unchanged under the no-action alternative. No impacts to cultural resources or aesthetic and scenic resources would be expected from any of the alternatives, and entries are not provided in Table S-1 for these categories. Major differences in potential impacts among the alternatives are discussed below. In addition to these differences, other minor differences are discussed in Chapter 4.

- The proposed action and the ion exchange alternative would ultimately decrease the overall risk pose to human health and the environment associated with management of high-level radioactive waste currently stored in the tank farms. As long as the waste remains in the tanks, particularly in liquid form, releases to the environment could occur as a result of leaks, spills, or tank system rupture.

- Although long-term risk would be reduced by immobilizing the waste, the proposed action and either ion exchange alternative would pose a risk greater than continued tank storage fro the period of DWPF operation (24 years). Under the ion exchange immediate replacement alternative, current levels of risk from tank farm operations would persist for an additional 10 years because high-level waste removal stabilization would be delayed 10 years. After all the waste has been immobilized, the risk would drop to a smaller risk from storing radioactive glass waste canisters underground in Glass Waste Storage Buildings and from residual radioactivity in the high-level waste tanks and processing facilities. Under the no-action alternative, the risk from managing high-level waste at the tank farms would continue indefinitely.

- Normal operation under the proposed action would result in airborne emissions of benzene and diphenyl mercury. However, DOE expects resulting ambient concentrations of these constituents to be within applicable environmental and occupational regulatory standards. These constituents would not be emitted under the immediate replacement alternative, which uses ion exchange for pre-treatment, or under the no-action alternative. Under the phased replacement alternative, benzene emissions would be the same as under the proposed action for 14 years. Thereafter, DOE expects benzene releases would be negligible and mercury releases would be substantially reduced because ion exchange would be used for pre-treatment.

- Radiological releases following an extremely unlikely earthquake (frequency of once every 5,000 years) could result in a dose of approximately 4,000 rem to a worker located 100 meters (328 feet) from the Vitrification Facility and greater doses to workers located closer to the facility. Such doses would result in death within a few days. Such an event would also result in doses to the public that exceed the DOE dose standard for normal operations. DOE is evaluating the details of proposed potential safety modifications to substantially reduce or eliminate the probability and consequences of such an event. These modifications would be implemented before the facility is operated with radioactive waste.

- Potential, but unlikely, chemical accidents under each of the alternatives could result in nitric acid concentrations that may cause nearby workers to experience or develop life-threatening health effects or prevent them from taking protective actions. Mitigative and protective equipment and procedures are in place to minimize the consequences of these potential accidents.

- Potential, but unlikely, chemical accidents for the proposed action and for the first 14 years of the phased replacement alternative could result in formic acid and benzene concentrations that may cause nearby

workers to experience or develop lief-threatening health effects or prevent them from taking protective actions. This potential impact would not exist for either the no-action alternative, the immediate replacement alternative, or the last 10 years of the phased replacement alternative. Mitigative and protective equipment and procedures are in place to minimize the consequences of these potential accidents.

- The ion exchange process would pose a lower risk from hazardous materials than would operation of ITP because fewer hazardous byproducts such as benzene would be produced.

- The ion exchange and no-action alternatives would eliminate the generation of DWPF organic waste as compared to the proposed action.

This Supplemental EIS also addresses the cumulative impacts of the proposed action with other existing and planned SRS facilities and offsite nuclear facilities, and unavoidable adverse impacts and irreversible commitment of resources for the proposed action and alternatives.

Table S-1. Summary comparison of potential environmental impacts among alternatives.

Area of Impact	Proposed Action (Preferred Alternative)	No Action
		NORMAL OPERAT
Geologic Resources	Construction: Temporary increased erosion in H-, S-, and Z-Areas and potential for minor soil contamination from spills.	Construction: Potential less than Proposed Action.
	Operations: Decreased potential for radiological contamination of soils from high-level waste tank releases.	Operations: Continuing potential for radiological contamination of soils from high-level waste tank releases.
Groundwater	Construction: Potential for minor contamination from spills.	Construction: Potential less than Proposed Action.
	Operations: Projected radiation dose from saltstone releases (0.03 millirem per year) within DOE standards. Highest nitrate concentrations projected at 80% of drinking water standards over 1,400-year time period. Other contaminants at lesser fractions of drinking water standards.	Operations: Projected impacts from saltstone disposal less than Proposed Action. However, risk of releases from tanks and potential groundwater contamination would continue.
Surface Water	Construction: Potential for temporary minor contamination from sedimentation.	Construction: Potential less than Proposed Action.

	Operations: Small increase in discharges of nonradioactive treated wastewaters (nonradiological).	Operations: No impacts expected.
Air Resources - Nonradiological	Construction: Minor temporary increase in fugitive dust emissions.	Construction: Increase less than Proposed Action.
	Operations: Increased emissions of benzene, mercury, and formic acid; within standards at site boundary.	Operations: No changes from existing conditions expected.
Air Resources - Radiological	Construction: No impacts expected. Operations: MEI^a dose: 0.001 millirem per year; population dose: 0.07 person-rem per year.	Construction: No impacts expected. Operations: No changes from existing conditions expected.
Ecological Resources	Construction: Minor displacement of biota from clearing of 40 hectares (100 acres); no effects on local and regional populations. Operations: Potential for minor increases in cesium concentrations in terrestrial biota; no effects on local and regional populations.	Construction: Impacts less than Proposed Action. Operations: No impacts expected.
Land Use	Construction: Increase in land requirements for Z-Area vault expansion to up to 73 hectares (180 acres) already dedicated to industrial use. Thirty hectares (75 acres) already cleared. Operations: No impacts expected.	Construction: Increase in land requirements of approximately 8 hectares (20 acres) already cleared for Z-Area vault expansion. Operations: No impacts expected.
Socioeconomics	Construction and Operations: Less than 0.2% temporary increase in employment, population, and income in region.	Construction and Operations: Less than 0.9% decrease in employment, population, and income in region.
Traffic and Transportation	Construction and Operations: Minor increase in traffic count on onsite and offsite roads.	Construction and Operations: Minor decrease in traffic count on onsite and offsite roads. No net change in the number of shipments of wastes and material.

Public Health (normal operations)	Construction: No impacts expected. Operations: Calculated 0.00004 excess fatal cancer per year within 80 kilometers (50 miles) from radionuclide releases. Calculated increase in lifetime chance of fatal cancer to MEI^a of 12 in 100 million from benzene releases and 1.2 in 100 million from radionuclide releases.	Construction: No impacts expected. Operations: No changes from existing conditions expected.
Worker Radiological Health	Construction: No impacts expected. Operations: Calculated 0.05 excess fatal cancer per year within facility worker population.	Construction: No impacts expected. Operations: No changes from existing conditions expected.
Worker Nonradiological Safety and Health	Construction and Operations: Estimated 20 minor injuries or illnesses per year.	Construction and Operations: Less than Proposed Action.
Waste Generation	Construction and Operations: Demand on SRS waste management facilities as average percent of SRS waste generation (30-Year-Forecast) (FY1995 - FY2018): 18% low-level <1% hazardous 10% mixed 11% sanitary Highly radioactive failed melters and possibly other equipment to be stored in dedicated DWPF Failed Equipment Storage Vaults.	Construction and Operations: No increase in waste generation from forecast level.
Decontamination and Decommissioning (D&D)	Construction and Operations: Increase in SRS inventory of facilities requiring eventual D&D.	Construction and Operations: Greater delay in ultimate D&D of the tank farms and associated facilities than for the Proposed Action.

ACCIDENT ANALYSES

Radiological	MEI^a,b Maximum dose^d: 6.8 rem Maximum risk^c,d: ^ 1.8-10^-7 latent fatal cancer per year	MEI^a Maximum dose^d: 0.01 rem Maximum risk^c,d: 4.6-10^-8 latent fatal cancer per year
	Population^b Maximum dose^d: 76,000 person-rem Maximum risk^c,d: 0.002 latent fatal cancer per year	Population Maximum dose^d: 62 person-rem Maximum risk^c,d: 0.0003 latent fatal cancer per year
	Collocated worker^b,e Maximum dose^d: 4,000 rem Probability of this accident: 5.2-10^-5 per year^f	Collocated worker^e Maximum dose^d: 1.7 rem Maximum risk^c,d: 5.7-10^-6 latent fatal cancer per year^
Chemical	No site boundary concentrations exceeding ERPG^g values. Benzene, formic acid, and nitric acid concentrations onsite [100 m (328 ft)] exceed ERPG values.	No site boundary concentrations exceeding ERPG^g values. Nitric acid concentrations onsite [100 m (328 ft)] exceed ERPG values.

a. MEI = Maximally exposed (offsite) individual.
b. DOE is evaluating the details of proposed measures that would reduce these conse of 200, and would also reduce or eliminate the probability of this accident sequ
c. Risk is the product of accident frequency per year and consequences.
d. This table presents the maximum dose and maximum risk from the accidents analyze the maximum dose and maximum risk may not be from the same accident.
e. The collocated worker is defined as an individual located 100 meters (328 feet) release occurs.
f. The latent fatal cancer risk is not calculated because the dose (4000 rem) would
g. ERPG = Emergency Response Planning Guidelines.

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1.0 PURPOSE AND NEED FOR AGENCY ACTION

1.1 Introduction

The U.S. Department of Energy (DOE) has prepared this Supplemental Environmental Impact Statement (EIS) in accordance with provisions of the National Environmental Policy Act (NEPA) of 1969, as amended, which require Federal agencies to assess the environmental consequences associated with their actions. It is DOE policy (DOE 1994a) to follow the letter and spirit of NEPA and to comply fully with the regulations of the Council on Environmental Quality (40 CFR Parts 1500-1508). This policy is carried out in accordance with DOE's NEPA Implementing Procedures (10 CFR Part 1021).

1.2 Background

1.2.1 OVERVIEW

DOE's Savannah River Site (SRS) occupies approximately 800 square kilometers (300 square miles) adjacent to the Savannah River, principally in Aiken and Barnwell counties of South Carolina, about 40 kilometers (25 miles) southeast of Augusta, Georgia, and about 32 kilometers (20 miles) south of Aiken, South Carolina (Figure 1.1-1). When established in the early 1950s, SRS's primary mission was to produce nuclear materials to support the defense, research, and medical programs of the United States. SRS's present mission emphasizes waste management, environmental restoration, and decontamination and decommissioning of facilities that are no longer needed for its traditional defense mission.

1.2.2 LIQUID HIGH-LEVEL RADIOACTIVE WASTE MANAGEMENT

The process used in the past to recover uranium and plutonium from production reactor fuel and target assemblies in SRS's two chemical separations areas (F- and H-Areas) resulted in liquid high-level radioactive waste. This waste, which now amounts to approximately 129 million liters (34 million gallons) (WSRC 1994a), is stored in underground tanks in the F- and H-Areas located near the center of the Site (Figure 1.1-2). SRS currently generates small amounts of high-level waste as a result of limited production activities. After its introduction into the tanks, the high-level waste settles, separating into a sludge layer at the bottom of the tanks and an upper layer of salts dissolved in water (supernatant). Evaporation of the supernatant in the tank farms using evaporators results in a third waste form in the tanks, crystallized saltcake.

Figure 1.1-1.
Figure 1.1-1. Savannah River Site
Figure 1.1-2.
Figure 1.1-2. SRS areas and DWPF facility locations.

The main components of the sludge are oxides and hydroxides of aluminum and iron. The sludge also contains mercury, a hazardous substance added in the chemical separations process. The sludge contains greater than 60 percent of the radionuclides. The supernatant contains mostly sodium salts and soluble metal compounds with the main radioactive constituent being an isotope of cesium (WSRC 1994b). Tables A-1 and A-2 in Appendix A present the typical

chemical and radionuclide composition of the high-level radioactive waste.

Table A-3 in Appendix A describes each tank type and its respective construction dates, capacity, and key design features; it also indicates the percentage of total waste volume and radioactivity currently being stored in each type of tank. Figure A-1 in Appendix A lists the status and contents of each individual high-level waste tank. The 1980 Double-Shell Tanks for Defense High-Level Radioactive Waste Storage EIS contains a detailed discussion of tank designs (DOE 1980a).

This high-level waste must be responsibly managed to protect people, now and in the future, from potential hazards. DOE and others in the scientific and technical community have long expressed the view that immobilization of the waste into a highly stable form for disposal is the prudent approach to achieve this objective because tank storage presents continuing risk of releases to the environment and exposure to people, both from normal operations and accidents. Historical information on tank releases is presented in Table A-4 in Appendix A.

In 1980, DOE prepared an EIS and issued a Record of Decision to continue a research and development program to develop technology for removing these wastes from the tanks and immobilizing the highly radioactive constituents in a form suitable for disposal (DOE 1979, 1980b). In its Record of Decision, DOE indicated that immobilization was the process most likely to ensure that the waste would remain contained in a form that would pose the least threat to human health or the environment.

In 1982, DOE published an EIS and stated in its Record of Decision a decision to design, construct, and operate the Defense Waste Processing Facility (DWPF) to immobilize liquid high-level waste in a form suitable for safe storage and transport and ultimate disposal at a permanent geologic repository (DOE 1982a, 1982b). In its Record of Decision, DOE stated that tank storage is only a temporary solution to managing this high-level waste. Thereafter, DOE selected borosilicate glass as the medium of choice for stabilization of high-level waste at SRS after completing an Environmental Assessment (DOE 1982c).

1.2.3 COMPLIANCE AGREEMENTS

Since 1982, DOE has entered into two major compliance agreements with regulatory agencies that affect DWPF. The first is the Federal Facility Agreement with the U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (SCDHEC), made effective in August 1993 (EPA 1993a). It was developed to ensure that environmental restoration activities at the SRS meet applicable requirements of the Comprehensive Environmental Response, Compensation, and Liability Act and the Resource Conservation and Recovery Act. DOE committed in this agreement to remove the high-level waste from those high-level waste tanks and tank system components, such as piping, that do not meet stringent standards, including adequate secondary containment to minimize the potential for releases to the environment. DOE also committed to develop, and is in the process of negotiating, a waste removal plan and schedule to be approved by EPA and SCDHEC. This plan and schedule is based on operating DWPF, including In-Tank Precipitation (ITP) and Extended Sludge Processing, which EPA and SCDHEC formally recognize in the agreement as appropriate treatment for high-level waste.

The second of these agreements is the SRS Land Disposal Restrictions Federal Facility Compliance Agreement between DOE and EPA, first made effective in March 1991 and last amended in June 1994 (EPA 1994a). This agreement specifies actions DOE must take to ensure compliance with the land disposal restriction requirements of the Resource Conservation and Recovery Act. It applies to certain SRS hazardous wastes that are also radioactive (i.e., mixed wastes), including SRS's high-level waste. The land disposal restrictions

require that hazardous and mixed waste be treated to meet specific treatment standards to reduce potential hazards and limit the amount of waste that can be stored in an untreated condition. EPA has specified vitrification as the treatment to be used for high-level waste (EPA 1990), and the SRS Land Disposal Restrictions Federal Facility Compliance Agreement requires DOE to vitrify this waste in the DWPF system as necessary to support the waste removal plan and schedule developed in accordance with the Federal Facility Agreement.

DOE expects the SRS Land Disposal Restrictions Federal Facility Compliance Agreement to be replaced by a consent order from SCDHEC in October 1995. The consent order would be used to enforce provisions of a Site Treatment Plan that DOE is currently developing for treatment of all SRS mixed waste in accordance with the land disposal restriction treatment standards. The SRS Site Treatment Plan and Consent Order are being developed in response to provisions of the Federal Facility Compliance Act of 1992.

DOE currently plans to begin operating ITP and Extended Sludge Processing in early 1995 and to begin radioactive operation of the DWPF Vitrification Facility in late 1995 to ensure timely removal of waste from the high-level waste tanks. However, operations would not begin until DOE has completed its evaluations and issued a Record of Decision on this Supplemental EIS.

1.2.4 1982 DWPF SYSTEM DESIGN

The DWPF system design evaluated in the 1982 EIS is illustrated in Figure 1.1-3. The design called for construction of two large canyon buildings (heavily shielded buildings where processing of highly radioactive materials is done by remote control) in S-Area, one for sludge pre-treatment and the vitrification process and one for salt pre-treatment. Pre-treatment of the sludge for vitrification was to be done by boiling the sludge with sodium hydroxide in the vitrification facility. An organic/zeolite ion exchange system was proposed to separate the high-level waste salt fraction into two streams: a low-volume highly radioactive fraction containing the majority of the soluble radioactive components and a high-volume low radioactivity salt solution containing the remaining soluble radionuclides. The 1982 DWPF system design included immobilization of all three of these waste streams.

DOE chose a waste immobilization technology called vitrification to treat the high-level waste sludge and the highly radioactive fraction from salt pre-treatment (DOE 1982b). Since that time, EPA has specified vitrification as the technology to be used to treat high-level wastes such as those at the SRS (EPA 1990). The DWPF vitrification process is designed to immobilize the radionuclides and other hazardous constituents by incorporating them into borosilicate glass. As designed, the final glass form would be produced in the DWPF vitrification facility (Figure 1.1-3) by combining the highly radioactive portions of the waste with frit (finely ground glass), melting the resulting mixture, and pouring it into stainless steel canisters to solidify. The radioactive canisters would then be sealed and held onsite in a Glass Waste Storage Building until a permanent geologic repository became available for final disposal. The potential hazards posed by high-level waste immobilized in this manner would be greatly reduced (DOE 1982b, 1982c).

The DWPF process selected in 1982 featured construction and operation in two stages. Stage 1 included construction and operation of a vitrification facility, which operated only to process. Stage 2 included construction and operation of an ion exchange facility for salt pre-treatment for separating the highly radioactive fraction of the salt solution for vitrification and the low radioactivity fraction for solidification in Z-Area as saltcrete.

Figure 1.1-3.
Figure 1.1-3. 1982 DWPF system design.

1.2.5 CURRENT DWPF SYSTEM DESIGN

In its Record of Decision for the 1982 EIS, DOE indicated that design changes were likely to occur in the DWPF process before startup (DOE 1982b). As expected, continued research and development, startup testing, and related activities led to design changes to improve efficiency and safety of the DWPF system (DOE 1991a, 1994b). The proposed process flow diagram is shown in simplified form in Figure 1.1-4. The most notable of these changes relates to the pre-treatment process for separating the high-level waste salt solution into high radioactivity and low radioactivity fractions. In 1983, DOE replaced ion exchange with ITP for salt solution pre-treatment. ITP was found to be more effective for removal of radionuclides from salt solution than the ion exchange resin being tested at that time, and it would use existing tanks, eliminating the need to build another large canyon building.

Recognizing that substantial advances have been made in ion exchange technology since the early 1980s, DOE again evaluated ion exchange as a replacement for ITP in the early 1990s taking into consideration programmatic, technical, and cost factors (Boyter 1992; Scott 1993b). From this later evaluation, DOE concluded that ion exchange was technically feasible but that ITP was still preferred, mainly due to cost, time delays required for implementation, and the greater potential for unknown process problems with the ion exchange system.

The use of ITP would yield two output streams: a small volume of precipitate (solid) slurry containing the majority of the highly radioactive components (cesium, strontium, and plutonium) and a large volume of low radioactivity salt solution containing the remaining soluble radionuclides. The low radioactivity salt solution would be transferred to Saltstone Manufacturing and Disposal, and the highly radioactive precipitate slurry would be sent to the Vitrification Facility.

The ITP replacement for ion exchange led to other modifications including: (1) Late Wash (under construction) to remove nitrites from the precipitate slurry, (2) the Salt Process Cell in the Vitrification Facility to convert and remove organics (primarily benzene) from the precipitate slurry, (3) the Organic Waste Storage Tank to store the removed organics (a secondary waste stream), (4) nitric acid introduction into the Vitrification Facility's Sludge Receipt and Adjustment Tank for acidity adjustment and to restore the nitrate concentration removed by Late Wash to desired levels for proper control of melter chemistry, and (5) installation of ammonia-reducing scrubbers at the Vitrification Facility.

Figure 1.1-4.

Figure 1.1-4. Current DWPF system design (simplified).

Pre-treatment of the high-level waste sludge to remove aluminum hydroxide has also been modified. The process described in the 1982 EIS involved aluminum removal by boiling the sludge in a sodium hydroxide solution in the Vitrification Facility. The current design for sludge pre-treatment, called Extended Sludge Processing, involves washing the sludge with a sodium hydroxide solution in selected high-level waste tanks.

The treatment and disposal method assessed in 1982 for the low radioactivity salt solution in Z-Area was also modified. DOE originally proposed to dispose of the saltcrete grout mixture in engineered trenches, but changed to a material called saltstone to be disposed of in concrete vaults at Saltstone Manufacturing and Disposal. This facility also receives similar wastes from the F- and H- Area Effluent Treatment Facility.

Other modifications have been introduced: (1) changes to the Vitrification Facility ventilation system to improve safety by reducing the chance that

hydrogen gas would form in flammable concentrations, (2) elimination of an evaporator at the Vitrification Facility so the radioactive wastewater is returned to the tank farm evaporator system, (3) addition of HEPA filters to the melter off-gas system to improve the efficiency of the air emission controls, and (4) underground vaults (partially constructed) at S-Area for storing highly radioactive failed equipment.

1.3 Purpose and Need for Agency Action

DOE must now decide whether and how to proceed with the DWPF system as modified since the 1982 EIS while ensuring appropriate consideration of potential environmental effects. DOE believes it can make the best decision by reassessing the environmental effects of completing and operating the DWPF system in light of these design changes, by evaluating the potential impacts of alternatives, and by identifying viable measures available to reduce impacts.

The potential environmental impacts of DWPF design changes have been considered on an individual basis in previous NEPA documentation. In addition, two Supplement Analyses were prepared in January 1991 and February 1994 to assist DOE in determining if a Supplemental EIS was needed (DOE 1991a, 1994b). This EIS was prepared to analyze the cumulative environmental impacts of operating DWPF as currently designed, and to provide the public with an opportunity to comment on the current design or possible alternatives. As noted in Section 1.2, DOE is obligated in compliance agreements to operate the DWPF to treat SRS's high-level waste and remove it from the high-level waste tanks on a schedule presently being negotiated with regulatory agencies.

In view of these considerations, and on the basis of the February 1994 Supplement Analysis, DOE has determined that a focused EIS-level review of the environmental impacts of the DWPF as now envisioned is timely and appropriate (DOE 1994c). This supplement to the 1982 EIS will help DOE decide whether and how to proceed with the DWPF system by assessing the environmental impacts of completing and operating the DWPF system as currently designed and the environmental effects of reasonable alternatives.

1.4 Related National Environmental Policy Act Documents

Several NEPA reviews that have been recently completed, are in process, or have been planned could affect DWPF operations, as described below. These documents are briefly summarized in Table 1.4-1.

Table 1.4-1. Major NEPA reviews related to DWPF as of November 1, 1994.

Site	Title	Type of NEPA document	Status
Savannah River Site	Urgent-Relief Acceptance of Foreign Research Reactor Spent Nuclear Fuel	EA^a	FONSI^b issued
	Interim Management of Nuclear Materials at SRS	EIS	In preparation
	F-Canyon Plutonium Solutions	EIS	Draft issued
	SRS Waste Management	EIS	In preparation
	Operation of the HB-Line Facility and Frame Waste Recovery Unit for Production of Plutonium-238 Oxide	EA	In preparation
Idaho National	Programmatic Spent Nuclear Fuel Management and Idaho National	PEIS	Draft issued

Engineering Laboratory	Engineering Laboratory Environmental Restoration and Waste Management Programs		
Pantex	Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components	EIS	In preparation
DOE Headquarters	Environmental Restoration and Waste Management	PEIS	In preparation
	Reconfiguration of the Nuclear Weapon Complex	PEIS	In preparation
	Proposed Policy for the Acceptance of United States Origin Foreign Research Reactor Spent Nuclear Fuel	EIS	In preparation
	Storage and Disposition of Weapons-Usable Fissile Materials	PEIS	In preparation

a. EA = Environmental Assessment; EIS = Environmental Impact Statement; PEIS = Programmatic EIS.
b. FONSI = Finding of No Significant Impact.

1.4.1 URGENT-RELIEF ACCEPTANCE OF FOREIGN RESEARCH REACTOR SPENT NUCLEAR FUEL

DOE has prepared an Environmental Assessment on the urgent-relief acceptance of 409 spent nuclear fuel elements from eight foreign research reactors in seven European countries and issued a Finding of No Significant Impact. The spent fuel would be shipped to the United States and transported to the SRS for storage. The Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Programmatic EIS is considering management alternatives for the spent fuel elements. One alternative examined is processing that would result in high-level waste that could be immobilized at DWPF.

1.4.2 INTERIM MANAGEMENT OF NUCLEAR MATERIALS AT THE SRS

DOE is preparing an EIS on interim management of nuclear materials that will evaluate in-process and stored nuclear materials at SRS to determine whether any materials require near-term stabilization to ensure continued safe management.

1.4.3 F-CANYON PLUTONIUM SOLUTIONS AT THE SRS

DOE has issued a Draft EIS on plutonium solutions currently stored in F-Canyon that evaluates alternatives for stabilization of these materials. The alternatives examined are no-action, processing to a plutonium metal, processing to a plutonium oxide, and transferring the solutions to the high-level waste tanks for vitrification in DWPF. The Draft EIS states that DOE does not consider vitrification of plutonium solutions to be an attractive alternative because of the many technical issues that must be addressed to demonstrate its feasibility, including the potential for inadvertent criticality.

1.4.4 SRS WASTE MANAGEMENT

DOE is preparing the SRS Waste Management EIS to evaluate the potential environmental effects of minimization, treatment, storage, and disposal of radioactive, hazardous, and mixed waste streams at SRS. The SRS Waste Management EIS will provide a basis for DOE to select a sitewide strategic

approach to managing present and future SRS waste generated by several activities including ongoing operations and potential actions, new missions, environmental restoration, and decontamination and decommissioning. The SRS Waste Management EIS will include the treatment of wastewater discharges in the F- and H- Area Effluent Treatment Facility, F- and H-Area Tank Farm operations and waste removal, and the construction and operation of a high-level radioactive waste evaporator in the H-Area Tank Farm. The SRS Waste Management EIS will also evaluate the Consolidated Incineration Facility for waste treatment.

1.4.5 OPERATION OF THE HB-LINE FACILITY AND FRAME WASTE RECOVERY UNIT FOR PRODUCTION OF PLUTONIUM-238 OXIDE

DOE is preparing an Environmental Assessment regarding a proposal to operate the HB-Line Facility and the Frame Waste Recovery Unit at the SRS to process the remaining civilian inventory of plutonium-238 materials for future use in space missions as a heat source fuel. These activities would result in the creation of high-level waste that could be immobilized at the DWPF. The waste generated by the processing of plutonium-238 materials would be considered in the SRS Waste Management EIS.

1.4.6 PROGRAMMATIC SPENT NUCLEAR FUEL MANAGEMENT AND IDAHO NATIONAL ENGINEERING LABORATORY ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT PROGRAMS

DOE has issued this Draft Programmatic EIS that addresses alternatives for complex-wide management of existing and projected quantities of spent nuclear fuel for an interim period ending in 2035. One alternative examined is processing that would generate high-level waste that could be immobilized at DWPF.

1.4.7 CONTINUED OPERATION OF THE PANTEX PLANT AND ASSOCIATED STORAGE OF NUCLEAR WEAPON COMPONENTS

DOE is preparing an EIS that addresses the proposed continued operations of the Pantex Plant and continued current nuclear component storage activities at various DOE sites. Among the alternatives for Pantex Plant operations is recovery of highly enriched uranium that subsequently could be processed and would generate high-level waste that could be immobilized at the DWPF.

1.4.8 ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT

DOE is preparing this Programmatic EIS to evaluate complex-wide and site-specific alternative strategies and policies to maximize efficiency in DOE's environmental restoration and waste management programs.

1.4.9 RECONFIGURATION OF THE NUCLEAR WEAPON COMPLEX

DOE is preparing this Programmatic EIS to address reconfiguration of its nuclear weapons complex. DOE intends to separate the reconfiguration proposal into two parts and will prepare a programmatic EIS on each part (Federal Register, 59 FR 54175). The first programmatic EIS is the Tritium Supply and Recycling Programmatic EIS, which will address alternatives associated with new tritium production and the recycling of tritium recovered from weapons being retired from the stockpile. DOE plans to analyze alternative technologies for producing tritium at five candidate sites including SRS. Tritium production at SRS could generate high-level waste that could be immobilized at DWPF.

The second programmatic EIS is the Stockpile Stewardship and Management Programmatic EIS, which will address reconfiguration of the rest of the nuclear weapons complex. Decisions made in the Stockpile Stewardship and Management Programmatic EIS could result in generation of high-level waste that could be immobilized at DWPF.

1.4.10 PROPOSED POLICY FOR THE ACCEPTANCE OF UNITED STATES ORIGIN FOREIGN RESEARCH REACTOR SPENT NUCLEAR FUEL

DOE is preparing an EIS to evaluate the potential impacts of the adoption and implementation of a policy to accept foreign research reactor spent nuclear fuel that contains uranium enriched in the United States. Under the proposed policy, the United States would accept approximately 24,300 elements of highly enriched uranium or low-enriched uranium spent nuclear fuel from foreign research reactors in approximately 30 nations during a 10- to 15-year period. The implementation of this policy would result in the receipt of foreign research reactor spent nuclear fuel at one or more United States marine ports of entry and overland transport to one or more DOE sites (including SRS). One alternative being examined is processing that would generate high-level waste that could be immobilized at DWPF.

1.4.11 STORAGE AND DISPOSITION OF WEAPONS-USABLE FISSILE MATERIALS

DOE is preparing this Programmatic EIS to assist in the development of a comprehensive national policy for the storage and disposition of weapons-usable fissile materials. The term weapons-usable fissile materials is used to refer to a specific set of nuclear materials that could be used in making a nuclear explosive for a weapon but does not include the fissile materials present in spent nuclear fuel or irradiated targets from reactors. One alternative being examined is processing that would generate high-level waste that could be immobilized at DWPF.

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2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Introduction

DOE has selected the following alternatives for analysis in this Supplemental EIS.

Proposed Action: Continue construction and begin operation of DWPF as currently designed. DOE would continue the DWPF process and facility modifications that are currently underway, complete startup testing activities, and operate once startup testing is complete. DOE has identified the proposed action as its preferred alternative.

No-Action: Do not operate the Vitrification Facility and associated facilities and structures, In-Tank Precipitation (ITP), or Extended Sludge Processing. Continue to manage SRS high-level waste in the F- and H-Area Tank Farms for an indefinite period until an alternative to the DWPF can be developed to effectively immobilize the liquid high-level radioactive waste. Continue current Saltstone Manufacturing and Disposal operations to treat waste from the F- and H- Area Effluent Treatment Facility.

Ion Exchange as an ITP Pre treatment Replacement: Replace ITP with ion exchange for high-level waste pre-treatment. DOE identified two feasible ways to implement this alternative.

- Phased Replacement: Operate ITP until an ion exchange replacement is available, which DOE estimates would take approximately 14 years under routine conditions.

- Immediate Replacement: Do not operate ITP. Continue to store high-level waste in the tanks until an ion exchange replacement is available, which, under an accelerated schedule, may be achievable in 10 years.

The proposed action, no-action, and the ion exchange replacement alternatives are discussed in Sections 2.2, 2.3, and 2.4, respectively. Section 2.5 discusses immobilization alternatives to borosilicate glass as the waste form produced by the DWPF, and Section 2.6 provides a summary comparison of the analyzed alternatives. Appendix A provides supplemental technical data.

2.2 Proposed Action

2.2.1 OVERVIEW

The proposed action is to continue construction and begin operation of the DWPF system as currently designed. DOE would continue the DWPF process and facility modifications that are currently underway, complete startup testing activities, and operate once startup testing was complete.

The DWPF system as currently designed includes facilities and structures located in S- and Z-Areas and the H-Area Tank Farm (Figure 1.1-2). Major facilities and structures are listed below. The environmental permitting and operational status of these facilities and structures is presented in Table 2.2-1. Sections 2.2.2 through 2.2.7.1 discuss the individual facilities and structures of the DWPF.

Pre-Treatment Processes, H-Area:

- Extended Sludge Processing
- In-Tank Precipitation
- Late Wash

Saltstone Manufacturing and Disposal (Figure 2.2-1 and Photo 2.2-1), Z-Area:
- Saltstone Manufacturing Plant
- Saltstone Disposal Vaults

Vitrification Facility (Photo 2.2-2), S-Area:
- Salt Process Cell
- Chemical Process Cell
- Mercury Purification Cell
- Melt Cell
- Canister Decontamination Cell
- Weld Test Cell

Table 2.2-1. Environmental permitting and operational status of DWPF facilities and structures.

Facility/structure	Operating status	Environmental permitting status
Dxtended Sludge Processing	Constructed and undergoing startup testing	Clean Water Act operating permit received
In-Tank Precipitation	Constructed and undergoing startup testing	Clean Water Act operating permit received Clean Air Act construction permit (nonradiological) received; operational permit pending SCDHEC inspection and completion of process modifications. ITP diesel generator - permit to operate pending operational tests and SCDHEC inspection Radiological air emissions construction approval received, but emission monitoring devices must be upgraded to meet current regulatory standards
Late Wash	Under construction	Clean Water Act construction permit received Clean Air Act construction permit received - permit to operate pending process modification completion
Saltstone Manufacturing Plant	Operating; treating waste concentrate from F- and H-Area Effluent Treatment Facility	Clean Water Act operating permit received Clean Air Act operating permit received
Saltstone Disposal Vaults	Two of 15 planned vaults constructed and operating; solidified waste concentrate from F- and H-Area Effluent Treatment Facility disposed in two constructed vaults	Industrial Waste Landfill permit received

Vitrification Facility	Constructed and undergoing startup testing	Clean Water Act operating permit received Clean Air Act construction permit (nonradiological) received; Canyon Stack Modifications - permit to operate pending process modification completion Radiological air emissions construction approval received, but emission monitoring devices must be upgraded to meet current regulatory standards
Chemical Waste Treatment Facility	Operating	Clean Water Act operating permit received
Glass Waste Storage Buildings	First building complete and awaiting startup; second building being planned	Covered under the Vitrification Facility permits
Organic Waste Storage Tank	Operating	Clean Air Act operating permit received Resource Conservation and Recovery Act interim status
Sewage Treatment Plant	Operating	Clean Water Act operating permits received
Water well system	Operating	Well approvals received

Figure 2.2-1.
Figure 2.2-1. Z-Area Layout
Figure Photo 2.2-1.
Photo 2.2-1. Saltstone Manufacturing and Disposal
Figure Photo 2.2-2.
Photo 2.2-2. DWPF Vitrification Facility

Support Facility and Structures Associated with the Vitrification Facility (Figure 2.2-2), S-Area:

- Chemical Waste Treatment Facility
- Organic Waste Storage Tank
- Glass Waste Storage Buildings
- Failed Equipment Storage Vaults

Utilities (Figure 2.2-2), S-Area:

- Water Well System
- Sewage Treatment Plant

Based on current operating plans and projected funding, high-level waste processing would be completed in approximately 24 years (WSRC 1994c).

The proposed action does not include certain DWPF design or operational modifications that would be made if they were found to be necessary as a result of ongoing startup testing or subsequent operation of the DWPF system. The environmental impacts of these modifications would be assessed in accordance with DOE's NEPA regulations (10 CFR Part 1021) to determine if additional NEPA documentation is required.

Operation of the DWPF system could be extended beyond 24 years if the volume

of high-level radioactive waste to be immobilized increases as a result of decisions made after other NEPA reviews. (See Section 1.4 for discussion of related NEPA documents.) Taking into account preliminary information available from the Proposed Policy for the Acceptance of United States Origin Foreign Research Reactor Spent Nuclear Fuel EIS, the Urgent-Relief Acceptance of Foreign Research Reactor Spent Nuclear Fuel Environmental Assessment, the F-Canyon Plutonium Solutions EIS, and the Interim Management of Nuclear Materials EIS, the incremental volume of high-level radioactive waste that could result from these activities and might be processed in DWPF is small compared to the 129 million liters (34 million gallons) of high-level radioactive waste currently stored in the tank farms. The cumulative environmental impacts of the proposed action plus the activities and facilities evaluated in these other NEPA documents are presented in Section 4.1.17. Information regarding the volume of high-level radioactive waste that could be generated by activities to be evaluated in the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components and the Storage and Disposition of Weapons-Usable Fissile Materials EISs is not yet available.

Figure 2.2-2.

Figure 2.2-2. S-Area layout.

Material Consumption

The DWPF system would use various materials in the pre-treatment and immobilization of high-level waste. Table A-5 in Appendix A presents the estimated annual consumption amounts of these materials. The use of the materials is explained in the individual process descriptions in Sections 2.2.2 through 2.2.5.

Waste Streams

The DWPF system would emit gases and radiological and nonradiological particulates into the atmosphere. The main organic emission would be benzene. Other emissions would include nitrogen oxides, carbon monoxide, sulfur dioxide, diphenyl mercury, and other volatile organics. Summaries of estimated air emissions from the proposed action are included in Tables A-6 and A-7. The air emissions permit limits for nonradiological pollutants are presented in Tables A-8, A-9, and A-10 in Appendix A. Provisions for monitoring air emissions from DWPF are described in the process description sections below.

Radioactive wastewater that would be generated by the Vitrification Facility and radioactive and nonradioactive wastewater generated by Extended Sludge Processing, ITP, Late Wash, and Saltstone Manufacturing would be recycled and reused. Nonradioactive wastewater from the Vitrification Facility is treated and discharged in accordance with South Carolina Department of Health and Environmental Control (SCDHEC) permits (Section 2.2.5.1). Sanitary wastewater from S- and Z-Areas is treated and discharged in accordance with SCDHEC permits (Section 2.2.6).

Stormwater runoff from the ITP and Extended Sludge Processing structures currently passes (and would continue to be passed) through radiation monitors. If uncontaminated, it is released via a National Pollutant Discharge Elimination System permitted outfall to Fourmile Branch. If contamination is suspected (i.e., radiation alarm monitors are activated), runoff is diverted to the H-Area stormwater retention basin. The water within the basin is sampled and analyzed and, if within permitted and SRS radioactivity limits, it is discharged via a National Pollutant Discharge Elimination System permitted outfall to Fourmile Branch. If contaminated, it is treated at the F- and H-Area Effluent Treatment Facility.

All construction at SRS must comply with state erosion and sedimentation control requirements of stormwater discharge regulations. These regulations,

which became effective in 1992 as part of the Clean Water Act, and associated permits issued under these regulations require DOE to prepare erosion and sediment control plans for all projects, regardless of the area of land disturbed. The U.S. Soil Conservation Service also reviews the plans developed by Westinghouse Savannah River Company. For projects disturbing less than 0.8 hectares (2 acres), the Westinghouse Savannah River Company Environmental Protection Department must approve the plan; the plan is then sent to SCDHEC for information. For projects disturbing more than 0.8 hectares (2 acres), approval must be obtained from SCDHEC.

Throughout the life of the project, SCDHEC, Westinghouse Savannah River Company, the U.S. Soil Conservation Service, and the U.S. Forest Service monitor the effectiveness of the erosion control measures; SRS personnel correct noted deficiencies. In addition, the Savannah River Ecology Laboratory has been monitoring Upper Three Runs and its tributaries near the DWPF since 1982 to assess the impact of DWPF construction activities on these streams and the effectiveness of erosion control measures. Erosion and sedimentation control plans (WSRC 1993g, 1994o) have been developed for Late Wash (formerly the auxiliary pump pit), currently under construction. Before beginning construction of a second Glass Waste Storage Building and additional Saltstone Disposal Vaults, DOE would develop erosion and sediment control plans for those facilities and other facilities to be constructed as part of the proposed or alternative actions considered in this Supplemental EIS. After construction is completed, erosion and sedimentation control measures would be included in the SRS Stormwater Pollution Prevention Plan (WSRC 1993p), which is a requirement of the stormwater permit covering operational activities (Permit SCR000000).

The solid wastes that would be generated by the DWPF system include low-level radioactive waste such as high efficiency particulate air (HEPA) filters and job control waste (protective clothing and radiological survey waste); hazardous waste such as laboratory waste; mixed waste such as spent microfilters and DWPF organic waste; failed melters or other highly radioactive failed equipment designated for interim storage in the Failed Equipment Storage Vaults; and sanitary (nonhazardous, nonradioactive) waste such as waste paper and cafeteria waste. Also, during construction of the facilities listed above, debris would be generated and disposed as nonhazardous, nonradioactive waste.

Table A-11 in Appendix A presents the forecasted volumes of each type of solid waste that would be generated by the proposed action.

2.2.2 PRE-TREATMENT PROCESSES

2.2.2.1 Extended Sludge Processing

The high-level waste sludge would be pre-treated in a process called Extended Sludge Processing, which uses existing high-level waste tanks, transfer lines, and slurry pumps in the H-Area Tank Farm. Extended Sludge Processing would remove aluminum hydroxide and soluble salts from the sludge before it is transferred to the Vitrification Facility by interarea pipeline via the Low Point Pump Pit (WSRC 1993a). Aluminum affects the hardness of the glass and the overall volume of glass waste, and soluble salts interfere with desired chemical composition of the glass waste.

Sludge would be washed in batches of approximately 2.6 million liters (700,000 gallons). Due to variations in the composition of the sludge batches, 4 to 17 washing cycles using from 757,000 liters to 2.3 million liters (200,000 gallons to 608,000 gallons) of wash water per cycle would be required to reduce the concentration of soluble salts to levels acceptable for feed to the Vitrification Facility. The washing process for a batch of sludge would take about 22 months to complete and would provide about 2.4 years of feed at 75 percent attainment for the Vitrification Facility. The sludge would be

transferred to the Vitrification Facility in 22,700-liter (6,000-gallon) batches (WSRC 1993a). The estimated chemical and radionuclide compositions of washed sludge are presented in Tables A-12 and A-13, respectively, in Appendix A.

The waste streams from Extended Sludge Processing would include air emissions and solid waste. Wastewater would be recycled and reused but not discharged from the process. The air emissions would consist of radionuclides that would be controlled by HEPA filters on the tanks. These emissions would be monitored for radioactive particulates using continuous sampling devices (DuPont 1988; WSRC 1993a). Low-level waste, mainly composed of HEPA filters and job control waste such as personal protective clothing and radiological survey waste, would be generated.

2.2.2.2 In-Tank Precipitation

As discussed in Section 1.2, ITP is a major modification from the 1982 design. The decision to replace ion exchange with ITP was made for several reasons. DOE determined that ITP would remove more cesium than the organic/zeolite ion exchange system, and studies indicated that ITP would be economically superior to ion exchange (Lee and Kilpatrick 1982). Finally, ITP could use existing tanks in the H-Area Tank Farm whereas ion exchange would require construction of a major additional canyon building. Related parts of ITP such as control rooms, chemical feed tanks, the filter building, and stack have been constructed (Photo 2.2-3). ITP would operate after scheduled testing has been completed in early 1995.

The process of in-tank precipitation (Figure 2.2-3) is designed to convert high-level waste into a form suitable for feed to the Vitrification Facility. The saltcake in the high-level waste tanks would be dissolved with the addition of inhibited water containing sodium hydroxide and sent to ITP. At ITP, sodium titanate would be added to adsorb strontium and plutonium, and sodium tetraphenylborate would be added to precipitate cesium, thereby removing these radionuclides from solution. The precipitate slurry would be agitated and pumped through a microfilter, which would separate the low radioactivity salt solution (filtrate) from the highly radioactive precipitate solids containing strontium, plutonium, and cesium. The low radioactivity salt solution would then be stripped of benzene (benzene forms from the radiolytic breakdown of the tetraphenylborate) using nitrogen gas in a stripping column, and sent to Saltstone Manufacturing and Disposal. Approximately 22.7 million liters (6 million gallons) of low radioactivity salt solution would be produced each year (WSRC 1993a). Table A-14 in Appendix A presents the typical chemical and radionuclide composition of the low radioactivity salt solution.

The precipitate solids would be washed to remove water-soluble salts and excess chemicals. Wastewater generated during the process would be recycled and reused. Sodium nitrite would then be added to the washed precipitate slurry to prevent corrosion of the tanks, and the slurry would be moved to a holding tank until needed by the Vitrification Facility. Approximately 1.9 million liters (490,000 gallons) of washed precipitate would be produced each year (WSRC 1993a). Table A-15 in Appendix A presents the typical chemical and radionuclide composition of the washed precipitate slurry.

The primary air emissions from ITP would be benzene, diphenyl mercury, and volatile radionuclides. Particulate emissions from the stripper would be controlled by a high efficiency mist eliminator and HEPA filters downstream (Figure 2.2-3). Particulate emissions from the high-level waste tanks would be controlled by HEPA filters. The permit limits for benzene and diphenyl mercury are presented in Table A-8 of Appendix A. Air emissions from ITP process tanks and filter building would be continuously monitored for benzene and continuously sampled for radioactive particulates (WSRC 1993a; Broaden 1994).

Figure Photo 2.2-3.
Photo 2.2-3. In-Tank Precipitation.
Figure 2.2-3.
Figure 2.2-3. In-Tank Precipitation process flow (simplified).

The solid wastes that would be generated at ITP include low-level radioactive waste such as HEPA filters, protective clothing, radiological survey waste, and decontamination waste; hazardous waste such as laboratory waste; mixed waste such as spent microfilters; and sanitary (nonhazardous, nonradioactive) waste such as waste paper.

As ITP microfilters become inefficient they must be replaced. The resulting waste filters, which would be highly radioactive and would contain leachable mercury and benzene, are considered mixed waste. The spent filters would be washed with sodium hydroxide and oxalic acid to remove mercury and solids from the filters. The washed filters would be placed in a shielded containment box. DOE proposes to dispose of the box in the proposed SRS Hazardous Waste/Mixed Waste Disposal Vaults, an action which will be addressed in the SRS Waste Management EIS. The treatment residue generated by washing the ITP filters would be returned to the process.

2.2.2.3 Late Wash

The existing auxiliary pump pit located in H-Area is being transformed into Late Wash and is now under construction. Wastewater and air permit modification construction permits have been received. Operating permits would be issued after final inspection of the completed facility.

When needed by the Vitrification Facility, precipitate slurry from ITP would be transferred to Late Wash for final washing. Sodium nitrite, added during the ITP process to prevent tank corrosion, would be reduced by Late Wash to prevent the formation of high-boiling point organic compounds, which testing has indicated would foul heat transfer surfaces in the Vitrification Facility's Salt Process Cell where precipitate hydrolysis occurs (WSRC 1994c). The reduction in nitrite concentration would also allow a catalyst concentration during precipitate hydrolysis that would not exceed the copper solubility limit in glass. By reducing nitrites in the precipitate slurry and reducing or eliminating other chemicals that would have been added during the precipitate hydrolysis process, use of the late wash process would reduce the quantity of the radioactive glass waste (DOE 1994b).

Late Wash would involve adding sodium tetraphenylborate to precipitate residual soluble cesium, and then reducing the nitrite concentration from the precipitate slurry by a filtration/dilution process using a microfilter similar to the one used at ITP. The Late Wash batch operation is designed to process batches of approximately 13,000 liters (3,400 gallons) of precipitate slurry. The washed slurry would be sent to the Vitrification Facility's Salt Process Cell by means of the Low Point Pump Pit. The filtrate produced during Late Wash operations would be stripped of benzene, chemically adjusted with sodium hydroxide, and transferred to the tank farm for reuse at ITP (WSRC 1994c).

The waste streams from Late Wash include air emissions and solid waste. Wastewater that would be generated during the process would be recycled and reused but would not be discharged. Air emissions from Late Wash would include benzene and radionuclides. Particulate emissions would be controlled by HEPA filters, a condenser, and a mist eliminator. Radioactive particulate emissions would be continuously sampled (Cauthen 1994b). The air emissions permit limit for benzene is 1.34 metric tons (1.5 tons) per year (SCDHEC 1994).

The solid waste generated at Late Wash would include low-level radioactive waste such as HEPA filters, job control waste, and spent filters which may qualify as mixed waste. DOE plans to manage these spent filters in a manner

similar to spent ITP filters (Section 2.2.2.2). Also, during construction, debris would be generated and disposed of as nonradioactive solid waste.

2.2.3 SALTSTONE MANUFACTURING AND DISPOSAL

The 1982 design proposed stabilizing the low radioactivity salt solution with cement to form "saltcrete," which would have been buried in underground engineered trenches. As a result of further research and development, the waste form was changed from a salt solution and cement matrix called "saltcrete" to a salt solution, cement, flyash, and slag matrix called "saltstone" (Whitfield 1988). The volume of saltstone to be disposed of increased due to the concentration of salt solution in the waste form. The volume further increased because the salt solution would be blended with a waste concentrate from the F- and H-Area Effluent Treatment Facility. Saltstone is less permeable and leachable than saltcrete.

The disposal method was also changed from the 1982 design. The initial disposal concept was to use engineered trenches that would be backfilled with native soil. Groundwater protection standards resulted in the need for an improved disposal method. Modeling studies showed that disposal in concrete vaults was likely to reduce the release of contaminants to levels that would meet the groundwater protection standards (Martin Marietta et al. 1992). The new facility required more land area [approximately 73 hectares (180 acres) versus 14 hectares (35 acres)] than the original treatment and disposal concept (DOE 1991a). To further reduce the leaching of contaminants into the groundwater, a temporary rain cover is used when the vault cell is being filled and a waste-free grout cap is placed over the vault cell when filled. Moreover, the planned closure of the vaults would involve placement of a sequence of clay/gravel, clay, gravel, and geotextile fabric layers totaling approximately 3 meters (10 feet) over each vault to reduce infiltration of rain water (Martin Marietta et al. 1992).

Saltstone Manufacturing and Disposal consists of the Saltstone Manufacturing Plant and Disposal Vaults (Figure 2.2-4 and Photo 2.2-1). The manufacturing plant is complete and two vaults (a single and a double) have been constructed. Thirteen more double vaults are planned. Each double vault is 180 meters (600 feet) long, 60 meters (200 feet) wide, 7.6 meters (25 feet) tall (Martin Marietta 1992). The vertical walls are 0.45 meters (1.5 feet) thick, while the base slab is 0.75 meters (2.5 feet) thick. Each vault will be divided into 12 cells (6 per side). The single vault is one half this width and has only six cells (WSRC 1992a). The facility has been operational since 1990 to treat and dispose of the waste concentrate from the F- and H-Area Effluent Treatment Facility. In the past, low-level waste from the Naval Fuel Material Facility was also disposed of at the vaults as allowed by SCDHEC (WSRC 1992a). The proposed action is to treat and dispose of a blend of eight parts of the low radioactivity salt solution from ITP with one part waste concentrate from the F- and H-Area Effluent Treatment Facility. Tables A-16 and A-17 in Appendix A present the approximate chemical and radionuclide composition of this waste blend. Saltstone Manufacturing and Disposal is expected to operate for about 30 years (WSRC 1992a).

Figure 2.2-4 illustrates the saltstone manufacturing process in which dry feed materials would be mixed with the low radioactivity salt solution to produce saltstone. The low radioactivity salt solution would be transferred in batches of approximately 95,000 to 132,000 liters (25,000 to 35,000 gallons) at the maximum rate of one batch per day (WSRC 1993a) to the Salt Solution Hold Tank. Dry materials (cement, slag, and flyash) would be blended in the desired ratio and transferred to the Premix Feed Bin. Premix and the low radioactivity salt solution would be fed to a mixer to produce saltstone grout for pumping to the concrete disposal vaults. Except for special design considerations and operating procedures because of the presence of low levels of radionuclides, the process is similar to a concrete batch plant.

The waste streams from Saltstone Manufacturing and Disposal include air emissions and solid waste. Wastewater that would be generated during the process would be recycled and reused, but would not be discharged from the process. The air emissions from Saltstone Manufacturing and Disposal include particulates, nitrogen oxides, carbon monoxide, sulfur dioxide, volatile organics, and volatile radionuclides. Particulate emissions are controlled by baghouses and HEPA filters (Figure 2.2-4). Table A-9 of Appendix A presents the air emissions permit limits for the nonradiological pollutants. The solid waste that would be generated at Saltstone Manufacturing and Disposal includes low-level radioactive waste such as HEPA filters and job control waste and sanitary (nonhazardous, nonradioactive) waste such as waste paper. Also, during construction of the additional vaults, construction debris would be generated. Anticipated radiological air emissions are listed in Table A-7 of Appendix A. Radiological effluent monitoring consists of two continuous sampling systems to monitor gaseous emissions at the operations building stack and the process building stack (WSRC 1992a).

Figure 2.2-4.

Figure 2.2-4. Saltstone Manufacturing and Disposal flow diagram.

2.2.4 VITRIFICATION FACILITY

As envisioned in 1982, the Vitrification Facility would immobilize the highly radioactive portion of the high-level waste by incorporating it into melted borosilicate glass and pouring the radioactive mixture into stainless steel canisters. DOE kept this basic concept in the current design but made safety improvements and added the Salt Process Cell for preparing the precipitate slurry.

The Vitrification Facility has been constructed and is undergoing nonradioactive startup testing. The facility consists of a series of remotely operated, heavily shielded process cells for preparing feed, making glass, and filling, sealing, and decontaminating canisters (Figure 1.1-4). These cells are the Salt Process Cell, Chemical Process Cell, Melt Cell, Canister Decontamination Cell, and Weld Test Cell. In addition, the Vitrification Facility has cold feed areas, a laboratory, and other support areas.

2.2.4.1 Salt Process Cell

Precipitate slurry from Late Wash would be transferred to the Salt Process Cell via the Low Point Pump Pit, where it would be prepared for blending with the sludge feed. The precipitate slurry feed would undergo acid hydrolysis for the purpose of separating it into a low radioactivity organic portion and a high radioactivity water-based portion. The organic portion would be separated from the water-based portion with condenser-decanters, washed to reduce the level of cesium, and then sent as a waste stream to the Organic Waste Storage Tank outside the vitrification building. The water-based portion would be sent to the Chemical Process Cell, and the noncondensable gases would vent to the Process Vessel Vent System (WSRC 1993b).

2.2.4.2 Chemical Process Cell

The Chemical Process Cell would receive the washed sludge from Extended Sludge Processing via the Low Point Pump Pit (Section 2.2.5.5), adjust it with nitric acid, and combine it with the water-based portion of the precipitate slurry in the Sludge Receipt and Adjustment Tank. The combined waste stream would then be mixed with frit and concentrated as feed to the Melt Cell. Overhead condensers attached to the tanks would condense the vapors and gases that result and recycle the condensates to the Recycle Collection Tank for subsequent transfer to the H-Area Tank Farm (WSRC 1993b). In the 1982 EIS, wastes generated during the vitrification process were to be treated in wastewater systems located in S-Area.

Initially, formic acid was to be added to the Sludge Receipt and Adjustment Tank to reduce metal oxides. However, testing indicated that decomposition of the formic acid resulted in the generation of unacceptable quantities of hydrogen gas, and Late Wash resulted in a nitrate-poor feed, so nitric acid was substituted. Nitrate-poor feed could cause metals to deposit on the bottom of the melter, and could potentially cause electrical short circuits, while high concentrations of hydrogen gas present an explosion hazard (WSRC 1992b). Nitric acid would supply the needed nitrates and yield less hydrogen gas than formic acid. To prevent buildup of hydrogen gas, a design modification has been incorporated to increase the air flow through the Sludge Receipt and Adjustment Tank, the Slurry Mix Evaporator, and Melter Feed Tank (WSRC 1993b).

Ionizing radiation from the normal decay of radionuclides in the precipitate slurry forms ammonium ions, which remain in the water-based portion. Testing indicated that ammonia could react with oxides of nitrogen and allow ammonium nitrate, a known explosive, to build up in the system. To reduce the chance of explosion, packed bed scrubbers were added to treat the vapor effluents from the tanks in the Chemical Process Cell (i.e., the Sludge Receipt and Adjustment Tank, the Slurry Mix Evaporator, the Recycle Collection Tank, and the Melter Feed Tank) (WSRC 1993b).

The Melter Off-Gas System is located in the Chemical Process Cell and Melt Cell and consists of two parallel systems, one as a backup. The melter off-gas would pass through a quencher to cool the gases, a scrubber to remove particulate matter, a condenser to remove moisture and mercury, a high efficiency mist eliminator to remove moisture and particulates, a HEPA filter to remove remaining submicron particles, and an exhauster fan which discharges the treated gas to the building exhaust system. The building exhaust system would pass the gases through a sand filter for additional particulate removal before discharge to the atmosphere through a stack (WSRC 1993b). In the 1982 design, the melter off-gas was not passed through a HEPA filter before reaching the sand filter (DOE 1982a).

2.2.4.3 Mercury Purification Cell

The Mercury Purification Cell would receive mercury from the Chemical Process Cell. The mercury would be washed, passed through packed columns with nitric acid and then with water, distilled, and packaged in storage containers (WSRC 1993b). Approximately 3,600 kilograms (8,000 pounds) of mercury would be recovered annually at 75 percent attainment (Towns 1993). The recovered DWPF mercury product was to be reused in canyon separations, but due to mission changes described in Chapter 1, is no longer needed. DOE has explored sale of this product to an offsite vendor and is currently reviewing other options, including amalgamation. The spent acid and water washes from the Mercury Purification Cell would return to the Chemical Process Cell for recycle to the H-Area Tank Farm (WSRC 1993b).

2.2.4.4 Melt Cell

The Melt Cell operation would heat the waste feed and frit mixture to form glass, pour it into a stainless steel canister, and seal the canister with a temporary plug. Each canister would contain approximately 1,680 kilograms (3,700 pounds) of glass. The typical glass waste would be about 72 percent frit and 28 percent waste (WSRC 1993b). The glass would be produced to a set of specifications contained in the Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms (DOE 1993f). The steps to be taken to meet those specifications are described in the DWPF Waste Form Compliance Plan (WSRC 1994n). Tables A-18 and A-19 in Appendix A present the estimated chemical and radionuclide composition of the glass waste, respectively.

2.2.4.5 Canister Decontamination and Weld Test Cells

The Vitrification Facility also includes the Canister Decontamination Cell and the Weld Test Cell. In the Canister Decontamination Cell, a slurry of glass frit would be used to remove potentially contaminated brown oxide coating off the canisters that would form as the canisters are filled. High pressure slurry blasting, similar to sandblasting, is used to remove this oxide coating. The used frit slurry would be recycled as feed to the glass melter. The decontaminated canister would have a final plug welded at the Weld Test Cell. Canister weld quality would be checked, the radiation and temperature levels monitored, and canisters surveyed to ensure the absence of radioactive contamination on the outside of the canisters before filled canisters would be transferred to the Glass Waste Storage Building (WSRC 1993b). These operations would be done remotely because the filled canisters would be highly radioactive.

2.2.4.6 Waste Streams

The Vitrification Facility would emit gases and radiological and nonradiological particulates. The main organic emission would be benzene. Trace quantities of phenol, triphenyls, biphenyl, diphenylamine, aniline, and diphenyl mercury would also be emitted.

The Vitrification Facility's ventilation system is divided into three zones determined by contamination levels. Zone 1 would serve areas with the highest potential for contamination, passing air through a sand filter before discharge through a stack. Zones 2 and 3 provide ventilation for areas of lower contamination such as personnel-occupied areas and corridors. Zone 3 discharges to Zone 2 where the air would pass through HEPA filters before discharge through another stack (WSRC 1993b). Table A-10 in Appendix A presents the air emissions permit limits for nonradiological pollutants.

Vitrification Facility air emissions would be monitored for radioactive and nonradioactive parameters. Radiological parameters that would be monitored include particulates (continuous sampler), iodine (carbon filter), noble gases (Kanne chamber), and high radiation levels (Geiger-Mueller detector). Nonradiological parameters that would be monitored include benzene (infrared technology), mercury (ultraviolet technology), and nitrogen oxides (chemiluminescence technology) (WSRC 1993b; Cauthen 1994b).

The Vitrification Facility would generate low-level radioactive waste, mixed waste, hazardous waste, and sanitary waste as a result of operations. Low-level waste would include job control wastes and air filters. Mixed and hazardous waste would be generated by laboratory operations. Highly radioactive melters and possibly other failed equipment would also be generated, and would be stored in the DWPF Failed Equipment Storage Vaults until a permanent disposal facility is identified. Nonhazardous and nonradioactive solid waste would be composed of office and cafeteria waste.

The Vitrification Facility would recycle approximately 37,850 liters (10,000 gallons) of radioactive wastewater per day at 75 percent attainment (Jacobs et al. 1993) [22,710 liters (6,000 gallons) at 45 percent attainment] to the high-level waste tank evaporator system after radioactive operations have begun. The Mercury Purification Cell, the Chemical Process Cell, the Melter Off-Gas and Process Vessel Vent Systems, the laboratory, and various condensate streams would generate this wastewater. Distillate from the tank farm evaporators would be sent to the F- and H-Area Effluent Treatment Facility for treatment before discharge to Upper Three Runs as is currently part of normal tank farm operations. During nonradioactive startup testing, the wastewater is, and would continue to be, sent to the F- and H-Area Effluent Treatment Facility or an offsite publicly-owned treatment facility (Dunaway 1994a). The Vitrification Facility is expected to generate

approximately 19,000 liters (5,000 gallons) per day of wastewater during nonradioactive startup testing (WSRC 1994c).

Options to reduce the DWPF recycle wastewater are in the investigation stage. Depending on the option chosen, a reduction in the DWPF recycle wastewater could have the following advantages:

- Less makeup water needed in the Vitrification Facility processes
- Less wastewater would be returned to the tank farms for processing through evaporators, resulting in less volume of evaporator distillate to be sent to the F- and H-Area Effluent Treatment Facility for treatment before being discharged to the environment

Nonradioactive wastewater management is described below in Section 2.2.5.1.

2.2.5 SUPPORT FACILITY AND STRUCTURES ASSOCIATED WITH THE VITRIFICATION FACILITY

2.2.5.1 Chemical Waste Treatment Facility and Cooling Tower

The Chemical Waste Treatment Facility, which receives and neutralizes nonradioactive wastewater from the Vitrification Facility, is operational at the rate of approximately 3,800 liters (1,000 gallons) per day (Damani 1994). The neutralized wastewater is then discharged to Upper Three Runs via McQueen Branch through a National Pollutant Discharge Elimination System permitted outfall (DW-004).

A cooling tower, currently in operation for startup testing, serves the Vitrification Facility and produces wastewater (cooling tower blowdown), which is discharged to Outfall DW-004 [approximately 140,000 liters (37,000 gallons) per day (Damani 1994)]. The cooling tower blowdown mixes with the neutralized wastewater and flows through a radiation monitor during radioactive operations. If radioactivity were suspected, the stream would be diverted to a tank, checked, and, if necessary, treated at the F- and H- Area Effluent Treatment Facility. The DW-004 discharge flow averages 144,000 liters (38,000 gallons) per day (Damani 1994) with average chemical concentrations of 25 milligrams per liter of sodium nitrate, 0.4 milligrams per liter of sodium permanganate, 30 milligrams per liter of sodium formate, and 20 milligrams per liter of sodium oxalate (WSRC 1993b). The discharge is monitored twice per month for biochemical oxygen demand, total suspended solids, oil and grease, total residual chlorine, and acidity (SCDHEC 1984). Table A-20 in Appendix A presents the permit limits and monitoring results for Outfall DW-004 obtained during nonradiological testing.

2.2.5.2 Organic Waste Storage Tank

The low radioactivity organic portion is separated from the precipitate slurry during precipitate hydrolysis in the Vitrification Facility's Salt Process Cell, condensed to a liquid, and transferred in an aboveground pipeline to the Organic Waste Storage Tank located outside the Vitrification Facility. The Organic Waste Storage Tank is further described in Section 2.2.7.

2.2.5.3 Glass Waste Storage Building

The Glass Waste Storage Building would store the radioactive glass waste canisters until a Federal repository is available. The building has been constructed and is located near the Vitrification Facility (Figure 2.2-2). This building has greater storage capacity than the building envisioned in the 1982 EIS. The 1982 design called for a building with an initial capacity

of 1,026 canisters and the potential for later expansion to 10,000 canisters (DOE 1982a). The current storage building has a capacity of 2,286 canisters (WSRC 1993b).

The vault area is designed to hold the radioactive glass waste canisters underground and protect operating personnel, the public, and the environment. It is an earthquake- and tornado-resistant concrete structure. Radiation shielding protection would be provided by concrete walls, earth embedment, and a concrete deck that forms the floor of the operating area. The stored canisters would be protected against external damage and cooled to prevent internal heat buildup from radioactivity (WSRC 1993b).

Radioactive decay heat from around the canisters would be removed by the building's forced air exhaust system. The exhaust air would be passed through the building's HEPA filter ventilation system and then discharged to the atmosphere through a stack attached to the building (WSRC 1993b). The exhaust air would be monitored for radioactivity using continuous air samplers (WSRC 1993b; Cauthen 1994b). No condensate is expected to accumulate in the ventilation system sump; however, if it did accumulate it would be drummed, monitored for radioactivity, and treated. Depending on radioactivity levels, DOE would send the condensate to the F- and H-Area Effluent Treatment Facility or incorporate it into the Vitrification Facility wastewater stream for recycle to the tank farm. DOE does not expect radioactivity in the condensate or exhaust air, although provisions have been made for its management if radioactivity is detected. If condensate accumulated before radioactive operations, it would be sent to the Chemical Waste Treatment Facility (Price 1994a).

Due to delays in siting a Federal repository for high-level waste, a second Glass Waste Storage Building is planned for construction in 2007. This building would have a similar capacity to the existing building. The design of the second building has not been developed, but it would also be designed to contain radioactivity in the event of natural disasters (Emerson 1994). If the siting of a Federal repository continues to be delayed, canister storage capacity up to a maximum of 10,000 radioactive canisters, as addressed in the 1982 EIS, could be constructed.

2.2.5.4 Failed Equipment Storage Vaults

In 1982, DOE decided that failed equipment that could not be repaired was to be decontaminated, packaged, and transferred to the SRS burial facilities (DOE 1982a). However, DOE was concerned that melters, and possibly other equipment, potentially could not be decontaminated to levels that would allow them to be handled or even repaired without resulting in unacceptable radiation doses to workers (DOE 1993a). Therefore, DOE is constructing vaults in S-Area near the Vitrification Facility to provide safe interim storage of this equipment until a permanent disposal facility can be identified. It is expected that this waste would consist primarily of failed melters; some process vessels and miscellaneous smaller failed equipment could also be stored in the vaults (Glenn 1994). Based on process knowledge and testing, DOE expects that wastes designated for vault storage would not qualify as mixed waste under the Resource Conservation and Recovery Act and has not obtained a permit to store mixed waste in the vaults. If DOE determines in the future that any of these wastes qualify as mixed waste, DOE would obtain the necessary regulatory approvals for the vaults or make alternate arrangements to ensure the wastes were managed in compliance with applicable regulations.

Construction of the first 2 vaults is nearly complete and DOE is planning to construct 4 more vaults adjacent to these 2 vaults in the near future (DOE 1993a; see Figure 2.2-2). A total of 12 vaults may be needed for failed melters (1 melter per vault) based on a 2-year design life for the melter (Glenn 1994). However, tests suggest that the melters may last 3 years or more (Aleman 1994), reducing the potential storage capacity needs for the future. Future storage needs are also uncertain as a result of uncertainties

in the operational life of other equipment and plans for permanent disposal of failed equipment. For analyses presented in this Supplemental EIS, DOE assumes that a total of approximately 14 vaults would be required over the 24-year operational life of DWPF (Glenn 1994). DOE expects that the eight additional vaults would be located in a cleared industrial area near the initial six vaults (Figure 2.2-2).

The Failed Equipment Storage Vaults are designed for the following capabilities: (1) remote transport, handling, storage, and retrieval of the boxes containing failed equipment; (2) monitoring of vault air and possible liquid effluents to prevent releases of radioactivity into the environment; (3) design of the vaults and covers to resist the effects of earthquake and tornado pressure; and (4) design of vaults and covers to reduce occupational radiation levels (DOE 1993a).

The vaults and removable covers would be constructed of reinforced concrete of sufficient thickness and strength to meet the criteria for seismic loads and radiation shielding. Each vault would be approximately 5.5 meters (18 feet) wide, 6.4 meters (21 feet) high, and 8.8 meters (29 feet) in length. The entire structure would be waterproofed by installation of appropriate membranes between the concrete and the soil and sub-base. A stainless steel sump in each vault would collect moisture by conducting it over sloped trenches placed around the bottom of the vault toward the sump (DOE 1993a).

Moisture that could collect in the vaults from condensation would be drummed and monitored for radioactivity. Depending on radioactivity levels, DOE would send the condensate to the F- and H-Area Effluent Treatment Facility or incorporate it into the Vitrification Facility wastewater stream for recycle to the tank farms. If condensate accumulated before radioactive operations, it would be sent to the Chemical Waste Treatment Facility (Price 1994b).

2.2.5.5 Interarea Transfer Facilities

DOE would use underground pipelines to transfer high-level waste precipitate and sludge from ITP and Extended Sludge Processing in H-Area to the Vitrification Facility in S-Area and to transfer the DWPF recycle stream back to H-Area Tank Farm. The transfer lines are constructed of corrosion-resistant stainless steel pipe housed in a carbon steel jacket to prevent releases to the environment. Leaks in the stainless steel pipe would be promptly detected because the waste would drain to leak detection boxes.

Each of these transfer lines is routed through the Low Point Pump Pit, a facility consisting of three below-grade, stainless steel pump tanks; housed in a building. The tanks are designed to receive these wastes by gravity feed and serve as reservoirs from which the wastes can be pumped in a controlled manner to their destination. Precipitate slurry would first be transferred from ITP to Late Wash, then to the Low Point Pump Pit before transfer to the Vitrification Facility. Sludge and recycle stream transfers would be accomplished directly through the Low Point Pump Pit. Emissions from the Low Point Pump Pit are exhausted through HEPA filters and monitored for radioactive particulates using continuous samplers (WSRC 1993b). Similar transfer facilities are in place between ITP and Saltstone Manufacturing and Disposal for transfer of the low radioactivity salt solution (WSRC 1992a).

2.2.6 S-AREA UTILITIES

S-Area operations send approximately 76,000 liters (20,000 gallons) of sanitary wastewater per day to the S-Area Sanitary Treatment Plant, which uses an activated sludge system. Z-Area is served by a septic tank and drain field. The effluent is disinfected by chlorination and discharged through a National Pollutant Discharge Elimination System permitted outfall (DW-003). The effluent flows to a stormwater retention pond, which overflows to Upper Three Runs via Crouch Branch. DOE samples and analyzes the discharge monthly for acidity, biochemical oxygen demand, total suspended solids, and fecal

coliform (SCDHEC 1984). The permit limits and monitoring results for DW-003 are presented in Table A-20 in Appendix A. In 1995, DOE expects that a new centralized sanitary wastewater treatment facility will be operational. This facility would treat sanitary wastewater from S-Area and other areas of SRS.

Previously, five National Pollutant Discharge Elimination System outfalls served the DWPF. However, the permitted outfalls for the concrete batch plant and the oil/water separator that were used during construction no longer operate. Outfall DW-005 discharges stormwater and the sewage treatment plant effluent from Outfall DW-003 to Crouch Branch. Table A-21 in Appendix A presents analytical results from monitoring this outfall.

The water system for S- and Z-Areas relies on three wells located in S-Area (Figure 2.2-2) to provide drinking and process water. They also provide water for emergency purposes such as fire fighting. The design flow of these wells is 12.8 million liters (3.4 million gallons) per day (DOE 1992a).

2.2.7 ORGANIC WASTE STORAGE AND TREATMENT

2.2.7.1 Organic Waste Storage Tank,

The low radioactivity organic portion is separated from the precipitate slurry during precipitate hydrolysis in the Vitrification Facility's Salt Process Cell, condensed to a liquid, and transferred in an aboveground pipeline to the Organic Waste Storage Tank. The Organic Waste Storage Tank, which has been constructed on a concrete foundation near the Vitrification Facility (Photo 2.2-4), presently stores nonradioactive organic waste generated during ongoing Vitrification Facility startup testing. It would continue to be used for this purpose and for storage of slightly radioactive organic waste generated under the proposed action.

Figure Photo 2.2-4.
Photo 2.2-4. Organic Waste Storage Tank.

The organic waste consists mostly of benzene and other aromatic compounds with a small amount of mercury, as follows: benzene (80-95 percent), biphenyl (5-15 percent), diphenylamine (0.5-2.0 percent), phenol (0.1-1.5 percent), and diphenyl mercury (0.003-0.02 percent, or about 15-120 milligrams per liter of mercury) (WSRC 1994p). During radioactive operations, this waste would also contain small amounts of radioactivity, expected to be almost entirely cesium-137, at a maximum concentration of 511 picocuries per gram (WSRC 1994p; DOE 1988a). The waste is considered to be a mixed waste subject to EPA's Resource Conservation and Recovery Act regulations and the South Carolina Hazardous Waste Management Regulations (Code of Laws of South Carolina, R. 61-79) because it is a radioactive waste that exhibits the characteristics of toxicity (due to its benzene and mercury concentrations) and ignitability (WSRC 1994p).

The Organic Waste Storage Tank is permitted by SCDHEC to store this organic waste under the Resource Conservation and Recovery Act and by the EPA under the Land Disposal Restrictions Federal Facility Compliance Agreement, and the facility is designed and operated in accordance with applicable South Carolina Hazardous Waste Management Regulations. The tank has a capacity of 568,000 liters (150,000 gallons) and consists of a stainless steel primary tank enclosed by a carbon steel secondary (outer) tank to provide complete secondary containment in case the primary tank leaks. The outside tank has a roof to exclude rainwater and a leak detection system. Spill and overfill protection controls are also in place (WSRC 1994p).

Air emission controls include a floating roof on the inner tank to minimize

evaporation of the organic liquid waste. Approximately 52,000 liters (13,800 gallons) of waste are necessary to float the roof and fully engage seals, which reduce estimated emissions from a maximum of 1,724 kilograms (3,800 pounds) per year to 272 kilograms (600 pounds) per year (WSRC 1994p).

The vapor space between the inner floating roof and the fixed outer roof is filled with nitrogen gas, at a slight pressure, to exclude oxygen and prevent combustion of vapors that accumulate; a foam injection fire suppression system is also provided. Vapors are vented through HEPA filters to remove radioactive particulates before release to the atmosphere (WSRC 1994p), and radioactive particulate air emissions are monitored using continuous samplers. The Organic Waste Storage Tank has an operating air permit from SCDHEC that sets limits for annual average benzene emissions at 32 grams (0.07 pounds) per hour and 281 kilograms (0.31 tons) per year (SCDHEC 1993).

A truck loading facility is located adjacent to the Organic Waste Storage Tank for transfer to tanker trucks of organic waste generated before radioactive operations. The facility consists of an area surrounded by dikes, a device to measure total flow, and an automatic shutoff switch to prevent overfilling (WSRC 1994p). Based on calculations using EPA's Emission Factors for Air Pollutants (EPA 1985), the estimated nonradioactive benzene emissions from loading operations would be 3.74 kilograms (8.25 pounds) during a 1-hour loading period for each tanker truck. This calculation assumes that the loading facility has a pumping rate of 379 liters (100 gallons) per minute while loading a 19,000 liter (5,000 gallon) tanker truck.

2.2.7.2 Organic Waste Treatment

As noted in Section 1.2, DOE is required to treat mixed waste, including the DWPF organic waste, in accordance with Resource Conservation and Recovery Act land disposal restriction treatment standards. The only standards currently applicable to the DWPF organic waste are for removal of the ignitability characteristic and for the toxicity characteristic with respect to mercury. EPA specifies treatment by incineration, use as a fuel substitute, or recovery of organics as the standard for removal of the ignitability characteristic. The treatment standard for mercury requires that mercury concentrations in the organic waste be reduced to 0.20 milligrams per liter or less; leachability of mercury from secondary wastes resulting from treatment (e.g., ash from incineration) must be reduced to these levels as well (EPA 1990). In common practice, the ignitability characteristic is removed by incineration, and secondary residual waste (e.g., ash) is stabilized to keep mercury from leaching at levels above the standard.

EPA has not yet specified a treatment standard for the toxicity characteristic with respect to benzene. However, DOE expects that this standard will be similar to that for mercury; that is, treatment to achieve a concentration in the waste or waste extract below a specified level (EPA 1991). Destruction processes such as incineration in a permitted hazardous waste incinerator would achieve this anticipated EPA standard.

The organic waste being produced during nonradioactive testing of the vitrification process qualifies as a nonradioactive hazardous waste. A total of approximately 68,000 liters (18,000 gallons) of this waste is expected to be produced (WSRC 1994p). When enough waste is collected in the tank, DOE plans to remove it from the tank and send it to an EPA-approved offsite hazardous waste treatment facility for treatment in accordance with applicable treatment standards. The waste would be sent by regulator-approved transporters in 19,000 liter (5,000 gallon) tanker trucks (WSRC 1994p).

Approximately 52,000 liters (13,800 gallons) of mixed organic waste produced during radioactive testing and operations would be initially accumulated and maintained in the Organic Waste Storage Tank to float the roof and thus minimize emissions. The storage tank has the capacity to store approximately

3 years of organic waste generated at DWPF operating at maximum (100 percent) attainment and about 4 years at 75 percent attainment. However, under the present startup and attainment schedule (WSRC 1994c), radioactive organic waste would be produced in mid-1996, but would not accumulate in sufficient quantities to float the tank roof until late 1997. Assuming the currently expected average attainment of 45 percent, tank capacity would not be exceeded for about 7 years (WSRC 1994c).

DOE proposes to treat this mixed organic waste at the Consolidated Incineration Facility, currently under construction on an approximately 1.2-hectare (3-acre) tract in H-Area between the Vitrification Facility and the H-Area Tank Farm. DOE has committed to do so in its Resource Conservation and Recovery Act Part B Permit Application to SCDHEC for the Organic Waste Storage Tank (WSRC 1994p). Organic waste that accumulates over the amount necessary to float the tank roof would be transferred to the Consolidated Incineration Facility via an overhead pipeline for treatment in accordance with the required treatment standards. The line is designed to drain by gravity to the Organic Waste Storage Tank to minimize releases to the environment in the event of mechanical failure in the transfer system. The organic waste would be fed directly to the secondary combustion chamber of the Consolidated Incineration Facility. Since the organic waste has a high heat value, it would also serve as auxiliary fuel for the incinerator, thus reducing the need for fuel oil. The Consolidated Incineration Facility has been permitted as a hazardous waste treatment facility by SCDHEC (SCDHEC 1992b) and is scheduled for full scale operational startup in February 1996, well before organic waste is expected to be accumulated in quantities that would necessitate treatment.

As with DWPF (Section 1.2), DOE committed to EPA in the Land Disposal Restrictions Federal Facility Compliance Agreement, as amended, to permit, build, and operate the Consolidated Incineration Facility on a specified schedule to treat mixed waste being stored at SRS. This schedule requires initial treatment of mixed waste by February 2, 1996 (EPA 1994a).

Although DOE has committed to operate the Consolidated Incineration Facility, DOE is still considering options to this facility for treating mixed waste, including organic waste, in its development of the Site Treatment Plan. DOE has also agreed to reevaluate the appropriateness of this facility to treat hazardous and mixed wastes, as well as incinerable low-level radioactive waste, in the SRS Waste Management EIS consistent with the Site Treatment Plan analyses. Results of these evaluations will be documented in the Record of Decision for that EIS and in the consent order for enforcing provisions of the Site Treatment Plan, which are expected to be issued by October 1995.

These actions are consistent with DOE contingency planning for treatment of the organic waste in the unlikely event that the Consolidated Incineration Facility is not available. Pertinent features of the Consolidated Incineration Facility and treatment options that DOE has examined for treating this waste or recovering the organics from it are provided in the following sections.

Consolidated Incineration Facility - The Consolidated Incineration Facility is designed to treat a wide variety of solid and liquid wastes other than DWPF organic waste. Processing facilities include a rotary kiln primary combustor with solid and liquid feed systems, an offgas cleaning system, a secondary combustion chamber with liquid feed systems, an ash solidification system, a scrubber blowdown system, and process control equipment. In accordance with South Carolina hazardous waste and air pollution control regulations, the incinerator is designed to achieve at least 99.99 percent destruction of principal organic hazardous constituents including benzene in DWPF organic waste (WSRC 1994q). The air pollution control system includes a wet scrubber system to remove particulates and acid gases, a cyclone separator and mist eliminator to remove moisture and entrained contaminants, and a HEPA filter for further removal of particulate radionuclides. A 46-meter (150-foot) stack

is provided to exhaust the cleaned offgases and filtered air from the building ventilation system to the atmosphere (WSRC 1994q). Continuous stack emission monitors are provided for carbon monoxide, radionuclides, and opacity (Crook 1994). Design provisions are also made for emissions sampling and analysis for other parameters, including organics and metals in accordance with permit conditions. DOE has been issued construction and operation approvals by EPA under the National Emission Standards for Hazardous Air Pollutants regulations for benzene and radionuclides, and a construction air permit from SCDHEC for this facility (EPA 1989a, 1989b; SCDHEC 1992a).

Table 2.2-2 provides estimates of total nonradiological air emissions and those nonradiological air emissions attributable to the combustion of the DWPF organic waste at the Consolidated Incineration Facility. Of the criteria pollutants listed in Table 2.2-2, DOE does not expect sulfur dioxide, gaseous fluorides, or lead emissions to result from combustion of the DWPF organic waste because this waste is not expected to contain sulfur, fluorine, or lead.

DOE also estimated emissions for the rest of the listed criteria pollutants attributable to the DWPF organic waste. These estimates were based on emission limits in the construction permit and are assumed to be proportional to the fraction of total waste feed represented by the DWPF waste feed. Estimates of actual waste feed to the incinerator will not be available until analyses are completed for the SRS Waste Management EIS and the Site Treatment Plan. However, the most recent projection,

Table 2.2-2. Estimated nonradiological air emissions from the Consolidated Incineration Facility.^a

	Emissions attributable to DWPF^b		CIF permitted ai
Criteria pollutants	(kilograms/ hour)	(pounds/ hour)	(kilograms/ hour)
Carbon monoxide	0.0011	0.0025	0.0064
Nitrogen oxides	0.5	1.1	2.8
Sulfur dioxide	None	None	17
Gaseous fluorides	None	None	0.064
Particulates (< 10 microns)	0.23	0.5	1.3
Total suspended particulates	0.23	0.5	1.3
Lead	None	None	0.061
Air toxics			
Benzene	0.038	0.084	0.038
Mercury	0.0044	0.0098	0.0044

a. Sources: DOE (1991b), SCDHEC (1992a). Consolidated Incineration Facility (CIF) permitted emissions are the same as maximum emission limits.

b. See text for analysis methods.

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completed in 1993, indicates that the DWPF organic waste stream would comprise 17.8 percent by weight of the total liquid and solid waste fed to the incinerator (WSRC 1993e), and this proportion was assumed for the carbon monoxide, nitrogen oxide, and particulate emissions listed in Table 2.2-2. The DWPF organic waste is almost entirely benzene and related organic compounds that burn more efficiently than the wide variety of other liquid and solid wastes projected to be fed to the incinerator. Therefore, the estimates in Table 2.2-2 are likely to be higher than actual DWPF organic waste contributions to these emissions, at least for carbon monoxide and particulates.

The DWPF organic waste would contribute nearly all the benzene and a portion of the mercury in the waste feed to the Consolidated Incineration Facility. This waste is therefore assumed to contribute 100 percent of the emissions of these two constituents (Table 2.2-2).

As noted in Section 2.2.7.1, the expected radioactivity in the DWPF organic waste would be almost entirely from cesium-137. The maximum expected emissions of cesium-137 from the Consolidated Incineration Facility are estimated to be 2.22 microcuries per year, or approximately 1 percent of the maximum expected cesium-137 emissions of 217 microcuries per year as reported in DOE's approved National Emission Standards for Hazardous Air Pollutants application (DOE 1988a). This result was obtained by assuming that these cesium-137 emission rates would be in the same proportion as the corresponding cesium-137 feed rates for the DWPF organic waste (0.085 curies per year) and total waste feed (8.327 curies per year) as listed in this permit application.

The Consolidated Incineration Facility would produce two main secondary wastes, incinerator ash and liquid bled from the wet scrubber system (called blowdown). These wastes could contain radioactive constituents and could also be hazardous wastes due to the presence of toxic metals such as mercury. Both of these wastes would require treatment to meet land disposal restriction treatment standards. Treatment and disposal options are being addressed in the Site Treatment Plan and the SRS Waste Management EIS. However, DOE proposes to use the Consolidated Incineration Facility ash solidification system to immobilize the incinerator ash and associated hazardous constituents in drums using cement (WSRC 1994q). Based on analyses performed to support development of the Site Treatment Plan, DOE has selected stabilization using the Consolidated Incineration Facility ash solidification system for treatment of scrubber blowdown. A permit modification seeking approval of this scrubber blowdown treatment was submitted to SCDHEC in June 1994. DOE will obtain the appropriate permits to treat the blowdown before starting up the Consolidated Incineration Facility. The stabilized ash and blowdown waste could require interim storage at an approved onsite hazardous waste storage facility until final decisions are made and implemented for disposal of this waste. Associated environmental impact analyses are being undertaken in the SRS Waste Management EIS.

Offsite Incineration - DOE had investigated the availability of offsite commercial incinerators to treat DWPF organic waste in 1989 (Papouchado 1990) and the availability of commercial incinerators to treat DOE's mixed waste on a complex-wide basis in 1991 (DOE 1991c). Results of these investigations indicated that offsite incineration capacity for treating SRS mixed waste was limited to only a few facilities and that, as a minimum, potentially viable facilities would be required to obtain permit modifications to treat the DWPF organic waste. DOE is not aware of the development of more suitable offsite capabilities in the past few years. Although the location and design of a suitable offsite incinerator(s) cannot be determined at this time, it would be required to meet the same minimum standards for destruction or removal efficiency (99.99 percent) and treatment of secondary waste streams as the Consolidated Incineration Facility, and would be subject to comparable air emissions control requirements.

Onsite Incineration in a Dedicated Facility - A dedicated waste incinerator was originally planned as an integral part of the DWPF when the design was modified in the early 1980s to include ITP. This concept was abandoned with DOE's decision to build the Consolidated Incineration Facility as a general purpose facility capable of treating a wide variety of SRS waste, including low-level, hazardous, and mixed wastes (WSRC 1993e). DOE again considered this option in 1989 (Papouchado 1990). While no technological difficulties appear to result from this option, it could take a minimum of 2 years or more to obtain the hazardous waste treatment and air construction permits and National Emission Standards for Hazardous Air Pollutants approval, as well as other necessary permits and approvals. Treatment onsite in a portable vendor-operated facility is another option that was considered, but no permitted incinerator contractor was found (Papouchado 1990).

Although the specific design features of either type of unit are not known, both would be required to meet the same minimum standards for efficiency (99.99 percent) and treatment of secondary hazardous waste streams as the Consolidated Incineration Facility. DOE expects that either unit would also be subject to air emissions controls and limits comparable to the Consolidated Incineration Facility, taking into account that only DWPF organic waste would be burned, and that emission rates would be comparable to those estimated in Table 2.2-2 for the organic waste. It is also assumed that design features comparable to the Consolidated Incineration Facility would be used to control and disperse air emissions. Although the specific SRS location for such a unit has not been identified, DOE would attempt to locate it on previously disturbed industrial land in the H- or S-Areas, potentially on or near the Consolidated Incineration Facility construction site.

Alternatives to Conventional Incineration for Destruction of DWPF Organic Waste - DOE has investigated alternatives to incineration to treat DWPF organic waste (e.g., Papouchado 1990; Carter and Morrison 1990; Holtzscheiter 1992, 1994). These include silver-catalyzed destruction, supercritical fluid oxidation, electric pyrolysis and immobilization, steam gasification in a commercially available detoxifier unit, and others. Each of these methods was found to require additional technology development and/or testing to demonstrate effectiveness in treating the DWPF organic waste, and some could not meet primary capacity or destruction or removal efficiencies. However, DOE keeps abreast of these and other developing technologies to ascertain their potential usefulness and could potentially select one as a viable means of treating the DWPF organic waste if its development indicates performance and cost advantages.

Required permits for hazardous waste treatment and air emissions would be needed to implement these options, as noted above for a dedicated incinerator. Air emissions would be expected to be no higher than incineration for pollutants of concern and, depending on the technology employed, could be far lower. Those treatment options that did not qualify as incineration under hazardous waste regulations would require a variance from EPA and SCDHEC and would have to be demonstrated to be as effective as incineration. Secondary wastes such as reaction residuals would be required to meet land disposal restriction treatment standards in a similar manner as would secondary wastes generated by incineration such as ash and scrubber blowdown. Although the specific location for an alternative treatment facility has not been identified, DOE expects that it would be located on previously disturbed industrial land in the H- or S-Areas, potentially on or near the Consolidated Incineration Facility construction site.

Selection of an alternate treatment for DWPF organic waste, if it becomes necessary, would be accomplished in the context of the Site Treatment Plan and Consent Order and the SRS Waste Management EIS or subsequent NEPA documentation.

Treatment for Recovery of Organics or Fuel Substitution - As noted above, the

Resource Conservation and Recovery Act land disposal restriction treatment standards for removal of the ignitability characteristic specify recovery of organics and fuel substitution as permissible treatment alternatives to incineration for the DWPF organic waste. DOE has considered the potential viability of treating this waste, including removal of radioactivity to levels allowing its release from regulatory control, for subsequent use as a fuel or chemical product. Either of these approaches depends on technical feasibility of decontaminating this waste, cost, marketability, and regulatory considerations.

The technical feasibility of removing cesium and mercury from the organic waste has been investigated, but only on a laboratory scale (Eibling 1994). This research demonstrated that reduction of cesium-137 from levels expected in the organic waste to very low levels (less than 100 disintegrations per minute per milliliter) is potentially feasible using ion exchange technology. Diphenyl mercury removal by chemical reduction followed by amalgamation has also been shown to be potentially feasible. However, both processes would require a substantial amount of research to determine design data and operating conditions. Safety issues may prohibit use of this treatment since current information indicates that it could be necessary for the mercury removal column to operate above the boiling point of benzene. As with incineration, secondary wastes would be generated that would require appropriate treatment and disposal (Eibling 1994).

DOE Order 5400.5, "Radiation Protection of the Public and the Environment," (DOE 1990a), provides requirements and guidelines for cleanup of residual radioactive material and release of property and equipment. Since the benzene is contaminated with radioactivity throughout its entire volume, and cleanup and release of benzene has not been attempted in the past, special release criteria and radiological survey techniques would have to be developed. Removal of mercury and cesium may make this waste usable only as a fuel or fuel additive. Additional processing would be required to further purify the waste to make it suitable for use as a product (Bignell 1994f).

In view of these disadvantages, and the cost-effectiveness and ready availability of incineration or other destruction technologies, DOE does not consider this to be a reasonable option for treatment of the DWPF organic waste at this time, and further analysis is not presented.

2.2.8 POLLUTION PREVENTION

The pollution prevention program at SRS consists of four major parts: (1) waste minimization through source reduction (reduction or elimination of pollution before it is actually generated) and recycling of solid waste; (2) source reduction and recycling of wastewater discharges and pollutants, mainly through system design and water conservation; (3) source reduction of air emissions mainly through the toxic and chlorofluorocarbon reduction programs; and (4) preferential procurement of products manufactured from recycled material.

The SRS pollution prevention program is implemented through the SRS Waste Minimization and Pollution Prevention Awareness Plan (WSRC 1994r). The plan includes objectives, goals, organizational responsibilities, training, evaluation, information exchange, and an implementation schedule. In addition to this sitewide plan, individual organizations have more specific pollution prevention plans that provide budget details, organization-specific objectives and goals, training requirements, and pollution prevention techniques to be used.

Since the beginning of the SRS Pollution Prevention Program, which was called the SRS Waste Minimization Program when it began in 1990, the program has reduced overall waste generated at the SRS. The amount of waste of all types that has been generated has decreased since 1991, with the greatest reductions

in hazardous waste and mixed waste (waste that is both hazardous and radioactive). Hazardous waste was reduced in 1993 by 24 percent from 1992 levels and mixed waste was reduced by 81 percent from 1992 levels (Hoganson and Miles 1994). These reductions are attributed mainly to substituting products that do not have hazardous ingredients for products that do. The Site has also been successful in implementing recycling programs. The SRS currently recycles paper, cardboard, scrap metal, antifreeze, used oil, tires, lead, drums, aluminum cans, lead-acid batteries, and other materials (Hoganson and Miles 1994).

DWPF participates in sitewide pollution prevention programs such as the paper and cardboard recycling program. In addition, H-, S-, and Z-Areas have organization-specific pollution prevention program plans (WSRC 1994s; 1994d).

DWPF has been designed with pollution prevention features. The Vitrification Facility would recycle frit slurry from the decontamination of filled radioactive glass waste canisters into the process and use it to make glass. The high heat value of the DWPF organic waste would allow the Consolidate Incineration Facility to operate with less fuel. Saltstone Manufacturing and Disposal flushes pipes with the waste solution rather than fresh water, reducing the overall amount of waste solidified per year by approximately 1.5 million liters (396,300 gallons) (WSRC 1993h). ITP and Late Wash would recycle wastewater by incorporating it into the processes. Extended Sludge Processing would recycle wash water to ITP if the salt concentration of the wash water is acceptable for use by ITP. Moreover, by replacing the S-Area Sanitary Treatment Plant with the Centralized Sanitary Treatment Plant, the residual chlorine that would normally be discharged to the environment would be eliminated. The Centralized Sanitary Treatment Plant would use ultraviolet radiation for disinfection.

2.2.9 DWPF SAFETY EVALUATION AND CONTROL

The major facilities included in the proposed action would be classified as "nuclear facilities" requiring a level of safety analysis and control comparable to accepted commercial nuclear practices, and beyond that of nonnuclear industrial facilities. All nuclear facilities receive a documented safety analysis to: (1) identify hazards within an operation; (2) describe and analyze the adequacy of measures taken to eliminate, control, or mitigate identified hazards; and (3) analyze and evaluate potential accidents and their associated risks. DOE gathers the results in a safety analysis report to show that the facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations (DOE 1992b). The safety analysis report describes the conditions under which authorization would be granted to commence safe radioactive operations.

Several DWPF buildings have been classified as Category I structures (WSRC 1994e) designed to withstand the effects of a design basis earthquake, an investment protection earthquake, and a design basis tornado. The design basis earthquake and investment protection are those with peak ground acceleration of 0.2g and 0.1g, respectively. Those Category I DWPF structures are the (1) vitrification building, (2) sand filter structure and inlet tunnel, (3) fan house, (4) Glass Waste Storage Building, and (5) Failed Equipment Storage Vaults (WSRC 1994e).

ITP high-level waste tanks (Type III) would be expected to maintain their structural integrity during an earthquake (Hsu et al. 1993). Studies conducted in 1973 showed that Type III tanks (including ITP tanks 48, 49, and 50) are expected to withstand seismic loading of up to 0.2g (Hsu et al. 1993). These conclusions are presently being reassessed as described in the H-Area/ITP Seismic Safety Issue Resolution Program Plan (Morin et al. 1994).

Various programs would be implemented for the proposed action to protect facility workers and the environment from radiological and nonradiological

hazards. Necessary programs are currently in place for pre-operational testing. The radiological control program (WSRC 1993i) includes provisions for control of radiological work, worker training, dosimetry, respiratory protection, and radiation protection program reviews. To ensure the safety of facility workers from nonradiological hazards, DOE has industrial safety, industrial hygiene, medical monitoring, and fire protection programs (WSRC 1991a, 1993j, 1994f). An environmental monitoring program surveys and quantifies the effects, if any, that routine and nonroutine SRS operations could have on the site, the surrounding environment, and the population living in the SRS vicinity. An environmental report containing the results of the environmental monitoring program is published annually (WSRC 1993k).

DWPF Safety Upgrade Program - DOE performed a safety study for DWPF (Kalinich 1994) that showed that the current Vitrification Facility design does not adequately assure confinement of radioactive material and benzene in the unlikely event of a design basis earthquake, which has an estimated probability of occurrence of once in 5,000 years. The study postulated that such an earthquake could result in loss of all incoming electrical power. The standby diesel generator systems and the purge systems for the process and storage tanks, which contain radioactive material or benzene, could also become disabled. These potential physical disruptions from an earthquake could further result in flammable or explosive mixtures of gases accumulating in some or all of the tanks, which, in turn, could result in explosions. These events could lead to a release of radioactive or hazardous material into the environment, which could result in large onsite and offsite consequences.

Analysis has demonstrated that all process tanks can be shown to withstand the direct effects of a design basis earthquake (Schwenker 1994). Consequently, the facility upgrades are needed to either prevent post-earthquake explosions within the tanks and within the vitrification building or to ensure that the Zone 1 ventilation would be able to operate during and after the earthquake to send all radioactive and hazardous materials from the Zone 1 canyon through the sand filter, which would reduce releases by a factor of 200 or greater. Also, chemical releases would be prevented by qualifying certain storage tanks to withstand a design basis earthquake and tornado (Schwenker 1994).

Potential upgrades to protect workers and the public were categorized into three types: process vessel ventilation systems, building ventilation system, and systems to prevent or reduce releases of hazardous chemicals. These upgrades could be achieved through additional barriers and within the basic design of the existing facility. These upgrades would ensure that radioactive and hazardous material would be confined to provide a level of safety to facility workers and the public that is within SRS standards (Schwenker 1994).

The most effective upgrades would be made to the vessel ventilation systems to prevent radioactive material from being released. The modified process vessel ventilation system would provide a nitrogen blanket for salt process cell tanks and a continuous nitrogen purge for chemical process cell and low point pump pit tanks. When ventilation flow to process tanks is less than a specified value, or normal electrical power is lost, the tanks ventilation piping would be isolated and the backup nitrogen supply would be put in service. The backup nitrogen tanks would be sized to provide enough nitrogen to supply the DWPF tanks for a minimum of 4 days before additional nitrogen would be needed. The proposed systems would operate without external electric power and without operator action in the event of total blackout and post earthquake. All of the system components would be designed to survive the design basis earthquake (Schwenker 1994). The result of these modifications would be to substantially reduce or eliminate the probability that radioactive or hazardous material releases would occur.

The second major area of proposed modification is to upgrade the Zone 1 exhaust system and all of its supporting systems, including the standby diesel generators, to ensure that these systems would survive the design basis

earthquake. Qualifying the equipment to survive the earthquake would improve assurance that Zone 1 of the vitrification building would continue to be ventilated and that the exhaust stream would be filtered through the sand filter. Zone 1 exhaust fan control systems would be modified to provide the capability to manually start the fans, control the inventory of the standby diesel generator fuel oil tanks, and monitor sand filter inlet pressure. An operator would be permanently stationed in the DWPF fan house to operate the exhaust system if necessary after an earthquake. This ventilation is necessary to prevent a flammable concentration of benzene from accumulating in the salt process cell and in the unlikely event of failure of the multiple barriers, to reduce, by a factor of at least 200, a possible release of radioactive and hazardous material. Coupled with the upgraded purge system, this degree of survivability of Zone 1 ventilation would diminish the probability of large releases of radioactive and hazardous material to levels that would be within SRS standards (Schwenker 1994).

The third area of upgrade would prevent or reduce releases of hazardous chemicals. Releases would be avoided by: (1) upgrading the outside storage tanks to survive the design basis earthquake and tornado (this would be done by installing additional structural supports and, if necessary, tornado missile shields for these tanks); (2) strengthening the support for the feed chemical storage tanks on the third level of the vitrification building and sump drain piping to withstand a design basis earthquake; and (3) implementing measures (such as strengthening or enlarging the containment dikes and adding administrative controls to limit the inventory of these chemicals) to ensure containment and segregation of the inventory of the nitric and formic acid dikes to prevent these chemicals from mixing and forming nitric oxides (Schwenker 1994). The result of these modifications would be to substantially reduce or eliminate the probability and consequences of these releases.

DOE is evaluating the details of these proposed modifications which would be implemented before the facility is operated with radioactive waste.

2.2.10 WORKFORCE

The workforce for the proposed action would be composed of construction and operations employees. The construction workforce is forecasted to fluctuate as remaining construction under the proposed action occurs; the highest estimate (270 employees) occurs in 1999 and 2000. The operations workforce is projected to be the highest in 1994. Table A-22 in Appendix A presents the estimated workforce, by year, for the proposed action. Despite the additional employment potentially required to implement the proposed action or either of the alternative actions, total site employment is projected to remain below the 1994 baseline employment level for all years with the exception of 1994 as shown in Figure A-2 in Appendix A.

2.3 The No-Action Alternative

Under the no-action alternative for this Supplemental EIS, DOE would continue current waste generation and waste management practices, such as storing high-level waste in the tanks. Specifically, under the no-action alternative, the Vitrification Facility, ITP, and Extended Sludge Processing would not operate. However, under this alternative, Saltstone Manufacturing and Disposal would continue to treat and dispose of the waste concentrate from the F- and H-Area Effluent Treatment Facility. Disposal would require the eventual construction of at least two vaults in addition to the two existing vaults. This alternative also assumes that the F-and H-Area Tank Farms would continue to receive waste from the F- and H-Area separations facilities, store it in Type III high-level waste tanks, and continue to operate the high-level waste evaporators to reduce the volume of waste.

A 30-year waste forecast of tank farm receipts shows that if tank farms and

evaporators operate as projected, tank space can be maintained at acceptable levels (Bignell 1994a). Therefore, the no-action alternative would mean that existing tanks would be used, the tank farms would continue to operate, and no new tanks would be built. Approximately 30 million liters (8 million gallons) of high-level waste would continue to be stored in Type I, II, and IV tanks (older tanks with a greater potential for releasing waste into the environment) (Bignell 1994b). The continuing risk of tank vulnerability to earthquake damage would remain. Tank failure following a design basis earthquake would likely release waste, causing substantial subsurface contamination. If continued monitoring were to indicate a high potential for tank leakage or failure, alternatives including new tank construction would be assessed at that time. The 1977 Final EIS, Waste Management Operations (ERDA 1977), evaluated the environmental impacts of storing high-level wastes. The SRS Waste Management EIS, under preparation, will also evaluate the environmental impacts of tank farm operations.

The no-action alternative includes mothballing the Vitrification Facility for an indefinite period. This condition would reduce the workforce from approximately 1,300 persons to approximately 195 persons for construction of two Saltstone Disposal Vaults, limited operations, security, and maintenance (Bignell 1994c).

The no-action alternative would result in SRS being unable to achieve or maintain timely compliance with environmental requirements and commitments made to environmental regulatory agencies applicable under the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund), the Resource Conservation and Recovery Act, and the Federal Facility Compliance Act.

Under the no-action alternative, radiological and nonradiological emissions to the atmosphere would continue essentially as at present as described in Section 3.4.

The no-action alternative would not change the current discharges to National Pollutant Discharge Elimination System outfalls in F- and H-Areas. Since the Vitrification Facility would not operate, the Chemical Waste Treatment Facility would not treat or discharge effluents, and the S-Area Sanitary Treatment Plant would release minimal effluent if it were still operating and not tied into the Centralized Sanitary Treatment Plant.

If the Vitrification Facility and its associated support facility and structures were to close, some waste would be generated. Also, minimal waste would be generated during the security and maintenance operations after closure. Saltstone Manufacturing and Disposal waste generation would remain largely unchanged from current rates. It is assumed that ITP and Extended Sludge Processing structures would revert to typical tank farm service, and, as part of the high-level waste tank farms, would generate typical tank farm operations waste streams such as protective clothing and radiological survey waste in typical amounts. Table A-11 in Appendix A presents forecasted volumes of solid waste by type that would be generated under the no-action alternative.

Taking into account the preliminary information available from other NEPA documents under preparation (Section 1.4), DOE does not expect that potential increases in the volume of high-level waste that could result would require additional high-level waste tanks. However, if DOE determines a need to propose new tanks, additional NEPA documentation would be developed at that time.

2.4 Ion Exchange as an ITP Pre-Treatment Replacement

SRS high-level waste requires pre-treatment to remove cesium from the soluble constituents and convert it to a form suitable for feed to the vitrification

process. ITP and ion exchange are the only methods DOE has identified to accomplish pre-treatment. The ion exchange system considered under this alternative would remove cesium from a waste solution by using columns filled with a granular material called resin. The resin has an abundance of ion exchange sites that easily remove selected ions from the waste solution. Considerable advances in technology have taken place since publication of the 1982 EIS, including the preliminary development of a resin that is much more efficient in removing cesium from high-level waste than the type of ion exchange materials originally proposed. DOE continues to support research on ion exchange.

DOE tested several kinds of resin for use on SRS high-level waste (WSRC 1992c). SRS high-level waste is unusual in that it requires an ion exchange medium that can extract cesium from a highly alkaline salt solution containing concentrations of aluminum and sodium salts that 10 ten times higher than the concentration of cesium in solution. The SRS-developed resorcinol/formaldehyde resin was chosen as the best ion exchange media for removing cesium from the alkaline soluble salt solution. Duolite- CS-100 resin, commercially available and already tested with SRS, Oak Ridge, West Valley, and Hanford wastes, is a backup candidate. The Duolite- CS-100 resin has been demonstrated to have approximately one tenth the capacity of the SRS- developed resorcinol/ formaldehyde resin (Bibler 1991). The SRS resin has undergone laboratory testing (Bibler 1994; Bibler and Crawford 1994). Large scale "mock-up" testing is being considered. However, the ion exchange process has not been demonstrated on a large scale nor has it been integrated with the vitrification process. Therefore, the discussion of this process is based on small-scale laboratory tests. If this alternative were chosen, large-scale demonstrations would be required to validate the safety basis and the efficiency of the process to remove cesium, strontium, and plutonium, and to demonstrate the impacts on glass quality.

Ion exchange for waste pre-treatment could be implemented in two ways: (1) phased replacement and (2) immediate replacement. In phased replacement, ITP would operate until the ion exchange facility had been designed, constructed, tested, and was available to replace it in approximately 14 years. In immediate replacement, ITP would not operate and waste removal from tanks would not begin until the ion exchange facility was operational, in approximately 10 years, meaning that the waste would remain in a more mobile state until that time. Under the immediate replacement alternative, the ion exchange facility is assumed to be available 4 years earlier. Because ITP would not be operating to empty the high-level waste tanks, DOE would design, construct, and test an ion exchange facility on an accelerated schedule. However, under either of these alternatives, DOE could begin sludge-only operations before the ion exchange facility is available by treating the sludge in Extended Sludge Processing and vitrifying it at the Vitrification Facility. The ion exchange facility under either scenario is expected to be similar, and is described below.

As currently envisioned, ion exchange would involve a five-step process (WSRC 1992c) (Figure 2.4-1):

- Step 1. Feed makeup: The proposed ion exchange system design would include a tank farm salt solution receipt tank in which sodium titanate would be added to the salt solution to remove plutonium and strontium.

- Step 2. Pre-filtration: Pre-filters would be set up to remove sodium titanate with adsorbed plutonium and strontium and sludge residue. The concentrated solids from the pre-filter would be pumped into a Solids Receipt Tank.

- Step 3. Cesium Removal Ion Exchange: The system would be designed with two or more cesium ion exchange columns in series. The proposed design is based on a column of resin being in service for six cycles. A cycle consists of the loading of a resin column with cesium from the waste stream, the

elution (extraction) of the cesium for transfer to the Vitrification Facility Feed and Hold Tank, and the regeneration of the resin in preparation for the next loading. After the sixth cycle the resin would undergo a final extraction step to remove the cesium for transfer to the Vitrification Facility Feed and Hold Tank, and the resin would then be transferred for final disposition. The spent extracted resin would be drummed and disposed as low-level radioactive waste or fed to the Vitrification Facility as necessary.

- Step 4. Vitrification Facility Feed and Hold Tanks: Two or more stainless steel tanks with shielding and secondary containment would be needed to receive waste streams, blend them, provide feed to the Vitrification Facility, and provide temporary de-coupling in the case of ion exchange or Vitrification Facility downtime. Hold tanks are required because the ion exchange system would operate essentially as a continuous process. The tanks would be designed to meet Vitrification Facility feed requirements without interruption.

- Step 5. Low Radioactivity Salt Solution Hold Tanks: At least two tanks would be needed to receive and sample the effluent stream from the ion exchange columns. A full tank would be sampled and analyzed for conformance to Saltstone Manufacturing and Disposal acceptance criteria while another tank is filling.

Figure 2.4-1.

Figure 2.4-1. Ion exchange process.

Table A-23 in Appendix A presents the estimated annual material consumption for an ion exchange facility.

Chromium and mercury would be the only two hazardous materials present in soluble high-level wastes from the ion exchange process (Scott 1993a). Unlike the ITP process, which removes mercury, ion exchange leaves mercury concentrations in the soluble waste bound for Saltstone Manufacturing and Disposal. Although this increased mercury content would still be within saltstone feed specifications (Scott 1993a), an increase in saltstone mercury content could require additional monitoring, control, or permit modifications. Table 2.4-1 compares the process stream from ion exchange to the ITP stream and to the Saltstone Manufacturing and Disposal acceptance criteria.

Table 2.4-1. Comparison of ion exchange process stream to ITP process stream and Saltstone Manufacturing and Disposal acceptance criteria.^a

Component	Saltstone Manufacturing and Disposal acceptance criteria	ITP stream	Ion
Salt solution (kilograms/hour)	NA^b	6,600	
Benzene (milligrams/liter)	3	<2	
Phenol (milligrams/liter)	1000	1000	
Isopropanol (weight percent)	0.2	0.28	
Methanol (weight percent)	0.03	0.03	
Strontium	4 - 10^-5	5 - 10^-7	

(picocuries/liter)		
Cesium (picocuries/liter)	1 - 10^-4	1 - 10^-5
Total Alpha (picocuries/liter)	1.8 - 10^-5	1 - 10^-6
Mercury (milligrams/liter)	500	<0.01

a. Source: Scott (1993a).
b. NA = Not applicable.

The ion exchange process would not release radiological or hazardous liquid material to the environment (Scott 1993a). However, potentially contaminated airborne emissions would be passed through HEPA filters and emissions rates of particulate radionuclides, radioactive iodine, and tritium would be measured. Table A-6 in Appendix A lists predicted nonradioactive airborne releases. The low-level, mixed, and hazardous waste generated by the DWPF with ion exchange, except for spent resin and benzene-contaminated mixed waste, would be approximately the same as in the proposed action. Approximately 11,000 kilograms (24,000 pounds) of spent resin would be generated each year (Scott 1993a) and would be disposed of at the SRS as low-level waste. Table A-11 in Appendix A presents the forecasted waste generation volumes by waste type for phased replacement and immediate replacement.

Permits are not expected to impact cost and schedule for this facility. Applications for new or modified permits would begin immediately after the conceptual design because they are needed to start construction. Modifications to the following permits would be required for construction and operation of an ion exchange facility (WSRC 1992c):

- Vitrification Facility Industrial Wastewater Permit
- Vitrification Facility Air Permit
- Tank Farm Industrial Wastewater Permit
- Tank Farm Air Permit
- Saltstone Manufacturing Industrial Wastewater Permit
- Saltstone Manufacturing Air Permit
- Saltstone Industrial Waste Disposal Permit
- Air Permit(s) for pump pit(s)

The ion exchange facility would be located on approximately 4 hectares (10 acres) of previously cleared and industrialized land in H-Area. It is estimated that immediate replacement would become operational in approximately 10 years and phased replacement would become operational in approximately 14 years. Under the phased replacement alternative, ion exchange would be integrated into the DWPF system at the end of an ITP batch when the processing tank is empty. To accomplish this integration, several system modifications would be required, including modifications to existing waste tanks, modifications to existing interarea transfer lines, and modifications to the Vitrification Facility (Scott 1993a). Under either the phased or immediate replacement alternatives, DOE may decide to operate the Vitrification Facility using sludge only as a feed on an interim basis.

The total estimated cost for designing, constructing, and testing the ion exchange facility is $500 million (Scott 1993b). Additional costs would be incurred under the immediate replacement alternative during the 10 years of ion exchange development because the Vitrification Facility would have to operate less efficiently by processing only sludge or would have to shut down, be maintained in standby until the ion exchange system was in place, and then

restarted. Under the latter scenario, equipment would be stored or placed in a maintenance/standby condition. Reacquiring resources lost during the intervening years, such as operator experience and facility design expertise, would incur costs above the current funding level ($150 million per year) for recruiting, training, and related activities during the restart period (WSRC 1994c). DOE estimates that cost would be reduced from the current funding level of $150 million per year to about $30 million per year during a 2-year period, then rise to about $180 million per year during the 3-year restart period (Cauthen 1994a). It is estimated that the immediate replacement alternative would require approximately $1.1 billion in addition to the initial $500 million cost for the ion exchange system. Table A-22 in Appendix A presents the estimated workforce for the phased replacement and immediate replacement alternatives.

2.5 Other Immobilizatoin Alternatives

In the 1982 EIS, DOE evaluated borosilicate glass as the reference waste form for the DWPF but did not propose or choose a final waste form on the basis of that evaluation. DOE did assess alternative waste forms in the Environmental Assessment on Waste Form Selection for Savannah River Plant High-Level Waste (DOE 1982c) and selected borosilicate glass as the waste form of choice. DOE has evaluated the development of immobilization methods and media for high-level wastes to determine if developments since the 1982 Environmental Assessment would make it necessary to reconsider the decision to use a vitrified borosilicate glass as the immobilization medium.

The 1982 Environmental Assessment on Waste Form Selection for Savannah River Plant High-Level Waste examined a variety of candidate waste forms before settling on crystalline ceramic as the best alternative to borosilicate glass as a waste form. The crystalline ceramic forms, which can be described as synthetic rock-type minerals, ranked highest in overall performance, including such factors as waste loading, mechanical stability, and leach resistance. However, crystalline ceramics required a complex process to produce, leading to a low ranking in the other major criterion, process simplicity (DOE 1982c). After preparing an Environmental Assessment, the DOE concluded that borosilicate glass could meet repository performance specifications. The Environmental Assessment showed that the difference in environmental effects and risks between the two waste forms was not significant.

In 1982, a number of countries had research and development programs underway on waste immobilization using a variety of material forms, ranging from relatively simple calcined products to glasses of various compositions, crystalline ceramics, and more complex, multi-layer products. France was already producing a borosilicate glass in a vitrification process at Marcoule. With relatively few exceptions, the subsequent technology development for immobilization of high-level wastes has centered largely on vitrification as the process of choice, although such waste forms as Synroc and other crystalline ceramics have continued to be studied. The development efforts over the past decade have focused predominantly on improving glass-waste mixtures and designing and testing melters and related hardware. Other nations involved in the development and application of immobilization technologies for their respective high-level wastes include France, Great Britain, Germany, Belgium, Japan, Russia, India, and China (Zhu and Chan 1989; Chan and Squires 1993).

France had adopted vitrification and produced the first radioactive glass at the Piver pilot plant at the Marcoule Nuclear Center in 1958. Based on the success of that batch operation, a continuous two- stage vitrification process (using a rotary kiln and metallic melter) called the Atelier de Vitrification Marcoule process was constructed and began processing high-level waste into borosilicate glass in 1978. After 10 years, that plant had vitrified about 1,230 cubic meters (43,431 cubic feet) of concentrated fission products solutions and generated 540 metric tons (600 tons) of glass packaged in 1,547

metallic canisters (Baehr 1989). It is still in operation. Two almost identical facilities have been constructed at the Cogema reprocessing facility at La Hague (Mallet and Sombret 1988). The process has also been adopted in the Windscale Vitrification Plant facility at Sellafield in Great Britain, using the higher throughput equipment developed for use at the La Hague vitrification facility (Elsden and Woodall 1988).

British Nuclear Fuels Limited has proposed to vitrify U.S. origin foreign research reactor spent nuclear fuel at the Sellafield facility. This proposal is outside the scope of this Supplemental EIS. DOE does not consider transportation of SRS high-level radioactive waste to Great Britain for vitrification to be a reasonable alternative because of the risk to human health and to the environment of transporting this waste.

The second major vitrification process is the PAMELA continuous single stage ceramic melter producing borosilicate glass, which has been successfully built and demonstrated with radioactive feed by Germany at the site of the former Eurochemie reprocessing plant in Mol, Belgium since 1985 (Wiese and Ewest 1988). This process (and its borosilicate glass product) is similar to the DWPF Vitrification Facility constructed at SRS. The USSR operated a vitrification plant using this melter technology from 1986 to 1988 (Baehr 1989), and the Japanese have also adopted this technology to make borosilicate glass at their Tokai Reprocessing Plant (Tsuboya and Tsunoda 1988). Russia is planning to immobilize high-level waste from reprocessing their water power reactor fuel in a glass matrix (Chan and Squires 1993). India has selected ceramic melter technology for vitrification of its high-level wastes at Tarapur into an alkali borosilicate matrix (Ramaswamy et al. 1993). Chan (1992) reports that all countries reprocessing or planning to reprocess spent fuel (Argentina, Belgium, China, Italy, and Switzerland, in addition to those identified above) are planning to vitrify their high-level waste into borosilicate glass.

Technology exchange on the vitrification process has occurred between DOE representatives and scientists from countries such as France, Germany, Japan, the United Kingdom, and Russia. DOE and agencies of these countries have established cooperative agreements, and DOE scientists have interacted with international colleagues in technology exchanges, onsite assessments, specialists' workshops, and cooperative research projects. These activities have advanced the DOE overall international exchange objectives of providing independent reviews of DOE programs, conserving DOE resources by incorporating foreign technology and by performing joint research, and ensuring consideration of U.S. views and policies when international evaluations are conducted and international standards set. Recent exchanges include: melter design and operation with Germany and Japan, melter sensors with Germany, operations force comparison with the United Kingdom, acceptance process with France, waste product quality with Russia, and material interface interactions with various countries.

Although studies have continued on the crystalline ceramic material called Synroc (NTIS 1994), no national program for immobilization of high-level wastes has considered adapting these materials as a preferred waste form, primarily due to the greater complexity of the process and the resulting higher costs of its construction and operation (McKee et al. 1984). In reviewing the current world-wide status of high-level waste immobilization research and development and implementation experience, DOE has not identified any rationale for reconsidering its 1982 decision to proceed with the DWPF process using borosilicate glass as the waste form.

2.6 Comparison of Alternatives

DOE describes the existing environment in Chapter 3 and uses it as the basis for evaluating potential environmental impacts in this Supplemental EIS. For many environmental resource categories, existing environmental conditions

would remain unchanged under the no-action alternative. Environmental consequences of the alternatives are analyzed in Chapter 4 and show minimal or negligible impacts for many resource categories. This section, including Table 2.6-1, compares potential impacts associated with each alternative using information from Chapter 4 for construction, normal operations, and accidents. No impacts to cultural resources or aesthetic and scenic resources would be expected from any of the alternatives, so entries are not provided in Table 2.6-1 for these categories. Major differences in potential impacts among the alternatives are discussed below. In addition to these differences, other minor differences are discussed in Chapter 4.

- The proposed action and the ion exchange alternative would ultimately decrease the overall risk posed to human health and the environment associated with management of high-level radioactive waste currently stored in the tank farms. As long as the waste remains in the tanks, particularly in liquid form, releases to the environment could occur as a result of leaks, spills, or tank system rupture.

- The series of figures in Figure 2.6-1 shows conceptual risk profiles over time for the various alternatives. Figure 2.6-1A shows a risk profile under the no-action alternative. Under this alternative, the risk from managing high-level waste at the tank farms would continue indefinitely. Figure 2.6-1B shows the risk profile for the proposed action, indicating a reduction in annual risk; from removing wastes from the tanks by operation of evaporators, ITP, Extended Sludge Processing, and the Vitrification Facility. It also shows a drop in risk at the conclusion of DWPF operation to a smaller, continuing risk from radioactive glass waste canisters stored underground in the Glass Waste Storage Building and from residual radioactivity in the high-level waste tanks and processing facilities.

  Figure 2.6-1C shows a risk profile under phased replacement from DWPF operating with ITP for a 14-year period, followed by DWPF operating with ion exchange for the remainder of DWPF operation. The ion exchange process would carry a lower risk than operation of ITP because fewer and less hazardous materials, especially organics such as benzene, would be produced as byproducts. Again at the conclusion of DWPF operations, the risk drops to a smaller, continuing risk from the radioactive glass waste canisters stored underground in the Glass Waste Storage Building and from residual radioactivity in the high-level waste tanks and processing facilities.

  Figure 2.6-1D represents immediate replacement risks that would occur from continued tank farm storage while the ion exchange technology is developed and the facility built. At that time, DWPF would operate with ion exchange. The overall risk under this alternative would be relatively large because of the 10-year delay in waste removal from tanks. This figure also shows the drop in risk at the end of DWPF operations for phased replacement.

Figure 2.6-1.

Figure 2.6-1 Qualitative comparison of annual risk over time for proposed action, no-action, and ion exchange alternatives.

- Normal operation under the proposed action would result in airborne emissions of benzene and diphenyl mercury. However, DOE expects resulting ambient concentrations of these constituents to be within applicable environmental and occupational health regulatory standards. These constituents are not emitted under the immediate replacement alternative, which uses ion exchange for pre-treatment, or under the no-action alternative. Under the phased replacement alternative, benzene emissions would be the same as the proposed action for 14 years; DOE expects benzene releases to be negligible and diphenyl mercury releases

to be substantially reduced thereafter when ion exchange would be used for pre-treatment.

- Radiological releases following an extremely unlikely earthquake (frequency of once every 5,000 years) could result in a dose of approximately 4,000 rem to a worker located 100 meters (328 feet) from the Vitrification Facility and greater doses to workers located closer to the facility. Such doses would result in death within a few days. Such an event would also result in doses to the public that exceed the DOE dose standard for normal operations. DOE is evaluating the details of proposed safety modifications to substantially reduce or eliminate the probability and consequences of such an event. These modifications would be implemented before the facility is operated with radioactive waste.

- Potential, but unlikely, chemical accidents under each of the alternatives could result in nitric acid concentrations that may cause nearby workers to experience or develop life-threatening health effects or prevent them from taking protective actions. Mitigative and protective equipment and procedures are in place to minimize the consequences of these potential accidents.

- Potential, but unlikely, chemical accidents for the proposed action and for the first 14 years of the phased replacement alternative could result in formic acid and benzene concentrations that may cause nearby workers to experience or develop life-threatening health effects or prevent them from taking protective actions. This potential impact would not exist for either the no-action alternative, the immediate replacement alternative, or the last 10 years of the phased replacement alternative. Mitigative and protective equipment and procedures are in place to minimize the consequences of these potential accidents.

- The ion exchange process would pose a lower risk from hazardous materials than would operation of ITP because fewer hazardous byproducts, such as benzene, would be produced.

- The ion exchange and no-action alternatives would eliminate the generation of DWPF organic waste as compared to the proposed action.

Table 2.6-1. Summary comparison of potential environmental impacts among alternati

Area of Impact	Proposed Action (Preferred Alternative)	No Action
		NORMAL OPERATION
Geologic Resources	Construction: Temporary increased erosion in H-, S-, and Z-Areas and potential for minor soil contamination from spills. Operations: Decreased potential for radiological contamination of soils from high-level waste tank releases.	Construction: Potential less than Proposed Action. Operations: Continuing potential for radiological contamination of soils from high-level waste tank releases.
Groundwater	Construction: Potential for minor contamination	Construction: Potential less than Proposed

	from spills. Operations: Projected radiation dose from saltstone releases (0.03 millirem per year) within DOE standards. Highest nitrate concentrations projected at 80% of drinking water standards over 1,400-year time period. Other contaminants at lesser fractions of drinking water standards.	Action. Operations: Projected impacts from saltstone disposal less than Proposed Action. However, risk of releases from tanks and potential groundwater contamination would continue.
Surface Water	Construction: Potential for temporary minor contamination from sedimentation. Operations: Small increase in discharges of nonradioactive treated wastewaters (nonradiological).	Construction: Potential less than Proposed Action. Operations: No impacts expected.
Air Resources - Nonradiological	Construction: Minor temporary increase in fugitive dust emissions.	Construction: Increase less than Proposed Action.
	Operations: Increased emissions of benzene, mercury, and formic acid; within standards at site boundary.	Operations: No changes from existing conditions expected.
Air Resources - Radiological	Construction: No impacts expected. Operations: MEI^a dose: 0.001 millirem per year; population dose: 0.07 person-rem per year.	Construction: No impacts expected. Operations: No changes from existing conditions expected.
Ecological Resources	Construction: Minor displacement of biota from clearing of 40 hectares (100 acres); no effects on local and regional populations. Operations: Potential for minor increases in cesium concentrations in terrestrial biota; no effects on local and regional populations.	Construction: Impacts less than Proposed Action. Operations: No impacts expected.
Land Use	Construction: Increase in land requirements for Z-Area vault expansion to up to 73 hectares (180 acres) already dedicated to industrial use. Thirty hectares (75	Construction: Increase in land requirements of approximately 8 hectares (20 acres) already cleared for Z-Area vault expansion.

	acres) already cleared. Operations: No impacts expected.	Operations: No impacts expected.
Socioeconomics	Construction and Operations: Less than 0.2% temporary increase in employment, population, and income in region.	Construction and Operations: Less than 0.9% decrease in employment, population, and income in region.
Traffic and Transportation	Construction and Operations: Minor increase in traffic count on onsite and offsite roads.	Construction and Operations: Minor decrease in traffic count on onsite and offsite roads. No net change in the number of shipments of wastes and material.
Public Health (normal operations)	Construction: No impacts expected. Operations: Calculated 0.00004 excess fatal cancer per year within 80 kilometers (50 miles) from radionuclide releases. Calculated increase in lifetime chance of fatal cancer to MEI^a of 12 in 100 million from benzene releases and 1.2 in 100 million from radionuclide releases.	Construction: No impacts expected. Operations: No changes from existing conditions expected.
Worker Radiological Health	Construction: No impacts expected. Operations: Calculated 0.05 excess fatal cancer per year within facility worker population.	Construction: No impacts expected. Operations: No changes from existing conditions expected.
Worker Nonradiological Safety and Health	Construction and Operations: Estimated 20 minor injuries or illnesses per year.	Construction and Operations: Less than Proposed Action.
Waste Generation	Construction and Operations: Demand on SRS waste management facilities as average percent of SRS waste generation (30-Year-Forecast) (FY1995 - FY2018): 18% low-level <1% hazardous 10% mixed	Construction and Operations: No increase in waste generation from forecast level.

	11% sanitary Highly radioactive failed melters and possibly other equipment to be stored in dedicated DWPF Failed Equipment Storage Vaults.	
Decontamination and Decommissioning (D&D)	Construction and Operations: Increase in SRS inventory of facilities requiring eventual D&D.	Construction and Operations: Greater delay in ultimate D&D of the tank farms and associated facilities than for the Proposed Action.
ACCIDENT ANALYSES		
Radiological	MEI^a,b Maximum dose^d: 6.8 rem Maximum risk^c,d: ^ 1.8-10^-7 latent fatal cancer per year	MEI^a Maximum dose^d: 0.01 rem Maximum risk^c,d: 4.6-10^-8 latent fatal cancer per year
	Population^b Maximum dose^d: 76,000 person-rem Maximum risk^c,d: 0.002 latent fatal cancer per year	Population Maximum dose^d: 62 person-rem Maximum risk^c,d: 0.0003 latent fatal cancer per year
	Collocated worker^b,e Maximum dose^d: 4,000 rem Probability of this accident: 5.2-10^-5 per year^f	Collocated worker^e Maximum dose^d: 1.7 rem Maximum risk^c,d: 5.7-10^-6 latent fatal cancer per year^
Chemical	No site boundary concentrations exceeding ERPG^g values. Benzene, formic acid, and nitric acid concentrations onsite [100 m (328 ft)] exceed ERPG values.	No site boundary concentrations exceeding ERPG^g values. Nitric acid concentrations onsite [100 m (328 ft)] exceed ERPG values.

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a. MEI = Maximally exposed (offsite) individual.
b. DOE is evaluating the details of proposed measures that would reduce these conse of 200, and would also reduce or eliminate the probability of this accident sequ
c. Risk is the product of accident frequency per year and consequences.
d. This table presents the maximum dose and maximum risk from the accidents analyze the maximum dose and maximum risk may not be from the same accident.
e. The collocated worker is defined as an individual located 100 meters (328 feet) release occurs.
f. The latent fatal cancer risk is not calculated because the dose (4000 rem) would
g. ERPG = Emergency Response Planning Guidelines.

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3.0 AFFECTED ENVIRONMENT

3.1 Introduction

This chapter describes the existing environmental and socioeconomic characteristics of the Savannah River Site (SRS) and the nearby region that could be impacted by the proposed action or its alternatives, as described in Chapter 2. The purpose of this chapter is to provide the environmental data needed to assess environmental consequences of the proposed action and alternatives discussed in Chapter 4. Information in the Final Environmental Impact Statement, Defense Waste Processing Facility, Savannah River Plant, Aiken, South Carolina (1982 EIS) (DOE 1982a) is updated where appropriate and is otherwise not repeated.

3.2 Geologic Resources

3.2.1 SOILS AND TOPOGRAPHY

The topography (contour of the land) of the Defense Waste Processing Facility (DWPF) area is generally flat and featureless. Local changes in elevation range from 30 to 50 meters (100 to 170 feet) above the lowlands near Upper Three Runs and Fourmile Branch (USGS 1987). The entire area is above the 100-year floodplain.

Previously disturbed soils in the area are mostly well drained and were formed from excavated areas, borrow pits, and other areas where major land shaping or grading activities have taken place. These soils are found beside and under streets, sidewalks, buildings, parking lots, and other structures. The soil material has been moved, so soil properties can vary within a few meters. Slopes of soils in the area generally range from 0 to 10 percent with a moderate erosion hazard. Soils range from sandy to clayey, depending upon the source of the soil material (USDA 1990).

Undisturbed soils in the area consist primarily of sandy surface layers above a subsoil containing a mixture of sand, silt, and clay (USDA 1990). These soils are well drained to somewhat excessively drained with slopes ranging from 0 to 10 percent. The permeability of these soils is generally high with a slight erosion hazard. None of the undisturbed soils that would be cleared and graded for construction by actions addressed in this Supplemental EIS are considered suitable as prime farmland (USDA 1990).

3.2.2 GEOLOGIC STRUCTURES

A recent study of available geophysical evidence (Stephenson and Stieve 1992) identified six faults under the SRS: Pen Branch, Steel Creek, Advanced Tactical Training Area, Crackerneck, Ellenton, and Upper Three Runs faults. Figure 3.2-1 shows the locations of these faults as well as a poorly defined fault (Millet Fault) located immediately offsite. The lines drawn on Figure 3.2-1 represent the projection of the faults to the ground surface. The location of faults must be considered when siting waste management facilities because South Carolina Department of Health and Environmental Control (SCDHEC) regulations specify a setback of at least 61 meters (200 feet) from a fault where displacement during the Holocene Epoch (approximately 35,000 years ago to the present) has occurred. The closest of these faults is approximately 4.8 kilometers (3 miles) northwest of the DWPF. Based on information

developed to date, none of the faults discussed in this section are considered to be capable as defined by the Nuclear Regulatory Commission in 10 CFR Part 100, Appendix A. The capability of a fault is determined by several criteria, one of which is whether or not the fault has moved at or near the ground surface within the past 35,000 years.

Several subsurface investigations conducted near DWPF encountered soft sediments classified as calcareous sands. These calcareous sands contain calcium carbonate (calcite), which can be dissolved by water. The calcareous sands were encountered at DWPF in borings between 33 to 45 meters (110 to 150 feet) below ground surface. Preliminary information indicates that these calcareous zones are not continuous over large areas (WSRC 1993b). If the calcareous material dissolved, possible settlement underground could result in settlement at the ground surface. No such settlement has been reported in any of the facilities near DWPF; however, DOE is currently investigating potential impacts from the sands.

3.2.3 SEISMICITY

Two earthquakes have occurred during recent years inside the SRS boundary. On June 8, 1985, an earthquake with a local Richter scale magnitude of 2.6 and a focal depth of 0.96 kilometer (0.59 mile) occurred on the Site. The epicenter was west of C- and K-Areas. The acceleration produced by the earthquake did not activate instruments in the reactor areas. On August 5, 1988, an earthquake with a local Richter scale magnitude of 2.0 and a focal depth of 2.68 kilometers (1.66 miles) occurred on the Site. Its epicenter was northeast of K-Area. This event was not felt onsite, and it did not trigger the seismic alarms in Site facilities. Existing information does not conclusively correlate the two earthquakes with the known faults on the Site.

Figure 3.2-1.
Figure 3.2-1. SRS faults.

Figure 3.2-1 shows the locations of the epicenters of these two earthquakes in relation to the Pen Branch Fault and the DWPF areas (S, Z, F, and H). A report on the August 1988 earthquake (Stephenson 1988) reviewed the latest earthquake history. This report predicts recurrence rates of 1 per year at a Richter scale magnitude of 2.0 in the southeast coastal plain. However, the report also notes that historic data available to calculate recurrence rates accurately are sparse.

A Richter scale magnitude 3.2 earthquake occurred on August 8, 1993, approximately 16 kilometers (10 miles) east of the city of Aiken near Couchton, South Carolina. Residents reported feeling this earthquake in Aiken, New Ellenton (immediately north of the SRS), North Augusta [approximately 40 kilometers (25 miles) northwest of the SRS], and at the Site.

3.3 Water Resources

3.3.1 GROUNDWATER

3.3.1.1 Aquifer Units

The most important hydrologic system underlying the SRS and, more specifically, the DWPF and associated facilities, is found in the Coastal Plain sediments, in which groundwater occurs in porous sands and clays. Figure 3.3-1 shows the names for geologic formations based on the physical character of the rocks (lithostratigraphy) and the corresponding names used to identify their water-bearing properties (hydrostratigraphy). The terms used in the 1982 EIS are shown on the figure to help correlate the information

presented in earlier works with that presented in this Supplemental EIS. Figure 3.3-1 identifies the shallow, intermediate, and deep aquifers. Depth-based identification will be used throughout the document to simplify discussion of groundwater resources and consequences. The Final Environmental Impact Statement, Continued Operation of the K-, L-, and P-Reactors, Savannah River Site (DOE 1990b) contains a more detailed discussion of SRS groundwater features. A report by the U.S. Geological Survey (Dennehy, Powell, and McMahon 1989) also contains pertinent information on the geology, groundwater resources, and surface water resources of the DWPF and vicinity.

3.3.1.2 Groundwater Flow

Numerous groundwater monitoring wells are installed near the DWPF and associated facilities to monitor water levels and quality in the upper part of the shallow aquifer. Groundwater in the shallow, intermediate, and deep aquifers flows in different directions. The direction of shallow groundwater movement depends on the depth of the streams that cut the aquifers. The shallow aquifer discharges to Upper Three Runs and Fourmile Branch. Shallow groundwater in the vicinity of S- and Z-Areas flows towards Upper Three Runs, McQueen Branch, or Fourmile Branch (DOE 1990b). Groundwater in the intermediate and deep aquifers beneath the SRS flows horizontally toward the Savannah River and southeast toward the coast (Arnett et al. 1992).

Figure 3.3-1.

Figure 3.3-1. Comparison of lithostratigraphy, 1982 hydrostratigraphic nomenclature, and current hydrostratigraphy for the SRS region.

Groundwater also moves vertically. In the shallow aquifer (Figure 3.3-1), groundwater moves downward vertically until its movement is obstructed by geologic materials that do not allow water to flow easily through them. At this point, groundwater flow in the intermediate and deep aquifers operates under a different set of physical conditions, flowing mostly in a horizontal direction. Groundwater in the intermediate and deep aquifers near the DWPF moves upward due to higher water elevations below the confining unit relative to the shallow aquifer. The thick clay material that forms the confining unit between the upper aquifer and the lower aquifers and the upward movement of groundwater in the lower aquifers help to protect the lower aquifers from contaminants in the shallow aquifer above. Additionally, Dennehy, Powell, and McMahon (1989) report that clays in soil near the DWPF tend to swell when submerged in salt solutions. Such swelling would further limit the migration of contaminants in the area and would also tend to help protect aquifers from contamination.

The depth to groundwater at the DWPF and associated facilities varies from 1 to 21 meters (4 to 68 feet). Table 3.3-1 summarizes the depth to groundwater and the direction of groundwater flow in the shallow aquifer. Figure 3.3-2 locates groundwater monitoring wells relative to facilities and streams. The Final Environmental Impact Statement, Waste Management Activities for Groundwater Protection, Savannah River Plant (DOE 1987) describes groundwater flow in aquifers beneath SRS in detail. Appendix F in the Final Environmental Impact Statement - Defense Waste Processing Facility, Savannah River Plant (DOE 1982a) discusses groundwater flow beneath the S- and Z-Areas in more detail.

3.3.1.3 Groundwater Quality

Excellent quality groundwater is abundant in this region of South Carolina from many local aquifer units. The water in the Coastal Plain Sediments is generally of good quality and suitable for municipal and industrial use with minimal treatment. The water is usually soft, slightly acidic (pH of 4.9 to 7.7) and low in dissolved solids. High dissolved iron concentrations occur in some aquifers. Groundwater is the only source for domestic water supplies at the SRS and, where necessary, it is treated to raise the pH and remove iron

(WSRC 1993l).

Figure 3.3-2.
Figure 3.3-2. Groundwater monitoring well series at DWPF and associated facilities.

Table 3.3-1. Shallow aquifer monitoring wells and related information for the DWPF and associated facilities.^a,b

Area	Well series	No. of wells	Depth to water meters^c	Flow direction	Outcrop stream
F-Area Tank Farm	FTF	27	12.7-20.7	north,west, and south	Upper Three Runs Fourmile Branch
H-Area Tank Farm	HTF	33	1.1-18.5	north and south	Upper Three Runs Fourmile Branch
Auxiliary Pump Pit	HAP	2	1.1-18.5	northeast	McQueen Branch
S-Area DWPF: Background Wells	SBG	6	7.3-15.9	northwest to northeast	Upper Three Runs Fourmile Branch
Vitrification Building	SCA	10	14.1-14.4	north and northeast	Upper Three Runs McQueen Branch
Low Point (Auxiliary) Pump Pit	SLP	2	11.6-12.1	northeast	McQueen Branch
Former Y-Area (northwest section of Z-Area) Waste Solidification and Disposal Facility	YSC	8	16.3-17.7	northeast	McQueen Branch
Z-Area Saltstone Facility, Background Wells	ZBG	3	15.5-16.0	northeast	McQueen Branch
Low-Point Drain Tank	ZDT	2	26.9-7.3	northeast	McQueen Branch

a. Source: Modified from Arnett, Karapatakis, and Mamatey (1993); see Figure 3.3-2 in this section for the location of facilities and well series.
b. All wells are in the shallow aquifer.
c. To convert to feet multiply by 3.281.

Industrial solvents, metals, tritium, and other constituents used or generated on the Site have contaminated the shallow aquifers beneath 5 to 10 percent of the SRS (Arnett, Karapatakis, and Mamatey 1993). Most contaminated groundwater at the SRS occurs beneath a few facilities; contaminants reflect

past and present operations and chemical processes performed at those facilities.

Annual Environmental Reports (Arnett et al. 1992; Arnett, Karapatakis, and Mamatey 1993) present specific groundwater data from more than 1,600 monitoring wells at SRS, including approximately 300 wells in the F- and H-Areas near the DWPF and associated facilities. Table 3.3-2 lists those constituents found in the groundwater in the shallow aquifer beneath the DWPF at levels exceeding water quality standards, as explained in the footnotes to the table. The SRS screens analytical results by computer to alert facility operators near the monitoring wells of potential groundwater contamination and the exceedance of a groundwater standard.

Table 3.3-2. Constituents found in groundwater monitoring wells in the shallow aquifer at the DWPF and associated facilities exceeding primary drinking water standards during October 1992 to September 1993.^a,b

Location	F-Area Tank Farm	H-Area Tank Farm	S-Area Background Wells	S-Area Vitrifi-cation Building	S-Area Low Point Pump Pit	Y-Area W Solidifi and Disp Facili
Well series	FTF	HTF	SBG	SCA	SLP	YSC
No. of wells	27	33	6	10	2	8
Gross alpha	X	X	---^c	---	---	---
Nonvolatile beta	X	X	---	---	---	---
Carbon tetrachloride	---	O	---	---	---	---
Cadmium (total)	X	X	---	---	---	---
1,2-Dichloroethane	---	X	---	---	---	---
Chromium (total)	O	---	---	---	---	---
Cesium 137	---	O	---	---	---	---
Mercury (total)	X	X	---	---	---	---
Nickel (total)	---	X	---	---	---	---
Nitrate as nitrogen	O	O	---	---	---	---
Lead (total)	X	X	---	O	---	---
Strontium 90	---	O	---	---	---	---
Technetium 99	---	O	---	---	---	---
Tetrachloro-ethylene	---	---	O	---	---	---
Thallium (total)	---	X	---	---	---	---
Trichloroethylene	---	X	---	---	---	---
1,1-Dichloroethylene	---	O	---	---	---	---
Radium (total)	X	X	---	---	---	---
Uranium 233, 234	---	O	---	---	---	---
Cobalt (total)	---	O	---	---	---	---
Tritium	X	X	X	X	---	X

a. Source: Arnett, Karapatakis, and Mamatey (1993, 1994).
b. This table shows constituents found in one or more monitoring wells with concent final primary drinking water standard.
c. A dash indicates constituents were not found in monitoring wells.
X = Constituent detected in more than one well in the series.
O = Constituent detected in only one well in the series.

Currently 60 (of which 59 are active) groundwater monitoring wells are installed in and around the F-and H-Area Tank Farms to identify groundwater contaminants due to tank farm operations. Chemical constituents associated with routine operations have been detected in groundwater samples collected

from several wells near the tank farms. These include radionuclides, heavy metals, organics, and inorganics as identified in Table 3.3-2.

Far fewer contaminants were found in the monitoring wells at S-Area near the Vitrification Facility than at the tank farms. Many of these constituents were found in background wells and, therefore, may not be the result of operations in the area (Table 3.3-2). At the S-Area Low Point Pump Pit, no chemical or radioactive constituents other than total dissolved solids were detected above the drinking water standards. Near the northwest section of Z-Area, no radioactive constituents were detected above the drinking water standards; however, other constituents identified in Table 3.3-2 are present.

In accordance with the SRS Federal Facility Agreement (EPA 1993a), DOE is currently investigating or planning to investigate causes for groundwater contamination. No contaminants have been detected in the intermediate and deep aquifers that provide process and drinking water to this area.

3.3.1.4 Groundwater Use

Groundwater is used as a domestic, municipal, and industrial water supply throughout the Upper Coastal Plain. Most municipal and industrial water supplies in Aiken County are developed from the deep aquifers. Domestic water supplies are developed primarily from the deep and the intermediate aquifers and less frequently from the shallow aquifers. In Barnwell and Allendale counties, some municipal users are supplied from the intermediate zone and overlying units that thicken to the southeast. At SRS, most groundwater production is from the deep aquifer, with a few lower-capacity wells pumping from the intermediate aquifer. Every major operating area at SRS has groundwater-producing wells. Total groundwater production at SRS ranges from 34,000 to 45,000 cubic meters (9 to 12 million gallons) per day.

DOE has identified 56 major municipal, industrial, and agricultural groundwater users within 32 kilometers (20 miles) of the center of the SRS (DOE 1987). The total amount pumped by these users, excluding SRS, is about 135,000 cubic meters (36 million gallons) per day. Nine wells are used to produce water from aquifers beneath the DWPF and associated facility areas: three wells in each of the F- and H-Areas from the deep aquifer; and three wells in S-Area, two wells in the deep aquifer, and one backup well in the intermediate aquifer (DOE 1992a). No production wells exist in Z-Area. All wells are designed to deliver up to 63 liters per second (1,000 gallons per minute) except for the backup well, which is designed to deliver 22 liters per second (350 gallons per minute). Water obtained from these wells is used for process requirements and drinking water. As noted in Section 3.3.1.3, groundwater contamination at the SRS is present in the shallow aquifers beneath a few facilities. Shallow aquifers are used as sources of drinking water only in areas where groundwater is not contaminated. All SRS drinking water wells are in zones of no contamination as required by the South Carolina Primary Drinking Water Regulations.

3.3.2 SURFACE WATER

3.3.2.1 Savannah River

The Savannah River bounds the SRS on its southwestern border for about 32 kilometers (20 miles), approximately 260 river kilometers (160 river miles) from the Atlantic Ocean. At the SRS, river flow averages about 283 cubic meters (10,000 cubic feet) per second. Three large upstream reservoirs - Hartwell, Richard B. Russell, and Strom Thurmond/Clarks Hill - minimize the effects of droughts and the impacts of low flow on downstream water quality and fish and wildlife resources in the river.

The Savannah River, which forms the boundary between the States of Georgia and South Carolina, supplies potable water to several municipalities. Upstream

from the SRS, the river supplies domestic and industrial water needs for Augusta, Georgia, and North Augusta, South Carolina. Approximately 203 river kilometers (126 river miles) downstream from the SRS, the river supplies domestic and industrial water needs for the Cherokee Hill Water Treatment Plant at Port Wentworth, Georgia, through intakes at river kilometer 47 (river mile 29) and for Beaufort and Jasper counties in South Carolina through intakes at about river kilometer 63 (river mile 39.2). SCDHEC regulates the physical properties and concentrations of chemicals and metals in SRS effluents under the National Pollutant Discharge Elimination System program. This agency also regulates chemical and biological water quality standards for SRS waters. On April 24, 1992, SCDHEC changed the classification of the State waters including the Savannah River and SRS streams from "Class B Waters" to "Freshwaters." The definitions of "Class B Waters" and "Freshwaters" are the same, but the "Freshwaters" classification imposes a more stringent set of water quality standards.

Table 3.3-3 lists the characteristics of Savannah River water upstream and downstream from the SRS. A comparison of these data shows that the water quality of the Savannah River for calendar year 1993 was not appreciably impacted by SRS discharges and that the constituents in SRS discharges are within the guidelines established for drinking water by the U.S. Environmental Protection Agency (EPA), SCDHEC, and DOE.

The five principal tributaries to the river on the SRS are Upper Three Runs, Fourmile Branch, Pen Branch, Steel Creek, and Lower Three Runs (Figure 3.3-3). These tributaries drain almost all of the SRS. Each of these streams originates on the Aiken Plateau in the Coastal Plain and descends 15 to 60 meters (50 to 200 feet) before discharging into the river. The streams, which historically have received varying amounts of effluent from various SRS operations, do not supply domestic or industrial water. The natural flow of SRS streams ranges from less than 1 cubic meter (35 cubic feet) per second in smaller streams such as Pen Branch to 6.8 cubic meters (240 cubic feet) per second in Upper Three Runs.

3.3.2.2 Upper Three Runs

Information provided in this section is derived from Wike et al. (1993). Upper Three Runs drains the watershed where DWPF and Z-Area are located. It is the largest stream on the SRS.

Upper Three Runs is a large, cool [annual maximum temperature of 26oC (79oF)] blackwater stream in the northern part of the SRS. It drains an area of approximately 545 square kilometers (210 square miles) and from October 1990 through September 1991 had a mean discharge of 6.8 cubic meters (240 cubic feet) per second at the mouth of the creek. The 7-day, 10-year low flow (the lowest flow expected in any consecutive 7-day period in any 10 years) is 2.8 cubic meters (100 cubic feet) per second. Upper Three Runs is approximately 40 kilometers (25 miles) long. Twenty-eight kilometers (17 miles) near the low end of Upper Three Runs lie within the boundaries of the SRS. Upper Three Runs receives more water from underground sources than other SRS streams and, therefore, has low dissolved solids, hardness, and pH values. Upper Three Runs is the only major tributary on the SRS that has never received thermal discharges.

Table 3.3-3. Water quality in the Savannah River upstream and downstream from the SRS (calendar year 1993).^a,b

Parameter	Unit of measure^c	MCL^d,e or DCG^f	Upstream Minimum^g	Upstream Maximum^g	Downst Minimum
Aluminum	mg/L	0.05-0.2^h	0.17	0.95	0.18

Ammonia	mg/L	NA^i,j	0.04	0.13	0.02
Cadmium	mg/L	0.005^d	ND	ND	ND
Calcium	mg/L	NA	3.2	4.3	3.3
Cesium-137	pCi/L	120^f	0.001	0.004	0.004
Chemical oxygen demand	mg/L	NA	ND	ND	ND
Chloride	mg/L	250^h	4	13	4
Chromium	mg/L	0.1^d	ND	ND	ND
Copper	mg/L	1.3^m	ND	ND	ND
Dissolved oxygen	mg/L	>5.0^n	6.8	11.5	6.2
Fecal coliform	Colonies/ 100 ml	1,000^n	13	1,960	5
Gross alpha radioactivity	pCi/L	15^d	<DL	0.059	<DL
Iron	mg/L	0.3^h	0.41	1.39	0.52
Lead	mg/L	0.015^k	ND	0.002	ND
Magnesium	mg/L	NA	1.08	1.38	1.11
Manganese	mg/L	0.05^h	0.067	0.088	0.04
Mercury	mg/L	0.002^d,e	ND	ND	ND
Nickel	mg/L	0.1^d	ND	ND	ND
Nitrite/Nitrate (as Nitrogen)	mg/L	10^d	0.17	0.31	0.18
Nonvolatile (dissolved) beta radioactivity	pCi/L	50^d	0.39	2.24	0.96
pH	pH units	6.5-8.5^h	6.0	6.8	6.0
Phosphate	mg/L	NA	ND	ND	ND
Plutonium-238	pCi/L	1.6^f	<DL	0.00086	<DL
Plutonium-239	pCi/L	1.2^f	<DL	0.00048	<DL
Sodium	mg/L	NA	4.9	11.6	5.3
Strontium-90	pCi/L	8^f	<DL	0.17	0.01
Sulfate	mg/L	250^h	4	8	4
Suspended solids	mg/L	NA	5	18	5
Temperature	yC	32.2^o	9.0	24.8	9.1
Total dissolved	mg/L	500^h	48	75	49

solids					
Tritium	pCi/L	20,000^e	<DL	726	411
Zinc	mg/L	5^h	ND	ND	ND

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a. Source: Arnett (1994).
b. Parameters are those DOE routinely measures as a regulatory requirement or as part of ongoing monitoring programs.
c. mg/L = milligrams per liter; a measure of concentration equivalent to the weight/volume ratio. pCi/L = picocuries per liter; a unit of radioactivity; one trillionth of a curie.
d. Maximum Contaminant Level (MCL), EPA National Primary Drinking Water Standards (40 CFR Part 141).
e. Maximum Contaminant Level (MCL): SCDHEC (1976a). See glossary.
f. DOE Derived Concentration Guides (DCGs) for water, DOE (1993b), DCG values are based on committed effective dose of 4 millirem per year for consistency with drinking water MCL of 4 millirem per year. See glossary.
g. Minimum concentration of samples. The maximum listed concentration is the highest single result found during one sample event. Less than (<) indicates concentration below analysis detection limit (DL).
h. Secondary Maximum Contaminant Level, EPA National Secondary Drinking Water Regulations (40 CFR Part 143).
i. NA = None applicable.
j. Dependent upon pH and temperature.
k. ND = None detected.
l. Source: Arnett (1993).
m. Action level for lead and copper.
n. WQS = water quality standard. See glossary.
o. Shall not exceed weekly average of 32.2oC (90oF) after mixing nor rise more than 2.8oC (5oF) in 1 week unless appropriate temperature criterion mixing zone has been established.

Figure 3.3-3

Figure 3.3-3. Major stream systems and facilities at the Savannah River Site.

When the 1982 EIS for the DWPF was prepared, DOE planned to discharge wastewater from DWPF to Fourmile Branch. However, the DWPF now sends discharges to Upper Three Runs via unnamed tributaries, Crouch Branch, and McQueen Branch. These discharges are permitted in National Pollutant Discharge Elimination System permit SC0000175 and consist of treated sanitary wastewater from the S-Area sewage treatment plant, treated industrial wastewater from the Chemical Waste Treatment Facility, and steam condensate and cooling tower blowdown in S-Area. Two other discharge locations were included in the permit (the discharges from the Concrete Batch Plant used in construction of the DWPF and the Construction Phase Equipment Washdown oil/water separator) but are no longer active outfalls. The flow of the treated sanitary wastewater discharge averages less than 0.001 cubic meters (0.033 cubic feet) per second while the flow of the combined treated chemical wastewater and cooling tower blowdown averages 0.002 cubic meters (0.065 cubic feet) per second. Comparison to the 7-day, 10-year low flow of 2.8 cubic meters (100 cubic feet) per second in Upper Three Runs shows that the present discharges from the DWPF are very small and would have minimal impact on Upper Three Runs. The analytical results for the two active outfalls show that the constituents of concern are maintained within the limits established by SCDHEC. Table 3.3-4 presents water quality data for Upper Three Runs for the calendar year 1993. Upper Three Runs also receives discharges via permitted outfalls from A-, B-, F-, and H-Areas with an average flow of 0.176 cubic meters (6.2 cubic feet) per second.

The stormwater runoff from most of the DWPF is collected and sent to a

retention pond north of S-Area. The effluent from this pond is discharged at permitted outfall DW-005 (General Stormwater Permit SCR000000) to Crouch Branch. The analytical results (Table A-21 in Appendix A) for grab samples collected from this outfall during a rainfall show minimal impact of stormwater on the water quality of Upper Three Runs. Monitoring studies conducted by the Savannah River Ecology Laboratory between 1982 and 1990 (Pechmann et al. 1993) indicate that Upper Three Runs water quality had not been significantly affected by construction site runoff but that Crouch Branch and McQueen Branch had been adversely affected. DOE has increased its erosion and sedimentation control efforts at DWPF and Z-Area since that time. Additional information on erosion and sedimentation control related to stormwater runoff is provided in Section 2.2.1.

3.4 Air Resources

3.4.1 CLIMATE AND METEOROLOGY

The climate at the SRS is characterized as a temperate climate with short, mild winters and long, humid summers. Throughout the year, the weather is affected by warm, moist maritime air masses (DOE 1991d).

Table 3.3-4. Water quality in Upper Three Runs upstream and downstream from SRS discharges (calendar year 1993).^a,b

Parameter	Unit of measure^c	MCL^d,e or DCG^f	Upstream Minimum^g	Upstream Maximum^g	Downst Minimum
Aluminum	mg/L	0.05-0.2^h	0.09	0.14	0.02
Ammonia	mg/L	NA^i,j	ND^n	0.04	ND
Cadmium	mg/L	0.005^d	ND	ND	ND
Calcium	mg/L	NA	0.4	0.9	1.4
Chemical oxygen demand	mg/L	NA	ND	ND	ND
Chloride	mg/L	250^h	2	3	2
Chromium	mg/L	0.1^d	ND	ND	ND
Copper	mg/L	1.3^k	ND	ND	ND
Dissolved oxygen	mg/L	>5.0^l	7.3	9.9	5.0
Fecal coliform	Colonies/ 100 ml.	1000^l	<2	691	52
Gross alpha radioactivity	pCi/L	15^d	0.52	5.92	<DL
Iron	mg/L	0.3^h	0.20	3.36	0.36
Lead	mg/L	0.015^k	ND	0.003	ND
Magnesium	mg/L	NA	0.301	0.349	0.034

Manganese	mg/L	0.05^h	ND	0.123	ND
Mercury	mg/L	0.002^d,e	ND	ND	ND
Nickel	mg/L	0.1^d	ND	ND	ND
Nitrite/Nitrate (as nitrogen)	mg/L	10^d	0.17	0.23	0.10
Nonvolatile (dissolved) beta radioactivity	pCi/L	50^d	<DL	3.54	0.20
pH	pH units	6.5-8.5^h	5.3	7.6	5.2
Phosphate	mg/L	NA	ND	ND	ND
Sodium	mg/L	NA	1.34	1.51	1.44
Sulfate	mg/L	250^h	1	1	1.0
Suspended solids	mg/L	NA	1	11	1
Temperature	degrees C	32.2^m	11.8	24	9.7
Total dissolved solids	mg/L	500^h	13	46	19
Tritium	pCi/L	20,000^d,e	<DL	2,730	<DL
Zinc	mg/L	5^h	ND	0.017	ND

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a. Source: Arnett (1994).
b. Parameters are those DOE routinely measures as a regulatory requirement or as part of ongoing monitoring programs.
c. mg/L = milligrams per liter; a measure of concentration equivalent to the weight/volume ratio. pCi/L = picocuries per liter; a unit of radioactivity; one trillionth of a curie.
d. Maximum Contaminant Level (MCL), EPA National Primary Drinking Water Standards (40 CFR Part 141). See glossary.
e. Maximum Contaminant Level (MCL): SCDHEC (1976a). See glossary.
f. DOE Derived Concentration Guides (DCGs) for water, DOE (1993b), based on committed effective dose of 4 millirem per year for consistency with drinking water MCL of 4 millirem per year. See glossary.
g. Minimum concentration of samples. The maximum listed concentration is the highest single result found during one sample event. Less than (<) indicates concentration below analysis detection limit (DL).
h. Secondary Maximum Contaminant Level (SMCL), EPA National Secondary Drinking Water Regulations (40 CFR Part 143).
i. NA = None applicable.
j. Dependent upon pH and temperature.
k. Action level for lead and copper.
l. WQS = water quality standard. See glossary.
m. Shall not exceed weekly average of 32.2oC (90oF) after mixing nor rise more than 2.8oC (5oF) in 1 week unless appropriate temperature criterion mixing zone has been established.
n. ND = None detected.

Current statistics on the local climate and meteorology at the SRS are based on approximately 20 to 30 years of meteorological data (temperature, wind speed and direction, relative humidity, and precipitation) collected at the

Site.

3.4.1.1 Occurrence of Violent Weather

The SRS area has an average of 55 thunderstorms per year. On an annual average, lightning will strike six times per year on a square kilometer (0.39 square mile) of ground (Hunter 1990). Thunderstorms can generate wind speeds as high as 64 kilometers per hour (40 miles per hour) and even stronger gusts. The highest 1-minute wind speed, recorded at Bush Field in Augusta, Georgia, between 1950 and 1990, was 100 kilometers per hour (62 miles per hour) (NOAA 1990).

Since SRS operations began, nine confirmed tornadoes have occurred on or close to the SRS. Eight of the nine tornadoes caused light to moderate damage. The tornado of October 1, 1989, caused considerable damage to timber resources on about 444 hectares (1,097 acres) and lighter damage on about 606 hectares (1,497 acres) over southern and eastern areas of the Site. Winds produced by this tornado were estimated to have been as high as 240 kilometers per hour (150 miles per hour) (Parker and Kurzeja 1990). No tornado-related damage has occurred to SRS production facilities.

Based on tornado statistics in the SRS area, the average frequency of a tornado striking any given location in South Carolina is estimated to be 7.11 x 10^-5 per year. This means that a tornado could strike any given location about once every 14,000 years (Bauer et al. 1989).

The safety-related SRS facilities have been built to withstand a maximum tornado wind speed of 451 kilometers per hour (280 miles per hour) (Bauer et al. 1989). The estimated probability of a location on the SRS experiencing wind speeds equal to or greater than this tornado wind speed is 1.2 x 10^-7 per year. The likelihood that such a tornado would happen is about once every 10 million years (Bauer et al. 1989).

A total of 36 hurricanes have caused damage in South Carolina over a 290-year period (1700 - 1989). The average frequency of occurrence of a hurricane in the state is once every 8 years; however, the observed interval between hurricane occurrences has ranged from periods as short as 2 months to as long as 27 years. Eighty percent of hurricanes have occurred in August and September.

Winds associated with Hurricane Gracie, which passed to the north of the Site on September 29, 1959, were measured as high as 121 kilometers per hour (75 miles per hour) on an anemometer located in F-Area. No other hurricane force wind has been measured on the Site. Extreme rainfall and tornadoes, which frequently accompany tropical weather systems, would probably have the greatest hurricane-related impact on SRS operations (Bauer et al. 1989).

3.4.1.2 Atmospheric Stability

Air dispersion models that predict downwind ground-level concentrations of an air pollutant released from a source are based on specific parameters such as stack height, wind speed, pollutant emission rate, and air dispersion coefficients. The air dispersion coefficients used in modeling are determined by atmospheric stability.

The ability of the atmosphere to disperse air pollutants is frequently expressed in terms of seven Pasquill-Gifford atmospheric turbulence (stability) classes, A through G. Occurrence frequencies for each of the seven Pasquill-Gifford stability classes at SRS have been determined using turbulence data collected from the SRS meteorological towers during the 5-year period from 1987 to 1991. Relatively turbulent atmospheric conditions that make atmospheric dispersion likely, represented by the unstable Pasquill-Gifford classes A, B, and C, occurred approximately 56 percent of the time. Stability class D, which indicates conditions that are moderately favorable

for atmospheric dispersion, occurred approximately 23 percent of the time. Relatively stable conditions that minimize atmospheric dispersion and are represented by the Pasquill-Gifford classes E, F, and G occurred about 21 percent of the time (Shedrow 1993).

3.4.2 EXISTING RADIOLOGICAL AIR QUALITY

3.4.2.1 Background and Baseline Radiological Conditions

Ambient air concentrations of radionuclides at the SRS include nuclides of natural origin such as radon from uranium in the soils; man-made radionuclides such as fallout from the testing of nuclear weapons; and emissions from coal-fired power plants and nuclear reactors. The SRS operates an atmospheric surveillance program consisting of 35 stations. Stations are located inside the SRS complex, on the Site perimeter, and at radial distances up to 161 kilometers (100 miles) from the Site (Arnett, Karapatakis, and Mamatey 1994).

Routine SRS operations release quantities of alpha- and beta-gamma-emitting radioactive materials in the form of gases and particulates. Gross alpha and nonvolatile beta measurements are used as a screening method for determining the concentration of all radionuclides in the air.

The average 1990 to 1992 gross alpha and gross beta activity, measured at the SRS and at radial distances of 40 kilometers (25 miles) to 161 kilometers (100 miles) from the Site, is shown in Table 3.4-1. The maximum levels of gross alpha radioactivity and gross beta radioactivity were found onsite near operating areas. During 1993, average gross alpha and nonvolatile beta concentrations onsite were similar to the average concentrations measured in offsite air (Arnett, Karapatakis, and Mamatey 1994). Nonvolatile beta concentrations do not include tritium (which accounts for more than 99 percent of the airborne radioactivity released from the site) or carbon-14.

Table 3.4-1. Average concentrations of gross alpha and nonvolatile beta radioactivity measured in air, 1991-1993 (in microcuries per milliliter).

Location	Number of locations	Average gross alpha radioactivity			Ave
		1991	1992	1993	1991
Onsite	5	2.5x10^-15	1.8x10^-15	1.9x10^-15	1.8x10^-1
Site perimeter	14	2.6x10^-15	1.8x10^-15	1.8x10^-15	1.8x10^-1
40-kilometer radius^b	12	2.5x10^-15	1.7x10^-15	1.8x10^-15	1.8x10^-1
161-kilometer radius	4	2.6x10^-15	1.7x10^-15	2.0x10^-15	1.8x10^-1

a. Source: Arnett, Karapatakis, and Mamatey (1994).
b. To convert kilometers to miles, multiply by 0.621.

Table 3.4-2 shows the maximum individual effective dose equivalent for emissions occurring during 1993. These calculations are based on a computer model (CAP88) that assumes all radioactive releases occurred from only one centrally located release point. The radionuclide responsible for the

highest dose, tritium, produces 98 percent of the total dose (Table 3.4-2). The total value of 0.2 millirem is less than the EPA airborne emission standard of 10 millirem per year to any member of the public due to radioactive emissions from DOE facilities (40 CFR Part 61 Subpart H).

3.4.2.2 Sources of Radiological Emissions

Table 3.4-3 shows major SRS production facilities and the types and quantities of r These are the most recently published data. The dose to a member of the public fro millirem calculated by use of the MAXIGASP code, which uses more realistic paramete code discussed previously. This dose is 0.96 percent of the 10 millirem per year E H). Tritium, in both elemental and oxide forms, made up more than 99 percent of th atmosphere from SRS operations (Arnett, Karapatakis, and Mamatey 1994). Operation the DWPF did not release any radionuclides in 1993 because they had not begun proce radionuclide emissions were recorded by stack monitors in the Z-Area. Small amount from fugitive emissions (emissions other than stacks or vents such as windows, door Saltstone Disposal Vaults (WSRC 1994g).

Table 3.4-2. 1993 maximum individual effective dose equivalent by radionuclide.^a

Radionuclide^b	Maximum individual effective dose equivalent^c,d (millirem)	Percent of dose^
Tritium (as the oxide)	0.18	98.4
Plutonium-238	1.2-10^-3	0.7
Plutonium-239^e	1.2-10^-3	0.6
Uranium-235, 238	7.5-10^-4	0.4
Iodine-129	3.3-10^-4	0.2
Americium-241, 243	2.4-10^-4	0.1
Strontium-89, 90 (Yttrium-90)^f	2.8-10^-5	0.02
Curium-242, 244	5.0-10^-5	0.03
Cesium-137 (Barium-137m)	3.1-10^-5	0.02
Carbon-14	4.6-10^-6	0.003
Tritium (elemental)	3.1-10^-6	0.002
Sulfur-35	4.4-10^-11	2-10^-8
Nickel-63	7.3-10^-12	4-10^-9
Iodine-131	1.5-10^-7	8-10^-5
Rubidium-106 (Rhodium-106)	7.3-10^-8	4-10^-5
Iodine-133	3.0-10^-8	2-10^-5
Cobalt-60	2.6-10^-10	1-10^-7
Xenon-135	1.8-10^-8	1-10^-5
Cesium-134	2.3-10^-8	1-10^-5
Cerium-144 (Praseodymium-144, 144m)	5.9-10^-16	3-10^-13
Europium-154	1.3-10^-14	7-10^-12
Europium-155	2.5-10^-16	1-10^-12
Antimony-125	3.7-10^-17	2-10^-13
Zirconium-95 (Niobium-95)	3.4-10^-17	2-10^-13
Total^g,h	0.2	

a. Source: Arnett (1994).
b. Radionuclides in parentheses are decay products that are included in effective dose equivalent calculations.
c. CAP88 dose calculations in Arnett, Karapatakis, and Mamatey (1994).
d. Numbers smaller than 0.001 are expressed in scientific notation.
e. Includes gross alpha.
f. Includes gross beta-gamma.
g. This value differs from that listed in Section 3.4.2.2 due to differences in computer models as discussed in the text.

h. Sums of the listed values may not equal totals due to rounding.

Table 3.4-3. 1993 atmospheric releases by source.^a

		Curies^c				
Radio-nuclide^b	Half-life	Reactors	Separations	Reactor materials	Heavy water	S
Gases and Vapors						
H-3 (oxide)	12.3 yrs	3.85-10^4	9.39-10^4	N/R^f	4.48-10^2	
H-3 (elem)	12.3 yrs	N/R	5.82-10^4	N/R	N/R	
H-3 Total	12.3 yrs	3.85-10^4	1.52-10^5	N/R	4.48-10^2	
Carbon-14	5.7-10^3 yrs	N/R	1.69-10^-2	N/R	N/R	
Argon-41	1.8 hrs	2.51-10^2	N/R	N/R	N/R	
Krypton-85	10.7 yrs	4.99-10^1	N/R	N/R	N/R	
Iodine-129	1.6-10^7 yrs	N/R	4.96-10^-3	N/R	N/R	
Iodine-131	8 days	N/R	8.89-10^-5	N/R	N/R	
Iodine-133	20.8 hrs	N/R	N/R	N/R	N/R	
Xenon-135	9.1 hrs	N/R	N/R	N/R	N/R	
Particulates						
Sulfur-35	87.2 days	N/R	N/R	N/R	N/R	
Cobalt-60	5.3 yrs	N/R	5.89-10^-9	N/R	N/R	
Nickel-63	100 yrs	N/R	N/R	N/R	N/R	
Sr-89,90^g	29.1 yrs	1.81-10^-4	1.88-10^-3	8.32-10^-5	7.19-10^-6	
Zr-95 (Nb-95)	64 days	N/R	N/R	N/R	N/R	
Ru-106	1.0 yrs	3.99-10^-6	5.76-10^-9	N/R	N/R	
Sb-125	2.8 yrs	N/R	N/R	N/R	N/R	
Cesium-134	2.1 yrs	N/R	1.49-10^-6	N/R	N/R	
Cesium-137	30.2 yrs	1.04-10^-4	5.28-10^-4	N/R	N/R	
Cerium-144	285 days	N/R	N/R	N/R	N/R	
Eu-154	8.6 yrs	N/R	N/R	N/R	N/R	
Eu-155	4.7 yrs	N/R	N/R	N/R	N/R	
U-235,238	4.5-10^9 yrs	N/R	1.86-10^-3	1.55-10^-5	N/R	
Pu-238	87.7 yrs	N/R	1.21-10^-3	N/R	N/R	
Pu-239^h	2.4-10^4 yrs	4.11-10^-6	1.06-10^-3	3.50-10^-6	8.42-10^-7	
Am-241,243	7.4-10^3 yrs	N/R	1.42-10^-4	N/R	N/R	
Cm-242,244	18.1 yrs	N/R	4.96-10^-5	N/R	N/R	

a. Arnett, Karapatakis, and Mamatey (1994).

b. H-3 = tritium
Sr = strontium
Nb = niobium
Ru = rubidium
Sb = antimony
Eu = europium
U = uranium
Pu = Plutonium
Zr = zirconium
Am = americium
Cm = curium

c. One curie equals 3.7-10^10 becquerels.

d. SRTC - Savannah River Technology Center.

e. Estimated releases from minor unmonitored diffuse and fugitive sources (i.e., sources other than stacks or vents such as windows or doors).

f. N/R = Not reported.

g. Includes unidentified beta-gamma emissions.

h. Includes unidentified alpha emissions.

3.4.3 NONRADIOLOGICAL AIR QUALITY

3.4.3.1 Background Air Quality

The SRS is in an area that is described as an attainment area since the area complies with National Ambient Air Quality Standards for criteria pollutants including sulfur dioxide, nitrogen oxides (reported as nitrogen dioxide), particulate matter (less than or equal to 10 microns in diameter), carbon monoxide, ozone, and lead (40 CFR Part 50). The closest nonattainment area to the SRS that does not meet National Ambient Air Quality Standards is the Atlanta, Georgia, air quality region, which is 233 kilometers (145 miles) to the west.

Sources in an attainment area have to comply with Prevention of Significant Deterioration regulations. These regulations apply to new and modified sources of air pollution if the net emissions' increase from the new or modified source is determined to exceed the Prevention of Significant Deterioration annual threshold limit (40 CFR Part 52). Modifications at the SRS have not yet triggered Prevention of Significant Deterioration permitting requirements nor is such development anticipated in the future.

3.4.3.2 Air Pollutant Source Emissions

DOE has demonstrated compliance with all state and Federal air quality standards. Compliance was demonstrated by estimating ambient air concentrations resulting from maximum potential emission rates using the calendar year 1990 (most recent) air emissions inventory data as the baseline year. This air quality compliance demonstration also included sources forecast for construction or operation through 1995 and permitted sources supporting the DWPF. The SRS based its calculated emission rates for the sources on process knowledge, source testing, permitted operating capacity, material balance, and EPA Air Pollution Emission Factors (EPA 1985; WSRC 1993m). Calculated ambient ground-level concentrations of criteria air pollutants and applicable toxic air pollutants at the Site boundary are shown in Tables 3.4-4 and 3.4-5. These results were calculated using maximum potential emissions from all operating SRS sources (i.e., not including DWPF and the Consolidated Incineration Facility). Actual Site boundary concentrations are expected to be lower than values reported in these tables.

Table 3.4-4. Estimated ambient concentrations of criteria air pollutants resulting from existing SRS sources (micrograms per cubic meter).^a,b

Pollutant^c	Averaging time	SRS maximum potential concentration	Most stringent AAQS^d,e (Federal or state)
SO2	3-hour	1,500 (1,200)^f	1,300^g
	24-hour	440 (300)	365^g
	Annual	22.2	80
NOx	Annual	21.7	100
CO	1-hour	3,660	40,000
	8-hour	800	10,000
Gaseous fluorides (as HF)	12-hour	2.44	3.7
	24-hour	1.16	2.9
	1-week	0.44	1.6
	1-month	0.11	0.8
PM10	24-hour	92.4	150
	Annual	9.5	50

O3	1-hour	NA^i	235
TSP	Annual geometric mean	18.8	75^h
Lead	Calendar quarter mean	0.014	1.5

----
a. Source: Hunter and Stewart (1994a).
b. The contributions are the maximum values that are applicable to the regulatory standards.
c. SO2 = sulfur dioxide; NOx = nitrogen oxides; CO = carbon monoxide; PM10 = particulate matter < 10 microns in diameter; TSP = total suspended particulates, O3 = ozone, HF = hydrogen fluoride.
d. AAQS = Ambient Air Quality Standard.
e. Source: SCDHEC (1976b).
f. The value in parentheses is the second high maximum value.
g. Concentration not to be exceeded more than once a year.
h. Source: 40 CFR Part 50.
i. NA = Not available.

Table 3.4-5. SRS air dispersion modeling results for toxic air pollutants (micrograms per cubic meter).^a

Pollutant	SCDHEC standard^b (micrograms per cubic meter)	SRS maximum potential concentration (micrograms per cubic meter)	Maximum concent percent standar
Formic Acid	225	<0.01	<0.01
Benzene^c			
24-hour	150	31.6	21.1
Annual	NA^d	0.17	NA
Mercury	0.25	0.004	1.6

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a. Source: Hunter and Stewart (1994b).
b. SCDHEC (1976b).
c. Calculated using TNX's actual benzene releases and maximum potential emissions from all other operating sources of benzene at SRS.
d. NA = Not applicable.

The modeled concentration for benzene at the site boundary is influenced by the TNX facility at SRS since it is the major source of benzene for facilities that are currently operating, and it is within 500 meters (1,640 feet) of the site boundary. The annual benzene concentrations, listed in Table 3.4-5, were calculated using TNX's actual benzene releases along with maximum potential emissions from other operating facilities at SRS. TNX's benzene emissions are from a pilot-scale operation of the DWPF glass melter and are intermittent.

3.4.3.3 Ambient Air Monitoring

The SRS performs no onsite ambient air quality monitoring for nonradiological air contaminants. State agencies operate ambient air quality monitoring sites in Barnwell and Aiken counties in South Carolina, and Richmond county in Georgia. Monitoring in these counties, which are near the SRS, demonstrates

compliance with National Ambient Air Quality Standards for particulate matter, lead, ozone, sulfur dioxide, nitrogen oxides, and carbon monoxide (40 CFR Part 81).

3.5 Ecological Resources

H-, S-, and Z-Areas, located near the center of SRS and approximately 1.6 to 3.2 kilometers (1 to 2 miles) southeast of Upper Three Runs (Figure 3.2-1), are heavily industrialized with little natural vegetation inside the fenced areas. These areas are characterized by buildings, paved parking lots, graveled construction areas, and laydown yards. While some grassed areas occur around the administration buildings and some vegetation is present along the ditches that drain the area, most of the developed areas have no vegetation. Wildlife is largely absent except for house sparrows (Passer domesticus), European starlings (Sturnus vulgaris), and barn swallows (Hirundo rustica) around the buildings. Pine plantations managed for timber production by the U.S. Forest Service (under an interagency agreement with DOE) cover surrounding areas.

In 1982, when the original EIS was published, the preferred option for disposing of low radioactivity salt solution was as saltcrete in engineered trenches. About 14 hectares (35 acres) in Z-Area were set aside for saltcrete disposal. By 1988, the technology had been modified to dispose of waste salts as saltstone in vaults. The vaults required more space than the trenches, so additional acreage was added to Z-Area for a total of approximately 73 hectares (180 acres). Before the change in disposal technology was approved, a NEPA determination was completed (DOE 1988b). It concluded that "the environmental effects associated with these additional... changes... have been reviewed and found to be insignificant.... There are no wetlands... in these areas.... No adverse impacts are expected on SRP wildlife because these areas contain no high quality wildlife habitat or feeding areas. No endangered or threatened species have been found in these areas" (DOE 1988b).

3.5.1 TERRESTRIAL ECOLOGY

H-, S-, and Z-Areas sit on an upland plateau between the drainage areas of Upper Three Runs and Fourmile Branch. The forested land surrounding the areas is planted in loblolly (P. taeda) or slash pine (P. elliotii). Bottomland hardwood stands exist in the floodplains of the two creeks and their tributary streams, the largest of which are McQueen Branch and Crouch Branch. Dominant bottomland hardwood species include red maple (Acer rubrum), box elder (A. negundo), bald cypress (Taxodium distichum), water tupelo (Nyssa aquatica), sweetgum (Liquidambar styraciflua), and black willow (Salix nigra) (Workman and McLeod 1990).

The land cover comprising Z-Area was planted in 1958 (Nielson 1994). Currently, approximately half the land encompassed by Z-Area (Photo 3.5-1) is covered with pines (less than 20 percent longleaf, the remainder loblolly and slash) and an understory typical of southeastern pine forests.

No land other than that already encompassed by H-, S-, or Z-Areas would be required for the proposed action or the alternatives.

3.5.2 WETLANDS

When the DWPF was originally constructed, it was necessary to destroy a Carolina bay, a type of wetland unique to the southeastern United States. As mitigation for the loss of this bay, four artificial woodland ponds were constructed on the periphery of the facility to study how well the animals

displaced from the Carolina Bay would compensate if provided with alternative habitats (Pechmann et al. 1993). One pond was later dismantled to accommodate Z-Area expansion. The remaining ponds support breeding amphibians and some wetland vegetation.

Unnamed tributaries of McQueen Branch and Crouch Branch, which are tributaries of Upper Three Runs, drain S-Area; Fourmile Branch drains H-Area; Z-Area is drained by McQueen Branch. There are no wetlands associated with these facilities other than the artificial ponds and the floodplains of the creeks.

Figure Photo 3.5-1.
Photo 3.5-1. Aerial photograph of Z-Area showing relationship of existing vaults, cleared areas, adn uncleared land.

3.5.3 AQUATIC ECOLOGY

One of the major SRS tributaries to the Savannah River is Upper Three Runs, which receives stormwater, sanitary treatment effluent, process water, and cooling tower blowdown from S- and Z-Areas. It also receives non-process cooling water, steam condensates, process effluents, and treated groundwater effluents from the 700-A Area, and ambient temperature cooling water, steam condensates, powerhouse washdown water, treated industrial wastewater, and ash disposal basin effluents from F- and H-Areas (Wike et al. 1993). In the recent past, it received industrial wastes from the 300-M Area Fuel Fabrication Facility. Section 3.3.2 describes the physical features of Upper Three Runs.

Based on studies by the Academy of Natural Sciences of Philadelphia and others (Floyd, Morse, and McArthur 1993), Upper Three Runs has one of the richest aquatic insect faunas of any stream in North America. A recent study (Floyd, Morse, and McArthur 1993) identified 93 species of caddisflies, including three species that had not previously been found in South Carolina and two species that are new to science. Other insect species found in the creek are considered endemic, rare, or of limited distribution (Floyd, Morse, and McArthur 1993).

The American sandburrowing mayfly (Dolania americana), a relatively common organism in Upper Three Runs, is listed by the Federal government as a candidate species for Federal protection. The species is sensitive to impacts or disturbances involving siltation, organic loading, or toxic releases (Wike et al. 1993).

Between 1987 and 1991, the density and variety of insects collected from Upper Three Runs decreased for unknown reasons. Data from 1991 indicate that the creek may be recovering from the unknown disturbance (Wike et al. 1993).

A recent study (Davis and Mulvey 1993) has identified a clam species (Elliptio hepatica) in the Upper Three Runs drainage that is presently known to occur in few other locations.

3.5.4 Threatened and Endangered Species

Threatened, Endangered, and Candidate Plant and Animal Species of the Savannah River Site (HNUS 1992a) describes threatened, endangered, and candidate plant and animal species known to occur or that might occur on the SRS. These include 5 bird species, 1 mammal species, 5 amphibian species, 5 reptile species, 1 fish species, 2 invertebrate species, and 19 plant species. Endangered and threatened species require specialized habitats. The only threatened or endangered species that is known to occur in the vicinity of H-, S-, or Z-Areas is the red-cockaded woodpecker. The habitats near these areas are not suitable for other threatened or endangered species.

The closest active red-cockaded woodpecker colony is located approximately 6.5 kilometers (4 miles) from the facilities (Mayer 1994). Red-cockaded woodpeckers prefer pine trees that are more than 70 years old for nesting and 30 years old for foraging (Wike et al. 1993). Because the trees on Z-Area are less than 40 years old (Nielson 1994), the site is unlikely to provide nesting habitat for the woodpecker.

Before construction of the DWPF, DOE held an Endangered Species Act Section 7 consultation with the U.S. Fish and Wildlife Service to discuss the potential for endangered species to be affected by the DWPF. At that time a survey of the 20 hectares (50 acres) including and surrounding the original Z-Area was conducted, and no endangered species or critical habitats were discovered (DOE 1982a).

DOE conducted a similar survey of uncleared portions of Z-Area in October 1994. No evidence was found that this area is occupied or used by the red-cockaded woodpecker or any other Federally threatened or endangered animal or plant species (Mayer 1994).

3.5.5 RADIOECOLOGY

Manmade or enhanced radionuclides in the biota of the SRS are described in Arnett, Karapatakis, and Mamatey (1994). Species inhabiting the areas near H-, S-, and Z-Areas most likely to be consumed by humans are white-tailed deer and feral hogs. These species are hunted across the Site during yearly organized hunts in October, November, and December. Before releasing an animal to a hunter, SRS technicians perform field analyses for cesium-137 at the hunt site. In 1993, hunters collected 1,553 deer and 147 hogs. The maximum 1993 cesium-137 field measurement for deer was 43 picocuries per gram; the average was 4.7 picocuries per gram. For hogs, the maximum value was 26 picocuries per gram and the average was 5.6 picocuries per gram. Deer and hogs are confiscated if the cesiu, concentration is 99 picocuries per gram or greater (WSRC 1991b). Field technicians estimate the doses from consuming the venison and pork and make this information available to the hunters.

In 1992, the estimated maximum dose received by a hunter was 49 millirem per year. The basis for this unique hypothetical maximum dose, which was for a hunter who harvested eight deer and one hog, is the assumption that the hunter consumed the entire edible portion of each animal. An additional hypothetical model involved a hunter whose total meat consumption for the year consisted of SRS deer [81 kilograms (179 pounds) per year] (Hamby 1991). Based on these low-probability assumptions and on the average concentration of cesium-137 (6.4 picocuries in deer harvested on the SRS), the estimated potential maximum dose from this pathway is 26 millirem per year or 26 percent of the annual 100 millirem dose limit for members of the public (DOE 1990a). Although a large percentage of this hypothetical dose is probably due to cesium-137 from worldwide fallout, the total estimate includes this background cesium-137 to be conservative.

Past studies have been performed to examine the cesium-137 content of deer in the southeastern United States. For example, between 1967 and 1971, over 1,000 deer from throughout the southeast were examined for cesium-137 concentrations. Deer in the Lower Coastal Plain had higher concentrations of cesium (an average of 28 picocuries per gram with an average of 45 picocuries per gram of muscle) than deer from any other southeastern region (range of 2.1 to 4.2 picocuries per gram) including the region containing SRS (Jenkins and Fendley 1973). In an earlier study, the mean concentrations of cesium-137 in deer collected between 1967 and 1968 in six southeastern states ranged from less than 1 picocurie per gram to 121 picocuries per gram (Jenkins and Fendley 1968). These values indicate that wildlife not associated with SRS have a measurable amount of cesium that is not a result of SRS releases. Most of this cesium is presumed to be from atmospheric testing of nuclear weapons.

Deer on the SRS are exposed to and will ingest the same radioactive fallout in addition to cesium deposited as a result of SRS operations. The average concentration of cesium-137 in deer collected from the SRS in 1992 was 6.4 picocuries per gram, and the maximum concentration was 22.4 picocuries per gram.

Other wildlife on the site that are incidentally monitored for radionuclides include turkeys and beavers. In 1993, 33 turkeys were monitored with a portable sodium-iodide detector. Concentrations of cesium-137 ranged from 1 to 5 picocuries per gram. Beavers are monitored with a portable Geiger-Mueller instrument. In 1993, 127 beavers had cesium-137 concentrations of 1 to 47 picocuries per gram (Arnett, Karapatakis, and Mamatey 1994).

3.6 Land Use

Land use on the SRS falls into three broad categories: forested or undeveloped, water and wetlands, and developed facilities. Approximately 734 square kilometers (280 square miles) of the SRS (91 percent of the Site) area are undeveloped (USDA 1991). About 90 percent of this undeveloped area is forested (HNUS 1992b).

Land use within F-, H-, S-, and Z-Areas is classified as heavy industrial. F- and H-Areas each occupy approximately 162 hectares (400 acres) of the Site. S- and Z-Areas encompass 109 hectares (270 acres) and 73 hectares (180 acres), respectively. Land within an 8-kilometer (5-mile) radius of these areas lies entirely within the SRS boundaries and is used either for industrial purposes or as forest land (WSRC 1991c).

3.7 Socioeconomics

Approximately 90 percent of the SRS workforce in 1992 lived in the SRS region of influence, which includes Aiken, Allendale, Bamberg, and Barnwell counties in South Carolina, and Columbia and Richmond counties in Georgia. For environmental justice and health effects analyses, the population within an 80-kilometer (50-mile) radius of SRS was characterized.

3.7.1 EMPLOYMENT

Between 1980 and 1990, total employment increased from 139,504 to 199,1 average annual growth rate of approximately 4 percent. The unemployment rates for 1980 and 1990 were 7.3 percent and 4.7 percent, respectively (HNUS 1992b). Table 3.7-1 lists projected employment data for the six-county region of influence. As shown, by the year 2000 employment levels are expected to increase 27 percent to approximately 253,000 (HNUS 1993).

Table 3.7-1. Forecast employment and population data for the SRS and the region of

Year	Employment (Region)	SRS Employment
1994	239,790	21,530
1995	242,030	20,060
1996	243,510	19,260
1997	245,560	18,920
1998	247,860	18,810

1999	250,280	19,040
2000	252,860	18,700
2001	255,530	18,700
2002	258,330	18,700
2003	261,230	18,700
2004	264,150	18,700

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a. Source: HNUS (1993); Turner (1994).

In 1990, employment at the SRS was 20,230 (DOE 1993c), representing 10 percent of the region-of-influence employment. In Fiscal Year 1992, employment at the SRS increased approximately 15 percent to 23,351, approximately 10 percent of regional employment, with an associated payroll of more than $1.1 billion. As listed in Table 3.7-1, Site employment in 2000 is expected to decrease to approximately 18,695 (Turner 1994), representing 7 percent of regional employment, and is expected to continue to decrease as a percent of regional employment in subsequent years.

3.7.2 INCOME

Personal income in the six-county region increased from almost $2.9 billion in 1980 to approximately $6.9 billion in 1990. Together, Richmond and Aiken counties accounted for 78 percent of the personal income in the region of influence in 1989. These two counties provide most of the employment opportunities in the region. Personal income in the region is likely to increase 27 percent to almost $8.8 billion in 1995 and to approximately $11.6 billion by 2000 (HNUS 1994).

3.7.3 POPULATION

Between 1980 and 1990, population in the region of influence increased 13 percent from 376,058 to 425,607. More than 88 percent of the 1990 population lived in either Aiken (28.4 percent), Columbia (15.5 percent), or Richmond (44.6 percent) counties. Table 3.7-1 presents population data for the region of influence forecast to the year 2004 (HNUS 1993). According to census data, in 1990 the estimated average number of persons per household in the six-county region was 2.72, and the median age of the population was 31.2 years (HNUS 1992b).

3.7.4 COMMUNITY CHARACTERISTICS

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires that Federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of their programs and activities on minority and low-income populations. DOE is in the process of developing official guidance on implementation of the Executive Order. The guidance that eventually is developed may depart somewhat from the approach taken in this Supplemental EIS for analysis of environmental justice issues. This approach is intended to identify the potential effects from onsite activities on individuals in the identified communities of people of color or low income. The following discussion describes the framework for analysis of environmental justice issues for the alternatives considered in this Supplemental EIS.

For consistency, data from the U.S. census of 1990 were used to identify and characterize populations, rather than more recent data gathered by South Carolina and Georgia. Although the South Carolina and Georgia data are based on the same 1990 U.S. Bureau of the Census reports, they are adjusted through sampling and statistical means. Because the assumptions and methodologies used by each state to adjust the 1990 U.S. census data are different, the bases for the two states' data estimates are not consistent. To ensure consistency across state boundaries, Federal rather than state data were used in the analyses.

The analysis of environmental justice issues presented in this Supplemental EIS is focused on potential offsite health effects from chemical and radioactive releases resulting from DWPF operation under the proposed action or its alternatives. The only pathway for offsite exposure from these releases is via the air. Standard population dose analyses for air releases are based on an 80-kilometer (50-mile) radius because expected dose levels beyond that distance are negligible. For purposes of the impact analysis, this Supplemental EIS presents the predicted average radiation doses received by individuals in the identified communities of people of color or low income, as described above, and compares them to the predicted average doses received in the remaining communities within the 80-kilometer (50-mile) region (Section 4.1.11.1). Table 3.7-2 provides data on the 1990 population distribution within an 80-kilometer (50-mile) radius of SRS.

Table 3.7-2. 1990 population distribution within 80 kilometers (50 miles).^a

	Kilometers^b				
Direction	0-8	8-16	16-32	32-48	48-6
N	0	2	5,321	10,020	5,06
NNE	0	6	1,320	2,066	4,44
NE	0	1	2,945	2,928	5,26
ENE	0	27	3,126	4,483	5,33
E	0	155	6,743	5,305	8,81
ESE	0	36	1,556	1,931	2,71
SE	0	26	547	6,511	6,68
SSE	0	40	391	7,690	1,35
S	0	1	558	1,332	7,25
SSW	0	2	897	2,008	4,18
SW	0	17	944	2,240	2,60
WSW	0	60	1,103	7,112	2,28
W	0	55	3,314	7,941	7,99
WNW	0	449	3,342	106,900	50,31
NW	0	271	5,899	87,930	26,57
NNW	0	363	18,030	27,160	6,66

Total	0	1,535	56,030	276,600	147,50

a. Source: Arnett (1993).
b. To convert to miles, multiply by 0.6214.

Racial and economic characteristics of the population within the 80-kilometer (50-mile) area are shown in Tables 3.7-3 and 3.7-4, respectively, and on Figures 3.7-1 and 3.7-2. Demographic data are most readily obtained by using U.S. Census Bureau definitions. For this Supplemental EIS, census tracts were chosen by DOE as a basis for analyzing data on communities. Specifically, DOE used data from each census tract area within an 80-kilometer (50- mile) radius of SRS to identify the racial composition of communities and the number of persons characterized by the U.S. Bureau of the Census as living in poverty. Data from smaller census units, blocks, and block groups, were considered. However, appropriate income data are not available for census blocks, and preliminary analysis indicated that no appreciable differences in the outcome of the analysis would occur with the use of block group data rather than tract data. The use of census tract data also facilitated graphic presentation of racial and income characteristics (see Figures 3.7-1, 3.7-2).

The 80-kilometer (50-mile) region contains 148 census tracts, 72 in South Carolina and 76 in Georgia. Table 3.7-2, used to generate exposures to airborne releases, shows only the population found inside the 80-kilometer (50-mile) radius, which is a smaller total population than that shown in Tables 3.7-3 and 3.7-4. The difference occurs because populations of entire census tracts were included in the latter two tables if 20 percent or more of the tract area fell within the 80-kilometer (50-mile) radius.

Table 3.7-3. General racial characteristics of population within 80 kilometers (50 miles).^a

State	Total population	White	African American	Hispanic	Asian	Nati Ameri
South Carolina	329,263	205,334	120,567	730	1,422	5
Georgia	360,350	237,243	111,513	3,145	4,942	6
Total	689,613	442,577	232,080	3,875	6,364	1,2

a. Source: U.S. Bureau of the Census (1990a).
b. Census data collection methodologies result in situations in which the total population data are not equal to the sum of the populations of the identified racial groups. Number of people of color = total population minus white population.
c. People of color population divided by total population.

Table 3.7-4. General poverty characteristics of population within 80 kilometers (50 miles).^a

Area	Total population	Persons living in poverty^b	Percent l pove
South Carolina	329,263	62,587	19.
Georgia	360,350	65,382	18.
Total	689,613	127,969	18.

a. Source: U.S. Bureau of the Census (1990b).
b. Families with income less than the statistical poverty threshold, which in 1990 was 1989 income of $8,076 for a family of two.

Figure 3.7-1.
Figure 3.7-1. Racial distribution of census tracts within 80-kilometers (50-miles).

Figure 3.7-2.
Figure 3.7-2. Low income distribution of census tracts within 80-kilometers (50-miles).

Table 3.7-3 shows that a total population of almost 700,000 live within the 80-kilometer (50-mile) area. Of that total population, approximately 443,000 (64 percent) are white. Within the minority population, referred to hereafter as people of color, approximately 94 percent are African American. The remainder of the population of people of color is made up of small percentages of Asian, Hispanic, and Native American persons. Figure 3.7-1 shows communities of people of color by census tract areas within 80 kilometers (50 miles).

Executive Order 12898 does not define minority populations. One approach to identifying minority communities would be to identify those communities that contain a simple majority of people of color (greater than or equal to 50 percent of the total community population). A second approach, identified by EPA, is that for environmental justice purposes, communities of people of color are defined as those that have higher-than-average (over the region of interest) percentages of minority persons (EPA 1994b). In Figure 3.7-1, shaded areas show census tracts where (1) people of color comprise 50 percent or more (simple majority) of the total population in the census tract, or (2) where people of color comprise less than 50 percent but greater than 35 percent of the total population in the census tract. DOE has adopted the latter, more expansive approach in this Supplemental EIS. This analysis is set forth in Section 4.1.10 (transportation effects) and 4.1.11.1 (public health effects).

Within 80 kilometers (50 miles) of SRS, 47 tracts (31.8 percent) contain concentrations of people of color that are equal to or greater than 50 percent of the total population in the tract. An additional 26 tracts (17.6 percent) contain between 35 and 50 percent people of color. These tracts with concentrations of people of color are well distributed throughout the 80-kilometer (50-mile) region, although weighted towards the south, with a higher concentration in the immediate vicinity of Augusta, Georgia.

Low-income communities generally are defined as those where 25 percent or more of the population is characterized as living in poverty (EPA 1993b). The U.S. Bureau of the Census characterizes persons in poverty as those whose income is less than a "statistical poverty threshold." The baseline threshold for the 1990 census was 1989 income of $8,076 for a family of two. This statistical threshold is a weighted average based on family size and the age of the persons in the family. Table 3.7-4 shows that within 80 kilometers (50 miles) of SRS more than 127,000 persons (19.6 percent of the total population) are characterized as living in poverty.

In Figure 3.7-2, shaded census tracts within the 80-kilometer (50-mile) region identify low-income communities. Within 80 kilometers (50 miles), 42 tracts (28.4 percent) are identified as low-income communities. These tracts are distributed throughout the region, although more exist to the south of the SRS and in portions of Richmond county, Georgia, primarily in the city of Augusta. (As discussed in Chapter 4, no adverse health effects are expected to occur in any offsite community, including minority and low-income communities.)

3.8 Cultural Resources

3.8.1 ARCHAEOLOGICAL SITES AND HISTORIC STRUCTURES

S- and Z-Areas were extensively surveyed in conjunction with the 1982 EIS. No important archaeological or historic artifacts, or sites eligible for inclusion in the National Register of Historic Places were found (DOE 1982a). Activities associated with the construction of F- and H-Areas during the 1950s would have probably destroyed historic and archaeological resources present in these areas as well (Brooks 1992). The existing SRS nuclear production facilities are not likely to be eligible for the National Register, either because they lack architectural integrity, do not represent a particular style, or do not contribute to the broad historic theme of the Manhattan Project and initial nuclear materials production (Brooks 1993, 1994).

3.8.2 NATIVE AMERICAN CULTURAL RESOURCES AND CONCERNS

In 1991, DOE conducted a survey of Native American concerns about religious rights in the Central Savannah River Valley. During this study, three Native American groups, the Yuchi Tribal Organization, the National Council of Muskogee Creek, and the Indian People's Muskogee Tribal Town Confederacy, expressed continuing interest in the region of the Savannah River site in regard to the practice of their traditional religious beliefs. The Yuchi Tribal Organization and the National Council of Muskogee Creek tribes have expressed concerns that several plant species such as redroot (Lachnanthes carolinianum), button snakeroot (Eryngium yuccifolium), and American ginseng (Panax quinquefolium) traditionally used in tribal ceremonies could exist on the SRS (NUS 1991a). Redroot and button snakeroot are known to occur on the SRS (Batson, Angerman, and Jones 1985) but are typically found in wet, sandy areas such as evergreen shrub bogs and savannas (Radford, Ahles, and Bell 1968). Neither species is likely to be found in the area of the DWPF, which has been cleared and graded or otherwise disturbed (e.g., cultivated) prior to acquisition of the Savannah River Site by the Atomic Energy Commission.

3.9 Aesthetics and Scenic Resources

The SRS facilities are scattered across the Site and are brightly lit at night. F-, H-, S-, and Z-Areas resemble industrial complexes consisting of large concrete structures, smaller administrative and support buildings, and parking lots. The facilities in these areas are visible when approached from SRS access roads. Otherwise, heavily wooded areas, which border the SRS road system and public highways that cross the Site, limit public view of the facilities.

3.10 Traffic and Transportation

3.10.1 REGIONAL INFRASTRUCTURE

The SRS is surrounded by a system of Interstate highways, U.S. highways, state highways, and railroads (Figure 1.1-1). No new regional roads or railroads have been constructed since the 1982 EIS was published.

3.10.2 SRS INFRASTRUCTURE

The SRS transportation infrastructure consists of more than 230 kilometers (143 miles) of primary roads, 1,931 kilometers (1,200 miles) of unpaved secondary roads, and 103 kilometers (64 miles) of railroad track (WSRC 1993n). These roads and railroads connect the SRS facilities and link them to offsite transportation services. Figure 3.10-1 shows the SRS railway system and network of primary roadways.

3.10.2.1 SRS Roads

In general, heavy traffic occurs in the early morning and late afternoon when workers commute to and from the Site (Table 3.10-1). During working hours, official vehicles and logging trucks constitute most of the traffic. As many as 30 logging trucks, which can impede traffic, may be operating on the Site, with an annual average of 15 trucks per day (WSRC 1992d). Tables 3.10-2 and 3.10-3 show other vehicles that contribute to site traffic. The total number of trucks longer than about 8 meters (25 feet) entering and exiting SRS daily is 785 (Swygert 1994b); 2 of these current daily truck shipments are of DWPF chemicals as shown in Table 3.10-2.

Figure 3.10-1.
Figure 3.10-1. Principal SRS facilities, roads, and railroads.

Table 3.10-1. Estimated SRS traffic - major roads.

Road	1994 baseline traffic^a
Offsite^a	
SC19	2,800^b
SC125	2,700^b
SC57	700^c
Onsite^d,e	
Road E at E-Area	741
Road 4 at S-Area, north of H-Area	872
Road F, south of Road 4	38
Road F, north of Road 4	69

a. 1994 vehicle counts were estimated from actual counts measured in 1989 (offsite) and 1992/1993 (onsite) by adjusting vehicle counts by the proportional change in SRS employment between measurement years and 1994; count is peak vehicles per hour.
b. Adapted from Smith (1989).
c. Adapted from TRB (1985).
d. Source: Swygert (1994a).
e. Morning traffic traveling toward S-Area.

Table 3.10-2. Estimated SRS truck shipments of DWPF chemicals (calendar year 1994).^a

Chemical	Usage (kilograms per year)^b	Shipments Per year	Shipments Per day
Nitrogen	6,471,057	471	2
Carbon dioxide	335,043	20	0
Sodium hydroxide	1,864,272	71	0

Nitric Acid	368,286	15	0
Formic acid	41,151	3	0
Glass frit	52,857	2	0
Copper formate	26,286	1	0
Sodium nitrite	175,854	7	0
Boric acid	64,697	3	0
Potassium nitrate	10,812	1	0
Oxalic acid	89,985	4	0
Sodium tetraphenylborate	576	1	0
Pre-mix cement	203,773	8	0
Total number of truck shipments^c		607	2

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a. Adapted from WSRC (1991d), Uzochukwu (1994a,b); McGuire (1994).
b. To convert to pounds, multiply by 2.205.
c. Shipments of flyash and slag, which are also used by DWPF, are not listed because they are received by rail.

Table 3.10-3. Estimated SRS waste shipments by truck (calendar year 1994).^a

Waste type	Destination	Volume Volume (cubic meters)^b	Shipments per year
Hazardous	Onsite/Offsite	1,119	1,792
Mixed	Onsite	1,931	2,291
Low-Level	Onsite	11,912	935
Construction debris	Onsite	Not available	Not available
Total truck shipments			5,018

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a. WSRC (1994i).
b. To convert to cubic feet, multiply by 35.31.

3.10.2.2 SRS Railroads

Under normal conditions, about 13 trains per day use the CSX tracks through the SRS (Burns 1993). Movement of coal and casks containing radioactive material constitutes the bulk of rail traffic at SRS (DOE 1991d).

The SRS rail classification yard is east of P-Reactor. This eight-track facility sorts and redirects rail cars. Deliveries of SRS shipments occur at onsite rail stations in the former towns of Ellenton and Dunbarton. From these stations, an SRS engine moves the railcars to the appropriate receiving facility. The Ellenton station, which is on the main Augusta-Yemassee line,

is the preferred delivery point. The Dunbarton station, which is on the discontinued portion of the Augusta-Florence line, receives less use.

3.10.3 NOISE

Previous studies have assessed noise impacts of SRS operational activities (DOE 1990b, 1991d, 1993c; NUS 1991b). These studies concluded that because of the remote locations of the SRS operational areas, onsite noise sources do not adversely affect individuals at offsite locations.

3.11 Occupational and Public Health

3.11.1 PUBLIC RADIOLOGICAL HEALTH

The release of radioactivity to the environment from a nuclear facility is an important issue for onsite workers and the public. The human environment contains many sources of radiation, and it is important to understand all the sources of ionizing radiation to which people are routinely exposed.

3.11.1.1 Sources of Environmental Radiation

Environmental radiation consists of natural background radiation from cosmic, terrestrial, and internal body sources; radiation from medical diagnostic and therapeutic practices; radiation from weapons test fallout; radiation from consumer and industrial products; and radiation from nuclear facilities. All radiation doses mentioned in this Supplemental EIS are "effective dose equivalents" (i.e., organ doses weighted for biological effect to yield equivalent whole-body doses), unless specifically identified otherwise (e.g., "absorbed dose," "thyroid dose," "bone dose").

Releases of radioactivity to the environment from the Site account for less than 0.1 percent of the total annual average environmental radiation dose to individuals within 80 kilometers (50 miles) of the Site (Arnett, Karapatakis, and Mamatey 1994).

Natural background radiation contributes about 80 percent of the annual dose of 357 millirem received by an average member of the population within 80 kilometers (50 miles) of the Site (Table 3.11-1). Based on national averages, medical exposure accounts for an additional approximately 15 percent of the annual dose, and the combined doses from weapons test fallout, consumer and industrial products, and air travel account for about 3 percent of the total dose (NCRP 1987a).

External radiation from natural sources comes from cosmic rays and emissions from natural radioactive materials in the ground. The radiation dose from external radiation varies with location and altitude.

Internal radiation from natural terrestrial sources consists primarily of potassium-40, carbon-14, rubidium-87, and daughter products of radium-226. Because the distribution of fertilizers and food containing these radionuclides is widespread and the population is mobile, the long-lived radionuclides that produce the internal dose have an averaging effect. The estimated average internal radiation exposure in the United States from natural radioactivity (primarily indoor radon daughter products) is 240 millirem per year (NCRP 1987b).

Table 3.11-1. Major sources of radiation exposure in the vicinity of the SRS.

Source of exposure	Dose to average individual (millirem/year)^a	Percentage of total exposure

NATURAL BACKGROUND RADIATION		
Cosmic radiation	29^b	
External terrestrial	24^c	
Internal terrestrial	40	
Radon in home	200	
Total Natural	293	82
MEDICAL RADIATION		
Diagnostic x-rays	39	
Radiopharmaceutical	14	
Total Medical	53	14.8
OTHER SOURCES		
Weapons test fallout	<1	<0.3
Consumer and industrial products	10	2.8
Air travel	1	0.3
Nuclear facilities (other than SRS) and transportation of radioactive materials	<1	<0.3
SRS - environmental radioactivity (1993)	0.25^d	0.07
Total	357	100

a. Values are effective dose equivalent from NCRP (1987a), unless noted otherwise.
b. NCRP (1987a) reports 26 millirem per year for sea level. This value is multiplied by a factor of 1.1 to correct for the altitude in the SRS region of about 300 meters (984 feet) above sea level to give 29 millirem per year.
c. NCRP (1987b) reports an absorbed dose rate for Augusta, Georgia, of 4 microrad per hour, which is 35 millirad per year. NCRP (1987b) uses a factor of 0.7 to convert absorbed dose to effective dose equivalent, so 35 X 0.7 = 24 millirem per year.
d. Arnett, Karapatakis, and Mamatey (1994).

Medical radiation is the largest source of man-made radiation to which the population of the United States is exposed. The average dose to an individual from medical and dental x-rays, prorated over the entire population, is 39 millirem per year (NCRP 1987a). Prorating the dose over the population, as done in this section, is a way to find an average dose that, when multiplied by the population size, produces an estimate of population exposure. It does not mean that every member of the population receives a radiation exposure from these sources. In addition, radiopharmaceuticals administered to patients for diagnostic and therapeutic purposes account for an average annual dose of 14 millirem when prorated over the population. Thus, the average medical radiation dose in the U.S. population is about 53 millirem per year.

In 1980, the estimated average annual dose from fallout from nuclear weapons tests was 4.6 millirem (0.9 millirem from external gamma radiation and 3.7 millirem from ingested radioactivity). Because no atmospheric nuclear weapons tests have been conducted since 1980, the average annual dose from fallout is now less than 1 millirem. This decline is due principally to radioactive decay.

A variety of consumer and industrial products yield ionizing radiation or contain radioactive materials and, therefore, result in radiation exposure to the general population. Some of these sources are television sets, luminous

dial watches, airport x-ray inspection systems, smoke detectors, tobacco products, fossil fuels, and building materials. The estimated average annual dose for the U.S. population from these sources is 10 millirem per year (NCRP 1987a). About one-third of this dose is from external exposure to naturally occurring radionuclides in building materials.

People who travel by aircraft receive additional exposure from cosmic radiation because at high altitudes the atmosphere provides less shielding from this source of radiation. The average annual airline passenger dose, when prorated over the entire U.S. population, amounts to 1 millirem (NCRP 1987b).

3.11.1.2 Radiation Levels in the Vicinity of the SRS

Table 3.11-1 summarizes the major sources of exposure for the population within 80 kilometers (50 miles) of the Site and for the river-water-consuming population in Beaufort and Jasper counties, South Carolina, and in Savannah, Georgia. Many factors, such as natural background dose and medical dose, are independent of the Site.

Atmospheric testing of nuclear weapons caused approximately 25,600,000 curies of cesium-137 to be deposited on the earth's surface (United Nations 1977). About 104 millicuries of cesium-137 per square kilometer were deposited in the latitude band where South Carolina is located (30yN to 40yN). The total resulting deposition was 2,850 curies on the 27,400 square kilometers (10,580 square miles) of the Savannah River watershed and 80 curies of cesium-137 on the Site. The deposited cesium-137 became attached to soil particles and has undergone slow transport from the watershed. Results from routine health protection monitoring programs indicate that since 1963 about 1 percent of the 2,850 curies of cesium-137 deposited on the total Savannah River watershed has been transported down the river (Du Pont 1983).

Onsite monitoring shows that an average of 50 millicuries per square kilometer (1976 to 1982 average) of cesium-137 are in the upper 5 centimeters (2 inches) of the soil column. This value is one-half of the amount originally deposited. This difference demonstrates that some of the cesium has moved down in the soil column and some has been transported in surface water to the Savannah River.

Other nuclear facilities within 80 kilometers (50 miles) of the Site include a low-level waste burial facility operated by Chem-Nuclear Systems, Inc., near the eastern SRS boundary, and the Georgia Power Company's Vogtle Electric Generating Plant, located directly across the Savannah River from the Site. In addition, Carolina Metals, Inc., which is northwest of Boiling Springs in Barnwell County, processes depleted uranium. The Chem-Nuclear facility, which began operation in 1971, releases essentially no radioactivity to the environment (Chem-Nuclear Systems, Inc. 1980), and the population dose from normal operations is negligible. The 80-kilometer (50-mile) radius population receives an immeasurably small radiation dose from transportation of low-level radioactive waste to the burial site. Plant Vogtle began commercial operation in 1987, and its releases to date have been far below DOE guidance levels and Nuclear Regulatory Commission regulatory requirements (Tichler, Doty, and Congemi 1994).

In 1992, releases of radioactive material to the environment from SRS operations resulted in a maximum Site perimeter dose from atmospheric releases of 0.11 millirem per year in the north-northwest sector around the Site, and a maximum dose from liquid releases of 0.14 millirem per year, for a maximum total annual dose at the Site perimeter of 0.25 millirem (Arnett, Karapatakis, and Mamatey 1994). The maximum dose to downstream consumers of Savannah River water occurred to Port Wentworth public water supply users and was 0.05 millirem per year (Arnett, Karapatakis, and Mamatey 1994).

In 1990, the population within 80 kilometers (50 miles) of the Site was

620,100 (Arnett, Karapatakis, and Mamatey 1994). The collective effective dose equivalent to the 80-kilometer (50-mile) population in 1993 was 7.6 person-rem from atmospheric releases (Arnett, Karapatakis, and Mamatey 1994). A person-rem is a unit of population exposure obtained by summing individual dose equivalent values for everyone in the population. The 1990 population of 65,000 people using water from the Cherokee Hill Water Treatment Plant near Port Wentworth (Savannah), Georgia, and the Beaufort-Jasper Water Treatment Plant near Beaufort, South Carolina, received a collective dose equivalent of 1.5 person-rem (Arnett, Karapatakis, and Mamatey 1994).

Gamma radiation levels, including natural background terrestrial and cosmic radiation measured at 179 locations around the Site perimeter during 1993, yielded a maximum dose rate of 102 millirem per year (Arnett, Karapatakis, and Mamatey 1994). This level is typical of normal background gamma levels measured in the general area (84 millirem per year measured by the EPA at Augusta, Georgia, in 1992). The maximum gamma radiation level measured onsite (N-Area) was 460 millirem per year (Arnett, Karapatakis, and Mamatey 1994).

Detailed summaries of the atmospheric and liquid releases from SRS that result in doses like those reported above are provided in a series of annual environmental reports (e.g., Arnett, Karapatakis, and Mamatey 1994 for the year 1993). Each of these environmental reports also summarizes radiological and nonradiological environmental monitoring performed and the results of the analyses of the environmental samples. These reports summarize the results of the extensive groundwater monitoring program at the Site, which uses more than 1,600 monitoring wells to detect and monitor both radioactive and nonradioactive contaminants in drinking water supplies in and around process operations, burial grounds, and seepage basins.

3.11.1.3 Radiation Levels in F-, H-, S-, and Z-Areas

Table 3.11-2 presents gamma radiation levels measured in F-, H-, S-, and Z-Areas in 1993. These values can be compared to the average dose rate of 69 millirem per year measured at the Site perimeter (Arnett 1994). This difference is attributable to differences in geologic composition, as well as facility operations in F- and H- Areas.

Table 3.11-2. External gamma radiation levels (milliRoentgen per year).^a,b

Location	Average	Maximum
F-Area	91	126
H-Area	103	146
S-Area	101	117
Z-Area	72	80

a. Source: Arnett (1994).
b. One milliRoentgen is approximately 1 millirem.

Analyses of soil samples from uncultivated areas provide a measure of the amount of particulate radioactivity deposited from the atmosphere. Table 3.11-3 lists maximum measurements of radionuclides in the soil for 1993 at F-, H-, S-, and Z-Areas, the Site perimeter, and at background [160-kilometer (100-mile)] monitoring locations. Measured elevated concentrations of these radionuclides around F- and H-Areas reflect releases from these areas.

Table 3.11-3. Maximum measurements of radionuclides in the soil for 1992

(picocuries per gram).^a

Location	Strontium-90	Cesium-137	Plutonium-238
F-Area	0.13	1.26	0.078
H-Area	0.086	1.57	0.026
S-Area	0.033	0.35	0.036
Z-Area	0.083	0.82	0.0066
Site perimeter	0.0096	0.65	0.0019
Background [160-kilometer (100-mile) radius]	0.077	0.35	0.0010

a. Source: Arnett (1994).

3.11.2 WORKER RADIATION EXPOSURE

One of the major goals of the SRS Health Protection Program is to keep worker exposures to radiation and radioactive material as low as reasonably achievable. An effective radiation protection program must minimize individual worker's doses while minimizing the collective dose to all workers in a given work group.

3.11.2.1 Sources of Worker Radiation Exposure at SRS

Worker dose comes from exposure to external radiation or from internal exposure when radioactive material is inside the body. In most SRS facilities, the predominant source of worker exposure is from external radiation. In those SRS facilities that process tritium, the predominant source of worker exposure is the dose from tritium that has been breathed or absorbed into internal body fluids. On rare occasions, other radionuclides can contribute to internal dose if they have accidentally been inhaled or ingested.

External exposure comes mostly from gamma radiation emitted from radioactive material in storage containers or process systems (tanks and pipes). Neutron radiation, which is emitted by a few special radionuclides, also contributes to worker external radiation in a few facilities. Beta radiation, a form of external radiation, has a lesser impact than gamma and neutron radiation because it has lower penetrating power and thus produces a dose only to the skin, rather than to critical organs within the body. Alpha radiation from external sources has no impact because it has no penetrating power.

Internal exposure occurs when radioactive material enters the body by inhalation, ingestion, or absorption through the skin. Once the radioactive material is inside the body, low energy beta and non-penetrating alpha radiation emitted by the radioactive material in close proximity to organ tissue can produce dose to that tissue. If this same radioactive material were outside the body, the low penetrating ability of the radiation emitted would prevent it from reaching the critical organs to produce dose. For purposes of determining health hazards, organ dose can be converted to effective dose equivalents. When comparing effective dose equivalents, the mode of exposure is irrelevant.

3.11.2.2 Radiation Protection Regulations and Guidelines

The current SRS Radiological Control Program is designed to implement Presidential Guidance issued to all Federal agencies on January 20, 1987. This guidance has been subsequently codified (10 CFR Part 835) as a Federal Regulation for all DOE activities. Policies and program requirements, formulated to ensure the radiological health protection of SRS workers and visitors, are documented in the SRS Radiological Control Manual, WSRC 5Q (WSRC 1993i). DOE performs regular assessments to ensure the continuing quality and effectiveness of the SRS Radiation Control Program by monitoring radiological performance indicators and by making periodic independent internal appraisals as required by 10 CFR Part 835.102. Appraisals are also conducted periodically by DOE and the Defense Nuclear Facilities Safety Board.

Appropriate control procedures, engineered safety systems, and worker training programs are established and implemented to ensure compliance with applicable regulations before beginning radioactive operation of any facility at the SRS, including the DWPF.

3.11.2.3 SRS Worker Dose

The purpose of the radiation protection program is to minimize dose from both external and internal exposure; it must consider both individual and group collective dose. It would be possible to reduce individual worker dose to very low levels by using numerous workers to perform extremely small portions of the work task. Frequent changing of workers would be inefficient and would result in a higher total dose received by all the workers than if fewer workers were used and each worker were allowed to get a slightly higher dose.

Worker doses at SRS have consistently been well below the DOE worker exposure limits. Administrative exposure guidelines are set 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 rem per year. For added protection of workers, SRS has adopted a more stringent limit called the administrative exposure guideline. This guideline was 1.5 rem per year in 1993.

Table 3.11-4 shows the maximum and average individual doses and the SRS collective doses for the years 1988 to 1993.

Table 3.11-4. SRS annual individual and collective radiation doses.^a

	Individual dose (rem)		
Year	Maximum	Average^b	Site collective dose (person-rem)
1988	2.040	0.070	864
1989	1.645	0.056	754
1990	1.470	0.056	661
1991	1.025	0.038	392
1992	1.360	0.049	316
1993	0.878	0.051	263

a. Adapted from: Du Pont (1989), Petty (1993), WSRC (1991e, 1992f, 1993o, 1994h).
b. The average dose includes only those workers who received a measurable dose during the year.

3.11.2.4 Worker Risk

Population statistics indicate that the overall death rate in the United States from all forms of cancer is about 23.5 percent (CDC 1993). Workers who are exposed to radiation have an additional risk of 0.004 latent fatal cancers per person-rem (ICRP 1991). In 1993, some 5,157 SRS workers received a measurable dose of radiation. Based on national averages, this group of 5,157 people is expected to contract approximately 1,200 fatal cancers from all causes during their lifetimes; however, this cancer incidence rate is dependent on the age and sex distribution of the population. In 1993, this group received 263 person-rem and may experience up to 0.1 additional cancer death due to their 1993 occupational radiation exposure. Continuing operation of SRS could result in up to 0.1 additional cancer death for each year of operation assuming future annual worker exposure continues at the 1993 level. In other words, for each 10 years of operation, one additional death from cancer among the work force that received a measurable dose could result.

3.11.3 WORKER NONRADIOLOGICAL SAFETY AND HEALTH

Industrial safety, industrial hygiene, medical monitoring, and fire protection programs have been implemented at the DWPF and across the SRS to ensure the nonradiological safety and health of DWPF workers. The industrial hygiene programs address a variety of topics relevant to DWPF, including nonradiological chemical exposure and hearing conservation.

3.11.3.1 Performance of SRS Safety and Health Programs

The Occupational Safety and Health Administration recordkeeping requirements (DOL 1986) specify the use of incidence rates, which relate the number of injury and illness cases and the resulting days lost from work to exposure (i.e., the number of hours worked). Incidence rates, which are based on the exposure of 100 full-time workers using 200,000 work hours as the equivalent (100 workers working 40 hours per week for 50 weeks per year), automatically adjust for differences in the hours of worker exposure to the workplace conditions that could result in injuries or illnesses. The Occupational Safety and Health Administration recordkeeping requirements also specify the types of injuries and illnesses that must be recorded for inclusion in incidence rate calculations. Incidence rates are generally calculated for total number of recordable cases, total number of lost workday cases, and total number of lost workdays.

Each year, the U.S. Department of Labor, Bureau of Labor Statistics reports the results of its annual survey of job-related injuries and illnesses in private industry. The injury and illness data supplied by the Bureau of Labor Statistics provide the most comprehensive survey data available on work-related injuries and illnesses in private industry. The Bureau of Labor Statistics estimates that in 1991, private industry employers experienced 8.4 work-related injuries and illnesses per 100 full-time workers (DOE 1993d).

Incidence rates provide an objective measure of the performance of SRS safety programs. The data in Table 3.11-5 can be used to compare the performance of SRS operations to that of general industry, the manufacturing industry, and the chemical industry (DOE 1993d).

The data in Table 3.11-5 demonstrate that SRS safety programs have resulted in incidence rates that are far below comparable rates for general industry, the manufacturing industry, and the chemical industry.

Table 3.11-5. Comparison of 1992 incidence rates for SRS operations to 1991 incidence rates for general industry, the manufacturing industry, and the chemical industry (illnesses and injuries per 100 full-time workers).

Incidence Rate	SRS Operations	General Industry	Manufacturing Industry	Chemic Indust
Total Recordable Cases	0.5	8.4	12.7	6.4
Lost Workday Cases	0.1	3.9	5.6	3.1
Lost Workdays	2.0	86.5	121.5	62.4

3.12 Waste and Materials

3.12.1 WASTE GENERATION

Information presented in this section reflects projected waste generation and planned waste management operations. Because the SRS mission is changing, the past and current waste generation amounts do not provide a baseline to judge the impact of DWPF waste generation on SRS waste management facilities. Therefore, future projected waste generation is discussed. The waste management plans discussed and the waste generation forecast presented in this section reflect expected and foreseeable Site operations, excluding decommissioning and environmental restoration activities. The specific assumptions and uncertainties applicable to waste management plans and the waste generation forecast are included in Table 3.12-1. Waste generation forecasts continue to be refined, and waste management decisions await the completion of the Site Treatment Plan and subsequent consent order pursuant to the Federal Facility Compliance Act and the SRS Waste Management EIS, under preparation. Therefore, actual waste volumes generated and the management of these wastes could differ from those assumed in this section.

The SRS generates several types of waste. The six basic categories are low-level radioactive waste; high-level radioactive waste; hazardous waste; mixed waste (radioactive and hazardous); transuranic waste; and sanitary waste (nonhazardous, nonradioactive solid waste). As discussed in Section 1.2.2, high-level radioactive waste was the product of processing nuclear materials. Its stabilization is the topic of this Supplemental EIS.

The waste types are described in the following subsections. Table 3.12-1 presents the projected total waste generation volumes for Fiscal Year 1995-2018 (the expected duration of the proposed action and phased replacement) and Fiscal Year 1995-2024 (the assumed duration of the no-action alternative and the first 30 years under immediate replacement).

3.12.1.1 Low-Level Radioactive Waste

Low-level radioactive waste is defined in DOE Order 5820.2A (DOE 1988c) as waste that is radioactive and cannot be classified as high-level waste, spent fuel, transuranic waste, or byproduct waste.

Table 3.12-1. Waste generation forecast for SRS operations (cubic meters).^a,b

Timeframe	Low-level waste	Mixed	Hazardous	Transuran
Fiscal Years 1995-2018	286,000	34,000	27,000	7,000

Fiscal Years 1995-2024	343,000	44,000	35,000	7,000

Note: The waste generation forecast is based heavily on assumptions, historical data, and anticipated operations of each facility. Assumptions and uncertainties that apply to this waste generation forecast are listed below.

Assumptions:

- Assume an effective facility waste minimization program that does not include implementation of radical technological developments that would result in a large decrease in waste generated.
- Assume available technologies and current regulatory, DOE, and waste certification requirements.
- Low-level radioactive waste generation volumes do not reflect compaction prior to disposal.
- Assume the following facilities will startup/shutdown in the following years:
    - -- DWPF Vitrification Facility operation - FY96 - FY18
    - -- 772-D Laboratory shutdown - FY98
    - -- Reactors/D-Area shutdown - FY97
    - -- Reactor Materials shutdown - FY98
    - -- Receiving Basin for Offsite Fuels/Resin Regeneration Facility shutdown - FY05
    - -- HB-Line shutdown - FY03
    - -- Consolidated Incineration Facility startup - FY96
    - -- H-Canyon shutdown - FY05
    - -- F-Canyon shutdown - FY03
    - -- 235-F Plutonium Fuel Facility and Thoria Line shutdown - FY13
    - -- 221-FB-Line shutdown - FY03
    - -- TNX shutdown - FY99
- Waste generation does not include failed melters, etc. to be stored in DWPF Failed Equipment Storage Vaults, waste from Late Wash (e.g., microfilters), or waste from environmental restoration or decontamination and decommissioning activities.

Uncertainties:

- Effect of future waste certification and treatment requirements on waste generation.
- Effect on waste generation due to more rigid compliance, disciplines in operations, etc., than in the past.
- Effect of delays in funding shutdowns, transitions, decontamination and decommissioning, and remediation.
- Effect of using contractors rather than SRS forces.
- Effect of future changes to the SRS mission.
- Effect of changing regulatory and legal requirements.

a. Source: WSRC (1994i).
b. To convert to cubic feet, multiply by 35.31.
c. Sanitary is nonhazardous nonradioactive solid waste.

Solid low-level radioactive waste typically includes protective clothing, soil, and small equipment. The noncombustible low-level waste from SRS facility operations is expected to be disposed of in the E-Area Vaults. Waste disposed of in this area would be containerized in 2.5-cubic meter (90-cubic feet) or 1.3-cubic meter (45-cubic feet) steel boxes. Originally, 20 vaults were to be constructed over a 20-year period. However, due to mission changes and projected waste generation, DOE is re-evaluating the need for future vaults. Each vault can accommodate approximately 34,000 cubic meters (1.2 million cubic feet) of containerized waste (WSRC 1994i).

DOE proposes to incinerate combustible low-level radioactive waste in the Consolidated Incineration Facility once the facility becomes fully operational (WSRC 1994j). The Consolidated Incineration Facility is expected to have sufficient capacity to treat approximately 18,000 cubic meters (630,000 cubic feet) of solid waste feed per year at 50 percent attainment (Lorah 1994). The treatment capacity at 70 percent attainment of the liquid waste feed excluding DWPF organic waste is approximately 3,900 cubic meters (138,000 cubic feet) per year (Lorah 1994) and the capacity for DWPF organic waste feed is approximately 740 cubic meters (26,000 cubic feet) per year (WSRC 1993d). DOE is re-evaluating treatment and disposal options for SRS low-level waste streams in the SRS Waste Management EIS, currently being prepared.

3.12.1.2 Hazardous Waste

Hazardous Waste is nonradioactive waste that is regulated by SCDHEC under the Resource Conservation and Recovery Act and corresponding state regulations. Waste is considered hazardous if it is listed as hazardous waste by EPA, or if it exhibits the characteristic(s) of ignitability, corrosivity, reactivity, or toxicity. SRS hazardous waste streams consist of a variety of materials. Examples of hazardous waste generated at the SRS include mercury, chromate, lead, paint solvents, various laboratory chemicals, and DWPF-generated organic waste from nonradioactive testing.

DOE began offsite shipments of hazardous wastes to treatment and disposal facilities in 1987. However, in 1990 DOE stopped the offsite shipment of hazardous waste originating in radiologically controlled areas and other wastes that had not been proven to be nonradioactive because laboratory techniques were not in place to demonstrate these wastes as nonradioactive. As a result, SRS presently ships only small quantities of hazardous waste for offsite recycling (e.g., recyclable solvents), treatment, or disposal.

Hazardous wastes generated at various site facilities are stored in hazardous waste storage facilities that are permitted by SCDHEC under the Resource Conservation and Recovery Act. These buildings will store waste until acceptable treatment and disposal methods can be implemented. At the forecasted generation rate, storage space will be at full capacity in Fiscal Year 1995 (WSRC 1994k).

DOE proposes treatment of hazardous waste generated at SRS for which EPA considers incineration to be the best demonstrated available or specified technology onsite in the Consolidated Incineration Facility. The Consolidated Incineration Facility is expected to have solid waste feed treatment capacity of approximately 18,000 cubic meters (630,000 cubic feet) per year at 50 percent attainment and liquid waste feed capacity (excluding DWPF organic waste) of 3,900 cubic meters (138,000 cubic feet) per year at 70 percent capacity.

DOE plans to dispose of incinerator ash and blowdown generated by the Consolidated Incineration Facility in the proposed Hazardous Waste/Mixed Waste Disposal Facility (WSRC 1994j). The Hazardous Waste/Mixed Waste Disposal Facility would also provide disposal for nonincinerable hazardous and mixed waste generated by SRS. The decisions regarding this facility, the Consolidated Incineration Facility, and other hazardous waste treatment and disposal options will be made in the context of the Site Treatment Plan and SRS Waste Management EIS currently in preparation.

3.12.1.3 Mixed Waste

Mixed waste is defined as radioactive waste that contains material listed as hazardous in the Resource Conservation and Recovery Act regulations or that

exhibits one or more of the following hazardous waste characteristics as defined under those regulations: ignitability, corrosivity, reactivity, or toxicity.

The SRS mixed waste program now consists primarily of providing continued safe storage until treatment and disposal facilities are available. Examples of mixed waste found at the SRS include mercury-contaminated oils, solvents, and radiologically contaminated lead.

SRS mixed waste is currently stored in onsite storage facilities that are approved by SCDHEC under the Resource Conservation and Recovery Act. As with hazardous waste at the SRS, DOE proposes to treat mixed waste for which EPA considers incineration to be the best demonstrated available or specified technology onsite in the Consolidated Incineration Facility with ash and blowdown disposal in the Hazardous Waste/Mixed Waste Disposal Vaults (WSRC 1994j). DOE also proposes to dispose of the mixed wastes such as the ITP filters in the vaults. DOE is evaluating these and other treatment and disposal options for SRS mixed waste in the context of the Site Treatment Plan and the SRS Waste Management EIS.

3.12.1.4 Transuranic Waste

Transuranic waste is defined as waste containing alpha-emitting transuranic radionuclides with half-lives greater than 20 years at concentrations greater than 100 nanocuries of transuranics per gram of waste. Transuranic waste consists primarily of job-control waste (protective clothing and radiological survey waste), but it may also include materials such as high efficiency particulate air (HEPA) filters, resins, and sludge.

Transuranic waste was originally buried in plastic bags and cardboard boxes in earthen trenches designed specifically for this waste. Beginning in 1965, transuranic waste was segregated according to curie content and whether or not the buried waste could be readily retrieved for future waste management activities.

Retrievable stored transuranic waste is presently stored in three configurations related to the time period of generation (WSRC 1994i). Retrievable transuranic waste generated between 1965 and 1974 is buried below grade in 120 concrete culverts in portions of the E-Area Solid Waste Disposal Facility. Transuranic waste generated from 1974 to 1986 is stored in 208-liter (55-gallon) drums on concrete pads (TRU Pads 2-5) and one asphalt pad (Pad 1). These wastes have been covered with approximately 1.2 meters (4 feet) of native soil. This configuration is referred to as "mounded pads." Waste generated after 1986 is stored in 208-liter (55-gallon) drums and other containers on concrete pads (TRU Pads 6-19).

DOE plans to construct facilities to process and repackage SRS transuranic waste as necessary to dispose of it offsite at the Waste Isolation Pilot Plant when completed. DOE is evaluating options for management of this waste in the Site Treatment Plan and the SRS Waste Management EIS, currently in preparation.

3.12.1.5 Sanitary Waste

Sanitary waste is solid waste that is neither hazardous as defined by the Resource Conservation and Recovery Act nor radioactive. It consists of salvageable material and materials that could be deposited in a municipal sanitary landfill. Sanitary waste streams include items such as paper, glass, discarded office material, and construction debris.

Sanitary waste that is not salvageable is currently disposed of in an onsite landfill. The most recently constructed landfill began operation in 1985.

This landfill was expanded in three sections; the current section being used is the Interim Sanitary Landfill project. Until the Waste Minimization Program began, over 36.3 metric tons (40 tons) of waste per work day was received by the landfill. Onsite interim sanitary landfill waste disposal volume is estimated at approximately 18.1 to 27.2 metric tons (20 to 30 tons) per day (WSRC 1994j). The Interim Sanitary Landfill was originally projected to provide service for the SRS until the first quarter of 1996. However, recently implemented recycling programs such as paper and aluminum can recycling have extended the projected service date until the fourth quarter of 1996 (WSRC 1994j).

Even though storage capacity has not yet been reached for the existing SRS sanitary landfill, as an interim measure DOE has entered into agreements with surrounding counties to dispose of sanitary waste at an offsite commercial landfill. Offsite disposal is expected to begin about October 1994. Future plans include siting a landfill onsite that will serve not only the SRS but also the surrounding counties.

Salvageable material such as aluminum cans, scrap metal, and tires are collected at the SRS salvage yard and sold to offsite recyclers.

SRS also operates the Burma Road Cellulosic and Construction Waste Landfill for the disposal of demolition and construction debris. The landfill is permitted by SCDHEC for the disposal of wastes such as uncontaminated soil, rock (stone), concrete rubble, and inert construction debris. DOE estimates that the landfill will reach permit capacity in approximately 15 years (the year 2008).

3.12.2 HAZARDOUS MATERIALS

The SRS Tier Two Emergency and Hazardous Chemical Inventory Report covering calendar year 1993 lists more than 225 hazardous chemicals that were present at some time during the year in excess of their respective minimum threshold level (3,732 kilograms or 10,000 pounds for hazardous chemicals and 187 kilograms or 500 pounds or less for extremely hazardous substances) (WSRC 1994l). Ten of these hazardous chemicals are described as extremely hazardous substances as designated under the Emergency Planning and Community Right-to-Know Act of 1986. The actual number and quantity of hazardous chemicals present on the site, as well as at individual facilities, change daily in response to use. The annual Superfund Amendments and Reauthorization Act reports for the SRS facilities include year-to-year inventories.

3.13 Decontamination and Decommissioning

DOE manages radioactively contaminated facilities for which it is responsible in a safe, cost-effective manner to ensure that releases of, and exposure to, radioactivity and other hazardous materials comply with Federal and state standards. Facilities, equipment, and valuable materials will be recovered and reused when practical. The decommissioning of all contaminated SRS facilities will include an environmental review process conducted in accordance with the requirements of NEPA and other applicable laws and regulations (DOE 1988c).

A program for decontaminating and decommissioning SRS facilities has been developed (WSRC 1994m). Over 6,000 buildings at SRS will eventually be declared surplus and will need to be decommissioned. About 25 facilities are involved in the proposed action and will be subject to the SRS Decontamination and Decommissioning Program requirements. Some of these facilities in Z-Area and in the F- and H-Area Tank Farms currently contain radioactive materials. Others would become contaminated as a result of DWPF startup. All SRS facilities, including those involved in the proposed action, will be evaluated

for contamination as part of the decommissioning process.

Disposition of high-level radioactive waste currently stored in underground tanks at SRS is a prerequisite to the success of any ultimate SRS Decontamination and Decommissioning Program plan. Operation of the DWPF continues to be a key element in planning for high-level radioactive waste disposition. The SRS Decontamination and Decommissioning Program, which would address the DWPF and the waste tanks, will address environmental and public review as part of the planning and decisionmaking process.

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4.0 ENVIRONMENTAL CONSEQUENCES

This chapter describes the potential environmental consequences of the proposed action and its alternatives. The analyses are based on facility information from Chapter 2, descriptions of the existing environment contained in Chapter 3, and other information described or referenced in this chapter. This chapter discusses the cumulative impacts of the proposed action and its alternatives in relation to other existing and reasonably foreseeable Savannah River Site (SRS) facilities and activities and to major facilities near the Site. Unavoidable adverse impacts and irreversible or irretrievable commitment of resources associated with these alternatives are also addressed.

Impacts are addressed in terms of direct physical disturbance, consumption of affected resources, and the effects of waste streams, effluents, and emissions on the chemical and physical quality of the environment. Assessments focus on potential impacts to air, water, and biota, as well as to people, including the health of workers and the public and socioeconomic changes.

4.1 Proposed Action

4.1.1 INTRODUCTION

As discussed in Chapter 2, the proposed action includes the construction of Late Wash, additional Failed Equipment Storage Vaults, a second Glass Waste Storage Building, and thirteen additional Saltstone Disposal Vaults. The proposed action also includes operation of the following:

Pre-Treatment Processes, H-Area:
- Extended Sludge Processing
- In-Tank Precipitation
- Late Wash

Saltstone Manufacturing and Disposal (Figure 2.2-1 and Photo 2.2-1), Z-Area:
- Saltstone Manufacturing Plant
- Saltstone Disposal Vaults

Vitrification Facility(Photo 2.2-2), S-Area:
- Salt Process Cell
- Chemical Process Cell
- Mercury Purification Cell
- Melt Cell
- Canister Decontamination Cell
- Weld Test Cell

Support Facility and Structures Associated with the Vitrification Facility (Figure 2.2-2), S-Area:
- Chemical Waste Treatment Facility
- Organic Waste Storage Tank
- Glass Waste Storage Buildings
- Failed Equipment Storage Vaults

Utilities (Figure 2.2-2), S-Area:
- Water Well System
- Sewage Treatment Plant

4.1.2 GEOLOGIC RESOURCES

There are no unique geologic features or minerals of economic value near the DWPF and associated facilities. For the proposed action, minor localized impacts to geologic resources (specifically soils) are anticipated. Late Wash, additional Failed Equipment Storage Vaults, and a second Glass Waste Storage Building would be constructed in industrial areas that have already been disturbed for construction of the existing buildings. Approximately 30 hectares (75 acres) of land are presently cleared and graded for present facilities and new vault construction in Z-Area. Additional land would be cleared and graded to build future vaults, resulting in a total of 73 hectares (180 acres) of land cleared. None of the soils on this additional land to be cleared and graded are considered suitable as prime farmland (Section 3.2.1).

As noted in Section 3.2.1, the native soils in S- and Z-Areas are rated as having a slight erosion hazard, indicating a slight probability that damage could occur if site preparation activities such as grading expose these soils. Most of the soils in S-Area and parts of Z-Area consist of spoil from excavated areas, borrow pits, and previous major land shaping or grading activities that have a slight to moderate erosion hazard rating. DOE would implement sediment and erosion control measures as necessary to be consistent with stormwater discharge regulations for construction of Late Wash, the Failed Equipment Storage Vaults, an additional Glass Waste Storage Building, and future Saltstone Disposal Vaults to minimize discharge of sediments to Upper Three Runs, Fourmile Branch, or associated tributaries. DOE anticipates that a separate plan for erosion and sedimentation control would be developed and implemented as each Saltstone Disposal Vault in Z-Area is constructed. For example, the plan for Vault 2 (WSRC 1992g) contains drawings, calculations, and detailed descriptions of control measures to be implemented to minimize erosion. Section 2.2.1 discusses erosion and sedimentation control in more detail.

Construction and operation activities could be expected to result in occasional spills (e.g., oil, fuel, and process chemicals). Formal spill prevention, control, and countermeasures plans for H-, S-, and Z-Areas to prevent, identify, and mitigate petroleum product spills are in place and are updated as conditions warrant (WSRC 1991f). A formal Best Management Practices Plan (WSRC 1991g) is in place for spill prevention and response for hazardous and toxic substance releases and is a condition of the Site National Pollutant Discharge Elimination System permit. Both the Spill Prevention, Control, and Countermeasures Plan and the Best Management Practices Plan are required to be updated at least every 3 years or as conditions warrant. In addition, SRS is obligated under the Federal Facility Agreement (EPA 1993a) to identify, evaluate and, if necessary, remediate spills of all hazardous substances, including radionuclides (e.g., high-level waste).

4.1.3 WATER RESOURCES

4.1.3.1 Groundwater

DOE does not expect construction activities to impact groundwater resources, although potential impacts from inadvertent spills (e.g., fuel oil spills) would exist. Hazardous materials would not be intentionally released to the environment. Mitigative and protective measures as provided in the SRS Spill Prevention, Control, and Countermeasures Plan (WSRC 1991f), the SRS Best Management Practices Plan (WSRC 1991g), and provisions required under the Federal Facility Agreement (EPA 1993a) would minimize introduction of undesired substances into soils and consequently groundwater at all construction sites.

During routine operations under the proposed action, the only additional

expected impact would be from the potential release of constituents from the saltstone stored in the vaults. The proposed action would require the construction of 15 vaults; two are already in place and receive saltstone as noted in Section 2.2.3. Because saltstone is classified as nonhazardous waste, Saltstone Manufacturing and Disposal is permitted as a "controlled release" industrial landfill disposal facility. The vaults are designed to fully contain the waste, but containment effectiveness is expected to diminish over time, leading to the slow release of contaminants. These contaminants are not expected to reach the shallow groundwater for at least 100 years (Martin Marietta et al. 1992).

To ensure compliance with the performance objectives stated in DOE Order 5820.2A (DOE 1988c), DOE prepared a radiological performance assessment of the Saltstone Disposal Vaults (Martin Marietta et al. 1992). The assessment evaluated the potential impacts through various environmental pathways after closure (when a vault or a group of vaults are filled) and capping of these vaults. Potential impacts were determined at the compliance point for groundwater protection [the point at which the predicted concentrations of contaminants in groundwater are the highest at or beyond 100 meters (328 feet) from any waste that had been disposed of at the vaults]. The assessment considered intact structures operating as designed as well as a worst case scenario in which the protective cap, vaults, and saltstone are fractured.

Nitrate is the largest nonradioactive contributor to potential groundwater contamination from normal operations of the vaults expressed as a percentage of drinking water standard. The peak calculated concentration is 5.2 milligrams per liter (at 7,100 years) for an intact facility and 36 milligrams per liter (at 1,400 years) for a degraded facility at the point of compliance. These estimated concentrations are below the drinking water standard of 45 milligrams per liter for nitrate (which is equivalent to 10 milligrams per liter expressed as nitrogen) (40 CFR Part 141).

For projected releases of radionuclides, ingestion of groundwater was demonstrated in the performance assessment to be the only pathway of concern. The dose analysis for the drinking water pathway is based on a person drinking 2 liters (0.5 gallons) per day of water having the maximum predicted concentration of radionuclides from a well located at the compliance point at any time after disposal. Total doses for all radionuclides are predicted to be less than 0.001 millirem per year for intact vaults and less than 0.06 millirem per year for degraded vault scenarios (Table 4.1-1). Ten radionuclides are of potential concern (tritium, carbon-14, selenium-79, strontium-90, technetium-99, iodine-129, cesium-137, plutonium-238, americium-241, and tin-126). The projected concentrations of all other radionuclides are sufficiently low to be eliminated from further concern. Radionuclides that contribute to the maximum predicted dose are iodine-129, selenium-79, and technetium-99. The earliest time that a maximum dose is predicted to occur is around 2,400 years after closure of Saltstone Manufacturing and Disposal. The drinking water standard dose limit of 4 millirem per year (40 CFR Part 141) is the most restrictive radiological limit via a water pathway for public doses. The maximum predicted doses presented in Table 4.1-1 are more than 100 times less than that limit.

Table 4.1-1. Maximum doses for radionuclides from ingestion of groundwater at the point of compliance.^a

Radionuclide	Concentration (microcuries per liter)	Time (year)^b	Effective dose equivalent (millirem per year)
Intact vaults/saltstone			
Selenium-79	1.2-10^-8	2.1-10^5	7-10^-5

Iodine-1 29	7.2-10^-9	>2.5-10^6	1-10^-3
Others			<2-10^-9
Degraded vaults/saltstone			
Selenium-79	4.4-10^-6	1.5-10^4	3-10^-2
Technetium- 99	1.1-10^-5	2.4-10^3	1-10^-2
Tin-126	2.2-10^-9	2.2-10^5	3-10^-5
Iodine-129	7.5-10^-8	3.2-10^3	2-10^-2
Others			<2-10^-8

a. Source: Martin Marietta et al. (1992).
b. Time after disposal at which maximum concentration in groundwater beyond 100-meter (328-feet) buffer zone occurs.

4.1.3.2 Surface Water

4.1.3.2.1 Construction

Under the proposed action, construction of Late Wash, additional Failed Equipment Storage Vaults, a new Glass Waste Storage Building, and new Saltstone Disposal Vaults would require compliance with the South Carolina Department of Health and Environmental Control (SCDHEC) general stormwater permit (SCR100000) for construction activities. In addition, stormwater runoff from these construction sites would be included in a stormwater management and sedimentation control plan to minimize the potential discharge of silt, solids, and other contaminants to surface water streams with the runoff. Provisions would be made to collect the stormwater where appropriate to control silt and suspended solids before discharge to a surface stream such as Upper Three Runs. Stormwater runoff retention ponds are currently located in the S- and Z-Areas to control the runoff from the locations where the Glass Waste Storage Building and future Saltstone Disposal Vaults would be built. For details on erosion and sedimentation control planning, see Section 2.2.1. Table A-21 in Appendix A presents water quality of outfall DW-005 from a stormwater retention pond in S-Area. At a flow of 20 liters (5 gallons) per minute, the effect of the retention pond discharge upon Crouch Branch would be minimal.

The Failed Equipment Storage Vaults in S-Area are sited in a location where the runoff during construction would not be collected in the existing stormwater retention pond in S-Area. DOE has adopted erosion and sedimentation control measures for construction of Late Wash (WSRC 1993g, 1994o).

4.1.3.2.2 Operations

During operations, the effluent from the S-Area sanitary wastewater facility and from the combined S-Area industrial wastewater and cooling water blowdown would continue to be discharged at permitted National Pollutant Discharge Elimination System outfalls DW-003 and DW-004, respectively. The flows and contaminant concentrations would be essentially unchanged from the present S-Area discharges and would continue to be discharged to Upper Three Runs via McQueen and Crouch Branches. The monitoring results for outfalls DW-003 and DW-004 are included in Table A-20 of Appendix A. By mid-1995, DOE plans to take the S-Area sanitary wastewater treatment facility out of operation and connect

the S-Area sewers to the new Centralized Sanitary Wastewater Treatment Facility, which will discharge to Fourmile Branch. Outfall DW-003 would be eliminated. Section 2.2.5.1 discusses the estimated contaminant contributions from the treatment of the wastewater at the Chemical Waste Treatment Plant.

The flow of the combined wastewater discharge (Chemical Waste Treatment Plant effluent and the cooling tower blowdown) would be approximately an average of 144,000 liters (38,000 gallons) per day or approximately 98 liters (26 gallons) per minute (Damani 1994). The lowest flow experienced in Upper Three Runs is 144,000 liters (38,000 gallons) per minute. Therefore, the discharge from DW-004 after mixing with the waters of would be diluted at least 1,400 times. This dilution would result in very low in-stream concentrations for chemicals present because of the neutralization at the Chemical Waste Treatment Plant as follows: 0.02 milligrams per liter of sodium permanganate, 0.02 milligrams per liter of sodium formate, and 0.014 milligrams per liter of sodium oxalate (derived from data in WSRC 1993b). In addition, the cooling tower system is treated with chemicals to inhibit growth of algae and microorganisms in the system and to minimize corrosion.
Small quantities of these chemicals would be present with the cooling tower blowdown that is discharged at DW-004. The impact of the discharge upon the water quality and flow of Upper Three Runs would be minimal.

As discussed in Section 2.2.4.6, Vitrification Facility wastewater contaminated with radionuclides would be recycled. The flow of the wastewater from the Vitrification Facility is expected to be approximately 37,850 liters (10,000 gallons) per day and would be returned to the tank farm evaporator system. The distillate from the evaporator would be processed through the F- and H-Area Effluent Treatment Facility and discharged to permitted outfall H-016. The additional distillate flow can be readily accommodated by the F- and H-Area Effluent Treatment Facility, which has a design flow of 1.6 million^ liters (432,000 gallons) per day (DOE 1994b). Table 4.1-2 lists the water quality permit limits and monitoring results for outfall H-016 as well as the projected composition of the treated wastewater from the DWPF Recycle Collection Tank, which receives the types of wastewater discussed in Section 2.2.4.6. As indicated from the analytical results, the F- and H-Area Effluent Treatment Facility would remove the constituents of concern; thus, the impact of the addition of the DWPF treated wastewater upon Upper Three Runs would be minimal.

The Glass Waste Storage Buildings and the Failed Equipment Storage Vaults are not expected to generate wastewater. If liquids accumulate in the structures, they would not be directly discharged to surface waters (Price 1994a,b); therefore, surface waters would not be appreciably impacted. If liquids were to accumulate in these buildings, the liquids would be collected, monitored for radioactivity, drummed, and recycled to the tank farms or transferred to the F- and H-Area Effluent Treatment Facility. During nonradioactive testing, any accumulated liquids would be taken to the S-Area Chemical Waste Treatment Plant for treatment and discharged via outfall DW-004 (Price 1994a). DOE does not plan to discharge process wastewater from Late Wash (Palowitch 1994) or the additional Saltstone Disposal Vaults, eliminating the potential impact from surface waters from these sources.

DOE would not discharge process wastewater from the In-Tank Precipitation Facility (ITP). Stormwater from the ITP process area and the Cold Feeds area would pass through radiation monitors and if uncontaminated, would discharge through outfalls H-008 and H-007, respectively. If stormwater monitors detect radioactivity in the stormwater, the water would be automatically diverted to the 241-8H stormwater retention basin, analyzed, and, if uncontaminated discharged through permitted outfall H-017. If radiation levels are above radioactive release guidelines, the water would be sent to the F- and H-Area Effluent Treatment Facility, treated, and discharged through permitted outfall H-016.

Table 4.1-2. Water quality data for F- and H-Area Effluent Treatment Facility discharge

(Outfall H-016) and projected DWPF wastewater treatment compared to National Pollutant Discharge Elimination System permit limits.

Parameter^a	Unit of measure (milligrams per liter)	Permit limits^a (Average)	Outfall H-016 results^b (Average)	Pr t RCT contrib s from laborat wastewa
BOD5^e	mg/L	20	2.1	NE^f
Suspended Solids	mg/L	30	1.3	NE
Ammonia	mg/L	20	0.1	NE
Oil and Grease	mg/L	10	2.8	NE
Chromium	mg/L	1.71	<0.02	<0.001
Copper	mg/L	1.46	0.01	<0.001
Lead	mg/L	0.29	<0.005	<0.001
Mercury	mg/L	0.045	<0.0001	<0.0001
Zinc	mg/L	1.48	0.04	<0.0001
Manganese	mg/L	MRO^g	<0.019	<0.001
Nitrates	mg/L	MRO	11	<0.001
Uranium	mg/L	MRO	<0.02	NE
TRC^h	mg/L	MRO	0.17	NE
Aluminum	mg/L	MRO	0.05	<0.001
Nickel	mg/L	MRO	0.04	<0.001

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a. National Pollutant Discharge Elimination System Permit SC0000175 limits for outfall H-016 (SCDHEC 1984).
b. Source: Arnett (1994).
c. Source: Dunaway (1994b).
d. RCT = Recycle Collection Tank. DWPF wastewater sources directed to the RCT are in Section 2.2.4.6.
e. BOD5 = 5-Day Biochemical Oxygen Demand.
f. NE = Not expected to be present.
g. MRO = Monitor and report results only.
h. TRC = Total Residual Chlorine.

4.1.4 AIR RESOURCES

4.1.4.1 Construction

Potential impacts to air quality from construction activities as a result of the proposed action include dust from clearing approximately 40 hectares (100 acres) of land and exhaust emissions from construction equipment. The amount

of dust produced would be proportional to the land area disturbed for the new facilities, all of which would be located near the center of SRS. The specific areas of SRS and the amount of land disturbed are discussed in Section 4.1.6.

Estimated air quality impacts were determined by first calculating the yearly amount of soil excavated during construction activities. The number of cubic meters of soil was then multiplied by soil density and air dispersion factors derived from information provided by Westinghouse Savannah River Company (Hunter and Stewart 1994b) to calculate the Site boundary-line impacts. As shown in Table 4.1-3, the overall construction impacts to air quality would be minimal, and the SRS sitewide compliance with state and Federal ambient air quality standards would not be affected by construction-related activities associated with DWPF operations.

Table 4.1-3. Estimated maximum incremental increase of particulates at the SRS boundary from construction activities (micrograms per cubic meter).^a

Pollutant	Averaging time	SCDHEC standard^b	Proposed action (DWPF)
Total suspended particulates	Annual	75	<0.01
Particulate matter (<10 microns)	24-hour	150	0.9
	Annual	50	<0.01

a. Based on Hunter and Stewart (1994b).
b. SCDHEC (1976b).

4.1.4.2 Operation

Operations under the proposed action would release both nonradiological and radiological airborne emissions in the H-, S-, and Z-Areas of SRS.

4.1.4.2.1 Nonradiological Air Emissions Impacts

Maximum ground-level concentrations for nonradiological air pollutants were determined from the Industrial Source Complex Version 2 (ISC2) Dispersion Model using maximum potential emissions from both DWPF and the SRS (Hunter and Stewart 1994a). The dispersion calculations for air toxics were performed with onsite meteorological data obtained from the H-Area tower for 1991. The dispersion calculations for criteria pollutants were performed with 1987 through 1991 onsite meteorological data from the H-Area tower.

The maximum permissible air emissions associated with the proposed action are shown in Table A-6 in Appendix A. Those predicted to result in the highest ground-level concentrations relative to total SRS emissions are benzene, diphenyl mercury, and formic acid as shown in Table 4.1-4. Benzene is present in the vitrification process as an impurity, a radiolysis product, and as the product of acid hydrolysis of sodium tetraphenylborate. Additionally, sodium tetraphenylborate reacts with soluble mercury salts to form insoluble diphenyl mercury (WSRC 1993a). Formic acid would be contributed primarily by the vitrification process. Table 4.1-4 shows estimated maximum ground-level concentrations at the SRS boundary for nonradiological air pollutants emitted at permit limit values for the proposed action (Table A-6 in Appendix A). The maximum ground-level concentrations in Table 4.1-4 are based on maximum potential emissions from SRS sources in operation and do not include the Consolidated Incineration Facility, which is presently under construction, and

those emissions associated with the proposed action.

Table 4.1-4. Estimated maximum ground-level concentrations at the SRS boundary resulting from permitted emission limits of nonradiological air pollutants (micrograms per cubic meter).^a

Pollutant	SCDHEC standard	SRS maximum potential concentration	DWPF	DWPF percent maxi
Benzene				
(24 Hr. Avg.)	150	32	4.2	1
(Annual Avg.)	NA^b	0.17	0.044	2
Mercury				
(24 Hr. Avg.)	0.25	0.004	0.001	2
Formic acid (24 Hr. Avg.)	225	<0.01	2.5	>2
Nitrogen oxides (Annual Avg.)	100	22	0.05	0
Carbon monoxide	40,000	3,600	22	0
(1 Hr. Avg.)	10,000	820	3	0
(8 Hr. Avg.)				
Particulates (PM10)	150	92	2.8	3
(24 Hr. Avg.)	50	10	0.1	1
(Annual Avg.)				
Sulfur dioxide				
(3 Hr. Avg.)	1,300^c	1,500	2.2	
(24 Hr. Avg.)	365^c	(1,200)^d	0.3	0
(1 Yr. Avg.)	80	440 (300)^d	<0.01	<
		22		
Total suspended particulates (Annual)	75	19	0.6	3
Lead (Quarterly)	1.5	0.014	<0.001	<

a. Source: Hunter and Stewart (1994a).
b. NA = Not applicable.
c. Concentration may be exceeded once per year.
d. The value in parentheses is the second high maximum value and is used to calculate percent of SRS maximum.

For each regulated pollutant, SRS would maintain compliance with Federal and state ambient air quality regulations during operations resulting from the proposed action (Table 4.1-4).

Table 4.1-5 shows air quality impacts to representative workers in the F- and H-Areas. These worker locations were chosen because they are nearby and coincide with known populations of non-DWPF workers. In all cases, exposures to these workers are less than permissible exposure levels as defined in 29

CFR Part 1910.100. Workers in the new H-Area training building would have higher exposures to air contaminants than workers in F-Area due to the proximity of DWPF operations.

Table 4.1-5. Nonradiological air pollution concentrations at worker locations for the proposed action.^a

Pollutant	OSHA Permissible Exposure Limits^c	Concentrations at worker lo (milligrams per cubic met F-Area^d
Nitrogen dioxide (as NOx)	9	0.26^e
Carbon monoxide	55	<0.01
Respirable particulates (PM10)	5	0.02
Total suspended particulates (TSP)	15	0.18
Sulfur dioxide (as SOx)	13	<0.01
Benzene	3.2	0.06
Mercury	0.1	0.019^e
Formic acid	9	0.02

a. Source: Hunter and Stewart (1994a).
b. Estimated concentrations of selected hazardous pollutants for designated worker in F- and H-Areas (8-hour average). Concentrations are based on emissions from sources associated with DWPF operations (S- and Z-Areas and ITP and Extended Sludge Processing in H-Area).
c. Occupational Safety and Health Administration Permissible Exposure Levels. Listed values are 8-hour time weighted average except for nitrogen dioxide and mercury, which are not-to-be-exceeded Ceiling Values. Source: 29 CFR Part 1910.100.
d. F-Area workers: Building 247-F (UTM Coordinates 436923.1E, 3683416.5N); H-Area worker: new training building (UTM Coordinates 440039.0E,3683693.3N).
e. 1-hour average.

4.1.4.2.2 Radiological Air Emissions Impacts

Maximally exposed offsite individual and population doses have been determined for atmospheric releases resulting from routine operations under the proposed action. Since the original EIS in 1982, process changes in DWPF have resulted in differences in estimates of releases of radioactivity to the environment. Additionally, some of the parameters for determining doses from atmospheric releases have changed.

The SRS-specific computer codes, MAXIGASP and POPGASP, were used to determine the maximum individual dose and the 80-kilometer (50-mile) population dose, respectively, resulting from routine atmospheric releases. The major radionuclides emitted from each source for the proposed action are included in Appendix A, Table A-7.

Table 4.1-6 shows the dose to the maximally exposed offsite individual, the population dose, and the dose for workers in F-Area for each of the major

radionuclides released during operations under the proposed action. The calculated maximum committed effective dose equivalent to the maximally exposed offsite individual is 0.001 millirem (Simpkins 1994a), which is well within the annual dose limit of 10 millirem for SRS atmospheric releases. In comparison, an individual living near the SRS receives a dose of about 300 millirem from natural radiation sources and 0.22 millirem from current SRS releases of radioactivity. The 1982 DWPF EIS estimated that the dose to the maximally exposed individual due to the operation of DWPF would be 0.063 millirem (DOE 1982a).

Table 4.1-6. Annual radiological doses to individuals and population within 80 kilometers (50 miles) of SRS.^a

	Maximally exposed offsite individual		Population		
Isotope	Dose (milli-rem)	Percent of total (%)	Dose (person-rem)	Percent of total (%)	Dose (mil rem)
Tritium	7.3-10^-5	6.4	3.3-10^-3	4.6	1.2-
Carbon-14	1.3-10^-5	1.1	2.6-10^-4	0.4	0.0-
Strontium-90	2.2-10^-4	19.1	5.8-10^-3	8.1	1.8-
Yttrium-90	5.2-10^-7	0.0	1.6-10^-5	0.0	1.1-
Cesium-137	8.2-10^-4	72.6	6.2-10^-2	86.4	2.4-
Cerium-144	7.2-10^-6	0.6	2.4-10^-4	0.3	1.2-
Praseodymium-144	5.2-10^-14	0.0	2.1-10^-13	0.0	1.8-
Promethium-147	1.2-10^-6	0.1	4.6-10^-5	0.1	2.5-
Total^b	1.1-10^-3	100	7.1-10^-2	100	2.7-

a. Source: Simpkins (1994a,b).
b. Sums of the listed values may not equal totals due to rounding.

The dose to the population within 80 kilometers (50 miles) of SRS from the proposed action is 0.07 person-rem. The major contributing radionuclide to the population dose is cesium-137, which is responsible for 86 percent of the population dose. Section 4.1.11.1 describes the potential health effects of these releases on the public and workers.

4.1.5 ECOLOGICAL RESOURCES

4.1.5.1 Terrestrial Resources

Natural vegetation or wildlife would not be destroyed or displaced by construction of the proposed facilities within S- and H-Areas because all construction would occur inside the developed fenced areas surrounding the existing facilities or within the facilities themselves. Neither construction nor operations would greatly increase the workforce or traffic in the area over that currently experienced, so measurable increased mortality to terrestrial animals or birds from vehicles is not expected to occur. DOE (1982a) identified no adverse impacts to terrestrial systems from operations of the proposed facilities.

Construction of additional Saltstone Disposal Vaults has the potential to impact terrestrial resources now found within the fence at Z-Area. Approximately 73 hectares (180 acres) for the Saltstone Disposal Vaults in Z-Area have been fenced and 30 hectares (75 acres) have been cleared of vegetation (Photo 3.5-1). Additional land (pine plantation) would be cleared

as needed for new disposal vaults. Vaults would be built on a schedule of approximately one every 18 months. Fifteen vaults would ultimately be required to dispose of all the saltstone, so although the precise amount of land required for the saltstone vaults has not been determined, the acreage already set aside is anticipated to be adequate (Townson 1994). Small mammals, reptiles, and birds that inhabit that area would be displaced or disturbed by the land clearing and associated construction activities, but the local and regional populations of these animals would not be impacted.

4.1.5.2 Wetland Resources

A 2-hectare (5-acre) Carolina Bay was destroyed during the initial construction of S-Area. Artificial ponds constructed around the periphery of S-Area as mitigation for the lost wetland provide breeding habitat for amphibians (Section 3.5.2). No other wetlands are within the project sites (Schalles et al. 1989). Therefore, the proposed action would not adversely impact wetland systems.

4.1.5.3 Aquatic Resources

Macroinvertebrate species such as those found in Upper Three Runs (including the American sandburrowing mayfly, Section 3.5.3) require well-oxygenated water (Thorp and Covich 1991; Hynes 1970). Sedimentation decreases the ability of organisms to assimilate oxygen, reducing the survival of individuals and the vigor of the community. During construction of the proposed facilities in S- and H-Areas and the Saltstone Disposal Vaults, DOE would follow sediment and erosion control plans to minimize discharge of sediments to Upper Three Runs, Fourmile Branch, or associated tributaries. See Section 2.2.1 for information about erosion and sedimentation control planning. The potential for adverse effects on aquatic biota is therefore considered to be minimal.

Current wastewater and stormwater discharges through permitted outfalls represent the principal potential sources of impacts to Upper Three Runs from operations (Section 4.1.3.2.2). However, these discharges are small, and permits require the discharged constituents to be maintained at levels that are protective of the aquatic community. The proposed action would not change these constituents. All process water generated in ITP and Late Wash would be recycled and ultimately discharged through the F-and H- Area Effluent Treatment Facility in accordance with the existing National Pollutant Discharge Elimination System permit. DOE does not expect discharges to surface water from operation of the Failed Equipment Storage Vaults, the Glass Waste Storage Buildings, or the Saltstone Disposal Vaults.

4.1.5.4 Threatened and Endangered Species

Z-Area is the only area within which DOE would clear additional land. The only threatened or endangered species that could potentially be impacted by the proposed action is the Federally endangered red-cockaded woodpecker. The closest active colony of this species occurs approximately 6.5 kilometers (4 miles) from Z-Area (Mayer 1994). In 1982, DOE consulted with the U.S. Fish and Wildlife Service in accordance with Section 7 of the Endangered Species Act to determine if endangered or threatened species or their habitats would be adversely affected by the construction of Z-Area (DOE 1982a). The U.S. Fish and Wildlife Service determined that no endangered or threatened species lived on or used as a critical habitat the 20-hectare (50-acre) area then being considered for the disposal vault site. Since then, the area being considered for the disposal site has expanded to 73 hectares (180 acres). The trees on Z-Area are too young (less than 40 years old; Nielson 1994) to be used as cavity trees by red-cockaded woodpeckers, which generally nest in trees 70 years old or older (Wike et al. 1993). The Westinghouse Savannah River Company conducted a biological assessment of all remaining uncleared

land in Z-Area during October 1994 and concluded in the assessment report (Mayer 1994) that no threatened or endangered species occupy this area. This report has been submitted to the U.S. Fish and Wildlife Service for review, initiating an informal consultation under Section 7 of the Endangered Species Act.

4.1.5.5 Radioecology

The proposed action would increase the annual amount of cesium-137 released from SRS to the environment over that reported for 1992 by approximately 18 times to 4.99 - 10^-3 curies. This value would be approximately 5 percent of the mean annual release of cesium-137 from SRS to the environment between 1955 and 1992 (0.0924 curies per year) (as reported in Arnett et al. 1993 and previous SRS Annual Environmental Reports). Because SRS-released cesium is a small component of the total cesium found in deer tissue (Section 3.5.5), and cesium releases under the proposed action would remain within historical ranges, DOE expects the impact on radioecology to be minimal.

4.1.6 LAND USE

None of the activities associated with the proposed action would impact SRS land use because construction of Late Wash, the Failed Equipment Storage Vaults, a new Glass Waste Storage Building, and new Saltstone Disposal Vaults would take place within the boundaries of H-, S-, and Z-Areas. All of these areas are already dedicated to industrial use. Since the 1982 EIS, the modification in the saltstone disposal process has increased land use requirements in Z-Area from 14.2 hectares (35 acres) to 73 hectares (180 acres). The additional lands required are within Z-Area, and approximately 30 hectares (75 acres) are currently cleared (Photo 3.5-1). The remaining land is forested and would be cleared as needed (Townson 1994). All activities would be consistent with the guidelines for land use plans contained in DOE Order 4320.1B, "Site Development Planning" (DOE 1992c).

4.1.7 SOCIOECONOMICS

As noted in Section 2.2.10, the only changes in employment expected to result from the proposed action are temporary increases in the number of construction workers needed to complete DWPF facilities. Therefore, this discussion addresses only those projects that have the potential to cause a change (either an increase or a decrease) in regional employment, population, or income. The following proposed construction projects are considered: Late Wash, additional Failed Equipment Storage Vaults, a second Glass Waste Storage Building, and new Saltstone Disposal Vaults.

Based on the number of new jobs predicted (Table A-22 in Appendix A), DOE calculated changes in regional employment, population, and income using the Economic and Demographic Forecasting and Simulation Model developed for the SRS six-county region of influence by Regional Economic Models, Inc. (REMI). To ensure that the model responds in a logical way to changes in an area's economy, it is based on inter-industry relationships specific to the region of influence. It also includes basic behavioral equations from economic theory. For additional information on the model, its development, and its uses, refer to the "The REMI Economic-Demographic Forecasting and Simulation Model" (Treyz, Rickman, and Shao 1992).

Because anticipated employment for operations between 1994 and 2018 would not change from current projections, only construction phase impacts were analyzed for the period 1994 through 2018. This discussion focuses on peak or maximum changes in employment, population, and personal income from the construction activities under the proposed action.

Results of this modeling effort indicate that the peak regional employment change from implementation of the proposed action is projected to occur in 1999 with approximately 384 additional jobs or a less than two tenths of one percent increase in baseline regional employment (HNUS 1994). Even in the peak year, considering the maximum possible impact from both construction and operations workforce changes, the proposed action is projected to have little impact on employment in the region.

Migration into the region lags slightly behind the initial change in employment. Modeling results indicate that the maximum potential change in population would occur in the year 2000 with approximately 542 additional people in the region of influence (HNUS 1994). Because this maximum increase is less than two tenths of one percent above the baseline regional population forecast, DOE expects a negligible impact from SRS employment changes on the demand for community resources and services such as housing, schools, police, health care, and fire protection.

Potential changes in total personal income are related to changes in employment and are projected to peak in the year 2000 with a $19 million increase over forecast income levels for that year (HNUS 1994). Because this would be a less than two tenths of one percent increase, implementation of the proposed action would have only a minimal, positive impact on regional income.

4.1.8 CULTURAL RESOURCES

Activities under the proposed action would include the construction of Late Wash, additional Failed Equipment Storage Vaults, a second Glass Waste Storage Building, and new Saltstone Disposal Vaults within H-, S-, and Z-Areas. DOE does not expect impacts to cultural resources from construction in H-Area because important cultural resources present would have been destroyed during original construction activities in the 1950s (Brooks 1992). Because no important archaeological resources were discovered during the S-Area survey conducted in conjunction with the 1982 EIS, additional construction within this area would not adversely impact cultural resources (Brooks and Hanson 1979; DOE 1982a). Most of Z-Area has been surveyed in the past, and no important cultural resources were discovered (Sassaman 1990; Brooks, Hanson, and Brooks 1986). However, as shown in Figure 4.1-1, a small portion of land in the southeast corner of Z-area (approximately 4 hectares or 10 acres) has not been previously surveyed. In compliance with the Programmatic Memorandum of Agreement between the DOE Savannah River Operations Office, the South Carolina State Historic Preservation Office, and the Advisory Council on Historic Preservation, DOE would survey this portion of Z-Area before beginning construction. DOE would mitigate, through avoidance or data recovery, impacts to cultural resources that may be discovered.

4.1.9 AESTHETICS AND SCENIC RESOURCES

None of the activities associated with the proposed action would have adverse impacts on aesthetic or scenic resources. Construction of new facilities would be within H-, S-, and Z-Areas, all of which are already dedicated to industrial use. None of the new facilities would be visible off the Site or from public access roads on the Site. Although construction activities could produce dust that would temporarily affect visibility in the area, DOE would follow standard construction practices to minimize dust generation. Facility operations under the proposed action would not produce emissions to the atmosphere that would be visible or would indirectly reduce visibility (Section 4.1.4).

Figure 4.1-1.

Figure 4.1-1. Cultural resource surveys in the vicinity of Z-Area.

4.1.10 TRAFFIC AND TRANSPORTATION

DOE analyzed potential impacts of the proposed action on workers and members of the general public based on SRS vehicle counts derived from employment data, amounts of bulk materials transported, and waste quantities expected to be generated by DWPF as currently designed. Potential changes in site traffic resulting from changes in construction and operations personnel (Bignell 1994c) and chemical and waste shipments under the proposed action were estimated to determine the impacts. Peak employee traffic flows and the number of off-peak, onsite material shipments were used as estimates of both offsite and onsite impacts. Vehicle counts were estimated based on current and projected levels of SRS employment and bulk material (chemicals, construction material, and wastes) truck shipments. The baseline and projected number of vehicles per hour were estimated from reported values in Smith (1989) and Swygert (1994a). The 1994 baseline (Section 3.10) and projected vehicle flow rates were adjusted proportionately with respect to changes in employment. Estimates are based on the year the proposed action reaches a maximum employment level (1999). Table 4.1-7 shows estimated peak vehicles per hour, increased number of vehicles per hour, and total number of vehicles per hour for representative onsite and offsite roads potentially affected by the proposed action. This table also shows the design capacity for these roads (vehicles per hour) and projected peak vehicles per hour as a percent of design capacity. Offsite vehicles per hour are listed as daily maximum values, while onsite vehicles per hour represent peak morning traffic traveling to S-Area. As indicated in this table, projected increases in traffic from the proposed action would not be expected to exceed road capacities. SC 19 and SRS road 4 at S-Area are projected to experience the largest increase in the number of vehicles per hour (35 and 11, respectively). These small increases in traffic levels would have negligible impact. It is expected that adverse health effects would not result from the increased traffic levels.

Table 4.1-7. Estimated traffic counts (vehicles per hour during peak hours).

Road	1994 baseline^a	Proposed action: Increment	Proposed action: Total	Design Capacity
Offsite				
SC19	2,800^b	35	2,835	3,000^b
SC125	2,700^b	34	2,734	3,200^b
SC57	700^c	9	709	2,100^b
Onsite				
E at E-Area	741^d,e	9	750	2,300^c
4 at S-Area	872^d,e	11	883	2,300^c
F south of	38^d,e	0	38	2,300^c
F north of 4	69^d,e	1	70	2,300^c

a. 1994 vehicle counts were estimated from actual counts measured in 1989 (offsite) and 1992/1993 (onsite) by adjusting vehicle counts by the proportional change in SRS employment between measured years and 1994; count is peak vehicles per hour.
b. Adapted from Smith (1989).
c. Adapted from TRB (1985).
d. Source: Swygert (1994a).
e. Morning traffic traveling toward S-Area.

Tables 4.1-8 and 4.1-9 present the estimated truck shipments of bulk chemical

and waste shipments, respectively. Traffic accidents and property damage offer the greatest potential for impacts associated with commuter vehicles and transport trucks. In addition to traffic accidents and property damage, other impacts associated with trucks include the possibility of the release of radioactive, mixed, and hazardous materials to the environment. While these releases are possible, the possibility of occurrence would be minimized by DOE's compliance with transport regulations, which require appropriate safety precautions (49 CFR Parts 171-177). The increase in the number of trucks entering and leaving the SRS in support of DWPF construction and operations activities would have negligible impact since shipments are estimated to be five per day.

The traffic and transportation routes were analyzed relative to the location of low-income and people of color communities identified in Section 3.7.4. None of the major offsite routes, SC19, SC125, or SC57 (Figure 3.10-1) lie primarily or disproportionately within those communities.

4.1.11 OCCUPATIONAL AND PUBLIC HEALTH

4.1.11.1 Public Health

4.1.11.1.1 Radiological Health Effects from Normal DWPF Operations

Radiation can cause a variety of ill-health effects in people. The major ill-health effects caused by environmental and occupational radiation exposures are delayed cancer fatalities, called latent cancer fatalities because the cancer can take many years to develop and cause death.

To relate a dose to its effect, DOE has adopted a dose-to-risk conversion factor of 0.0004 latent cancer fatalities per person-rem for workers and 0.0005 latent cancer fatalities per person-rem for the general population (ICRP 1991). The latter factor is slightly higher because of the presence of groups of people like infants or children who may be more sensitive to radiation than workers.

These factors can be used to estimate the effects of exposing a population to radiation. For example, in a population of 100,000 people exposed only to background radiation (0.3 rem per year), 15 latent cancer fatalities per year would be calculated to be caused by radiation (100,000 persons - 0.3 rem per year - 0.0005 latent cancer fatalities per person-rem = 15 latent cancer fatalities per year).

Table 4.1-8. Estimated truck shipments of chemicals attributable to the proposed action.^a

Chemical	Shipments per year	Shipments per day
Nitrogen (gas)	495	2
Carbon dioxide	7	<1
Sodium hydroxide	59	<1
Nitric Acid	6	<1
Formic acid	4	<1
Glass frit	25	<1
Copper formate	1	<1

Sodium nitrite	10	<1
Boric acid	1	<1
Potassium nitrate	1	<1
Oxalic acid	10	<1
Sodium tetraphenylborate	14	<1
Sodium titanate	1	<1
Pre-mix cement	567	3
Total number of truck shipments^b	1,201	5

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a. Sources: McGuire (1994), Rutland (1994), Uzochukwu (1994a,b), WSRC (1991d).
b. Shipments of flyash and slag, which are also used by DWPF, are not listed because they are received by rail.

Table 4.1-9. Estimated waste shipments by truck associated with the proposed action.^a,b

Waste type	Destination	Volume^b,c (cubic meters)
Hazardous	onsite/offsite	2
Mixed	onsite/offsite	30
Low-Level	onsite	2,200
Construction debris	onsite	250
DWPF organic waste^d	offsite	23
Total number of truck shipments		

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a. Source: WSRC (1994i).
b. To convert to cubic feet, multiply by 35.31.
c. Expected annual waste generation.
d. From WSRC (1994p). Consists only of nonradioactive organic waste generated during DWPF testing.

Sometimes, calculations of the number of latent cancer fatalities associated with radiation exposure do not yield whole numbers, and, especially in environmental applications, yield values less than 1. For example, if a population of 100,000 were exposed as above, but to a dose of only 0.001 rem to each person, the collective dose would be 100 person-rem, and the corresponding calculated number of latent cancer fatalities would be 0.05 (100,000 persons - 0.001 rem - 0.0005 latent cancer fatalities/person-rem = 0.05 latent fatal cancers).

These same concepts can be applied to estimating the effects of radiation exposure to a single individual. Consider the effects, for example, of exposure to background radiation over a lifetime. The "number of latent

cancer fatalities" corresponding to a single individual's exposure over a (presumed) 72-year lifetime to 0.3 rem per year is the following:

1 person x 0.3 rem per year x 72 years x 0.0005 latent cancer fatalities per person-rem = 0.011 latent cancer fatalities

This value should be interpreted in a statistical sense; that is, the estimated effect of background radiation exposure to the exposed individual would result in a 1.1-percent lifetime chance that the individual might incur a latent fatal cancer caused by the exposure. As referenced in Section 3.11.2.4, vital statistics on mortality rates from cancer for 1990 indicate that the overall lifetime cancer fatality rate in the U.S. from all forms of cancer is about 23.5 percent (23,500 fatal cancers per 100,000 deaths).

The factors presented above and used in this Supplemental EIS to relate radiation exposure to latent cancer fatalities are based on the 1990 Recommendations of the International Commission on Radiation Protection (ICRP 1991). These factors are consistent with those used by the U.S. Nuclear Regulatory Commission in its rulemaking Standards for Protection Against Radiation (10 CFR Part 20). The factors apply where the dose to an individual is less than 20 rem and the dose rate is less than 10 rem per hour. At doses greater than 20 rem, the factors used to relate radiation doses to latent cancer fatalities are doubled. At much higher doses, prompt effects, rather than latent cancer fatalities, could be the primary concern.

In addition to latent cancer fatalities, other health effects could result from environmental and occupational exposures to radiation. These effects include nonfatal cancers among the exposed population and genetic effects in subsequent generations. The nonfatal cancers and genetic effects are less probable than fatal cancers as consequences of radiation exposure. Dose-to-risk conversion factors for non-fatal cancers and genetic effects (0.0001 per person-rem and 0.00013 per person-rem, respectively) are substantially lower than for fatal cancers. This Supplemental EIS presents estimated effects of radiation only in terms of latent cancer fatalities because that is the major health effect from exposure to radiation.

Multiplying the 0.07 person-rem per year dose to the population residing within 80 kilometers (50 miles) of the SRS as presented in Section 4.1.4 by the dose-to-risk estimator for the public results in an estimated 0.000035^ cancer fatality in that population per year of DWPF operation and 0.00084 cancer fatality over the 24 years of DWPF operation. Similarly, multiplying the 0.001 millirem dose per year to the maximally exposed individual^ (a hypothetical member of the public assumed to permanently reside at the location of highest calculated dose) by this risk estimator results in an increased probability of a fatal cancer of 5 in 10 billion per year of operation and 1.2 in 100 million over the 24 years of DWPF operation. Multiplying the 0.0027 millirem dose to the worker by the 0.0004 per person-rem risk estimator (ICRP 1991) for workers results in an increased probability of a fatal cancer of 1 in 1 billion per year and 2.6 in 100 million over the 24 years of DWPF operation. As indicated in Section 4.1.4, DOE expects that air emissions from construction activities would not have an impact on offsite air quality. Consequently, adverse radiological health consequences from construction activities would not be expected. Health impacts to DWPF workers are discussed in Section 4.1.11.2.

DOE has performed an analysis that indicates that radiological doses received from airborne releases under the proposed action would not disproportionately affect people of color or low income within 80 kilometers (50 miles) of SRS. Traditional impact analyses generally have not examined the impacts of emissions on health of subgroups identified by race or economic status. This Supplemental EIS examines whether communities of people of color or low income could be the recipients of disproportionately high and adverse impacts of emissions. Even though adverse radiological health impacts are not expected, an analysis to determine whether such impacts could be disproportionately

distributed is presented in the spirit of Executive Order 12898. Figures 3.7-1 and 3.7-2 identified communities of people of color or low income by census tract. This section presents the predicted average radiation doses received by individuals in the identified communities and compares them to the predicted average doses received in the other remaining communities within the 80-kilometer (50-mile) region.

Figure 4.1-2 shows a wheel with 22.5 degree sectors and concentric rings from 16 to 80 kilometers (10 to 50 miles) at 16-kilometer (10-mile) intervals. The fraction of the maximum site boundary radiological dose was calculated for each sector (Simpkins 1994a). This sector wheel was laid over the census tract map and each tract was assigned to a sector. For purposes of this analysis, if a tract falls in more than one sector, the tract was assigned to the sector with the largest value.

Figure 4.1-2.

Figure 4.1-2. Fractions of the maximum site boundary radiological dose within 80-kilometer (50-mile region).

As shown on Figure 4.1-2, higher fractions of the maximum dose would be received by people living near the site compared to those living further away. However, as noted in Section 3.7.4, census tracts with concentrations of people of color or low income are distributed throughout the 80-kilometer (50-mile) region, although weighted to the south of SRS and near Augusta, Georgia. This distribution tends to minimize disproportionate radiological doses among the identified community types in the region.

To determine the per capita radiation dose received in each type of community in the 80-kilometer (50-mile) region, the number of people in each tract was multiplied by that tract's dose value to obtain a total population dose for each tract. These population doses were summed over all sectors of the region for each type of community and divided by the total community population to obtain a community per capita dose. These results are shown in Table 4.1-10.

Table 4.1-10. Per capita maximum annual dose for individuals by identified communities.

	Dose (millirem)				
	For all communities	Community of people of color (greater than or equal to 50 percent)	Community of people of color (between 35 percent and 50 percent)	Community of white persons	Community of low income persons
Predicted per capita dose	1.7-10^-4	1.6-10^-4	1.6-10^-4	1.8-10^-4	1.3-10^-4

Because these numbers are very small and differ very little, this analysis indicates that people of color or low income in the 80-kilometer (50-mile) region would not be disproportionately impacted.

The traffic and transportation routes described in Section 4.1.10 were analyzed relative to the location of low income and people of color communities. None of the major offsite routes, SC19, SC125, or SC57 (Figure 3.10-1) lie primarily or disproportionately within those communities.

4.1.11.1.2 Nonradiological Health Effects from Normal DWPF Operations

The only nonradiological carcinogenic emission expected from the proposed action is benzene. As indicated in Section 4.1.4, the estimated maximum increase in benzene concentration at the site boundary as a result of the proposed action would be 0.044 micrograms per cubic meter^ averaged over 1 year. The calculation of benzene-induced health effects that could occur as a result of atmospheric releases of benzene from the proposed action is based on a lifetime cancer fatality risk factor of 8.28 - 10^-6 cancer fatalities per microgram per cubic meter averaged over 70 years (EPA 1994c). Multiplying the annual average site boundary concentration from the proposed action of 0.044 microgram per cubic meter^ over the proposed 24 years of DWPF operation by the cancer fatality factor results in an increased lifetime probability of a fatal cancer of 1.2 in 10 million. The average benzene exposure to the 80-kilometer (50-mile) population and its associated potential health risks would be lower.

The distribution of benzene concentrations among communities of people of color or low income would be essentially identical to those presented above for radiological dose, so people of color or low income communities would not be disproportionately affected by benzene emissions.

4.1.11.2 Worker Radiological Health

DOE estimates consequences of radiological hazards to the DWPF workers by using historical experience at other SRS facilities. The F-Canyon facility is similar to DWPF in that both facilities process radioactive materials using isolated equipment that is remotely operated and maintained. The number of DWPF workers expected to receive measurable radiation exposure is projected to be approximately 500 workers. The total radiation exposure to the DWPF close-in worker population from normal operations, including Z-Area and ITP, is projected to be 118 person-rem per year (WSRC 1993a,b). Using the current dose-risk conversion of 0.0004 fatal cancer per person-rem (NCRP 1993), DOE estimates that up to 0.05 fatal cancer could result from occupational radiation exposure for each year of DWPF operation. Operation of the DWPF for 24 years with radiation exposure at the projected level could result in a total incremental risk from occupational radiation of approximately 1 fatal cancer. This value is less than 1 percent of the fatal cancers expected in this worker population from non-SRS causes (CDC 1993).

4.1.11.3 Worker Nonradiological Safety and Health

Normal operations within the proposed action do not directly expose workers to facility-specific industrial hygiene hazards beyond those that could be experienced during equipment repair or maintenance activities (WSRC 1993b). Chemical exposure hazards associated with cold feed preparation and storage facilities occur only if the chemicals escape the confines of the vessels and piping. The mechanisms and frequency of chemical releases from confinement within cold feed operations are identified and addressed in this Supplemental EIS as abnormal events that could present a risk to operating personnel.

Nonradiological hazards associated with operation of DWPF include chemical releases (e.g., benzene, mercury) from ventilation stacks, benzene releases from the Organic Waste Storage Tank;, and common safety and industrial hygiene hazards. However, DWPF does not place demands on workers or equipment which would subject them to the adverse effects of unique or high hazards (beyond those of a type and magnitude routinely encountered and/or accepted by the general public) during the conduct of normal operations. Barriers (e.g., engineering controls, safety and health programs, operating procedures, administrative controls, employee training, and personal protective equipment) are defined and in place to protect DWPF workers from nonradiological hazards. Barriers must fail or be compromised before ill effects are experienced. Reviews, inspections, tests, and other controls exist to ensure the suitability and effectiveness of required barriers.

Based on data from F-Canyon, industrial injuries occur very infrequently (frequency of 2.4 - 10^-5 per person-hour) (WSRC 1993b). Most F-Canyon injuries have been minor, although two broken bones were reported within the 5-year injury/illness data bank. In the history of F- and H- Area operations (more than 30 years), there have been two industrial fatalities. Since DWPF is similar to F-Canyon in terms of the types of tasks performed, this injury/fatality rate can be applied to DWPF industrial operations.

The projected staffing for S- and Z-Area facilities includes 492 production and production support workers and supervisors, of which 27 are assigned to Z-Area or the Vitrification Facility control room (WSRC 1993b). The staff would work a 5-week shift rotation, which allows for classroom training on the fifth week. Assuming 4 hours per week overtime, this results in an average of 1,760 person-hours per year in production and production support (e.g., laboratory, maintenance) activities. For the 465 workers (excluding control room and Z-Area staff), this results in 8 - 10^5 person-hours per year required to operate the Vitrification Facility in production/production support. Based on the 2.4 - 10^-5 injuries per person-hour estimated above, 20 injuries or illnesses per year are predicted for DWPF (WSRC 1993b). Most of the injuries are expected to be minor, such as bruises, minor cuts, or mild skin irritation. Applying this illness/injury rate to the ITP and Extended Sludge Processing workforce would result in approximately eight additional illnesses or injuries per year.

4.1.12 ACCIDENT ANALYSIS

An accident is an unexpected or undesirable "initiating" event that leads to a release of radioactive or toxic materials within a facility or to the environment. Initiating events that can lead to an accident fall into three broad categories: external initiators, internal initiators, and natural phenomena initiators. External initiators (e.g., aircraft crashes and resulting explosions or fires) originate outside a facility and can affect the ability of the facility to maintain confinement of its radioactive or hazardous material. Internal initiators originate within a facility (e.g., equipment failures or human error) and are usually the result of facility operation. Natural phenomena initiators include weather-related occurrences (e.g., floods and tornadoes) and earthquakes. Sabotage and terrorist activities (e.g., intentional human initiators) might create either external or internal initiators. This accident analysis defines initiators as events that cause, directly or indirectly, a release of radioactive or hazardous materials within a facility or to the environment by failure or bypass of confinement. Sections 4.1.12.1 and 4.1.12.2 address the accident analysis results for radiological materials, and Section 4.1.12.3 addresses the accident analysis for hazardous chemicals.

4.1.12.1 Radiological Accident Analysis

An evaluation of the safety of the DWPF and its related facilities was performed by identifying the hazards associated with each facility, analyzing each facility's response to postulated events and accidents, and determining the resulting consequences. This section summarizes the radiological accident analysis for the proposed action.

An initial set of reasonably foreseeable accidents was identified and analyzed. Safety documents (e.g., safety analysis reports and justifications for continued operations) developed for each facility were the sources of the set of accidents for this Supplemental EIS. Accidents were selected for evaluation that would have greater consequences than others and would "bound" the remainder of potential accident scenarios. Appendix B describes the methodology, the supporting data, and additional accident analysis information in greater detail.

DOE assessed the potential impacts from a selected spectrum of radiological release accidents, ranging from low to high frequencies of occurrence, with their resulting consequences (i.e., doses and latent fatal cancers). Table 4.1-11 presents the frequency ranges used to characterize accidents.

Table 4.1-11. Accident scenario/sequence frequency ranges.^a

Accident description	Accident frequency ranges
Anticipated accidents	These sequences are anticipated to occur in the lifetime of the facility. Frequency range is from more than once per year to once per hundred years.
Unlikely accidents	These sequences are improbable and are not expected to occur during the lifetime of the facility. Frequency range is from once in a hundred years to once in ten thousand years.
Extremely unlikely accidents	These sequences are considered to be extremely improbable events. Frequency range is from once in ten thousand years to once in a million years.
Not reasonably foreseeable accidents	These sequences are those that would be expected to occur less than once in a million years.

a. Frequency ranges identified in DOE (1994d).

DOE also analyzed the "risk" associated with accidents within each frequency range. Accident risks are typically determined by multiplying the "likelihood" or estimated annual frequency of an accident by the consequences resulting from that accident if it occurs and, therefore, are usually expressed in units of consequence per year (e.g., dose per year or fatalities per year). Calculating a risk value enables dissimilar accidents that have different frequencies and consequences to be easily compared.

The reasonably foreseeable accidents, identified by reviewing existing safety documentation, were screened to select accidents within each frequency range that present the greatest consequences and risk. These accidents, which bound other accidents within the same frequency range, are referred to as "maximum reasonably foreseeable" accidents and were selected for further evaluation in this Supplemental EIS. DOE evaluated not reasonably foreseeable accidents, but concluded that their risks would not be expected to be greater than those accidents with other frequency ranges that were analyzed. This section summarizes the maximum reasonably foreseeable radiological accidents in each frequency category for the proposed action. Detailed descriptions of these particular accidents are provided in Section B.4 of Appendix B. For each accident described, the estimated consequences to members of the public and workers are also provided. Dose-to-risk conversion factors presented in Section 4.1.11.1 were used to calculate these impacts.

For health effects to occur, an accident must result in a release of hazardous material to, or an increase in radiation levels in, the immediate environment. The released material must be transported to locations occupied by humans. The quantities of radioactive materials that reach locations where people are and the ways they interact with humans are important factors in the determination of health effects. To calculate these health effects, information is needed on parameters such as meteorology.

The meteorological data needed for site-specific relative concentration calculations are wind speed, wind direction, and a measure of atmospheric stability. Conservatively, worst-case meteorological conditions have historically been used in safety analysis reports. These conditions are defined as those meteorological conditions that, for a given release, produce concentrations at a downwind distance location that would not be exceeded 99.5 percent of the time, referred to as the 99.5 percentile. More realistic or expected meteorological conditions are usually used for environmental assessments of accident consequences (DOE 1993e). These meteorological conditions are the median conditions, defined as those that for a given release produce consequences at a defined downwind location that would be exceeded 50 percent of the time. The accident consequences presented in this section of the Supplemental EIS were calculated using 99.5 percentile meteorology.

An SRS-developed computer code AXAIR89Q (Simpkins 1994c) estimates potential radiation doses to maximally exposed individuals or population groups from accidental releases of radionuclides. The AXAIR89Q code is a highly automated, site-specific environmental dispersion and dosimetry code for postulated airborne releases. The environmental dispersion models used are based on the Nuclear Regulatory Commission Regulatory Guide 1.145 (NRC 1983). The exposure pathways considered in the AXAIR89Q code include inhalation of radionuclides and gamma irradiation from the radioactive plume.

Doses from the inhalation of radionuclides in air depend on the amount of radionuclides released; the dispersion factor; the physical, chemical, and radiological nature of the radionuclides; and various biological parameters such as breathing rate and how long it takes the body to rid itself of the radionuclide (biological half-life). A breathing rate of 12,000 cubic meters (424,000 cubic feet) per year for adults is used in the AXAIR89Q code.

External gamma radiatin doses from the traveling plume depend on the distribution of the radionuclides in the air, the energy of the radiation, and the extent of shielding. The AXAIR89Q code takes no credit for shielding in calculating doses.

In addition to using 99.5 percentile meteorology and taking no credit for shielding, the AXAIR89Q code also provides no credit for the probable plume rise from stack or heated releases. Therefore, the offsite individual doses calculated by the AXAIR89Q code are upper bounds of radiological consequences for the postulated atmospheric releases.

4.1.12.2 Radiological Accident Analysis Results

Table 4.1-12 presents the estimated maximum number of latent fatal cancers expected from each maximum reasonably foreseeable accident. The table shows the calculated consequences to a maximally exposed offsite individual, the offsite population within 80 kilometers (50 miles), and a collocated worker located at 100 meters (328 feet) (Section 4.1.11.1). A more detailed description of the terms used to describe the exposed individuals is provided in Section B.3.2.1 of Appendix B.

In the anticipated accident frequency range, the accident that poses both the highest consequence and highest risk is an uncontrolled chemical reaction in the Sludge Receipt and Adjustment Tank at the DWPF Vitrification Facility. In the unlikely accident frequency range, the accident that poses both the highest consequence accident and highest risk is a melter spill at the DWPF. In the extremely unlikely accident frequency range, the accident that poses both the highest consequence and highest risk is a 0.2g earthquake at the DWPF. Detailed descriptions of the accidents are provided in Section B.4 of Appendix B. These accidents are unique to DWPF operations and do not necessarily bound those accidents that may occur as a result of normal tank farm operations that would continue under the proposed action. For a

discussion of these accidents, see Section 4.2.12.1.

A qualitative evaluation has also been made of the radiological impact to the "close-in" workers (i.e., workers within the facilities) from the selected accident scenarios. Facility workers include personnel within the DWPF located in the corridors immediately adjacent to the remote process cells, which have concrete walls four feet thick, and personnel in the support and administrative buildings attached to and adjacent to the DWPF within the property protection fence (Gehr 1994). Predictions of latent potential health effects become increasingly difficult to quantify as the distance to the accident location decreases because the individual worker exposure cannot be precisely defined with respect to the presence of shielding and other protective features. The worker may also be acutely injured or killed by physical effects of the accident itself.

Table 4.1-12. Bounding radiological accidents for the proposed action.^a

		Dose (rem)^b		Dose (person-re
Frequence range	Occurrences per year	MEI	Collocated worker	Offsite population
Anticipated accidents highest risk and highest consequences	0.045	0.0002	0.002	2.5
Unlikely accidents highest risk and highest consequences	0.0093	0.03	0.29	490
Extremely unlikely accidents highest risk and highest consequences	5.2X10^-5	6.8	4,000	76,000

a. Sources: WSRC (1993b), Bignell (1994d), Huang and Hang (1994).
b. DOE is evaluating the details of proposed measures that would reduce these potential consequences by at least a factor of 200 and would also reduce or eliminate the probability of this accident sequence (Section 2.2.9).
c. NA = Not applicable. The latent fatal cancer risk is not calculated because the dose (4,000 rem) would result in death within a few days.
NOTE: The DOE limits for radiation dose from normal operations are 100 mrem/year for any member of the public and 5 rem/year for workers.

- Uncontrolled Chemical Reaction in the Sludge Receipt and Adjustment Tank at the DWPF Vitrification Facility

  This event is characterized by foaming, boilover, gassing, and/or belching of tank contents as a result of an incorrect transfer of chemical quantity or material. This event would occur in one of the process cells. Fine particulate materials released from the tank would be removed from the process cell by the Zone 1 Ventilation System. The Zone 1 exhaust is filtered by a 99.95 percent efficient sand filter before being released to the environment. Liquid materials would be contained in stainless steel-lined sumps and canyon walls and subsequently pumped to the Recycle Collection Tank. Nonessential personnel could be evacuated depending on the severity or undetermined status of the reaction. As indicated in Table 4.1-12, doses to the collocated worker and to the maximally exposed offsite individual would be well below the respective dose standards for normal operations. Only small radiation doses would be expected among close-in

workers (Gehr 1994).

- Melter Spill at the DWPF Vitrification Facility

  The Melter Spill at DWPF could occur as a result of: an electrical short from the heating elements to the melter housing causing a small hole; excessive offgas surge forcing liquid glass out the pour spout with no canister in place to receive the radioactive liquid (e.g., during replacement of a filled canister); failure of the bottom drain valve; or a water spill into the melter generating an offgas surge sufficient to force liquid glass out of the pour spout during filled canister replacement. The melter is located in a process cell. The spilled molten glass would solidify; however, some radioactive material would be volatilized. The volatilized material would be removed from the process cell by the Zone 1 Ventilation System, which is filtered by a 99.95 percent efficient sand filter before being released to the environment. As in the previous accident, doses to the collocated worker and to the maximally exposed offsite individual would be well below the respective dose standards for normal operations, as indicated in Table 4.1-12. Only small radiation doses would be expected among close-in workers (Gehr 1994).

- Earthquake at the Vitrification Facility

  An earthquake more severe than the design basis earthquake for the Vitrification Facility could cause the Zone 1 Ventilation System and the process vessel purge systems to fail. Because the Vitrification Facility process vessel inventories generate combustible gases such as hydrogen and benzene failure of the purge systems could lead to explosions inside the process vessels. A large fraction (approximately 50 percent) of the fine particulate material in the air produced by the explosions, as well as from subsequent spilling/splashing and creation of fine droplets, would eventually escape from the vitrification building to the environment (Gehr 1994). As indicated in Table 4.1-12, the doses calculated to the maximally exposed individual would substantially exceed the annual limits of dose for normal operations. The calculated dose to the collocated worker of about 4,000 rem would most likely result in death within a few days. Radiation-induced fatalities would also be expected among unprotected workers at even closer distances to the release location. However, an accident of this magnitude is extremely unlikely, expected to occur only once in 20,000 years. DOE is evaluating the details of the proposed measures that would substantially reduce these consequences to levels that are below SRS safety guidelines (see Section 2.2.9). These modifications would reduce or eliminate the probability of this accident sequence. If the sequence occurred, these modifications would reduce these consequences by at least a factor of 200. These modifications would be installed before the facility is operated with radioactive waste.

Radiological Synergistic Effects

Synergistic effects are those resulting from combinations of individual agents that are greater than those achievable by the agents acting alone. DOE is not aware of any synergistic effects resulting from exposures to radiation and a carcinogenic chemical, such as benzene, which are both known to result in an increased incidence of cancer. Indeed, synergistic effects of radiation and other agents have been identified in only a few instances, most notably from the combined effects of radiation exposure and smoking among uranium miners in causing lung cancer. Generally, synergistic effects from common-cause radiological accidents are not included in this evaluation. However, the cumulative impact of a design basis at SRS is discussed in Appendix B, Section B.3.3. From this discussion, it was assumed that the radiological consequences from this common cause accident scenario were additive rather than synergistic. Radioactivity released from multiple sources or released simultaneously with hazardous chemicals could affect the clean-up or

mitigation of the resulting hazard that could have a greater impact than if the releases were separate. DOE maintains emergency plans that would provide protective actions and mitigate consequences that could occur during a common-cause accident.

Secondary Impacts from Postulated Accidents

The main focus of these accident analyses was to determine how large the consequences of postulated accident scenarios would be to public and worker health and safety. However, DOE recognizes that accidents involving releases of materials can also adversely affect the surrounding environment. For the purposes of this analysis, postulated impacts upon the environment from potential accident scenarios are referred to as "secondary impacts."

To determine the greatest impact that could occur to the environment from the postulated accidents considered within this Supplemental EIS, each radiological accident scenario was evaluated to determine potential secondary impacts. The following subsections qualitatively summarize the results of the evaluations.

Since the main pathway for contamination from the accidents discussed above is via airborne releases, DOE expects only limited radiological contamination of surface or groundwater on or off site. Therefore, adverse impacts on water quality and aquatic biota from the postulated accident scenarios considered in this Supplemental EIS would not be expected.

Except for severe accident scenarios such as those initiated by large earthquake, only minor economic impacts are expected from accident scenarios analyzed in this Supplemental EIS. DOE would use existing workforce members to clean up contamination in the facility area where the accident is postulated to occur. Additionally, DOE expects that offsite contamination would be minimal or would not occur. For severe accidents such as an earthquake, substantially larger economic impacts would be incurred either to repair the facilities or place them in a condition where further risks to workers and the public would be minimized.

Since the facilities considered in this Supplemental EIS are not needed to support the national defense program, none of the postulated accident scenarios would impact the national defense capabilities of the United States.

It is expected that contamination of the environment from the accidents postulated in this Supplemental EIS would be limited to the immediate area surrounding the facility where an accident is postulated to occur. None of the accidents postulated would result in measurable offsite contamination. Therefore, DOE expects that the impacts on terrestrial biota, land use, and treaty rights from the accidents analyzed in this Supplemental EIS would be minor.

4.1.12.3 Summary of Chemical Hazards

In order to assess the hazards involved in activities and operations supporting vitrification at the SRS, nonradiological chemical hazards were also analyzed. The health effects resulting from exposure to different toxic chemicals are more difficult to quantify than those resulting from radiological exposures because less is known about chemical effects. Therefore, the consequences of chemical accidents in this Supplemental EIS are presented in terms of airborne concentrations at various locations. These airborne concentration values are then compared to established exposure guidelines to enable the decisionmaker to determine the relative impact for each postulated chemical hazard. This section addresses postulated chemical accident scenarios associated with the vitrification-related facilities and operations under the proposed action.

The technical bases for addressing chemical hazards posed by the proposed action were provided in the DWPF Safety Analysis Report (WSRC 1993b), the In-Tank Precipitation Addendum to the Liquid Waste Handling Facilities Safety Analysis Report (WSRC 1993a), and the Saltstone Justification for Continued Operations (WSRC 1992e). The DWPF and ITP safety documentation provides quantitative analyses of potential chemical accident scenarios, and Saltstone Manufacturing and Disposal safety documentation provides a brief qualitative discussion addressing chemical accident hazards. DOE expects that chemical hazards posed by Extended Sludge Processing and Late Wash would be less severe and would be bounded by those provided in the DWPF and ITP evaluations. Therefore chemical hazards from these facilities are not addressed in this Supplemental EIS.

Appendix B, Section 6 provides a detailed discussion addressing all the chemical accident scenarios analyzed for the proposed action and the associated assumptions, methodology, and models used. Table 4.1-13 lists the results of the postulated chemical accident scenarios that would produce airborne concentrations exceeding the Emergency Response Planning Guideline (ERPG) values ERPG-2 or ERPG-3 (AIHA 1991). This table provides airborne concentrations at 100 meters (328 feet) and at the Site boundary for the postulated chemical accidents. Based on these results, the chemical releases considered would not have an adverse effect on the public. This conclusion is based on the fact that none of the chemical airborne concentrations at the site boundary exceed the ERPGs. However, all of the chemical accident scenarios listed in Table 4.1-13 would produce airborne concentrations that exceed ERPG-2 values and thus could result in irreversible or other serious health effects, or symptoms that could impair a worker's ability to take protective action if exposed for a period of time greater than 1 hour. Furthermore, five of the postulated chemical accidents would yield airborne concentrations that exceeded ERPG-3 values, which could result in the unacceptable likelihood that a person would experience or develop life-threatening health effects if exposed for a period of time greater than 1 hour. The SRS Emergency Plan (WSRC 1993f) was designed to respond to and mitigate the potential consequences of an accident. These accidents are unique to DWPF operations and do not necessarily bound those accidents that may occur as a result of normal tank farm operations and which would continue under the proposed action (Section 4.2.12.1).

Table 4.1-13. Summary of chemical accidents for the proposed action that exceed ERPG-2 or ERPG-3 values.

		Airborne Conce
Accidents	Frequency	At 100 meters^a (mg/m^3)^c
Benzene^d release from DWPF OWST^e explosion	0.00027	14,000
Benzene^d release from DWPF due to tornado^f	0.0001	10,000
Benzene^d release during column cleaning at ITP	0.00011	240
Benzene^d release due to chemical reaction at ITP	0.5	5,800
Benzene^d release due to a tetraphenylborate tank spill at ITP	0.6	400
Formic acid release from DWPF cold feed area due to tornado^f	0.0001	100
Formic acid release from DWPF cold feed area due to earthquake^g	0.002	100

Formic acid release from DWPF chemical and industrial waste treatment area due to tornado^f	0.0001	49
Formic acid release from DWPF chemical and industrial waste treatment area due to earthquake^g	0.002	49
Nitric acid release from DWPF cold feed area due to tornado^f	0.0001	63
Nitric acid release from DWPF cold feed area due to earthquake^g	0.002	63
Nitric acid release from DWPF chemical and industrial waste treatment area due to tornado^f	0.0001	63
Nitric acid release from DWPF chemical and industrial waste treatment area due to earthquake^g	0.002	63

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a. To convert to feet, multiply by 3.281.
b. ERPG - Emergency Response Planning Guidelines.
c. Milligrams per cubic meter.
d. Suspected human carcinogen - available epidemiologic studies are conflicting or insufficient to confirm an increased risk of cancer in exposed humans.
e. OWST - Organic Waste Storage Tank.
f. 176 kilometer per hour maximum wind speed.
g. 0.1g seismic event.

Additionally, it is assumed that the closer the exposed individual is to an accident location, the higher the release concentrations in the air. Thus, the maximum airborne concentrations that close-in workers (i.e., workers within the facilities) could encounter may greatly exceed the ERPG-3 values. While perhaps not instantly lethal, even short exposures could be extremely dangerous.

The wastewater sent to Saltstone Manufacturing and Disposal, located in Z-Area, contains hazardous substances. However, concentrations of these contaminants would be low and would not present exposure hazards to workers. Sodium hydroxide, the one hazardous constituent that is present at higher concentrations, would be safely handled in accordance with standard industrial practices. Saltstone Manufacturing and Disposal operations would not pose major chemical hazards to either onsite or offsite populations (WSRC 1992e). Thus, a quantitative analysis of chemical hazards posed by Saltstone Manufacturing and Disposal was not performed.

Chemical Synergistic Effects

The chemical accident hazards considered in this evaluation did not include the synergistic effects of simultaneous releases from a common accident initiator because information about the effects of concurrent exposure to various chemical combinations is scarce. Furthermore, DOE is not aware of synergistic effects resulting from exposures to radiation and a carcinogenic chemical, such as benzene, each of which are known to result in an increased incidence of cancer. However, release of more than one chemical could affect the cleanup or mitigation of the resulting chemical hazard that could have a greater impact than if the chemical releases were separate. The SRS maintains emergency plans that would specify protective actions and mitigate consequences

that could occur during simultaneous chemical releases due to a common accident initiator.

Figure 4.1-3.

Figure 4.1-3. Qualitative representation of annual risk over time for the proposed action.

Figure 4.1-3 shows a conceptual risk profile over time for the proposed action. This risk depiction includes radiological and nonradiological risks, as well as risks from accidents and normal operations. This figure provides an indication of risk from DWPF operations using ITP and the reduction in high-level waste tank risk due to removal of waste from the tanks. This figure also shows a drop in risk at the conclusion of DWPF operation to a smaller, continuing risk from the radioactive glass waste canisters stored underground in the Glass Waste Storage Building and from residual radioactivity in the high-level tanks.

4.1.13 WASTE GENERATION

This section discusses the potential impacts on waste management facilities at SRS resulting from generation of low-level radioactive, hazardous, mixed, construction debris, and sanitary (nonhazardous, nonradioactive solid) wastes attributable to the proposed action. Table A-11 in Appendix A presents the waste volumes estimated to result from the proposed action. The treatment and disposal options for these waste streams, except for sanitary waste and the highly radioactive failed equipment specifically designated for interim storage in the Failed Equipment Storage Vaults (Section 2.2.5.4), are being evaluated in the SRS Waste Management EIS, currently being prepared. The current plans for management of the DWPF waste streams are discussed below. To characterize the potential impact of the waste generated by the proposed action on existing and planned SRS waste management infrastructure, the estimated contribution of DWPF waste relative to the amount of similar wastes projected to be generated sitewide and treated, stored, or disposed of in facilities designated for sitewide service was calculated by waste type. This calculation was based on information provided in Table A-11 in Appendix A and Table 3.12-1. Table A-11 in Appendix A presents the waste forecast volume and characteristics for the proposed action, and Table 3.12-1 presents the projected totals for SRS waste generation from Fiscal Year 1995 through Fiscal Year 2018 when processing under the proposed action is projected to be complete. Table 4.1-14 presents the fraction of each type of waste generated at SRS that would be attributable to the proposed action. The fraction is expressed as the average percentage of total waste of each type at SRS that would be generated by the proposed action during high-level waste processing. Additionally, the highest fraction of the total waste of each type generated in a single year is listed as the maximum percent. These two values provide estimated average and worst case impacts on the waste management system at SRS. These estimates do not include waste volumes generated as a result of environmental restoration or decontamination and decommissioning of SRS facilities. If wastes generated by these activities were included, they would lower the percentage of total SRS waste attributable to DWPF. The estimates given in Table 4.1-14 also do not include waste from Late Wash or highly radioactive failed melters or other equipment from the Vitrification Facility. The waste generation rate and waste classification (i.e., low-level or mixed) have not yet been determined for Late Wash microfilters.

Table 4.1-14. Waste generation impact for the proposed action.^a,b

Waste type	Average fraction of total attributed to proposed action (percent)	Maximum fraction of total attributed to proposed action (percent)

Low-Level	18	66
Hazardous	<1	3
Mixed	10	80
Sanitary	11	19

a. Adapted from Bignell (1994c), Cauthen (1994c), Dausey (1994), Hagenbarth (1994), Reeves (1994), WSRC (1994i).

b. Average and maximum estimates do not include failed melters or other highly radioactive failed equipment designated for interim storage in the Failed Equipment Storage Vaults which are dedicated to these DWPF wastes. Estimates also do not include waste (e.g., spent microfilters) from Late Wash.

However, DOE expects the filters to have characteristics very similar to spent ITP filters, and would manage them in a similar manner (Table A-11 in Appendix A). Failed melters or other highly radioactive failed equipment designated for interim storage in the Failed Equipment Storage Vaults (Section 2.2.5.4) are not included in the table since these vaults would be dedicated to DWPF failed equipment and SRS waste management facilities in sitewide service would not be affected. The Failed Equipment Storage Vaults could receive a failed melter with a volume of approximately 310 cubic meters (11,000 cubic feet) every 2 years (one melter per vault) (Glenn 1994). The amount of other highly radioactive failed equipment that would be placed in the vaults is presently unknown; however, DOE estimates that a total of 14 vaults may be required over the assumed 24-year operating period of DWPF. Based on process knowledge and testing, DOE expects that wastes designated for vault storage would not qualify as mixed waste under the Resource Conservation and Recovery Act and has not obtained a permit to store mixed waste in the vaults. If DOE determines in the future that any of these wastes qualify as mixed waste, DOE would obtain the necessary regulatory approvals for the vaults or make alternate arrangements to ensure that the wastes were managed in compliance with applicable regulations (Glenn 1994).

Although interim storage of failed equipment is expected to have no impact on other sitewide waste management infrastructure, regular maintenance and monitoring of these vaults would be required to ensure continued safety of this storage method until DOE identifies a permanent disposal facility for this waste. Transport to and disposal of the failed equipment at a permanent disposal facility also has potential for environmental impact which DOE would evaluate in other NEPA documentation, as appropriate.

The plan currently being considered for managing DWPF low-level waste (exclusive of failed equipment) involves incineration in the Consolidated Incineration Facility (if the waste is combustible) or disposal in the E-Area vaults (WSRC 1994j). The Consolidated Incineration Facility is designed to treat the DWPF combustible low-level waste (WSRC 1994q). As noted in Chapter 3, the annual operating capacity of the Consolidated Incineration Facility for incineration of solid waste is approximately 18,000 cubic meters (630,000 cubic feet) at 50 percent attainment (Lorah 1994). It is estimated that the Consolidated Incineration Facility would operate approximately 3 years to treat the low-level combustible waste that would be generated by DWPF. The design capacity of the E-Area vaults would accommodate SRS's (including DWPF) low-level radioactive waste; for 20 years (WSRC 1993d).

It is estimated that the DWPF low-level waste would use only approximately 2 years of this capacity if it is assumed that the DWPF low-level waste was not combustible or compactable.

As noted in Table A-11 in Appendix A, hazardous waste would be generated at a rate of approximately 2 cubic meters (71 cubic feet) per year. The hazardous waste would consist primarily of analytical solutions and solvent rags with methylene chloride, acetonitrile, and acetone (WSRC 1994i), which can be appropriately treated by incineration followed by ash stabilization. The plan currently being considered for managing the hazardous waste generated at DWPF involves incineration in the Consolidated Incineration Facility (WSRC 1994j). In addition to being designed for the incineration of low-level waste, the Consolidated Incineration Facility is also designed and permitted to treat combustible hazardous waste (WSRC 1993q; SCDHEC 1992b). As noted in Chapter 3, the annual operating capacity of the Consolidated Incineration Facility for liquid waste feed excluding DWPF organic waste is approximately 3,900 cubic meters (138,000 cubic feet) per year at 70 percent attainment and for solid waste feed is approximately 18,000 cubic meters (630,000 cubic feet) per year at 50 percent attainment (Lorah 1994). Assuming hazardous waste from DWPF is 100 percent liquid and mixed waste from DWPF is 50 percent liquid and 50 percent solid, it is estimated that the approximate operational time for the Consolidated Incineration Facility to treat the hazardous and mixed waste (excluding DWPF organic waste) generated by the DWPF annually would be less than 2 days for liquids and less than 1 day for solids.

Mixed waste (excluding the DWPF organic waste stream) generated as a result of the proposed action would include laboratory waste similar to that generated in the hazardous waste category and contaminated equipment that is hazardous as well as radioactive. Mixed waste would be generated at a rate of approximately 30 cubic meters (1,060 cubic feet) per year in Fiscal Year 1996 (WSRC 1994i). As with low-level and hazardous waste, the plan for managing the mixed waste generated at DWPF involves incineration in the Consolidated Incineration Facility for those wastes that are combustible. As noted above, it is estimated that the Consolidated Incineration Facility would have to be operated approximately 2 days to treat the hazardous and mixed waste (excluding DWPF organic waste) generated annually by DWPF.

The DWPF organic waste stream (primarily benzene) generated during operation would be mixed waste and would be generated at an estimated 150 cubic meters (5,300 cubic feet) per year starting in Fiscal Year 1996 (Cauthen 1994c). This amount represents approximately 20 percent of the Consolidated Incineration Facility annual operating capacity for this waste. The organic waste would have a high heat value, so by incinerating the organic waste, the Consolidated Incineration Facility would need less fuel to operate (WSRC 1993d). Using the organic waste as a fuel would be a positive impact on the operation of the Consolidated Incineration Facility because it would reduce fuel consumption.

The volume of SRS sanitary waste (nonhazardous, nonradioactive solid waste) that would need to be recycled or disposed would increase as a result of the proposed action. Sanitary waste generated by DWPF operations would include construction waste, office waste, and cafeteria waste. Construction waste would be generated during the construction of Late Wash, additional Failed Equipment Storage Vaults, a second Glass Waste Storage Building, and the additional Saltstone Disposal Vaults. Reusable construction materials would be stored for later use onsite. Scrap wood would be burned or chipped for mulch, and paint and paint products would be sold to an offsite vendor. Inert construction debris would be disposed in facilities permitted to receive these wastes, such as SRS onsite erosion control sites. Paper, aluminum cans, and

cardboard would be collected for recycling. Scrap metal, office equipment, drums, and other salvageable items would be sold to an offsite vendor (WSRC 1994j). Finally, sanitary waste without a recycling option would be screened and then transported to a permitted landfill for disposal.

The impact of sanitary waste generation would be to increase the volume of material managed by existing SRS storage facilities and collection and transport utilities that support offsite recycling, sales, and disposal. It is expected that the erosion control sites would be the only onsite disposal facilities impacted. The erosion control site currently operating at SRS is the Burma Road Cellulosic and Construction Waste Landfill. It is estimated that construction debris from the proposed action would use approximately 2,600 cubic meters (93,000 cubic feet) of capacity (Reeves 1994). These impacts would be lessened by the continued expansion of the SRS Waste Minimization Program described in Section 2.2.8.

4.1.14 DECONTAMINATION AND DECOMMISSIONING

About 25 buildings are associated with the proposed action. Some of these facilities already contain radioactive material (i.e., Z-Area and ITP waste tanks in H-Area Tank Farm). Therefore, the proposed action would have minimal incremental decontamination and decommissioning impact on them. Over 6,000 buildings at SRS, including 5 reactors, 2 canyons, and 2 high-level waste tank farms, currently make up the SRS inventory for potential future decontamination and decommissioning. The impact of the proposed action on the number of buildings that will eventually undergo decontamination and decommissioning is relatively minor; however, the facilities associated with the proposed action contain or would contain highly radioactive material. Disposition of the high-level radioactive waste currently stored in underground tanks at SRS is a prerequisite to the ultimate success of SRS decontamination and decommissioning. Operation of the DWPF is a key element in planning for ultimate high-level radioactive waste disposition.

DOE has anticipated the need for eventual decommissioning of the Vitrification Facility in facility and process design and operational planning (WSRC 1993b). Operations would be conducted to minimize the spread of radioactive contamination. Process equipment is designed to minimize areas where contaminated materials could accumulate. Process functions are compartmentalized to allow isolation so that effective decontamination can be achieved. Down-draft ventilation of operating and processing areas would minimize surface contamination from airborne contaminants. Protective coatings have been applied to concrete surfaces subject to chemical or radioactive spills to reduce the amount of contamination absorbed into the concrete. Stainless steel cell and area liners are provided to facilitate decontamination in selected areas where accumulation of radioactive contamination could increase personnel radiation exposure. Process cells are provided with sumps and pumps for liquid removal and wash down capability. The Vitrification Facility has been designed to facilitate future decommissioning in accordance with DOE General Design Criteria (DOE 1989).

Design features have also been incorporated in the ITP Filter/Stripper Building to facilitate decommissioning. The two filter cells have stainless steel liners for the floors, sumps, and walls for ease of decontamination, and building ventilation is designed to confine radioactivity within these cells. The high-level radioactive waste tanks used in ITP operations were highly contaminated from previous SRS waste management activities and do not represent additional decontamination and decommissioning impact.

4.1.15 UNAVOIDABLE ADVERSE IMPACTS AND IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

This section describes adverse impacts attributable to the proposed action that cannot be avoided. It also describes the irreversible and irretrievable commitment of resources that would be associated with the proposed action.

4.1.15.1 Unavoidable Adverse Impacts

Several unavoidable adverse impacts are expected as a result of startup, startup testing, and continued operation of the proposed action until waste processing is complete.

Construction associated with Late Wash, additional Failed Equipment Storage Vaults, a second Glass Waste Storage Building, and the Saltstone Disposal Vaults would generate dust during earth moving and land clearing that would be unavoidable but would be controlled as necessary by water and dust suppressants. The remoteness of S- and Z-Areas would minimize offsite impacts.

The primary nonradiological air emissions associated with normal operations of the DWPF under the proposed action would include benzene, diphenyl mercury, and nitrogen oxides. Table 4.1-4 shows the predicted contribution of each of these regulated pollutants from DWPF operations to the overall maximum concentration at the Site boundary. These air emissions would comply with all regulatory requirements.

Unavoidable radiation exposures from normal operation under proposed action, which include increased occupational exposures as well as exposures to the general public, would be well below established DOE limits. The hypothetical maximally exposed offsite individual would receive an effective dose equivalent of 0.001 millirem from DWPF operations compared to about 300 millirem that would be received from natural radiation sources. The major radionuclide contributing to the potential exposure is cesium-137.

Construction of new Saltstone Disposal Vaults would require clearing and grading and would result in loss of up to approximately 40 hectares (100 acres) of forested land within Z-Area. This unavoidable impact would be spaced over time as new vaults were constructed every 18 months. Small mammals, reptiles, and birds occupying this habitat would be displaced or disturbed by land clearing and associated construction activities, but local and regional populations of these wildlife species would not be severely impacted.

Construction of the vaults would limit use of this area for other purposes (e.g., agriculture) for the long term.

Some contamination of shallow groundwater at and near the Saltstone Disposal Vaults is projected to occur from leaching of radionuclides and other pollutants (e.g., nitrate). However, releases from the vaults are not expected to reach the shallow groundwater for at least 100 years, and contamination would remain below drinking water standards beyond a distance of 100 meters (328 feet) from the vaults.

DWPF would continue to withdraw groundwater at the current rate of approximately 7.6 million liters (2 million gallons) per month from the aquifers that underlie the facility (Cauthen 1994d). There would be no surface water usage.

Operation of DWPF would result in the release of additional treated wastewater through permitted outfalls; however, no adverse impact to aquatic organisms in receiving streams is anticipated.

While some unavoidable increase in traffic would be associated with the proposed action, the increase is expected to have negligible impact on local traffic conditions and would cause no road to exceed design capacity. Approximately 1,200 shipments of chemicals and construction materials attributable to the proposed action are anticipated to occur on an annual basis.

DOE anticipates that only minor unavoidable adverse impacts on public or worker health would result from the proposed action. The calculated discharges and exposures of pollutants (including radioactivity) to the public and facility workers would be many times below normal risk levels. The proposed action would result in an additional 0.000035 cancer fatalities per year to the offsite population from airborne releases of radioactivity, and an increased lifetime cancer risk; to the maximally exposed member of the public of 1.2 in 10 million from airborne benzene releases over the duration of facility operations. Industrial injuries would occur at approximately the same annual rate as is currently experienced at F-Canyon and would consist primarily of minor bruises, minor cuts, or skin irritations.

An unavoidable adverse impact resulting from operation of the DWPF would be the generation of new waste, including low-level radioactive, hazardous, mixed, and nonhazardous solid waste. The generation of these wastes is expected to be less than 20 percent of the overall waste volume generated at the SRS.

4.1.15.2 Irreversible or Irretrievable Commitment of Resources

The startup and operation of the DWPF would commit approximately 162 hectares (400 acres) of land, natural resources, and associated natural resource services (e.g., groundwater for drinking, natural habitats) to waste management usage for an indefinite period of time; it would also consume energy, raw materials, and other natural and manmade resources. Resources that would be irreversibly or irretrievably committed during operation include materials that could not be recovered or recycled and materials that would be consumed or reduced to irrecoverable forms. For example, a minor irreversible and irretrievable commitment of resources would be the consumption of fuel oil during construction of additional vaults for Z-Area.

Operation of the DWPF would involve the future commitment of land resources. At present this land is dedicated to industrial and waste management usage, and with the exception of land already committed to the two existing Saltstone Disposal Vaults, all other land could be converted for other purposes.

The construction of the vaults and other facilities associated with the proposed action would require the commitment of construction materials such as concrete and steel. Operation of the DWPF would also require commitment of process chemicals such as nitrogen, sodium hydroxide, nitric acid, glass frit, sodium nitrite, and other chemical substances (Table A-5 in Appendix A). The final disposition of solid, hazardous, and radioactive waste generated as a consequence of operating the DWPF would involve the commitment of additional land area to dispose of these waste streams.

DOE estimates that the proposed action would require an annual electric energy consumption of approximately 32,000 megawatt-hours (Dickinson 1994). Electric power would be provided by onsite generation and purchases of offsite power. Using standard factors for energy

conversion (Toole 1994), 15,500 tons of coal would be consumed per year to produce this electricity. When operating, diesel generators would provide electrical power for emergency functions and backup power supply.

4.1.16 DWPF ORGANIC WASTE TREATMENT OPTIONS

4.1.16.1 Introduction

As discussed in Section 2.2.7, DOE proposes to treat the DWPF organic waste (benzene) generated during radioactive operations by incineration at the Consolidated Incineration Facility, presently under construction near DWPF. DOE evaluated management options for treating this waste stream in the event that the Consolidated Incineration Facility is not available. Three options being considered by DOE are offsite incineration, onsite incineration at a dedicated incinerator (i.e., an incinerator designed and operated to treat only DWPF organic waste), and onsite treatment by technologies other than conventional incineration. Potential environmental impacts attributable to a decision to treat this waste at the Consolidated Incineration Facility or these alternative facilities are evaluated in the following subsections. Potential impacts of the Consolidated Incineration Facility provide the baseline for the analyses.

4.1.16.2 Consolidated Incineration Facility

As noted in Section 2.2.7.2, startup of the Consolidated Incineration Facility is scheduled for early 1996 before planned generation of mixed organic waste at DWPF. Thus, no construction impacts are considered attributable to treatment of DWPF waste at the Consolidated Incineration Facility.

Land Use, Cultural Resources, and Biota - The Consolidated Incineration Facility site and surrounding area before construction was previously disturbed, dedicated industrial land that supported common biota (plants and animals) characteristic of such sites. As a result, no appreciable potential for impacts to land use, cultural resources, wetlands and other intact natural habitats, or threatened or endangered species are expected to result from either construction or operation of the Consolidated Incineration Facility (DOE 1992d).

Soil and Water Resources - DOE expects potential impacts to soils, surface water, and groundwater attributable to treatment of DWPF organic waste at the Consolidated Incineration Facility to be minimal. Potential adverse impact to soils from normal Consolidated Incineration Facility operations is expected to be limited to minor localized contamination from occasional spills of fuel and other potentially hazardous materials in use at the Consolidated Incineration Facility. As noted in Section 4.1.3.1, appropriate measures are in place to minimize potential spills and to identify and remediate spills when they occur.

No surface water would be used by the Consolidated Incineration Facility, nor would process effluents be directly discharged to the environment. Some indirect wastewater discharges could result from treatment of occasional process wastewater generated at the Consolidated Incineration Facility. Treated wastewater would be analyzed, discharged, and monitored in accordance with an SRS National Pollutant Discharge Elimination System permit, which would be obtained or modified as necessary. The Consolidated Incineration Facility is expected to use 102 liters (27 gallons) per minute of groundwater from the deep aquifers (Black Creek and Middendorf formations) for process (e.g., scrubber

makeup) and domestic purposes (DOE 1992d). The proportion of water use attributable to incineration of DWPF organic waste at the Consolidated Incineration Facility is not known. However, this waste would be likely to require relatively less water for ash handling and scrubber operation than most other waste fed to the facility because it burns efficiently, leaves little ash, and does not form large amounts of acids when burned. Assuming that water use is proportional to a 1993 estimate of waste feed on a weight basis [17.8 percent for DWPF organic waste (WSRC 1993e)], 18 liters (5 gallons) per minute of this water use would be attributable to DWPF organic waste treatment.

Occupational Health and Safety - Compliance with established SRS health and safety programs, as well as Consolidated Incineration Facility operations procedures, would assure the nonradiological health and safety of Consolidated Incineration Facility workers during normal operations and in the event of accidents having the potential for toxic chemical exposure (DOE 1992d). In addition, training on safe work practices and regularly scheduled inspections of safety systems and equipment would help to ensure the continuing safe operation of the Consolidated Incineration Facility. Because similar safety-related programs and activities occur in all SRS facilities, the frequency and severity of occupational injuries and illnesses that might occur at the Consolidated Incineration Facility would not be expected to be different from the frequency and severity experienced by SRS as a whole (Section 3.11.3).

Socioeconomics and Infrastructure - The Consolidated Incineration Facility staffing level is expected to peak at 225 persons during construction, then decrease to 83 persons during operation (McVay 1994). The workforce level is unlikely to be greatly influenced by incineration of benzene at the facility. In any event, changes in the workforce would be small in relation to both the expected SRS workforce (predicted to be 19,262 in 1996; Section 3.7) and regional population. As indicated in Sections 4.1.7 and 4.1.10, direct and indirect impacts on socioeconomics and local or regional infrastructure (e.g., traffic and transportation) from such small changes in the workforce are expected to be negligible.

Air Resources and Human Health - Air emissions attributable to treatment of the DWPF organic waste at the Consolidated Incineration Facility described in Section 2.2.7.2 were used to estimate ground level concentrations of pollutants of concern. These predictions are based on specific air dispersion modeling results for benzene from the Consolidated Incineration Facility stack as reported by DOE (1992d). The estimated benzene emissions from the stack are 0.038 kilograms (0.084 pounds) per hour (SCDHEC 1992a), which result in a maximum ground-level concentration of 0.01 micrograms per cubic meter averaged over a 24-hour period (DOE 1992d). The maximum ground-level concentrations for the criteria pollutants and mercury were calculated using the relationship between emissions and resulting concentration. Variations in averaging times (e.g., from 24-hour to 8-hour average concentrations) were calculated using conversion factors provided by SCDHEC (1992c).

Table 4.1-15 shows the resulting estimates of maximum site boundary-line concentrations from total Consolidated Incineration Facility emissions and from those emissions attributable only to DWPF organic waste. For each air contaminant, the maximum concentrations are below state and Federal ambient air quality standards (SCDHEC 1976b). This estimated annual average maximum concentration of benzene at the Site boundary, assuming it occurs each year for the proposed 24 years of DWPF organic waste feed to the Consolidated Incineration Facility, would result in an increased lifetime probability of fatal cancer of 1.1 in 1 billion, based on the risk factor presented in Section 4.1.11.1.2.

Table 4.1-15. Estimated maximum boundary line concentrations from the Consolidated Incineration Facility.^a

Criteria pollutant	Averaging time	From DWPF organic waste feed to CIF^b (micrograms per cubic meter)	From total CIF emissions (micrograms per cubic meter)	Air stan (mic per mete
Carbon monoxide	1-hour	0.001	0.004	40,0
	8-hour	0.001	0.003	10,0
Nitrogen oxides	Annual	0.02	0.09	100
Particulates (=< 10 microns)	24-hour	0.06	0.34	150
	Annual	0.01	0.04	50
Total suspended particulates	Annual geometric mean	0.01	0.04	75
Air toxics				
Benzene	24-hour	0.01	0.01	150
	Annual	0.0004	0.0004	NA^d
Mercury	24-hour	0.001	0.001	0.25

a. Derived from emissions data presented in Table 2.2-2, air dispersion factor for Consolidated Incineration Facility benzene emissions provided in DOE (1992d).
b. CIF = Consolidated Incineration Facility.
c. SCDHEC (1976b).
d. NA = Not applicable.

As stated in Section 2.2.7.1, the radionuclide of concern in the DWPF organic waste is cesium-137, which would contribute 2.2 - 10^-6 curies per year to the Consolidated Incineration Facility emissions. Based on calculations for the Vitrification Facility (Stack 291-S), which has stack parameters similar to the Consolidated Incineration Facility stack, the calculated maximally exposed individual due to the Consolidated Incineration Facility emissions attributable to DWPF organic waste is 3.6 - 10^-7 millirem. Using the risk estimator presented in Section 4.1.11.1.1, this dose would result in an estimated increased lifetime probability of fatal cancer of 1.8 in 10 trillion.

The calculated population dose within 80 kilometers (50 miles) of SRS due to Consolidated Incineration Facility emissions attributable to DWPF organic waste incineration is 2.8 - 10^-5 person-rem, which yields an estimated annual number of cancer fatalities from DWPF waste treated in the Consolidated Incineration Facility of 1.4 - 10^-8.

Accidents - As with other radioactive or hazardous material treatment facilities, operation of the Consolidated Incineration Facility involves the potential for accidents (e.g., material spills, leaks, fires, or explosions) to occur. As a result, some risk to onsite workers and the

general public is associated with operating the Consolidated Incineration Facility. The SRS maintains an operational event database on facilities situated in the 200-Area in which the Consolidated Incineration Facility is located. Based on this operational database, the frequency of a leak at an existing facility is approximately 0.2 event per year. Frequencies for events such as overflows, transfer errors, and uncontrolled reactions at existing facilities that result in spills to the environment are approximately 0.2, 1.0, and 0.2^ events per year, respectively (Du Pont 1988). Engineering and administrative controls described in the database are being implemented within the Consolidated Incineration Facility design and management program to reduce potential for these accidents.

The organic waste sent to the Consolidated Incineration Facility would also serve as an auxiliary fuel for the incinerator and could contribute to a postulated explosion. An explosion in the Consolidated Incineration Facility rotary kiln is considered to be a maximum reasonably foreseeable accident in the combustion process. Under certain special or upset conditions, it is possible to accumulate an explosive atmosphere in or around the kiln area. The frequency of an explosion in the rotary kiln is estimated to be 0.0015 per year (WSRC 1993c). An explosion in the rotary kiln would cause a radiological and nonradiological release of material in the form of airborne ash. This radiological release would result in a calculated dose of 9.2 - 10^-8 rem to the maximally exposed individual, 6.1 - 10^-4 person-rem to the offsite population within 80 kilometers (50 miles), and 2.9 - 10^-4 person-rem to the onsite population (DOE 1992d).

Small fires and large fires occur with different frequencies. For small fires, operating experience records from the SRS Beta-Gamma Incinerator were analyzed to determine the occurrence frequency because the occupancy, operation, and design of the Consolidated Incineration Facility are expected to be similar to that of the Beta-Gamma Incinerator. According to analyses in the Consolidated Incineration Facility Fire Risk Assessment (WSRC 1993c), the frequency for a small fire at the Consolidated Incineration Facility is estimated to be 0.33 per year. The Consolidated Incineration Facility Fire Risk Assessment estimates the frequency of large fires at SRS to be 6.05 per 100,000 years per 10,000 square feet of facility, yielding a large fire occurrence frequency of 2.34 per 10,000 years within the entire Consolidated Incineration Facility. The consequences of fires can be monetary losses, injuries and death of personnel from the fire, and radioactive dose. The radiological consequences of fires would result in a calculated dose of up to 2.0 - 10^-5 rem to the maximally exposed individual, 0.12 person-rem to the offsite population within 80 kilometers (50 miles), and 0.058 person-rem to the onsite population (DOE 1992d).

Since the organic waste is transported from the DWPF to the Consolidated Incineration Facility by means of an overhead gravity-drained piping system, DOE expects transportation risks for the proposed action to be negligible.

4.1.16.3 Offsite Incinerator

Use of an existing offsite incinerator to treat the DWPF organic waste would conform to EPA's specified technology for this waste. As with incineration at the Consolidated Incineration Facility, it offers the potential benefits of resource recovery by using DWPF organic waste as a fuel substitute. Impacts associated with construction would be avoided with this option. Operational impacts are expected to be comparable to those potentially incurred by the Consolidated Incineration Facility, although they would depend on the local conditions with respect to facility location, design, and operating characteristics; natural

resource characteristics; socioeconomics; demographics; and other features. Such a facility would be required to obtain and maintain permits and approvals and would be required to operate in accordance with similar limitations and standards as the Consolidated Incineration Facility as described in Section 4.1.16.2. These include a hazardous waste treatment permit with associated performance standards for destruction or removal efficiency (99.99 percent) and treatment of secondary wastes (e.g., ash and scrubber blowdown); air permits and approvals with emission limits for criteria pollutants, air toxics, and radionuclide emissions; wastewater treatment and discharge limits; and safety and health standards.

Shipping the untreated organic waste offsite for treatment and disposal could result in a lower number of occupational injuries and illnesses for SRS workers (although the frequency and severity of occupational injuries and illnesses for SRS as a whole, expressed in incidence rates, might remain unchanged) since only non-SRS workers would be involved in the transportation and eventual treatment and disposal. If treatment and disposal were to occur at another facility, the potential for occupational injuries and illnesses, regardless of their magnitude, would not be eliminated but simply transferred to the other location.

Similarly, potential accident scenarios (leaks, spills, explosions, and fires) for an offsite incinerator are also likely to be comparable to those inherent in operating the Consolidated Incineration Facility. However, the impacts of accidental releases from an offsite incinerator would vary depending on its location (e.g., distance to general public) and the engineering and administrative controls used to mitigate the severity of the release.

The potential risks clearly would be greater than those for the proposed action due to offsite transportation of DWPF-generated organic wastes. For the proposed action, it is assumed that the organic waste would be transported in 19,000-liter (5,000-gallon) tanker trucks from the SRS to an offsite incinerator facility.

The overall risk associated with the transport of organic waste from the SRS to an offsite incinerator involves the consideration of the potential for injuries and fatalities associated with tanker truck highway accidents, and the increase in lifetime risk of cancer in the exposed population from a release of benzene in a highway accident. The frequency of truck transportation accidents depends on such factors as traffic volume, winter driving conditions, highway interchange designs, roadway grades, and posted speed limits. These factors, in turn, depend on a specific transportation route.

EPA statistics of releases and costs associated with truck shipment of hazardous materials provide a perspective for a transportation accident rate estimate for all accidents, whether they cause a release or not, of 8.5 - 10-^7 accidents per kilometer traveled for all road types (EPA 1984). An estimate of 20 percent of truck accidents that release hazardous materials applies to all container types used for shipment. The EPA study found that the expected amount of hazardous material released in a tanker truck accident was lower by one order of magnitude than for any other class of container.

The occurrence of highway injuries and fatalities for truck accidents can be estimated from data reported by the National Highway Safety Administration (DOT 1982). Injuries are reported to occur in 24 percent of truck accidents. Fatalities occur in about 8.6 percent of all single truck accidents. Therefore, the estimated injury- and fatality-causing accident rates are 2.0 - 10^-7 and 7.3 - 10^-8 per kilometer traveled, respectively.

For an organic waste transportation accident, a 19,000-liter (5000-gallon) benzene spill would be expected to form a pool with a 24-meter (80- foot) radius and to totally evaporate within 2 to 7.5 hours after the accident (DOE 1990c) depending on weather conditions. The specific exposure hazards that could result from a tanker truck accident are as follows: toxic inhalation, thermal radiation from fires, blast wave overpressure from explosions, and asphyxiation conditions due to oxygen deficiency.

4.1.16.4 Dedicated Onsite Incinerator

Construction Impacts - As described in Section 2.2.7.2, DOE would locate a dedicated incinerator on previously disturbed industrial land in the H- or S-Areas of the site, possibly at or near the existing Consolidated Incineration Facility site. No more than 1.2 hectares (3 acres) of land would be required (DOE 1992d) for a permanent facility and, due to previous disturbance, appreciable impact to cultural resources or natural biota (i.e., plants and animals) would be unlikely to occur. Installation of a dedicated onsite incinerator to treat the DWPF organic waste presents the potential for minor temporary adverse effects in the form of localized dust, erosion, and sedimentation, and small spills of fuel oil of the same nature as described for other construction projects associated with the proposed action (e.g., new Glass Waste Storage Building). It would be subject to the same control measures.

DOE expects the workforce required to construct a permanent, dedicated onsite incinerator to be considerably smaller than the peak workforce of 225 workers currently estimated to be required to construct and start up the Consolidated Incineration Facility because of the small size of a dedicated incinerator. As noted in Sections 4.1.7 and 4.1.10, increases of this magnitude would have no appreciable effect on local or regional socioeconomics or infrastructure.

As noted, DOE expects only minor impacts to occur from construction of a permanent dedicated onsite incinerator. Impacts would be even less if a prefabricated or portable unit were to be installed instead of a permanent facility.

Operations Impact - As with the other incineration options considered, a dedicated benzene incinerator would conform to EPA's specified technology for this ignitable waste. However, assuming no other waste would be incinerated at the facility, this option does not have the resource recovery benefit of serving as a substitute fuel as is offered by the Consolidated Incineration Facility and potentially offered by treatment at an offsite facility. With few exceptions, the environmental impact of operating a dedicated benzene incinerator is expected to be essentially identical to that attributable to incinerating this waste at the Consolidated Incineration Facility as described in Section 4.1.16.2. As noted in Section 2.2.7.2, a dedicated incinerator would be required to comply with identical requirements for destruction or removal efficiency (99.99 percent), air emissions, and treatment and disposal of secondary wastes (e.g., scrubber blowdown). Related impacts including water use, wastewater treatment and discharge, and potential health effects attributable to benzene treatment would also not be expected to be appreciably different. The anticipated occupational injury/illness experience attributable to incineration of benzene would be expected to be similar in that incineration is involved in either option and the same types of safety-related programs and activities would be implemented in either situation.

DOE expects that the workforce required to operate a permanent, dedicated onsite incinerator would be considerably smaller than the 83-person workforce presently anticipated to be needed to operate the Consolidated Incineration Facility; however, Consolidated Incineration

Facility workforce requirements would not be expected to change appreciably as a result of incineration of DWPF organic waste at the Consolidated Incineration Facility. The workforce would be greater than that attributable to incineration of this waste at the Consolidated Incineration Facility. As noted in Sections 4.1.7 and 4.1.10, increases of this size would not appreciably affect local or regional socioeconomics or infrastructure.

DOE assumes that the potential release scenarios (leaks, spills, explosions, and fires) inherent in operating an onsite dedicated incinerator would be similar to those for the Consolidated Incineration Facility. However, it is assumed that the radiological and nonradiological consequences would be less in a dedicated incinerator facility. This assumption is based on the fact that the source term for the accident would only be the slightly radioactive benzene generated at the DWPF and not a variety of mixed and low-level wastes currently considered for the Consolidated Incineration Facility.

Since the organic waste would be transported from the DWPF to the dedicated incinerator facility by means of a piping system similar to that used to transport this waste to the Consolidated Incineration Facility, the transportation risks for this option would be comparable.

4.1.16.5 Alternatives to Conventional Incineration

Construction Impacts - As with a dedicated incinerator, DOE would locate onsite treatment units near the Vitrification Facility in H- or S-Area on industrial land subject to previous disturbance. Land requirements would be expected to be 1.2 hectares (3 acres) or less. Construction impacts would be essentially the same as those expected to result from construction of a dedicated onsite incinerator. As with the dedicated incineration option, the potential exists to reduce construction impacts below these low levels by installing a prefabricated or portable unit(s).

Operations Impact - Unless the treatment option implemented under this alternative conformed to EPA's definition of a hazardous waste incinerator, it would not comply with EPA's specified technology for treating this ignitable waste, and a variance would have to be sought and obtained from EPA to use this system. Use of a non-incineration option may not offer the advantage of recovering the energy content of the DWPF organic waste by using it as a fuel substitute as is the case with the Consolidated Incineration Facility and, potentially, the offsite incineration option.

DOE expects impacts due to operation of the facility to be comparable to those expected for a dedicated onsite incinerator as discussed in Section 4.1.16.4, but operation could result in less impact to some resources depending on the specific technology chosen. It is assumed for this analysis that air emissions would be comparable to, or possibly less than, those expected for the incineration options. This assumption is reasonable in that destruction or removal of air toxics, including benzene and mercury, would likely be required to be at least as effective as incineration to obtain a treatability variance from EPA, and non-incineration alternatives could reduce or possibly eliminate criteria pollutants (e.g., nitrogen oxides, particulates) that are inherent to the combustion process.

The alternative of treating the DWPF organic waste by a method other than incineration would result in an occupational injury/illness experience that is dependent on the method(s) selected, and could be greater or less than that posed by incineration. DOE would ensure that effective engineering controls, procedures, and equipment would be in place as necessary to ensure that the potential for occupational

injury/illness would be no greater than that posed by onsite incineration options.

Accidents for alternative treatment processes are comparable to those identified for incineration such as leaks, spills, explosions, and fires. However, accident scenarios addressing the risks for these specific alternatives are not further addressed because design details of these alternatives cannot be anticipated. Organic waste would be piped to the treatment unit(s) considered under this option, so transportation risks for these alternative treatment options are assumed to be comparable to the dedicated onsite incineration option.

4.1.17 CUMULATIVE IMPACTS

The SRS and surrounding areas contain major DOE and non-DOE facilities other than the DWPF. The activities associated with the existing SRS facilities produce environmental consequences that are included in the baseline environmental conditions (Chapter 3). Cumulative Impacts presented in this section consider and include, where appropriate, the impacts of existing offsite facilities and reasonably foreseeable onsite facilities and operations as well as those of the proposed action.

Radiological impacts from the operation of Plant Vogtle on the Savannah River across from the SRS and the soon-to-be discontinued commercial low-level waste disposal facility at Barnwell have also been included. Socioeconomic impacts from the construction of Phase I of the Savannah River Research Campus just outside the SRS boundary have also been included.

Additionally, a number of facilities planned or under construction at the SRS are being considered in the NEPA documentation listed below.

- Proposed facilities and actions included in the SRS Waste Management EIS:
    - Operation of Consolidated Incineration Facility
    - Hazardous Waste/Mixed Waste Disposal Vaults
    - Solvent Storage Tanks S33 - S36
    - Replacement High-Level Waste Evaporator
    - M-Area Vitrification (Vendor Demonstration Process)
    - New Waste Transfer Facility
- F-Canyon Plutonium Solutions EIS (DOE 1994f)
- Preliminary information from the Interim Management of Nuclear Materials EIS, currently being prepared
- Draft Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs EIS, Volume I, Appendix C, SRS Spent Nuclear Fuel Management Program (DOE 1994e)

Activities currently being analyzed in the SRS Waste Management EIS will contribute to the cumulative environmental impacts. These analyses have yet to be completed; therefore, only those facilities and activities for which data are available are discussed quantitatively; other facilities and activities are discussed qualitatively. A number of other planned facilities have not been included in the cumulative impacts analysis because decisions on these facilities involve DOE policy issues. For example, this cumulative impact assessment does not consider planning by DOE related to reconfiguring the nation's weapons complex; a Programmatic EIS is scheduled for publication in 1995. The cumulative impact assessment does not present quantitative impacts for the Environmental Restoration and Waste Management Programmatic EIS, the Foreign Research Reactor Spent Nuclear Fuel EIS, or the Storage and

Disposition of Weapons-Usable Fissile Materials EIS.

Taking into account preliminary information available from the Proposed Policy for the Acceptance of United States Origin Foreign Research Reactor Spent Nuclear Fuel EIS, the Urgent-Relief Acceptance of Foreign Research Reactor Spent Nuclear Fuel Environmental Assessment, the F-Canyon Plutonium Solutions EIS, and the Interim Management of Nuclear Materials EIS, the incremental volume of high-level radioactive waste that could result from these activities and might be processed in DWPF is small compared to the 129 million liters (34 million gallons) of high-level radioactive waste currently stored in the tank farms. Therefore, the change in environmental impacts is also expected to be relatively small, consisting primarily of continuing operational impacts and risk in the areas presented below for the additional operating time required. Additional radioactive glass waste canisters would be produced with associated impacts. However, as with existing SRS high-level radioactive waste, vitrification of high-level radioactive waste resulting from decisions made in these EISs would result in lower risk than continued storage. Information regarding the volume of high-level radioactive waste that could be generated by activities discussed in the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components and the Storage and Disposition of Weapons-Usable Fissile Materials EISs is not yet available.

Cumulative impacts have been determined for land use and terrestrial ecology, socioeconomic impacts, air quality, occupational and public health; (including environmental justice), and waste generation. Other contributions by the proposed action to cumulative SRS impacts (e.g., impacts to aquatic biota, traffic impacts, and aesthetic impacts) are minor and are therefore not included.

4.1.17.1 Land Use and Terrestrial Ecology

The land that would be committed to DWPF activities at the SRS lies within existing onsite industrial compounds or undeveloped onsite areas devoted to the continued mission of the Site. Previously undeveloped land that DOE would commit to DWPF would be limited to approximately 40 hectares (100 acres), which would be converted from woodlands to industrial use under the proposed action.

Based on decisions yet to be made in Appendix C of the Spent Nuclear Fuel EIS (DOE 1994e), some previously undeveloped land at SRS could be committed to support new spent nuclear fuel interim storage facilities. Depending on site selection, a maximum of approximately 52 hectares (130 acres) may be converted from woodlands or old fields to industrial facilities and supporting infrastructure. The alternatives analyzed in the Interim Management of Nuclear Materials EIS and the F-Canyon Plutonium Solution EIS would not add substantially to the land use requirements at SRS.

The potential land requirements for new treatment and/or disposal facilities under consideration in the SRS Waste Management EIS are not clearly defined. At a minimum, DOE would complete construction of the Consolidated Incineration Facility and the Replacement High-Level Waste Evaporator in H-Area and begin construction of the Hazardous Waste/Mixed Waste Disposal Vaults in E-Area. These projects would involve use of approximately 1.2 hectares (3 acres) in H-Area and 16 hectares (40 acres) in E-Area. Land use requirements associated with other SRS waste management projects under consideration are unknown at this time but are expected to have minimal additional impacts on land use.

Cumulatively, about 110 hectares (275 acres) of SRS land could be cleared and converted to facilities and infrastructure as a result of DWPF, construction of new spent nuclear fuel facilities, and

construction of waste management facilities. This usage represents approximately 0.15 percent of the undeveloped land on the SRS and would have minimal cumulative impact on long-term land use. The proposed action in this Supplemental EIS accounts for approximately 33 percent of this land use.

Terrestrial ecological resources would also be impacted by these cumulative land use requirements. Small mammals, reptiles, and birds that live on these 110 hectares (275 acres) would be displaced or disturbed by land clearing and associated construction activities; however, the local and regional populations of these animals would not be impacted in the long term. DOE does not expect threatened or endangered species to be impacted because the trees in Z-Area are too young to be used as cavity trees by red-cockaded woodpeckers and because the sites considered for spent nuclear fuel construction activities contain no habitat suitable for any threatened or endangered species found on the SRS (DOE 1994e).

4.1.17.2 Socioeconomics

Minimal cumulative impacts on the socioeconomic resources in the SRS region would occur from the proposed action. DOE expects the greatest change in employment to be from construction activities for which there would be an increase of approximately 270 direct construction jobs. No new operations employment is expected to be associated with the proposed action. The total change in employment is predicted to peak between 1999 and 2000 with approximately 380 additional jobs per year in the six-county region. This change would represent a temporary increase of less than two tenths of one percent from the baseline regional employment forecast.

Depending on management alternatives and sites selected, spent nuclear fuel activities at the SRS could require a maximum of approximately 2,700 construction workers. Operations employment is not expected to increase as a result of spent nuclear fuel activity.

Construction of the Consolidated Incineration Facility requires a peak workforce of approximately 225 employees, mostly existing SRS workers (DOE 1992d). Construction of the Replacement High-Level Waste Evaporator could require a peak workforce of approximately 70 employees (WSRC 1994c). DOE does not expect additional employment to be associated with the operation of either of these facilities. Workforce requirements associated with other SRS Waste Management EIS projects under consideration are unknown at this time but are expected to have minimal additional impacts on socioeconomic resources in the region.

The construction of Phase I of the Savannah River Research Campus being constructed just outside the site boundary could require approximately 150 workers. Once completed in early 1995, the Campus could also employ an estimated 200 people (Saccone 1994). These additional jobs would have a minimal impact on socioeconomic resources in the region.

DOE believes that no new construction or operations jobs would be created by the implementation of any of the plutonium solution stabilization alternatives described in the F- Canyon Plutonium Solutions EIS. The processing to plutonium oxide alternative would require the construction of a new facility (or expansion of an existing facility) to convert low-fired plutonium oxide into high-fired (completely oxidized) plutonium oxide and to package the oxide in an inert atmosphere. The development of this facility could require as many as 150 construction workers in a given year. All construction and operations jobs probably would be filled through the reassignment of existing SRS workers (e.g., transfer from the FB-Line to the new oxide

processing facilities). Therefore, DOE does not anticipate measurable impacts to regional socioeconomic resources from changes in SRS employment levels.

DOE believes that it could fill the jobs associated with the implementation of any of the alternatives being analyzed in the Interim Management of Nuclear Materials EIS through the reassignment of workers. Thus, DOE anticipates no measurable impacts to socioeconomic resources from increases in operations employment. Similarly, DOE believes that current SRS workers could fill construction jobs necessitated by the implementation of any of the alternatives analyzed in the Interim Management of Nuclear Materials EIS, thereby having no measurable impact on regional socioeconomic resources.

The maximum potential change in employment associated with construction and operation of DWPF facilities, new waste management facilities, new spent nuclear fuel facilities, and the Savannah River Research Campus in the year 2002 would be a maximum increase of approximately 2,960 direct construction or operations jobs. This 1.1 percent increase in baseline regional employment would have only a temporary, minor impact on the region of influence. The proposed action would account for approximately 2 percent of these additional jobs.

4.1.17.3 Air Quality

Table 4.1-16 compares the cumulative concentrations of nonradioactive air pollutants from the SRS, including those from the proposed action, to Federal and state regulatory standards. The values provided are the maximum modeled concentrations that would occur at ground level on or beyond the Site boundary. In most cases, the maximum concentrations are at different locations for different pollutants. The data demonstrate that, even with emissions from different DWPF activities, releases of toxic air pollutants from the SRS would be below regulatory standards.

Based on results from atmospheric models, which tend to overestimate pollutant concentrations, some criteria air pollutants could approach regulatory standards. Site sulfur dioxide concentrations would reach over 80 percent of both the 3-hour and 24-hour limits under all alternatives. In addition, the concentrations of particulates less than 10 microns would approach 62 percent of the 24-hour standard. However, DWPF activities alone would have a minor impact on existing maximum modeled concentrations at the Site boundary.

DOE evaluated the cumulative impacts of airborne radioactive releases in terms of cumulative dose to a maximally exposed individual at the Site boundary. DOE has included the impacts of the two-unit Vogtle Electric Generating Plant [approximately 16 kilometers (10 miles) southwest of the center of the SRS near Waynesboro, Georgia] in this cumulative total. The radiological emissions from operation of the Chem-Nuclear low-level waste disposal facility adjacent to the SRS in Barnwell, South Carolina, are very low, and are not included. Table 4.1-17 lists the results of this analysis, assuming 1992 emissions as the baseline. The highest cumulative dose under the proposed action would be 1.8 millirem per year, well below the regulatory limit (40 CFR Part 61 Subpart H) of 10 millirem per year. The locations of the maximally exposed individual for the different facilities are not the same. Therefore, this value would overstate the cumulative impact.

Table 4.1-16. Cumulative maximum ground-level concentrations of criteria and toxic air pollutants at the SRS boundary (micrograms per cubic meter).^a

Total

Criteria Pollutants	Averaging time	cumulative concentration^b	Air quality standard^c	Per sta
Nitrogen oxides	Annual	34	100	33
Sulfur dioxides	3-hour	1,200^d	1,300^e	96
	24-hour	300^d	365^e	82
	Annual	22	80	28
Particulate matter (y 10 microns)	24-hour	93	150	62
	Annual	10	50	19
Total suspended particulates	Annual	19	75	25
Lead (quarterly)	Annual	0.02	1.5	1
Carbon monoxide	1-hour	3,600	40,000	9
	8-hour	820	10,000	8
Toxic Pollutants				
Benzene	Annual	0.2	NA^f	NA
	24-hour	32	150	21
Mercury	24-hour	0.004	0.25	2
Formic Acid	24-hour	2.5	225	1

a. Sources: Hunter and Stewart (1994a,b).
b. All SRS sources including DWPF, Percent of standard, Spent Nuclear Fuel Management alternatives, F-Canyon Plutonium Solutions alternatives, and Interim Management of Nuclear Materials alternatives.
c. SCDHEC (1976b).
d. The value listed is the second high maximum value.
e. Concentration may be exceeded once per year.
f. NA = Not applicable.

Airborne emissions at Plant Vogtle were reported to have delivered a maximally exposed individual total body dose of 0.0011 millirem during 1992 (Sundaram 1994). Since the SRS and Plant Vogtle share nearly the same 80-kilometer (50-mile) population, the ratio of SRS population and maximally exposed individual doses was used as an estimator of the population dose from Plant Vogtle emissions. Using this approach, the population dose attributable to Plant Vogtle was estimated to have been about 0.083 person-rem in 1992. Adding the population dose from Plant Vogtle, the total collective offsite population dose from all SRS activities in 1992, the projected population dose from the proposed action, and the highest projected population dose from alternatives considered in Appendix C of the Spent Nuclear Fuel EIS (DOE 1994e), the F- Canyon Plutonium Solutions EIS (DOE 1994f), and preliminary information for the SRS Interim Management of Nuclear Materials EIS yields a total cumulative dose of 69.1 person-rem, of which the proposed action accounts for less than 1 percent.

Table 4.1-17. Annual cumulative radiological health effects to offsite population and facility workers.

	Offsite population
	Total collective

	Maximally exposed individual		(to 80-kilometer pop	
Activity	Dose^a	Fatal cancer^b	Dose^c	Fatal ca
Proposed action	1.00E-06	5.0E-10	0.07	3.5E
Current SRS practices	2.5E-04	1.3E-07	7.6	3.8E
Plant Vogtle	1.10E-06	5.5E-10	0.083	4.2E
SRS spent nuclear fuel^f	4.70E-04	2.4E-07	16	8.0E
F-Canyon plutonium solutions^g	8.90E-06	4.3E-09	0.39	1.9E
Interim management of nuclear materials^h	1.10E-03	5.5E-07	45	2.3E
Total:	1.83E-03	9.2E-07	69.1	3.5E

a. Dose in rem.
b. Probability of fatal cancer.
c. Dose in person-rem.
d. Incidence of excess fatal cancers.
e. NA = Not applicable.
f. Highest values from DOE (1994e).
g. Highest values from DOE (1994f).
h. Highest values from preliminary information

Environmental restoration, decontamination and decommissioning, and waste management activities and facilities to be assessed in the SRS Waste Management EIS will also add as yet undetermined increments to airborne emissions of radioactive and nonradioactive materials.

4.1.17.4 Occupational and Public Health

Table 4.1.17 summarizes the cumulative health effects of routine SRS operations, including those projected for DWPF radioactive releases. It also lists potential cancer fatalities for the public and workers due to exposure to radiation. The table provides the (airborne) annual radiological dose to the hypothetical maximally exposed individual in the offsite population. This cumulative impact results in a total of 0.03 additional cancer fatality per year to the 80-kilometer (50-mile) population from releases of radioactivity, of which the proposed action accounts for less than 1 percent. This cumulative impact is 0.39 additional fatal cancer per year to onsite workers, of which the proposed action accounts for approximately 12 percent. The cumulative lifetime fatal cancer risk; to the maximally exposed offsite individual from the cumulative site boundary benzene concentration listed in Table 4.1-16 is 5.5 in 10 million. The proposed action accounts for approximately 22 percent of this offsite risk. DOE does not expect adverse public health effects from cumulative releases of the non-carcinogenic toxic pollutants listed in Table 4.1-16 (mercury and formic acid) because these releases result in site boundary concentrations less than 2 percent of the state standard.

The environmental dispersion characteristics of the cumulative atmospheric releases of radionuclides and benzene are approximately the same as those of the proposed action. Therefore, the distribution of estimated adverse health effects among socioeconomic groups would be the same as that shown in Section 4.1.11.1, and no disproportionately high cumulative health impacts would be experienced by minority or low-income populations.

Environmental restoration, decontamination and decommissioning, and waste management activities and facilities to be assessed in the SRS Waste Management EIS will also add as yet undetermined increases to occupational and public health effects.

4.1.17.5 Waste Generation

Table 4.1-18 presents cumulative volumes of low-level radioactive, hazardous, mixed, and sanitary waste generated by SRS. These values include the proposed action, the contribution from other Site activities, and values from the bounding case in Appendix C of the Spent Nuclear Fuel Management EIS (DOE 1994e), the F- Canyon Plutonium Solutions EIS (DOE 1994f), and preliminary information for the Interim Management of Nuclear Materials EIS. The existing site and proposed action values are based on the SRS 30-year waste forecast (WSRC 1994i) and estimates of failed melters and other highly radioactive solid waste generated by DWPF. The 30-year waste forecast assumes the following facility startup/shutdown schedule:

	Activity	Fiscal Year
-	ITP startup	1995
-	DWPF Vitrification Facility startup	1996
-	772-D Laboratory shutdown	1998
-	Reactors/D-Area shutdown	1998
-	Reactor Materials shutdown	1998
-	Receiving Basin for Offsite Fuels/Resin Regeneration Facility shutdown	2005
-	HB-Line shutdown	2003
-	Consolidated Incineration Facility startup	1996
-	H-Canyon shutdown	2005
-	F-Canyon shutdown	2003
-	235-F Plutonium Fabrication Facility and Thoria Line shutdown	2013
-	221-FB-Line shutdown	2003
-	TNX shutdown	1999

Environmental restoration and decontamination and decommissioning activities, which are expected to become an increasingly important part of the DOE mission at SRS in the future, have not been factored into this analysis. These activities are expected to produce large quantities of low-level radioactive, hazardous, and mixed waste and will undergo appropriate NEPA evaluation.

Table 4.1-18. Cumulative SRS waste generation from 1995 to 2018, by type, including DWPF but excluding environmental restoration and decontamination and decommissioning contributions.^a

	Volume generated (cubic meters)	
Waste type	Cumulative total	Proposed Action

Low-Level	556,000	52,100
Hazardous	26,700	48
Mixed	36,000^b	4,200
Sanitary	678,000	73,500

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a. These totals do not include failed melters and other highly radioactive failed equipment to be stored in the Failed Equipment Storage Vaults or waste from Late Wash (e.g., spent microfilters).
b. Preliminary information for the SRS interim management of nuclear materials EIS includes "Hazardous/Mixed" waste values. For this cumulative impact analysis, these values are included in the mixed waste total.

4.1.18 MITIGATION MEASURES

In the draft Supplemental EIS, DOE identified "Safety-Related Modifications to the Vitrification Facility" as a potential mitigation measure. Since publication of the draft Supplemental EIS, DOE has further considered these potential modifications, and has committed to evaluate the proposed modifications and implement those modifications necessary to reduce risk to below levels DOE considers acceptable before the facility is operated with radioactive waste. For this reason, these modifications have been incorporated into the proposed action, and are described in Section 2.2.9.

4.2 The No-Action Alternative

4.2.1 INTRODUCTION

This section describes potential environmental consequences expected to result from adopting the no-action alternative. Under this alternative, the Vitrification Facility, the In-Tank Precipitation Facility (ITP), and Extended Sludge Processing, although already built, would not operate. The Vitrification Facility and the ITP building would be shut down, and high-level waste tanks used for ITP and Extended Sludge Processing would return to service as part of normal tank farm operations. Saltstone Manufacturing and Disposal would continue to operate to treat and dispose of waste concentrate from the F- and H-Area Effluent Treatment Facility. High-level waste would continue to be stored in the high-level waste tanks for an indefinite period.

4.2.2 GEOLOGIC RESOURCES

Because DOE expects no new construction for this alternative other than two additional Saltstone Disposal Vaults to dispose of waste from the F- and H-Area Effluent Treatment Facility, the potential for impacts to geologic resources would be minor. For the no-action alternative, construction of new vaults for saltstone storage in Z-Area would occur at a much slower rate (one vault every 13 years for a total of two additional vaults) than the proposed action, so the impacts to the soils would be less and would be extended over a longer period of time. As discussed in Section 4.1.2, provisions to mitigate fuel and process chemical spills that may occur are in place, including the SRS Spill Prevention, Control, and Countermeasures Plan (WSRC 1991f), and the SRS Best Management Practices Plan (WSRC 1991g).

DOE would continue to store high-level waste in the high-level waste tanks, including older tanks (Types I, II, and IV), and the potential for release of waste to soils in the area from spills and leaks would continue. As noted in Appendix A, Tank 16 and a transfer line to Tank 37 in the H-Area tank farm

have leaked in the past and contaminated the soil in the vicinity of the tanks.

4.2.3 WATER RESOURCES

4.2.3.1 Groundwater

As noted in Section 2.3, under the no-action alternative it is assumed that at least two additional vaults would be constructed in Z-Area. Potential impacts to groundwater during the construction of these additional vaults are expected to be minimal and similar to impacts discussed under the proposed action. As noted in Section 4.2.2, DOE would use mitigative and protective measures to minimize the potential for introduction of undesired substances into soils and consequently groundwater at all construction sites.

During the operations phase of this alternative, leaks due to cracks in the walls of old tanks or transfer lines could occur. Such incidents (cracks and resultant leaks) did occur in the H-Area Tank 16 and at the Tank 37 concentrate transfer system as identified in Table A-4 of Appendix A. It is assumed that any future leaks would be similar to those that occurred in Tank 16 and would pose potential threats to groundwater resources. The SRS is obligated under the Comprehensive Environmental Response, Compensation, and Liability Act and the Federal Facility Agreement (EPA 1993a) to identify, evaluate, and if necessary, remediate all releases of hazardous substances, including releases of radionuclides. Drinking water standards have not been exceeded to date as a result of tank farm operations. However, under the no-action alternative, the potential for releases of high-level waste to the environment would continue indefinitely.

Under the no-action alternative, four Saltstone Disposal Vaults would be built; two of these vaults are already in place and receive saltstone. The potential impacts to groundwater from the use of these 4 vaults would be less than the impacts of the proposed action because that alternative would require 15 vaults. Under the proposed action, the peak concentration of nitrate is predicted to be 5.2 and 36 milligrams per liter at the compliance point for an intact and degraded facility, respectively. It is estimated that the peak concentration of nitrate in groundwater due to the operation of four vaults would be less than these predicted values for the proposed action.

Under the no-action alternative, ITP and Extended Sludge Processing would be discontinued and the tanks used in these processes would revert to the storage of high-level radioactive liquid wastes.

4.2.3.2 Surface Water

The no-action alternative would not change the discharges to currently permitted National Pollutant Discharge Elimination System outfalls in the F- and H-Areas or the surface water conditions discussed in Chapter 3. Since the DWPF would not be in operation, there would be no discharge from the S-Area Chemical Waste Treatment Plant. Effluent from the sanitary wastewater treatment plant would be reduced or eliminated, although DOE plans to replace this facility by a centralized sewage treatment facility. Thus, surface water quality from the existing conditions stated in Chapter 3 would be expected to be the same or slightly improved with the no-action alternative.

As indicated in Section 4.1.3.2, DOE would be required to control stormwater runoff from the construction of the additional Saltstone Disposal Vaults under a stormwater management and sedimentation control plan that complies with the requirements of SCDHEC and the South Carolina Land Resources Conservation Commission permits. After the vaults were built, a stormwater management plan would be used to comply with the SCDHEC general stormwater permit SCR000000.

4.2.4 AIR RESOURCES

Potential impacts to air quality from construction activities under the no-action alternative would include dust from clearing approximately 8 hectares (20 acres) of land for the two additional vaults in Z-Area, as well as exhaust emissions from construction equipment. The amount of dust produced would be proportional to the land area disturbed for the new facilities, all of which would be located near the center of the SRS. Estimated air quality impacts were determined using the same method described in Section 4.1.4.1, and results are indicated in Table 4.2-1. The SRS sitewide compliance with state and Federal ambient air quality standards would not be affected.

Table 4.2-1. Estimated maximum incremental increase of particulates at the SRS boundary from construction activities (micrograms per cubic meter).^a

Pollutant	Averaging time	SCDHEC standard	No-action alternative
Total suspended particulates	Annual	75	<0.01
Particulate matter (<=10 microns)	24-hour	150	0.8
	Annual	50	<0.01

a. Based on Hunter and Stewart (1994a).
b. SCDHEC (1976b).

Operation under the no-action alternative would not release additional nonradiological emissions beyond those described in Section 3.4 because no new facilities would operate. Therefore, the no-action alternative would not produce additional impacts on the existing air quality at the SRS beyond those described in Section 3.4. Under the no-action alternative, the existing radiological doses from the SRS would not change from those described in Section 3.11.1.1.

4.2.5 ECOLOGICAL RESOURCES

4.2.5.1 Terrestrial Resources

No additional land or clearing would be required for the additional Saltstone Disposal Vaults that would be used to dispose of F- and H-Area Effluent Treatment Facility waste. One vault would be required about every 13 years. Construction would have minimal impacts to animal populations in the vicinity of the Saltstone Disposal Vaults.

4.2.5.2 Wetland Resources

The no-action alternative would not adversely impact wetland systems because no wetlands are associated with F-, H-, S- or Z-Areas (Schalles et al. 1989).

4.2.5.3 Aquatic Resources

The no-action alternative would not adversely impact aquatic systems. Construction of the additional Saltstone Disposal Vaults would require adhering to sediment and erosion control plans to minimize discharge of sediments to Upper Three Runs or associated tributaries.

4.2.5.4 Threatened and Endangered Species

The no-action alternative would not adversely impact threatened or endangered species or their habitats. Enough land has been cleared to support two vaults required for the no-action alternative.

4.2.5.5 Radioecology

The no-action alternative would not change the existing radioecological conditions on the SRS because the quantity of radioactivity released to the environment would not change from the amount described in Chapter 3.

4.2.6 LAND USE

Under the no-action alternative, the additional vaults required for saltstone disposal in Z-Area would require less land than the proposed action; they would not impact land use because the area is already dedicated to industrial use. All activities would be consistent with the guidelines for land use plans contained in DOE Order 4320.1B, "Site Development Planning" (DOE 1992c).

4.2.7 SOCIOECONOMICS

Under the no-action alternative, DWPF and its associated support facilities would not be completed and would not operate. Thus, some negative impacts would occur from the displacement of workers currently employed at DWPF to perform pre-operational activities. The Economic and Demographic Forecasting and Simulation Model for the six-county region of influence was used to assess the construction and operation impacts on regional employment, population, and income from implementation of this alternative.

The greatest change in employment would occur in 1999 with a decrease of approximately 1,790 jobs in the region of influence. This change would represent a decline of less than one percent in the affected baseline regional employment forecast and would have only a minimal impact (HNUS 1994).

Because migration into and out of the region would lag behind the initial change in population, the maximum potential change in population would occur during the period from 2009 to 2011 with a loss of approximately 3,080 people per year (HNUS 1994). Given a maximum decrease of less than one percent from the baseline regional population forecast, DOE expects the potential impact on community resources and services such as housing, schools, police, health care, and fire protection to be negligible.

Potential changes in total personal income would be related to changes in employment and would peak in the year 2018 with a $248 million decrease from forecast income levels for that year (HNUS 1994). Because this would be a less than one percent decline, implementation of this alternative would have only a minimal impact on regional income.

4.2.8 CULTURAL RESOURCES

Construction of additional disposal vaults in Z-Area would not impact cultural resources because the area that would be disturbed has been previously surveyed and no important cultural resources were discovered (Sassaman 1990; Brooks, Hanson, and Brooks 1986).

4.2.9 AESTHETICS AND SCENIC RESOURCES

Construction of additional disposal vaults would not impact aesthetic and scenic resources because additional vaults would be within Z-Area next to existing vaults of similar appearance. None of the vaults would be visible off the Site or from public access roads on the Site. Although construction activities would produce dust that could temporarily affect visibility in the area, DOE would follow standard construction practices to minimize dust generation and erosion. Facility operations under the no-action alternative would not produce emissions to the atmosphere that would be visible or would indirectly reduce visibility.

4.2.10 TRAFFIC AND TRANSPORTATION

Under the no-action alternative, DWPF and its associated facilities would not operate. Consequently, chemical or construction material usage would not change appreciably from current conditions. The number of shipments associated with this alternative would be essentially zero except for those associated with shutdown operations (e.g., deinventory) from the transportation of these materials.

The impact of the no-action alternative would generally show a decrease in DWPF employment and corresponding decreased traffic flow in S-Area. Therefore, a small positive impact is expected for the no-action alternative.

4.2.11 OCCUPATIONAL AND PUBLIC HEALTH

4.2.11.1 Public Health

Under the no-action alternative, it is assumed that the level of radiation exposure to members of the public would remain as currently experienced and described in Section 3.11.1.2. Radiation exposure from high-level waste management activities at the tank farms, and the consequent adverse radiological public health effects associated with that exposure, are assumed to continue indefinitely. Because the no-action alternative would not involve emissions of benzene after the Organic Waste Storage Tank; has been emptied, the adverse public health consequences from DWPF benzene emissions would be eliminated.

4.2.11.2 Worker Radiological Health

For SRS workers, the radiological risk associated with the no-action alternative, under which DOE would continue to store high-level waste in tanks, is assumed to remain at levels described in Section 3.11.2.4 for an indefinite period.

4.2.11.3 Worker Nonradiological Safety and Health

Implementation of the no-action alternative would result in a lower number of worker injuries and illnesses each year for the SRS because DWPF would not be operating; the projected DWPF employment would decrease by about 930 people and thus the overall number of SRS injuries and illnesses would decrease.

The no-action alternative would use currently employed tank farm workers, who would continue to manage the storage of the waste in its present location. Workers in such waste management facilities encounter industrial hazards such as electrical energy and steam, and experience injuries such as falls, bruises, and lacerations. In 1988, based on data from the 200-Area Fault Tree

Data Bank and Safety Department records, the frequency of worker injuries in waste management facilities was reported to be 7.5 per year for the period of October 1974 through March 1987 (Du Pont 1988). All of the injuries were first aid or medical treatment cases; no lost workday cases were reported during the period.

4.2.12 ACCIDENT ANALYSIS

4.2.12.1 Radiological Accident Analysis Results

A screening and analysis of accidents at the tank farms in the different frequency ranges was performed using the same methodology described in Sections 4.1.12.1 and B.3.2 of Appendix B. Accidents selected for analysis are briefly described in this section. Additional information is provided in Section B.5 of Appendix B. In the anticipated accident frequency range, the accident that poses both the highest consequence and highest risk is a fire in a waste tank HEPA filter that releases radioactive materials to the atmosphere. In the unlikely accidents frequency range, the accidents that are bounding are an earthquake in H-Area (producing the highest consequence) and an organic fire in an H-Area waste tank (producing the highest risk). Two accidents are chosen from this frequency range because the highest consequence accident is not the highest risk. In the extremely unlikely accidents frequency range, the accident that poses the highest consequence and risk is a hydrogen explosion in an H-Area pump tank. Hydrogen is formed in the waste receiver tanks when radiation causes the water in the liquid waste solution to disassociate, forming hydrogen and oxygen. The potential for fire is controlled by maintaining a flow of air through the waste tank gas spaces to remove these gases. If the ventilation system for a tank failed and a source of ignition was present, a hydrogen explosion could occur.

Table 4.2-2 summarizes the results from Appendix B of the bounding radiological accidents for the no-action alternative for the maximally exposed offsite individual, the collocated worker at 100 meters (328 feet), and the offsite population. As indicated in Table 4.2-2, doses to the collocated worker and to the maximally exposed offsite individual would be well below the respective dose standards for normal operations.

As described in Section 4.1.12.2, the difficulty in quantitatively assessing the dose to close-in workers (i.e., workers within the facility) hinders a quantitative evaluation; therefore, a qualitative evaluation has been made on the radiological impact to close-in workers from the selected accident scenarios:

- Fire in a Waste Tank Filter

  A waste tank purge exhaust ventilation HEPA filter fire could be caused by combustible particles that have been deposited on the filter if an ignition source such as welding in the vicinity of the filter or an electrical short on the exhaust blower is present. This fire could cause the entire filter for a tank to be destroyed and the material that was deposited on the filter to become airborne. The filter is located outside of the waste tank. It is conservatively assumed that the filter contains 3 curies of radioactivity from 1-year-aged supernatant. Liquids would not be released to the environment. It is estimated that the filter fire would result in an airborne release of less than a gallon of supernatant. Area radiation monitors would immediately detect an initial release of radioactive material and, since no operator action is assumed to mitigate this event, all workers would be evacuated immediately. This action would be taken to ensure that worker dose would be minimized (Hall 1994; Satterfield 1994).

- Organic Fire in a Waste Tank

This accident assumes that, although no breach of the tank walls or top occurs, excessive heat would defeat the ventilation exhaust filter, allowing airborne releases to the environment through the ventilation exhaust. The fire would not cause a liquid release. Two separate mechanisms would contribute airborne particles generated as a result of the organic fire. The first would involve the production of respirable particles due to the vaporization of supernatant in the tank by the heat of combustion. This mechanism would contribute 0.2 liter (0.05 gallon) of respirable particles. The second mechanism would involve burning organic material. This mechanism would contribute 0.2 liter (0.05 gallon) of respirable particles and result in a total airborne release of 0.42 liter (0.11 gallon) of supernatant to the environment. Area radiation monitors would immediately detect an initial release of radioactive material and workers would be evacuated immediately (Hall 1994; Satterfield 1994).

Table 4.2-2. Bounding radiological accidents for the no-action alternative.^a

		Dose (rem)		Dose (person-rem)	
Frequency range	Occurrences per year	MEI	Collocated worker	Offsite population	M
Anticipated accidents highest risk and highest consequences	0.025	0.004	0.56	22	4
Unlikely accidents highest risk and	0.005	0.001	0.21	6.4	3
highest consequences	0.0002	0.003	0.51	10	3
Extremely unlikely accidents highest risk and highest consequences	2.0x10E-5	0.01	1.7	62	1

a. Sources: WSRC (1994b), Bignell (1994d), and Mangiante (1994).
NOTE: The DOE limits for radiation dose from normal operations are 100 mrem/year fo public and 5 rem/year for workers.

- Earthquake

Damage to the facility from an earthquake is based on two effects: soil liquefaction and pipe breaks. It is assumed that Tanks 21-24 would become partially uncovered due to soil liquefaction (the loss of structural integrity of saturated soils under building foundations as a consequence of earthquake vibrations) and the uncovered lines would rupture, allowing waste to leak into the ground. Workers in the immediate vicinity of this spill would be evacuated. Response procedures require radiation monitoring by health protection personnel prior to reentry to the area by emergency response personnel. Reentry would be allowed only under controlled conditions to limit worker exposure during cleanup activities (Hall 1994; Satterfield 1994).

- Hydrogen Explosion at a Pump Tank

Assuming the pump tank is filled with recently generated canyon wastes to its normal operating level (65 percent) when the explosion occurs and

assuming the pump tank and tank cell are breached, the tank contents would be released to the environment with less than a gallon becoming airborne. Area radiation monitors would immediately detect an initial release of radioactive material and workers would be evacuated (Hall 1994; Satterfield 1994).

The synergistic effects and secondary impacts of these accidents would be similar to those described in Section 4.1.12.2.

4.2.12.2 Summary of Chemical Hazards for the No-Action Alternative

The qualitative discussion of chemical processes and hazards in the Liquid Waste Handling Facilities Safety Analysis Report (Du Pont 1988) provided the technical basis for addressing chemical hazards at waste tank farm facilities posed by the no-action alternative.

The waste tank farms use bulk quantities of chemicals to control corrosion and to assist in decontamination processes related to the continued storage of liquid radioactive waste in the existing tank farm facilities. Additionally, several chemicals are present in the radioactive waste streams received from the separations facilities. The hazards associated with various chemical accidents include toxicity, chemical burns, asphyxiation, corrosion, and flammability.

Released hazardous chemicals create the potential for the concentration of vapors (or fumes from leaked chemicals that could cause a chemical reaction) in the immediate area of a release. However, the waste tank farm safety analysis report (Du Pont 1988) addressed chemical hazards in a purely qualitative manner without discussing potential chemical accident scenarios. For the purposes of this Supplemental EIS, hypothetical bounding hazardous chemical release scenarios were assessed in order to provide the decisionmaker a quantified frame of reference when comparing alternatives. These scenarios included releases of nitric, hydrochloric, and sulfuric acid; phosphorus pentoxide; and ammonia within the buildings in which they are used.

Appendix B, Section B.6.2, provides a detailed discussion that addresses all the hypothetical chemical accident scenarios analyzed for the no-action alternative and the associated assumptions, methodology, and models used. The analysis results presented in Table 4.2-3 show that only the nitric acid release scenario was calculated to have appreciable adverse effect for the collocated worker at 100 meters (328 feet). This release scenario exceeds the ERPG-3 value (by an order of magnitude), which could result in the unacceptable likelihood that a person would experience or develop life-threatening health effects if exposed for a period of time greater than one hour. Severe injury or death to workers could be considered as a likely outcome for this accident. The SRS Emergency Plan (WSRC 1993f) is designed to respond to and mitigate the potential consequences of such an accident.

Additionally, the closer the exposed individual is to an accident location, the higher the release concentrations in the air. Thus, the maximum concentrations that close-in (i.e., workers within the facilities) workers could encounter could greatly exceed the ERPG-3 values. While perhaps not instantly lethal, even short exposures are extremely dangerous.

Table 4.2-3. Chemical accident for the no-action alternative that exceeds ERPG-2 or ERPG-3 values.

		Airborne concentrations		
Accident	Max. daily amount (kilograms)^a	At 100 meters^b (mg/m^3)^c	At Site boundary (mg/m^3)	ER (m

Hypothetical nitric acid release from waste tank farms (Building 241-61H)	42,600	830	2.0	5.

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a. To convert kilograms to pounds, multiply by 2.2.
b. To convert to feet, multiply by 3.3.
c. mg/m^3 = milligrams per cubic meter.
d. ERPG - Emergency Response Planning Guidelines.

The synergistic effects of these chemical accidents would be similar to those described in Section 4.1.12.3.

4.2.12.3 Summary Risk Trend Perspective

Figure 4.2-1 presents a conceptual risk profile over time for the no-action alternative. For this alternative, the only contribution is continuing risk from accidents and normal operations at tank farm facilities.

Figure 4.2-1.
Figure 4.2-1. Qualitative representation of annual risk over time for the no-action alternative.

4.2.13 WASTE GENERATION

This section discusses the impacts on the waste management system at SRS as a result of the no-action alternative. The waste generation that would result from the no-action alternative is discussed in Chapter 2. The wastes generated by use of ITP and Extended Sludge Processing tanks after they have reverted to use in normal tank farm operations and by Saltstone Manufacturing and Disposal to process and dispose of F-and H-Area Effluent Treatment Facility residuals are assumed to continue at approximately current generation rates. Wastes attributable to the Vitrification Facility and its supporting facilities would decrease to a level associated with maintenance and security operations.

The SRS waste management system has been sized and designed to accommodate the estimated waste streams resulting from the proposed action (WSRC 1993d). The no-action alternative would reduce the need for this capacity.

The continued operation of Saltstone Manufacturing and Disposal and continued storage of the high-level waste in the F- and H-Area Tank Farms would result in the generation of low-level radioactive hazardous, mixed, and sanitary wastes. In addition, the construction of two more vaults at Saltstone Manufacturing and Disposal would generate construction debris. Table 4.2-4 presents the approximate waste generation by waste type for the no-action alternative and the percentage decrease of impact on the SRS waste management facilities as compared to the proposed action. The impacts associated with the management of these waste types would decrease from those discussed in Section 4.1.13.

Table 4.2-4. Waste generation impact for the no-action alternative.^a

Waste type	Decrease in total generation from proposed action forecast (percent)
Low-level	55
DWPF organic	100

Mixed	93
Hazardous	38
Sanitary	85
Construction debris	86

a. Adapted from: Bignell (1994c), Cauthen (1994c), Dawsey (1994), Hagenbarth (1994), Reeves (1994), WSRC (1994i).

4.2.14 DECONTAMINATION AND DECOMMISSIONING

Decontamination and Decommissioning considerations for the no-action alternative would be essentially the same as described in Section 3.13. However, the high-level waste tank farm could not be decontaminated and decommissioned until an acceptable alternative method is found for removal and disposal of the high-level waste contained in these tanks.

4.2.15 UNAVOIDABLE ADVERSE IMPACTS AND IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

This section describes adverse impacts for the no-action alternative that could not be avoided. It also describes the irreversible and irretrievable commitment of resources that would be associated with the no-action alternative.

4.2.15.1 Unavoidable Adverse Impacts

The unavoidable adverse impacts of the no-action alternative include adverse impacts of continued storage of accumulated liquid high-level waste in the existing tanks and the displacement of the workers currently employed in pre-operational aspects of the DWPF. The continued operation of Saltstone Manufacturing and Disposal would also cause unavoidable adverse impacts in treating and disposing of the waste concentrate from the F- and H-Area Effluent Treatment Facility, but the impacts of the saltstone operation would be smaller than those under the proposed action.

Construction of two additional vaults in Z-Area would generate dust during earth moving and land clearing that would be unavoidable. One vault would be constructed every 13 years, each requiring approximately 4 additional hectares (10 acres) of land to be committed to waste management usage.

Because the DWPF and associated facilities would not operate, some negative impacts would occur from the displacement of the operations workforce currently employed at the DWPF. The greatest change in employment would occur in 1995 when operations end and would result in a decrease of approximately 520 jobs in the six-county region of influence.

Radiation exposure and resulting adverse health effects to members of the SRS workforce assigned to the tank farms and to members of the public would continue indefinitely as a result of the no-action alternative.

The continued operation of Saltstone Manufacturing and Disposal and continued storage of high-level waste in the F- and H-Area Tank Farms would result in the generation of low-level waste, hazardous waste, mixed waste, and sanitary waste. The total volume of waste generated would represent a small percentage of the total waste volume generated at the SRS.

4.2.15.2 Irreversible and Irretrievable Commitment of Resources

Under the no-action alternative, approximately 8 hectares (20 acres) of land, natural resources, and associated natural resource services would be committed to waste management usage for an indefinite period of time as a result of disposing of low-level radioactive waste; from the F- and H-Area Effluent Treatment Facility in the Saltstone Disposal Vaults. Additionally, some activities associated with the no-action alternative would consume energy, raw materials, and other natural and manmade resources. Other resources that would be irretrievably committed under the no-action alternative include materials that could not be recovered or recycled and materials that would be consumed or reduced to irrecoverable forms.

4.2.16 CUMULATIVE IMPACTS AND MITIGATION MEASURES

Cumulative Impacts - DOE anticipates that cumulative impacts under the no-action alternative would be smaller than those described for the proposed action (Section 4.1.17) during the period that DWPF would operate. The reason the impacts would be smaller is that construction and operational impacts due to the proposed action would not occur. The extent to which these impacts would be smaller is essentially the incremental difference in impacts described for the proposed action in Section 4.1 and impacts described for the no-action alternative in Section 4.2. However, under the no-action alternative, risks to human health and the environment from managing high-level waste at the tank farms would continue indefinitely.

Mitigation Measures - Measures to mitigate adverse environmental consequences of the no-action alternative (e.g., secondary containment systems, tank cooling systems) are an integral part of the F- and H-Area Tank Farm design and operation. No additional mitigation measures beyond those described in Section 2.3 have been identified.

4.3 Ion Exchange as an In-Tank Precipitation (ITP) Pre-Treat

4.3.1 INTRODUCTION

This section describes the environmental consequences that are expected to result from using the ion exchange process either as a phased replacement or an immediate replacement instead of ITP. Under phased replacement, ITP would operate for approximately 14 years while ion exchange technology was designed, constructed, and tested, and then be replaced by ion exchange. Under immediate replacement, ITP would not operate and waste removal from tanks would not begin for approximately 10 years, when the ion exchange facility would become operational under an accelerated schedule. As noted in Chapter 2, the ion exchange facility would be built on approximately 4 hectares (10 acres) of previously disturbed land in H-Area.

After operation of the ion exchange facility has begun, the environmental impacts would be the same for both phased and immediate replacement. For most potential impacts, the effects of phased replacement would be the same as those of the proposed action for the first 14 years, and the impacts of immediate replacement would be the same as those of the no-action alternative for the first 10 years. This chapter presents separate discussion for phased and immediate replacement only when the impacts would be different (e.g., socioeconomics, traffic and transportation, accident analyses, and waste generation).

4.3.2 GEOLOGIC RESOURCES

The phased and immediate replacement of ITP by the ion exchange facility would have identical impacts on geologic resources. The potential impacts from soil erosion under both of these alternatives would be the same and would be slightly greater than under the proposed action due to construction of the ion exchange facility.

During construction and operations associated with this alternative, fuel and process chemical spills could occur as described for the proposed action. Resulting impacts would be similar to those of the proposed action.

4.3.3 WATER RESOURCES

4.3.3.1 Groundwater

The phased and immediate replacement of ITP by ion exchange would have identical impacts on groundwater. In addition to construction activities noted Section 4.1.3.1 for the proposed action, ion exchange would require construction of a building to house the ion exchange facility and support facilities. The impacts to groundwater due to construction activities (i.e., spills and leaks) are therefore expected to be similar to those discussed in the proposed action due to increased construction activity.

During the operations phase of ion exchange, the potential impacts to groundwater from the use of the Saltstone Disposal Vaults would be similar to those discussed in Section 4.1.3.1. However, as noted in Table 2.4-1, if ion exchange were phased in, the chemical composition of the process waste would change slightly. Although phenol and benzene would be entirely absent from the ion exchange process waste, the concentration of mercury in the waste would be more than five times greater than in the waste stream produced from ITP. Leaching studies conducted as part of the radiological performance assessment for Saltstone Manufacturing and Disposal indicated that hazardous metals in saltstone would not be a limiting factor in the performance of the facility because concentrations in the solution would be maintained at or below specified limits.

4.3.3.2 Surface Water

The phased and immediate replacement of ITP by ion exchange would have identical impacts on surface water. DOE would implement an erosion and sedimentation control plan, such as those referenced in Section 2.2.1, for stormwater runoff during the construction phase of the project. Additionally, after the ion exchange facility is placed in operation, stormwater runoff from the area would be directed when appropriate to a retention pond, monitored for pollutants, and treated, if needed, before being released to a surface stream via a permitted outfall. Potential impacts on surface water are therefore expected to be minor.

As with ITP, no wastewater discharges from ion exchange would occur because the process wastewater would be recycled and reused (Scott 1993a). The surface water discharges from the Vitrification Facility would be the same for ion exchange as for the proposed action. Thus, the impact on Upper Three Runs would be similar to that of the proposed action.

4.3.4 AIR RESOURCES

The phased and immediate replacement of ITP by the ion exchange facility would have essentially identical impacts on air resources during construction. During operation, the difference in operating duration of ITP and ion exchange would cause a corresponding reduction or elimination of benzene emissions for phased and immediate replacement, respectively. Current emissions from high-level waste tanks would continue for an additional 10 years under the immediate replacement alternative.

4.3.4.1 Construction

Potential impacts to air quality from construction activities under the ion exchange alternatives would include dust from clearing land and exhaust emissions from construction equipment. The amount of dust produced would be proportional to the land area disturbed for the new facilities, all of which would be located near the center of the SRS. As shown in Table 4.3-1, the overall construction impacts to air quality would be minimal and the SRS sitewide compliance with state and Federal ambient air quality standards would not be affected by construction-related activities.

Table 4.3-1. Estimated maximum incremental increase of particulates at the SRS boundary (micrograms per cubic meter).^a

Pollutant	Averaging time	SCDHEC standard^b	Alternate action (ion exchange)
Total suspended particulates	Annual	75	<0.01
Particulate matter (<=10 microns)	24-Hour	150	0.9
	Annual	50	<0.01

a. Based on Hunter and Stewart (1994a).
b. SCDHEC (1976b).

4.3.4.2 Operation

The operation of the phased replacement alternative would release both nonradiological and radiological emissions from the H-, S-, and Z-Areas of the SRS. Nonradiological emissions would be similar to the proposed action except for the absence of benzene emissions and the reduction of diphenyl mercury emissions after ion exchange is implemented. Radiological emissions are estimated to be the same as for the proposed action.

4.3.4.2.1 Nonradiological Air Emissions Impacts

For immediate replacement, emissions and impacts would be the same as the no-action alternative for the first 10 years because no new facilities would operate.

For phased replacement, the primary air emissions for the initial 14 years of ITP operation would be identical to those described in Section 4.1.4.2.1 for the proposed action (see Tables 4.1-4 and 4.1-5). Under ion exchange, benzene and formic acid emissions would not exist in the ion exchange process. In addition, diphenyl mercury emissions from ion exchange operations would be minimal because the mercury would remain in solution. However, mercury would still be released from the vitrification process and would result in the highest ground-level concentration relative to total SRS emissions. Table 4.3-2 shows the estimated maximum ground-level concentrations at the SRS

boundary resulting from air emissions during the ion exchange operational phase. For each regulated pollutant, SRS would maintain compliance with both Federal and state ambient air quality regulations during ion exchange operations.

Table 4.3-2. Estimated maximum ground-level concentrations^ at the SRS boundary (micrograms per cubic meter).^a

Pollutant	SCDHEC standard	SRS maximum potential concentration	DWPF	DWPF percent of SRS maximum
Mercury				
(24 Hr. Avg.)	0.25	0.004	0.001	25
Nitrogen oxides				
(Annual Avg.)	100	22	0.05	0.2
Carbon Monoxide				
(1 Hr. Avg.)	40,000	3,500	22	0.6
(8 Hr. Avg.)	10,000	820	3	0.4
Particulates (PM^10)				
(24 Hr. Avg.)	150	92	3	3
(Annual Avg.)	50	10	0.1	1
Sulfur dioxide				
(3 Hr. Avg.)	1,300^b	1,500 (1,200)^c	2.2	0.2
(24 Hr. Avg.)	365^b	440 (300)^c	0.3	0.1
(1 Yr. Avg.)	80.0	22	<0.01	<0.1

a. Source: Hunter and Stewart (1994a).
b. Concentration may be exceeded once per year.
c. The value in parentheses is the second high maximum value and is used to calculate percent of SRS maximum.

Table 4.1-5 shows the air quality impacts to collocated workers for both the training facility in H-Area and for a worker in F-Area with use of ITP during the first 14 years of phased replacement, which is the same as the proposed action. Air quality impacts to collocated workers under ion exchange would be minimal because no benzene or formic acid would be emitted, and diphenyl mercury emissions would be reduced.

4.3.4.2.2 Radiological Air Emission Impacts

Table 4.1-6 shows the annual dose to the maximally exposed offsite individual and the population dose for each of the major isotopes released during DWPF operations. The calculated maximum committed effective dose equivalent to this hypothetical individual was 0.001 millirem per year (Simpkins 1994a), which is within the annual dose limit of 10 millirem for SRS atmospheric releases. In comparison, an individual living near the SRS receives an annual dose of approximately 300 millirem from natural radiation and 0.22 millirem from all other SRS releases of radioactivity.

The dose to the population within 80 kilometers (50 miles) from DWPF operations for either ion exchange alternative is 0.07 person-rem. The major contributing radionuclide is cesium-137, which is responsible for 86 percent of the population dose (Simpkins 1994a).

4.3.5 ECOLOGICAL RESOURCES

4.3.5.1 Terrestrial Resources

The phased replacement and the immediate replacement of ITP by the ion exchange facility would have essentially identical impacts on ecological resources. The ion exchange facility would be built within the boundaries of H-Area on previously disturbed land. The construction of the ion exchange facility would adhere to a sediment and erosion control plan to minimize erosion of soils on the site. Construction and operation of the ion exchange facility would not greatly increase the workforce or traffic in the area over current levels, so no measurable increased mortality from vehicles would occur to terrestrial animals or birds.

4.3.5.2 Wetland Resources

Because there are no wetlands in the area on which the ion exchange facility would be built, wetlands would not be impacted.

4.3.5.3 Aquatic Resources

The construction of the ion exchange facility would require a sediment and erosion control plan to control discharges of sediments to surface water. All process water used in the ion exchange process would be recycled or discharged through previously permitted outfalls. Therefore, impacts on aquatic biota are expected to be minor.

4.3.5.4 Threatened and Endangered Species

No threatened or endangered species occur in or near H-Area, so DOE does not expect impacts from construction or operation of the ion exchange facility.

4.3.5.5 Radioecology

The atmospheric releases of cesium-137 from this alternative are estimated to be the same as the proposed action (Section 4.1.5.5). Thus, the impact on radioecology would be the same as that described in Section 4.1.5.5.

4.3.6 LAND USE

The phased and immediate replacement of ITP by the ion exchange facility would have identical impacts on land use. Impacts on land use from either alternative would be essentially the same as those described for the proposed action (Section 4.1.6), except that approximately 4 hectares (10 acres) in H-Area would be used for an ion exchange facility. This additional construction would not impact land use because H-Area is dedicated to industrial use. All activities would be consistent with the guidelines for land use plans contained in DOE Order 4320.1B, "Site Development Planning" (DOE 1992c).

4.3.7 SOCIOECONOMICS

4.3.7.1 Phased Replacement

In addition to the activities discussed in Section 4.1.7, this ion exchange pre-treatment alternative would require construction of an ion exchange facility as a replacement for the ITP. Data from Table A-22 in Appendix A were used in the Economic and Demographic Forecasting and Simulation Model for the six-county region of influence to assess the impact on regional employment, population, and income from this alternative. Because baseline employment would not change from projected levels for continuing operations using ITP, construction phase impacts were analyzed for the period 1994 through 2018. This discussion focuses on peak or maximum changes from the construction phase of this alternative.

The peak employment change from implementation of this alternative is projected to occur in the year 2006 with approximately 706 additional jobs or an increase of less than three tenths of one percent in baseline regional employment for that year (HNUS 1994). Even in the peak year, this alternative is projected to have little impact on employment in the region.

Because migration into the region would lag behind the initial change in employment, the maximum potential change in population is projected to occur in the year 2008 with approximately 930 additional people in the region of influence (HNUS 1994). Given a maximum increase of less than two tenths of one percent from the baseline regional population forecast, DOE expects the potential impact on the demand for community resources and services such as housing, schools, police, health care, and fire protection to be negligible.

Potential changes in total personal income are related to changes in employment and are projected peak in the year 2007 with a $49 million increase over forecast income levels for that year (HNUS 1994). Because this would be a less than three tenths of one percent increase, implementation of this alternative is expected to have only a minimal impact on regional income.

4.3.7.2 Immediate Replacement

The Economic and Demographic Forecasting and Simulation Model for the six-county region of influence was used with data from Table A-22 in Appendix A to assess the potential impact on regional employment, population, and income from implementation of this alternative. This discussion focuses on peak or maximum changes from both construction and operations.

The peak employment change is projected to occur in the year 2000 with approximately 621 additional jobs in the six-county region (HNUS 1994). This change would represent a less than three tenths of one percent increase in the baseline regional employment forecast and is projected to have a minimal impact on socioeconomic resources in the region.

Because migration into the region would lag behind the initial change in employment, the maximum potential change in population is projected to occur in the year 2003 with approximately 700 additional people in the region of influence (HNUS 1994). Given a maximum increase of less than two tenths of one percent from the baseline regional population forecast, DOE expects the potential impact on the demand for community resources and services such as housing, schools, police, health care, and fire protection to be negligible.

Potential changes in total personal income are related to changes in population and are projected to peak in the year 2003 with a $27 million increase over forecast income levels for that year (HNUS 1994). Because this would represent a less than two tenths of one percent increase in the baseline forecast, implementation of this alternative is projected to have only a small impact on regional income.

4.3.8 CULTURAL RESOURCES

The phased and immediate replacement of ITP by the ion exchange facility would have identical impacts on cultural resources. Impacts on cultural resources from construction and operation of ion exchange would be the same as those described for the proposed action (Section 4.1.8). Construction of the ion exchange facility in H-Area would not impact cultural resources because important cultural resources would have been destroyed during original construction in the 1950s (Brooks 1992).

4.3.9 AESTHETIC AND SCENIC RESOURCES

The phased and immediate replacement of ITP by the ion exchange facility would have identical impacts on aesthetics and scenic resources. Impacts from construction and operation of ion exchange would be the same as those described for the proposed action (Section 4.1.9).

4.3.10 TRAFFIC AND TRANSPORTATION

4.3.10.1 Phased Replacement

DOE analyzed potential impacts to workers and members of the general public using the same methods described in Section 4.1.10 for the proposed action. For the first 14 years of operation, this alternative would have the same chemical consumption, waste generation, and associated truck shipment rates as for the proposed action (Section 4.1.10). However, construction workforce increases would result in an increase in the peak employee traffic flow offsite and onsite from construction of the ion exchange facility while ITP continues to operate. Table 4.3-3 shows estimated peak vehicles per hour, increased number of vehicles per hour, and total number of vehicles per hour for representative onsite and offsite roads potentially affected by phased replacement. This table also shows the design capacity (vehicles per hour) and projected peak vehicles per hour as a percent of capacity. Offsite vehicles per hour are listed as daily maximum values for these roads, while onsite vehicles per hour represent peak morning traffic to S-Area. These estimates indicate that SC 19 and Road 4 at S-Area have the largest increase in the number of vehicles per hour (61 and 19, respectively) and that road capacities would not be exceeded by projected increases in traffic from phased replacement. These small increases in traffic levels would have negligible impact.

Table 4.3-3. Estimated traffic counts (vehicles per hour) during peak hours.

Road	1994 baseline^a	With phased replacement Increment	With phased replacement Total	Design capacity	Percen capac
		Offsite			
SC19	2,800^b	61	2,861	3,000^b	96
SC125	2,700^b	59	2,759	3,200^c	87
SC57	700^c	15	715	2,100^c	34
		Onsite			
E at E-Area	741^d,e	16	757	2,300^c	33

4 at S-Area	872^d,e	19	891	2,300^c	39
F south of 4	38^d,e	1	39	2,300^c	2
F north of 4	69^d,e	2	71	2,300^c	3

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a. 1994 vehicle counts were estimated from actual counts measured in 1992/1993 (Swygert 1994a) by adjusting vehicle counts by the proportional change in SRS employment between 1992/1993 and 1994.
b. Adapted from Smith (1989).
c. Adapted from TRB (1985).
d. Source: Swygert (1994a).
e. Morning traffic traveling toward S-Area.

Table 4.3-4 presents the number of truck shipments for chemicals used by ion exchange. Table 4.3-5 presents the expected number of waste shipments per year. The total number of waste and chemical shipments together is estimated to be four per day, which would have negligible impact onsite or offsite.

Table 4.3-4. Estimated truck shipments of chemicals associated with ion exchange operation.^a

Chemical	Shipments per year	Shipments per day
Sodium nitrate	2	<1
Sodium hydroxide	9	<1
Sodium titanate	1	<1
Nitric Acid	4	<1
Ion exchange resin	2	<1
Total number of truck shipments^b	18	<1

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a. Scott (1993a).
b. Shipments of flyash and slag, which are also used by DWPF, are not listed because they are received by rail.

Table 4.3-5. Estimated waste shipments by truck associated with ion exchange operation.^a

Waste type	Destination	Volume (cubic meters)^b,c	Shipments per year	Shipme per d
Hazardous	onsite/offsite	2	4	<1
Mixed	onsite/offsite	30	50	<1
Low-level	onsite	2,200	170	1
Construction debris	onsite	250	9	<1
Total number of truck shipments			233	1

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a. Dawsey (1994), Hagenbarth (1994), Stevens (1994), WSRC (1994i).
b. To convert to cubic feet, multiply by 35.3.

c. Expected annual waste generation.

Traffic accidents and property damage would be the primary impacts associated with commuter vehicles and transport trucks. Other impacts associated with trucks would include the possibility of the release of radioactive, mixed, and hazardous materials to the environment. While these releases are possible, the possibility of occurrence would be minimized by adhering to transport regulations under 49 CFR Parts 171-177 requiring appropriate safety precautions.

The increase in the number of trucks entering and leaving the SRS in support of DWPF construction and operations activities would have negligible impact because shipments are estimated to be only three per day during off-peak hours.

4.3.10.2 Immediate Replacement

DOE expects the level of employment, bulk material transportation waste generated, and the resulting impacts under the immediate replacement alternative to be similar to phased replacement as described in Section 4.3.10.1.

4.3.11 OCCUPATIONAL AND PUBLIC HEALTH

4.3.11.1 Public Health

After the ion exchange facility becomes operational, the phased and immediate replacement alternatives would have identical impacts on public health. Under either alternative, radionuclide emissions and their associated doses from ion exchange pre-treatment would be the same as those for the proposed action. Consequently, the associated radiological health effects and the related environmental justice aspects are the same as indicated in Section 4.1.11.

Since ion exchange does not involve the production or release of benzene, the adverse health effects from benzene emissions for immediate replacement would not exist. For phased replacement, the first 14 years of ITP operation would result in an increased lifetime probability of fatal cancer to the maximally exposed member of the public of 7.3 in 100 million from exposure to site boundary benzene concentrations.

4.3.11.2 Worker Radiological Health

Except for an additional 10 years of radiation exposure and potential health effects to workers from current tank farms activities under immediate replacement, the phased and immediate replacement of ITP by the ion exchange facility would have identical impacts on worker radiological health. Projected worker radiation exposure from ITP, about 8 person-rem per year (WSRC 1993b), is a relatively small part of the overall occupational radiation exposure for the proposed action (i.e., less than 10 percent). DOE expects the incremental impact of ion exchange on DWPF worker radiological health to be small for the following reasons:

- Radionuclide inventory for ion exchange would be the same as that fed to the ITP process (Scott 1993a).

- Worker radiation exposure for both facilities would be kept as low as reasonably achievable in accordance with the radiation protection

program described in the SRS Radiological Control Manual (WSRC 1993i).

- Ion exchange would be conducted in a heavily shielded facility similar to F-Canyon and would involve about 200 workers. Of these, about 40 would be projected to have some radiation exposure associated with their work. Ion exchange worker exposure, based on F-Canyon experience, is projected to be 8 to 10 person-rem per year. These exposures are comparable to ITP worker exposure projections.

4.3.11.3 Worker Nonradiological Safety and Health

The phased and immediate replacement of ITP by the ion exchange facility would have identical impacts on worker nonradiological health. Implementation of these ion exchange alternatives would result in a number of injuries and illnesses each year comparable to that for the proposed action. The net total number of workers required would not change. Ion exchange would involve ITP workers who, like the DWPF workers required for the proposed action, would continue to experience injuries and illnesses with the frequency described in Section 4.1.11.3 for F-Canyon.

4.3.12 ACCIDENT ANALYSIS

4.3.12.1 Ion Exchange Radiological Accident Analysis

In view of the pre-conceptual state of the design for the ion exchange pre-treatment process, potential accident sequences in the ion exchange process have been evaluated by applying engineering judgment to the proposed design and considering accident events at similar facilities. The following paragraphs describe these potential accidents; their consequences are presented at the conclusion of the section.

Nuclear Criticality in the Salt Solution Receipt Tank

As described in Section 2.4, the proposed ion exchange system design would include a tank farm salt solution receipt tank into which sodium titanate would be added to remove plutonium and strontium. This process could cause fissile solids to become concentrated, which could result in a nuclear criticality. However, a study (Chandler 1993) has shown that the titanium in sodium titanate, present in both ion exchange and ITP, is sufficiently effective at preventing the fissile material that may be present from reaching criticality. This hazard was therefore eliminated from further consideration.

Hydrogen Fire or Explosion in Salt Solution Receipt Tank

Hydrogen and oxygen would be generated in the salt solution receipt tank by the radiation-induced disassociation of water (radiolysis), but the hydrogen generation rate would be much lower than with sodium tetraphenylborate present, as is the case with ITP. Additionally, benzene (which is also flammable) would not be in the tank, as it would be in the ITP process. The absence of benzene and reduced rate of hydrogen generation lessen the concern that flammable mixtures would build up in the tank.

DOE has studied the formation of flammable mixtures in the tank and the consequences of ignition for the ITP process. In the ion exchange process, the accumulation of flammable mixtures in the tank would be less, so this hazard would be conservatively bounded by the corresponding fire and explosion hazard in the ITP process (Hyder 1993).

Hydrogen Accumulation in Ion Exchange Feed Tanks

The presence of radioactive isotopes would cause radiolytic hydrogen generation and accumulation in other ion exchange; feed tanks. A hydrogen burn in these tanks might release or disperse their contents, approximately 37,850 liters (10,000 gallons) per tank in the conceptual design, representing about 1/50 of the volume of radioactive solution present in the salt solution receipt tank at the beginning of operations. Hydrogen production due to radiolysis would occur at a slower rate than ITP because no organic material would be present. The lack of ignition sources in these tanks would further reduce the likelihood of a release.

Pressurization or Ignition of Resin Columns

In several events in the United States and elsewhere, ion exchange columns allowed to remain loaded with radioactive materials for an extended period of time have burst as the result of radiation heating and the associated gas and chemical reactions (Hyder 1993). It must be assumed that a potential for such accidents as a consequence of operational errors with cesium-loaded ion exchange columns exists.

The results of accidents of this type typically include severe local contamination as the result of dispersion of the loaded resin but relatively little release and contamination outside the immediate area (Hyder 1993). Radioactive aerosols produced by resin combustion would be captured by filters before release to the atmosphere. Radioactive contaminants would be contained because operations of this kind are conducted in a shielded remote area and because most of the activity is associated with the resin particles, which are too large to be airborne.

Leaks

If pipes, valves, or columns containing solutions fail, leakage of cesium could occur. The result would be local dispersion of the contaminated solution and the potential for further dispersion as the result of aerosol formation or leaks to the groundwater (Hyder 1993).

Proper design, operation, and maintenance would minimize leaks. Additionally, the dispersion of activity through this mechanism would be mitigated by providing adequate sumps and equipment for recovering spilled solutions and air purification equipment designed to prevent airborne releases (Hyder 1993).

Improper Operation

This category includes a variety of operating errors such as transferring solution to the wrong tank, double batching, and errors in analysis and cold feed makeup. In general, the consequences of such errors are primarily process failure and the need to recycle solution or to clean up spilled material. Improper operation can also lead to other accident scenarios discussed above, such as leaks or burst columns (Hyder 1993).

Accident Consequences

The conceptual design status of this alternative does not permit more than a generalized discussion of the potential consequences of these accidents. Since most of the operations would occur in remote, shielded locations, DOE would not expect these accidents to result in fatalities among the close-in workers (i.e., those workers in the facility) (Hyder 1993). With respect to offsite individuals, doses exceeding 500 millirem to the maximally exposed offsite individual would be considered highly unlikely. An accident producing

that dose would be required to vaporize approximately 14,400 curies of cesium-137, the amount present on average in about 5,800 kilograms (12,800 pounds) of solution (Hyder 1993). Vaporization of that quantity of water would require the combustion of 92 kilograms (202 pounds) of hydrogen gas, the accumulation of which in any of the process vessels is highly unlikely. Although the inventory of cesium isotopes on ion exchange columns would be greater, the consequences of a pressurization or ignition of a column are not likely to be substantially greater than the tank accidents because of the location of these ion exchange units within a shielded, controlled-ventilation facility designed to contain such releases.

The synergistic effects and secondary impacts of these accidents would be similar to those described in Section 4.1.12.2.

4.3.12.2 Summary of Chemical Hazards for Ion Exchange

Under immediate replacement, the chemical hazards would be similar to those presented in Section 4.1.12.2 for the no-action alternative for 10 years until the ion exchange facilities could be made operational. The toxicological hazards would be greatly reduced with ion exchange because sodium tetraphenylborate would no longer be used, which would eliminate the generation of benzene. Chromium and mercury are the only two hazardous materials that would be present in the soluble wastes from the ion exchange process in meaningful concentrations (Scott 1993a). These chemicals would still be within Saltstone Manufacturing and Disposal feed specifications and do not present meaningful accident exposure hazards to workers. Consequently, some chemical hazards listed in Table 4.1-17, such as the sodium tetraphenylborate tank spill and benzene accidents, are eliminated.

Under the phased replacement alternative, the potential accident consequences would be similar to those described in Section 4.1.12.3 for operating ITP until the ion exchange process is operational, which would not occur until after 14 years of operation.

4.3.12.3 Summary Risk Trend Comparison

Figure 4.3-1 portrays conceptual risk profiles over time for phased and immediate replacement. This risk depiction includes both radiological and nonradiological risks, as well as risks from both accidents and normal operations. Figure 4.3-1A shows a risk profile for phased replacement in which DWPF would operate with ITP for about 14 years, followed by DWPF operating with ion exchange for the remainder of the processing time. Ion exchange would carry a lower risk than ITP because fewer and less hazardous materials, especially organics such as benzene, would be produced as byproducts. Figure 4.3-1A also shows a decrease in risk from high-level waste tanks as waste is removed. At the conclusion of DWPF operations, this risk drops to a smaller, continuing risk from the radioactive glass waste canisters stored underground in the Glass Waste Storage Building and from residual radioactivity in the high-level waste tanks and processing facilities.

Figure 4.3-1B shows a risk profile for immediate replacement including risks from continued tank farm waste storage while the ion exchange technology is developed and the facility built. After that time, DWPF would operate with ion exchange for about 24 years. Figure 4.13-1B also shows a decrease in risk from high-level waste tanks as waste is removed. Because of the 10-year delay in waste removal from tanks, the higher period of risk in the near term continues for a longer period for immediate replacement compared to phased replacement. Figure 4.3-1B also shows the drop in risk at the end of DWPF operations, as with phased replacement.

4.3.13 WASTE GENERATION

The impacts of waste generation under both the phased replacement and immediate replacement alternatives were analyzed in terms of potential demand on in-place or planned SRS waste management infrastructure using the same methods and assumptions described in Section 4.1.13.

Figure 4.3-1

Figure 4.3-1 Qualitative representation of annual risk over time for ion exchange.

4.3.13.1 Phased Replacement

Chapter 2 and Table A-11 of Appendix A present the waste forecast amounts and characteristics for the phased replacement alternative, and Chapter 3 presents the projected totals for Site waste generation until 2018. Table 4.3-6 presents the percent of total waste generated at the SRS attributable to phased replacement. The average value represents the total waste generated during operation of the phased replacement compared to the total waste generated by the SRS for the same time period. The maximum percentage of the total is the highest fraction of the total site waste contributed by DWPF in a single year. As with the proposed action, these estimates do not include wastes generated as a result of environmental restoration and decontamination and decommissioning of SRS facilities, failed equipment to be stored in the Failed Equipment Storage Vaults, and waste from Late Wash, including spent filters. These two percentages provide estimates of average and worst case impacts on the waste management system at the SRS.

Table 4.3-6. Waste generation impact for the phased replacement alternative.^a,b

Waste type	Average fraction of total SRS generation (1995-2018) attributed to phased replacement alternative (percent)	Maximum fraction of annual SRS generation i year (1995-2018) attrib to phased replacemen alternative (percent
Low-level	18	62
Hazardous	<1	3
Mixed	8	79
Sanitary	11	19

a. Adapted from Bignell (1994c), Cauthen (1994c), Dawsey (1994), Hagenbarth (1994), WSRC (1994i).

b. Average and maximum estimates do not include failed melters or other highly radioactive failed equipment designated for interim storage in the Faile Equipment Storage Vaults which are dedicated to these DWPF wastes. Estimates also do not include waste from Late Wash (e.g., microfilters).

As noted in Section 2.2.1 and illustrated by comparing Tables 4.1-14 and 4.3-6, the low-level radioactive, mixed, hazardous, and sanitary wastes generated by the phased replacement, except for spent resin and benzene-contaminated mixed waste, would be approximately the same as in the proposed action. The management of these waste types, including spent resin that would be considered low-level radioactvie waste;, and their impacts on the SRS waste management system are discussed in Section 4.1.13. Operation under phased replacement is expected to generate a comparable volume of failed melters and other highly radioactive failed equipment to that expected from the proposed

action and would result in comparable impacts (Section 4.1.13).

4.3.13.2 Immediate Replacement

Section 2.2.1 and Table A-11 in Appendix A present the waste forecast amounts and characteristics for the immediate replacement alternative, and Table 3.12-1 presents the projected totals for the Site waste generation until 2024. Table 4.3-7 presents the percent of total waste generated at the SRS attributable to immediate replacement. The average value represents the total waste generated during operation of immediate replacement (Fiscal Years 1995 to 2024) (data for sitewide generation were not available for Fiscal Years 2024 to 2028) compared to the total waste generated by the SRS for the same time period. The maximum percentage of the total is the highest fraction of the total site waste contributed by DWPF in a single year. These two percentages provide estimates of average and worst case impacts on the waste management system at the SRS. These percentages do not account for waste generated as a result of environmental restoration and decontamination and decommissioning of SRS facilities.

Table 4.3-7. Waste generation impact for the immediate replacement alternative.^a,b

Waste type	Average fraction of total SRS generation (1995-2024) attributed to immediate replacement alternative (percent)	Maximum fraction of generation attribu immediate replac alternative in an (1995-2024) (per
Low-level	15	62
Hazardous	1	3
Mixed	1	79
Sanitary	11	19

a. Adapted from Bignell (1994c), Cauthen (1994c), Dawsey (1994), Hagenbarth (1994), WSRC (1994i).
b. Average and maximum estimates do not include failed melters or other highly radioactive failed equipment designated for interim storage in the Failed Equipment Storage Vaults which are dedicated to these DWPF wastes.

As indicated in Table A-11 in Appendix A, the total waste generated from this alternative is greater than either the proposed action or phased replacement because waste would be generated for an additional 10 years. However, as illustrated by comparing Tables 4.1-14 and 4.3-7, the low-level radioactive, mixed, hazardous, and sanitary waste would be approximately the same as in the proposed action, except for spent resin and benzene-contaminated mixed waste generated by the immediate replacement alternative. The management of these waste types and their impacts on the SRS waste management system are discussed in Section 4.1.13. Operation under the immediate replacement alternative is expected to generate a volume of highly radioactive melters and other failed equipment and result in comparable impact to that expected under the proposed action as described in Section 4.1.13.

4.3.14 DECONTAMINATION AND DECOMMISSIONING

The phased and immediate replacement of ITP by the ion exchange facility would have identical impacts on decontamination and decommissioning. Additional facilities would be constructed for the ion exchange process. Although some of these facilities would be subjected to high levels of radioactive contamination, the incremental increase in the overall inventory of SRS

contaminated facilities discussed in Section 3.13 would be small.

4.3.15 UNAVOIDABLE ADVERSE IMPACTS AND IRREVERSIBLE OR IRRETRIEVABLE COMMITMENT OF RESOURCES

This section describes unavoidable adverse impacts associated with the immediate or phased replacement of ITP by the ion exchange process. The section also describes the irreversible and irretrievable commitment of resources that would be associated with immediate or phased replacement of ITP.

4.3.15.1 Unavoidable Adverse Impacts

The SRS would experience minimal unavoidable impacts as a result of replacing ITP with the ion exchange process, whether the replacement is immediate or phased.

4.3.15.1.1 Phased Replacement

Impacts from phased replacement would be the same as those described for the proposed action (Section 4.1.15.1) plus ion exchange facility construction impacts for the first 14 years; for the remaining 10 years of operation, impacts associated with ITP would be eliminated and replaced by impacts associated with ion exchange operation. Potential impacts to air quality from construction activities for the ion exchange facility would include dust from the clearing of land, as well as exhaust emissions from construction equipment. The operation of ion exchange would have air emissions similar to the proposed action except for reduced diphenyl mercury emissions and the absence of benzene emissions. Some land in H-Area would be used for the ion exchange facility, but this land is already disturbed and dedicated to industrial use. Peak employment is expected to occur in the year 2006 when approximately 470 temporary construction jobs would be created; however, the incremental demand for community resources and services would be minimal. Since ion exchange operation does not involve the release of benzene, the potential for adverse health effects from benzene emissions associated with the proposed action would be eliminated after ion exchange is implemented.

4.3.15.1.2 Immediate Replacement

For first 10 years, impacts would be the same as the no-action alternative (Section 4.2.15.2) plus impacts associated with constructing the ion exchange facility. Since ion exchange does not involve the release of benzene, the adverse health effects from benzene emissions associated with the proposed action would be eliminated.

4.3.15.2 Irreversible or Irretrievable Commitment of Resources

Under phased and immediate replacement, approximately 166 hectares (410 acres) of land would be converted to waste management usage (Saltstone Disposal Vaults, DWPF, and the ion exchange facility) for an indefinite period of time, although the actual land conversion would be delayed several years by immediate replacement. These alternatives would also consume energy, raw materials, and other natural and manmade resources. Resources that would be committed irreversibly or irretrievably during operation include materials that could not be recovered or recycled and materials that would be consumed or reduced to unrecoverable forms.

4.3.15.2.1 Phased Replacement

Resources committed from phased replacement would be the same as those described for the proposed action (Section 4.1.15.2) with the exception of increased commitment of construction materials and process chemicals for the ion exchange facility. The construction of the Saltstone Disposal Vaults and other facilities associated with this alternative would require the commitment of construction materials such as concrete and steel, and operation of the DWPF and the ion exchange process would require the commitment of process chemicals (Table A-23 in Appendix A). Process chemicals for the proposed action (Table A-5 in Appendix A) would be used for the first 14 years. Implementation of this alternative would involve the future commitment of land resources, natural resources, and associated natural resource services associated with the 166 hectares (410 acres) of land.

4.3.15.2.2 Immediate Replacement

Resources committed under immediate replacement would be the same as those described under phased replacement except that process chemicals associated with the ITP would not be used and total chemical shipments are expected to be four per day. DOE expects the low number of shipments to cause negligible impacts onsite or offsite.

The primary impacts associated with commuter vehicles and transport trucks would be traffic accidents and property damage. Other impacts associated with trucks would include the possibility of the release of radioactive, mixed, and hazardous materials to the environment. While these releases are possible, the possibility of occurrence would be minimized by transport regulations under 49 CFR Parts 171-177 requiring appropriate safety precautions.

4.3.16 CUMULATIVE IMPACTS AND MITIGATION MEASURES

Cumulative Impacts - The cumulative impacts of both phased and immediate replacement, including the impacts of existing offsite facilities and reasonably foreseeable onsite facilities and operations, would be equal to or less than those of the proposed action (Section 4.1.17). Benzene risks would decrease, but otherwise the impacts would essentially be the same. The extent to which these impacts would differ is essentially the incremental difference in impacts for the proposed action in Section 4.1 and impacts described for phased and immediate replacement in Section 4.3.

Mitigation Measures - There are no mitigation measures planned for either phased or immediate replacement at this time.

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