APPENDIX C Savannah River Site Spent Nuclear Fuel Management Program

Department of Energy Programmatic
Spent Nuclear Fuel Management
and
Idaho National Engineering Laboratory
Environmental Restoration and
Waste Management Programs
Final Environmental Impact Statement
Volume 1
Appendix C
Savannah River Site
Spent Nuclear Fuel Management Program
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1. INTRODUCTION

The U.S. Department of Energy (DOE) is engaged in two related decisionmaking pr concerning: (1) the transportation, receipt, processing, and storage of spent nucl DOE Idaho National Engineering Laboratory (INEL) which will focus on the next 10 ye (2) programmatic decisions on future spent nuclear fuel management which will empha years.

DOE is analyzing the environmental consequences of these spent nuclear fuel man actions in this two-volume Environmental Impact Statement (EIS). Volume 1 supports programmatic decisions that will have applicability across the DOE complex and desc purpose and need for this DOE action. Volume 2 is specific to actions at the INEL. which limits its discussion to the Savannah River Site (SRS) spent nuclear fuel man supports Volume 1 of the EIS. Other documents supporting Volume 1 focus on spent n management programs for the Hanford Site, INEL, Naval Nuclear Propulsion Program, a

As part of its planning process for this two-volume EIS, DOE issued an Implemen October 29, 1993. The organization of this document is consistent with the provisi the Implementation Plan and are outlined below:

- Chapter 2 contains background information related to the SRS and the framew environmental regulations pertinent to spent nuclear fuel management.
- Chapter 3 identifies spent nuclear fuel management alternatives that DOE co at the SRS, and summarizes their potential environmental consequences.
- Chapter 4 describes the existing environmental resources of the SRS that sp activities could affect.
- Chapter 5 analyzes in detail the environmental consequences of each spent n management alternative and describes cumulative impacts. The chapter also

information on unavoidable adverse impacts, commitment of resources, short-
environment and mitigation measures.

2. BACKGROUND

The chapter contains an overview of the Savannah River Site (SRS) and a descrip regulatory framework related to the actions that this document evaluates. In addit U.S. Department of Energy (DOE) Spent Nuclear Fuel (SNF) Management Program as it r SRS. Finally, it describes the representative sites located on the SRS that could spent nuclear fuel facilities.

2.1 SRS Overview

The SRS is a key DOE facility for research on and processing of special nuclear U.S. Government built the Site in the early 1950s to produce the basic materials - plutonium-239 and tritium - used in the fabrication of nuclear weapons. The DOE Sa Operations Office manages the SRS, and Westinghouse Savannah River Company (WSRC) o the Site under contract to DOE.

2.1.1 Site Description

The SRS occupies an area of approximately 310 square miles (800 square kilomete South Carolina, in a generally rural area about 25 miles (40 kilometers) southeast and 12 miles (19 kilometers) south of Aiken, South Carolina (Figure 2-1). The Sava the southwestern border of the SRS, which includes portions of Aiken, Barnwell, and Counties. The average population density (1990 census data) in the six-county regi around the Site is 140 people per square mile (54 per square kilometer); the larges 2,595 people per square mile (1,002 per square kilometer) in the City of Augusta (H other population centers - Aiken, Allendale, Barnwell, and North Augusta, South Car within 22 miles (40 kilometers) of the Site. Three small towns - Jackson, New Elle Snelling, South Carolina - are adjacent to the SRS boundary to the northwest, north respectively. Based on 1990 U.S. Census Bureau data, the population within a 50-mi radius of the SRS is approximately 620,100 (Arnett et al. 1993).

The Site consists primarily of managed upland forest with some wetland areas. roadways occupy approximately 5 percent of the SRS land area. Access to the Site i Figure 2-1. National location of SRS. public transportation limited to through t U.S. Highway 278, SRS Road 1, and the CSX Railroad corridor.

The SRS contains 15 major production, service, and research and development (R& previously supported nuclear materials production and can support processing operat management activities. Major SRS facilities include five nuclear reactors, two che plants, a fuel and target fabrication facility, the Defense Waste Processing Facili Replacement Tritium Facility, a heavy-water rework plant, and the Savannah River Te (SRTC), formerly called the Savannah River Laboratory. In addition, the University Research Foundation operates the Savannah River Ecology Laboratory (SREL) on the Si contract to DOE. Under an interagency agreement, the U.S. Forest Service operates River Forest Station, which manages the natural resources and secondary roads on th facilities are in defined areas scattered across the Site. Each area is identified as summarized in Table 2-1. Figure 2-2 shows the locations of the principal SRS fa reactor, waste storage, and separations areas are at least 4 miles (6 kilometers) i boundary.

The primary SRS facilities were related to the production of nuclear materials. manufactured fuel and target components for shipment to the SRS reactors. Original operated five reactors; at present, all are in shutdown status. Shielded railroad irradiated fuel to the F- or H-Area Canyon for the recovery of nuclear materials. separations processes dissolve irradiated components in acid, and extract and separ nuclear materials. In H-Area, additional processes extract other products from irr

DOE neutralizes and stores the high-level liquid radioactive waste generated by facilities in underground tanks. DOE plans to process this waste into a borosilica in the Defense Waste Processing Facility when that facility becomes operational, an waste form at the SRS until an offsite geological repository is available. [DOE ha

Supplemental EIS related to Defense Waste Processing Facility operations (DOE 1994a
to the underground waste storage tanks, DOE has established a centrally located 196
(0.8-square-kilometer) site between F- and H-Areas, called E-Area, for the disposal
radioactive waste and the storage of transuranic (TRU) radioactive waste and mixed
radioactive) waste. The Site also has a central sanitary landfill and buildings in

Table 2-1. Description of functions and principal facilities at SRS areas.

Area	Function	Principal facilities
A	Main DOE administration area, research laboratories	Main administration building, Savanna Technology Center, Savannah River Eco Laboratory, powerhouse
B	Wackenhut Services, Inc., administration area (security)	Administration building, WSRC Enginee building, WSRC training buildings
C	One of five SRS reactors	C-Reactor, training facilities, cooli
D	Central powerhouse and heavy-water rework	Powerhouse, heavy-water rework facili
E	Waste disposal and storage	Solid Waste Disposal Facility
F	Process plutonium	F-Area Canyon, FB-Line, tank farm
G	Various support functions	Spread throughout the Site: railroad U.S. Forest Service installations
H	Process uranium and tritium	H-Area Canyon, HB-Line, Effluent Trea Facility, tank farm, Receiving Basin Fuels, Consolidated Incineration Faci
K	One of five SRS reactors	K-Reactor, cooling basins, cooling to
L	One of five SRS reactors	L-Reactor, cooling basins
M	Production of fuel and target assemblies	Slug and target production facilities treatment facility
N	Receiving	Central Shops
P	One of five SRS reactors	P-Reactor, cooling basins
R	One of five SRS reactors	R-Reactor, cooling basins
S	Process high-level radioactive waste	Defense Waste Processing Facility
TNX	Applied research and development	Analytical laboratory, Defense Waste Technology facilities, various mockup treatment facilities
Z	Waste treatment and handling	Saltstone facility

(N-Area) for the storage of nonradioactive hazardous wastes and mixed waste. DOE i
EIS on waste management activities at the SRS (DOE 1995a).

The Site contains facilities for processing support and for research and develo
include operational coal-fired powerhouses in A-, D-, and H-Areas that generate ele
Figure 2-2. Location of principal SRS facilities (see Table 2-1). The largest po
H-, and S-Areas through a 7-mile (11-kilometer) steam line. D-Area also contains t
rework facility at which DOE purified the deuterium oxide (heavy water) used as the
coolant in SRS reactors. TNX-Area facilities study chemical and waste processing p
production-scale equipment. Finally, A-Area facilities include the Savannah River
the Savannah River Ecology Laboratory, and the DOE and Westinghouse Savannah River
administrative offices.

The SRS employs approximately 20,000 people. Most of these employees work for
Westinghouse Savannah River Company and its subcontractors. The remainder work for
Savannah River Ecology Laboratory, Wackenhut Services, Inc., the U.S. Forest Servic
contractors.

2.1.2 Site History

The U.S. Atomic Energy Commission (AEC), a DOE predecessor agency, selected the
for the SRS in November 1950 after a study of more than 100 prospective sites. The
selected E. I. du Pont de Nemours and Company, Inc., to build and operate the facil
began in February 1951; the basic plant was completed in 1956 at a cost of $1.1 bil
land. On October 3, 1952, operations began with the startup of a unit of the heavy
plant. Criticality occurred in the first production reactor on December 28, 1953.

In 1972, the AEC designated the SRS as the nation's first National Environmenta
Through the years, scientists have performed a wide range of investigations on the
flora, and fauna of the Site.

2.1.3 Mission

The historic mission of the SRS was to serve the national security interests of by safely processing nuclear materials while protecting the health and safety of em public and protecting the environment. The SRS was responsible for producing triti nuclear materials for national defense. At present, it supports the viability of t recycling limited-life components. The SRS also produces isotopes for nonweapons a nation's space program and for medical applications.

The SRS spent nuclear fuel mission is to manage DOE-owned spent fuel in a cost- that protects the safety of SRS workers, the public, and the environment. The goal activities are the accurate quantification and characterization of DOE-owned spent assessment of spent nuclear fuel storage facilities, elimination of current spent n vulnerabilities, and identification of technologies and requirements for interim ma ultimate disposition of spent nuclear fuel.

2.1.4 Management

The DOE Savannah River Operations Office manages the SRS; the Westinghouse Sava River Company operates the Site under contract to DOE. Westinghouse assumed operat responsibility in April 1989 from E. I. du Pont de Nemours and Company, Inc., which the Site since 1951.

2.2 Regulatory Framework

This section summarizes the framework of environmental protection regulations a spent nuclear fuel management at the SRS. The framework is based on Federal and So laws and one local ordinance, as discussed below. Volume 1 (Section 7.0) of this E Impact Statement (EIS) provides additional information on the major Federal environ regulations, Executive Orders, and DOE Orders that apply to spent nuclear fuel mana alternatives.

2.2.1 Federal

The U.S. Environmental Protection Agency (EPA) has authorized South Carolina to most provisions of the Clean Air Act, Resource Conservation and Recovery Act, and C that apply to SRS spent nuclear fuel management. EPA Region IV has the lead respon Clean Air Act standards for radionuclide emissions from DOE facilities, imposing mo approval requirements on SRS spent nuclear fuel management activities that could re radionuclide emissions.

In addition, EPA Region IV has Resource Conservation and Recovery Act authority radioactive hazardous (mixed) waste management, affecting wastes from spent nuclear EPA Region IV and the DOE Savannah River Operations Office have entered into a Fede Compliance Agreement on SRS mixed waste management.

The U.S. Army Corps of Engineers District Engineer for the Charleston District Clean Water Act Section 404 and the Rivers and Harbors Act permitting program for S nuclear fuel construction activities that would affect U.S. waters.

In accordance with the Endangered Species Act, the SRS would consult with the U Wildlife Service, Charleston Field Office on impacts that spent nuclear fuel constr could have on threatened and endangered species.

2.2.2 State

The South Carolina Department of Health and Environmental Control implements th State laws that would affect SRS spent nuclear fuel management activities:

- Pollution Control Act (nonradioactive emissions and discharges, and nonhaza management)
- Hazardous Waste Management Act (nonradioactive hazardous waste management)
- Safe Drinking Water Act
- Groundwater Use Act
- Stormwater Management and Sediment Reduction Act

The U.S. Army Corps of Engineers District Engineer for the Charleston District

agreement with the South Carolina Department of Health and Environmental Control wh department issues Clean Water Act Section 401 water quality certifications. The So Department of Health and Environmental Control also receives SRS reports in accorda Emergency Planning and Community Right-To-Know Act.

The South Carolina State Department of Archives and History includes the State Preservation Office. In accordance with the National Historic Preservation Act, th with the State Historic Preservation Officer on impacts that construction activitie cultural resources.

2.2.3 Local

The only local requirement applicable to SRS spent nuclear fuel management is t County Sediment Control Ordinance, which would affect construction activities.

2.3 Spent Nuclear Fuel Management Program at the Savannah River Site

This EIS addresses the management of approximately 2,742 metric tons of heavy m 3,023 tons) of spent nuclear fuel that would be stored at various locations within over the next 40 years (1995-2035). At present, DOE has stored approximately 206.3 (227.4 tons), or about 8 percent of this material, at the SRS. The spent nuclear f the SRS that DOE has included in the analyses in this document includes:

- 184.4 MTHM (203.3 tons) of Savannah River Defense Production [highly enrich (HEU) aluminum-clad fuels], including plutonium target material, and other fuels
- 4.6 MTHM (5.1 tons) of commercial spent fuel (primarily zirconium-clad)
- 11.9 MTHM (13.1 tons) of test and experimental reactor Zircaloy-clad fuel
- 5.4 MTHM (6.0 tons) of test and experimental reactor stainless steel-clad f

Spent nuclear fuel is currently stored in the Receiving Basin for Offsite Fuels reactor disassembly basins, and in basins in F- and H-Canyons. Table 2-2 shows the fuel stored at these facilities.

Table 2-2. SRS Fuel Inventory by Facility.

Facility	Quantity (MTHM)
Receiving Basin for Offsite Fuel	60.73
L-Reactor Disassembly Basin	118.11
K-Reactor Disassembly Basin	3.32
P-Reactor Disassembly Basin	1.41
F-Canyon	22.63
H-Canyon	0.07
Total	206.27

Source: Wichmann (1995).

The F- and H-Area Canyons at the SRS are among the only remaining operable chem separations facilities of their kind in the DOE Complex. Each canyon has an associ that serves as an interim staging area where reactor fuel bundles and targets await Separations Process. The basins currently contain 13 reactor fuel assemblies (H-Ar clad targets (F-Area).

DOE has stored most of the remaining aluminum-clad spent nuclear fuel from SRS operations under water in concrete reactor storage basins. Three reactor disassemb and L-Reactors) contain reactor fuel and target material. These structures were bu were not intended for the prolonged storage of radioactive materials. Wet (underwa potentially viable for stainless steel-clad fuel elements, is not satisfactory for which are subject to corrosion and pitting.

In March 1992, chemical processing operations were suspended in the canyons to potential safety concern. The concern was subsequently addressed but prior to resu processing, the Secretary of Energy directed that defense related chemical separati reprocessing) be phased out at the SRS. Since the decision, DOE has determined tha related to the disposition of nuclear material, including spent nuclear fuel, is su Environmental Policy Act (NEPA) process. Non-safety related facility operations ha down with the exception of Pu-238 processing associated with the support of NASA mi

As a result of these shut-downs, the canyons and the basins used for storage of and irradiated targets have a large inventory of in-process solutions and fuel and Some materials stored in the L- and K-Reactor disassembly basins have corroded, rel materials to the pool water. DOE is preparing an environmental impact statement th

risks that these and other SRS materials represent to the public and workers and wi near-term need for the actions to stabilize these materials to ensure continued saf (DOE 1995b). These actions would take place over the short-term (about 10 years), make programmatic decisions on disposition.

DOE stores other spent fuel in the Receiving Basin for Offsite Fuels (RBOF) on basin, which is in H-Area near the center of the Site, has been operating and recei origin since 1964. This 15,000-square-foot (1,393-square-meter) facility consists basin, two storage basins, a repackaging basin, a disassembly basin, and an inspect basins and their interconnecting transfer canals hold about 500,000 gallons (1,893, Spent fuel elements arrive in lead-lined casks weighing from 24 to 70 tons (about 2 tons), which a crane lifts from a railroad car or truck trailer and places in the u 30 percent of the fuels in the Receiving Basin for Offsite Fuels consist of uranium steel or Zircaloy, which SRS facilities cannot process without modifications.

2.4 Vulnerabilities Associated with SRS Spent Nuclear Fuel

In August 1993, the Secretary of Energy commissioned a comprehensive baseline a the environmental, safety, and health vulnerabilities associated with the storage o the DOE complex. The purpose of this assessment was to determine the inventory and the Department's Reactor Irradiated Nuclear Material, which includes spent nuclear irradiated target material. The assessment also evaluated the condition of the fac fuel and identified the vulnerabilities and problems currently associated with thes Vulnerabilities in nuclear facilities are conditions or weaknesses that could lead to the public, unnecessary or increased exposure to workers, or release of radioact environment. Loss of institutional controls, such as a cessation of facility fundi facility maintenance and control, could cause some vulnerabilities.

Based on this evaluation process DOE released a report to the Secretary of Ener Fuel Working Group Report on Inventory and Storage of the Department's Spent Nuclea other Reactor Irradiated Nuclear Materials and Their Environmental, Safety and Heal Vulnerabilities (i.e., "The Working Group Report," Volumes I, II, and III), to the December 7, 1993 (DOE 1993). This report identified over 100 vulnerabilities assoc fuel storage in the DOE complex, including 19 at the Savannah River Site. The repo that five facilities and three burial grounds warranted priority attention from man unnecessary increases in worker radiation exposure and cost during cleanup. The Sa L- and K-Reactor Disasssembly Basins were among these facilities. The report group associated with each facility into three categories for management attention based action should be initiated: less than 1 year, 1 to 5 years, and more than 5 years.

After issuing the Working Group Report, DOE developed a Plan of Action to addre vulnerabilities, taking into consideration currently available resources for implem Action is a consolidation of individual action plans designed to address each spent vulnerability in a manner that reflects the DOE (1) sense of urgency, (2) concern f protection, (3) commitment to avoid or otherwise mitigate environmental impacts, an compatible long-term solutions.

The interim goal for the Savannah River Site reactor disassembly basins, pendin the removal of the stored material, is the stabilization of basin conditions to red address known vulnerabilites. The long-term goal of the action plan is a safe star reactor-irradiated nuclear material within a 5-year period, consistent with safe an sound operations, including completion of appropriate NEPA review. These actions w mitigating the identified vulnerabilities while DOE pursues other courses of action

The 19 vulnerabilities identified for the Savannah River Site now have complete (DOE 1994b, 1994c, 1994d). Table 2-3 lists SRS vulnerabilities by facility, tracki categorization, and Action Plan status.

DOE is currently implementing a number of the 19 Action Plans. These actions h evaluated under the NEPA review process. The remaining corrective actions, those t out through FY99, would also undergo NEPA review prior to implementation. Only one outstanding actions, the construction of a dry storage facility, would likely requi documentation (e.g., an EIS). The construction of such a facility is addressed pro EIS as part of the Decentralization, 1992/1993 Planning Basis, Regionalization, and alternatives. Construction of new facilities would require site-specific NEPA docu

Table 2-3. SRS vulnerabilities by facility, vulnerability, tracking number, prior Action Plan status.

	Priority	
Site/Facility	Eight major	Less than

	Vulnerability Number	Description	facilities wit vulnerabilities	1 year
SRS/L-Reactor Disassembly Basin	SRS-01	Potential unmonitored buildup of radionuclide or fissile materials in sand filters.	y	
SRS/L-Reactor Disassembly Basin	SRS-04	Lack of authorization basis in operating the sand filter cleanup system for L-Area Disassembly Basin.	y	
SRS/Reactor Disassembly Basins	SRS-05	Corrosion of aluminum clad fuel, targets, and components.		
SRS/L-Reactor Disassembly Basins	SRS-06	Cesium-137 activity level in L-Basin.	y	
SRS/L-Reactor Disassembly Basins	SRS-07	Determine whether gas bubbles release is a potential hazard above the bucket storage area at L-Reactor.	y	
SRS/K-, L-, P-Reactors	SRS-08	Lack of Reactor Authorization Basis.	y	
SRS/K-Reactor Disassembly Basins	SRS-09	Corrosion of Mark 31 A and B target slugs in K and L disassembly basins.	y	
SRS/P-Reactor Disassembly Basins	SRS-10	Hoist Rod Corrosion		y
SRS/K-, L-Reactor Disassembly Basins	SRS-11	Reactor Disassembly Basin Safety Analysis Envelope.	y	
SRS/L-Reactor Disassembly Basin	SRS-12	Inadvertent flooding of L-Reactor Disassembly Basin.	y	
SRS/K-Reactor Disassembly Basin	SRS-13	Inadvertent flooding of K-Reactor Disassembly Basin.	y	
SRS/P-Reactor Disassembly Basin	SRS-14	Inadvertent flooding of P-Reactor Disassembly Basin.	y	

Table 2-3. (continued).

Site/Facility	Vulnerability Number	Description	Priority: Eight major facilities wit vulnerabilitie	Less than 1 year
SRS/RBOF; P-, R-, L-, C-, R-Reactors	SRS-15 (NOTE: RBOF is a less than 1 year vulnerability)	Conduct of operations at reactor facilities and RBOF.	y	
SRS/Receiving Basin for Offsite Fuel (RBOF)	SRS-16	Inadequate tornado protection at RBOF.		y
SRS/Receiving Basin for Offsite Fuel (RBOF)	SRS-17	Seismic vulnerability of RBOF.		y
SRS/H-Area Canyon	SRS-18	Seismic vulnerability of H-Area Canyon.		
SRS/F-Area Canyon	SRS-19	Seismic vulnerability of F-Area Canyon.		

SRS/K-, L-, P-Reactor Disassembly Basins and RBOF y
SRS-20
Inadequate leak detection system in the underground water-filled RINM storage basin.
SRS/L-, K-, P-Reactor Disassembly Basins y
SRS-21
Inadequate seismic evaluation and potential inadequacies of structures, systems, and components to withstand a design basis event.

2.5 Representative Host Sites

DOE has identified two SRS areas as representative host sites for potential fac implementation of programmatic decisions on spent nuclear fuel management (Figure 2

- F- and H-Areas (considered together) for the modification or expansion of e new wet storage, and support facilities
- An undeveloped site for the construction of major new facilities, primarily Core Facility or dry storage vault.

Figure 2-3. Representative host sites on Savannah River Site. 2.5.1 F- and H-Areas

These two areas contain most of the current spent nuclear fuel facilities and o SRS, including the Receiving Basin for Offsite Fuels. Therefore, DOE would focus f under any of the alternatives in these areas as well, for cost-effectiveness and be would occur in areas that had been previously disturbed.

F- and H-Areas are about 2 miles (3.2 kilometers) apart near the center of the Site boundary is approximately 7.5 miles (12 kilometers) to the west. DOE uses the 5-mile (8-kilometer) radius of the two areas either for industrial purposes associa operations or as managed forest land. The closest facility to F- and H-Areas is th Waste Disposal Facility, which lies between the two areas (Figure 2-3). DOE uses t dispose of SRS solid low-level radioactive waste and to store TRU radioactive waste

The F-Area separations facilities occupy about 420 acres (1.7 square kilometers were designed primarily for the recovery of plutonium-239 from irradiated and unirr materials. DOE used the F-Area Canyon to dissolve target materials and produce sol contained the various products extracted from fission products. Further processing products from solution to solid form for shipment off the Site. Large tanks in F-A liquid radioactive waste for future stabilization and disposal through the Defense Facility.

H-Area facilities occupy about 395 acres (1.6 square kilometers). The H-Area C irradiated fuel elements or target assemblies from reactors. Primary operations in of irradiated targets and fuel tubes, chemical and physical separation, and purific DOE stores high-level liquid waste in large tanks in H-Area, as in F-Area, for futu disposal through the Defense Waste Processing Facility.

2.5.2 Undeveloped Representative Host Site

DOE has selected an undeveloped representative host site for the construction o that F- or H-Area could not accommodate. This site is to the south and east of H-A SRS Road E and close to an existing railroad line, as shown in Figure 2-3. The SRS connections to existing electricity, water, and steam networks with minimal additio The use of this site would have the advantage of consolidating spent nuclear fuel-r F- and H-Areas and close to the center of the SRS.

This site is representative of many available areas on the SRS that could suppo fuel management activities. For example, DOE has identified a different representa possible construction of the Expended Core Facility for the management of naval spe (see Appendix D of Volume 1 of this Environmental Impact Statement). DOE would con detailed siting analysis before implementing any programmatic decision at the SRS. assess, as necessary, the environmental consequences of the siting of any facilitie specific NEPA documentation.

3. SPENT NUCLEAR FUEL ALTERNATIVES

This chapter describes the five management alternatives for spent nuclear fuel U.S. Department of Energy (DOE) has evaluated for the Savannah River Site (SRS) as Volume 1 of this Environmental Impact Statement. These alternatives are:

1. No Action
2. Decentralization
3. 1992/1993 Planning Basis
4. Regionalization (with 2 subalternatives for the SRS)
5. Centralization (with 2 subalternatives for the SRS)

The activities covered by the alternatives range from maintaining the current i fuel at the SRS without receiving any more shipments (Alternative 1), through keepi inventory and accepting or sending off some limited shipments (Alternatives 2 throu at the Site all DOE spent nuclear fuel and some from other sources (Alternative 5). examined an option for shipping all spent nuclear fuel at the SRS to another locati (a variation of Alternatives 4 and 5). Table 3-1 summarizes the quantities of mate received, shipped out, and ultimately managed at the SRS under the various alternat assessed the aluminum-clad spent nuclear fuel separately from nonaluminum-clad fuel steel and Zircaloy) because the options for managing them at the Site could be diff in Section 3.1.

The analytical approach used in this document produces estimates of consequence as large as or larger than any that could occur or be expected under the alternativ comparison of the impacts of the principal technologies for managing spent nuclear

This chapter also provides an overview of the SRS management approach and descr alternatives as they relate to the SRS (Sections 3.1 and 3.2). In addition, the ch compares the potential environmental consequences of each alternative (Section 3.3)

Table 3-1. Quantities (MTHM)a of spent nuclear fuel that would be received, shippe at the SRS under the five alternatives.b,c

Alternative	Fuel Type	Currently at SRS	Receive	Ship Out	Tot SRS alt
1. No Action	Aluminum	184.40	0.00	0.00	184
	Nonaluminum	21.87	0.00	0.00	21
	Totals	206.27	0.00	0.00	206
2. Decentralization	Aluminum	184.40	11.02	0.00	195
	Nonaluminum	21.87	2.60	0.00	24
	Totals	206.27	13.62	0.00	219
3. 1992/1993 Planning Basis	Aluminum	184.40	13.69	0.00	198
	Nonaluminum	21.87	2.80	0.00	24
	Totals	206.27	16.49	0.00	222
4. Regionalization - A (by fuel type)	Aluminum	184.40	28.69	0.00	213
	Nonaluminum	21.87	0.00	(21.87)	0
	Totals	206.27	28.69	(21.87)	213
4. Regionalization - B (by location at SRS)	Aluminum	184.40	19.93	0.00	204
	Nonaluminum	21.87	30.42	0.00	52
	Totals	206.27	50.35	0.00	256
4. Regionalization - B (by location, elsewhere)	Aluminum	184.40	0.00	(184.40)	0.0
	Nonaluminum	21.87	0.00	(21.87)	0.0
	Totals	206.27	0.00	(206.27)	0.0
5. Centralization (at SRS)	Aluminum	184.40	28.69	0.00	2
	Nonaluminum	21.87	2,506.84	0.00	2,5
	Totals	206.27	2,535.53	0.00	2,7
5. Centralization (elsewhere)	Aluminum	184.40	0.00	(184.40)	0.0
	Nonaluminum	21.87	0.00	(21.87)	0.0
	Totals	206.27	0.00	(206.27)	0.0

a. To convert metric tons of heavy metal to tons, multiply by 1.1023.
b. Numbers may not sum due to rounding.
c. Source: Wichmann (1995).

3.1 SRS Management Approach

3.1.1 Management Options

DOE has evaluated three options for the management of spent nuclear fuel at the five alternatives considered for this EIS. These technical management options are storage of all fuels and the processing of aluminum-clad fuels. DOE could implemen individually or in combination under any of the five alternatives. DOE would base or more of these technical management options on additional analysis, including a s specific National Environmental Policy Act (NEPA) review based on this programmatic

3.1.1.1 Wet Storage. As described above in Section 2.3, the SRS currently maintains its

spent nuclear fuel in wet storage in the Receiving Basin for Offsite Fuels and seve Wet storage under the 40-year interim management plan (except under the No Action a would require that DOE construct a new wet storage pool at the SRS and move all fue Prior to this transfer, DOE could place all the aluminum-clad fuel in stainless ste further corrosion and breakdown of the fuel cladding. The stainless steel- and Zir could also require canning. The SRS would monitor and maintain the water quality a of the fuel in the storage pool throughout the interim management period.

Under this wet storage option, the spent nuclear fuel would be in an interim st could require further treatment depending on the DOE decision on its ultimate dispo

3.1.1.2 Dry Storage. DOE currently has no dry storage facilities for spent nuclear fuel at the

Site. Dry storage of SRS aluminum-clad fuels under this management plan would requ development prior to the construction of a dry storage facility. Although such fac DOE sites and at commercial locations, DOE believes that the characteristics of SRS sufficiently different to require some research and development before the design a facility for this fuel. DOE would can all fuel before placing it into the dry stor also have to maintain and monitor the facility for the remainder of the 40-year man

As with wet storage, the dry storage option would place the spent fuel into an form that could require further treatment later depending upon DOE's decision on ul

3.1.1.3 Processing and Dry Storage. One method under this option would be for the SRS

to process existing aluminum-clad spent nuclear fuel through the existing separatio F- and H-Area Canyons, and place the nonaluminum-clad fuels and any future receipts The process using existing capability would result in the generation of both separa (e.g., uranium oxide), which would be stored on the site in existing facilities, an products that would be placed in existing waste storage facilities for later conver form through the Defense Waste Processing Facility (DWPF). DOE would maintain and dry storage facility containing the nonaluminum-clad spent fuel. Variations of thi are also possible, such as processing all the aluminum-clad fuel currently on the S received from elsewhere, or developing the capability at the SRS for processing for without chemical separations.

The process option selected for evaluation in this document is representative o processing options that might be employed, but is not necessarily the one that DOE Detailed NEPA evaluations would be required to implement any spent nuclear fuel man at the SRS.

3.1.2 Management Plan

Figure 3-1 summarizes DOE's overall plan for the interim management of aluminum nonaluminum-clad fuels at the SRS. This flowchart shows actions for all alternativ Action, as explained in Section 3.2.1.

3.1.2.1 Aluminum-clad Fuels. Depending on the alternative and option selected, DOE could

(within constraints of mission commitments) consolidate some aluminum-clad fuel in

Basin for Offsite Fuels to take advantage of this facility's superior water quality aluminum-clad fuel into dry storage, wet storage, or initiate processing (Figure 3- process aluminum-clad fuel without any consolidation work. Before moving the fuel storage, DOE would place it in cans. DOE would hold the canned fuel or the stabili processing in storage for the 40-year interim management period until it decided th

DOE would place aluminum-clad fuels received by the SRS from other locations in storage. DOE could not implement any of the options for aluminum-clad fuels, with processing using existing SRS capabilities, without a technology development effort

3.1.2.2 Nonaluminum-clad Fuels. DOE options for the management of nonaluminum-clad

fuels at the SRS are somewhat different, in that only dry or wet storage is conside The processing of these fuels at the Site is not an option because the SRS does not operational facilities capable of separating these materials. To improve aluminum- DOE could consolidate the nonaluminum-clad fuel inventory in a reactor basin where resistant stainless steel or Zircaloy cladding would be less susceptible to corrosi remain there until DOE built new dry or wet storage facilities. DOE would then can move it into the new storage. DOE would place any nonaluminum-clad fuel received a completion of the new facilities directly into storage. The fuel would remain in t until DOE decided its ultimate disposition.

Figure 3-1. Diagram of how SRS would manage aluminum-clad and nonaluminum-clad f available.

3.2 Description of Alternatives

3.2.1 Overview

Table 3-2 compares actions under each of the five alternatives. These actions requirements for transportation, stabilization, facilities, and research and develo address for each alternative. Transportation would include onsite movements as wel shipment of spent fuel. The consideration of facilities addresses not only new one required, but also the use of existing structures and capabilities such as the F- a SRS. Finally, each alternative would involve some level of research and developmen related to spent nuclear fuel interim management (e.g., stabilization, transportati ultimate disposition.

Alternative 1 (No Action) addresses only the interim wet storage option, while Alternatives 2 through 5 considers three options: dry storage, wet storage, and pr aluminum-clad fuels and placing the other fuels into storage. In addition, Alterna an option for the shipment of spent nuclear fuel off the SRS. This analytical appr relative impact of viable interim storage technologies for the range of alternative considering for the SRS. However, this information is not sufficient to support th specific interim storage technology at the SRS because DOE has not completed site-s and development for dry storage and wet storage methods or an evaluation of other p In addition, the specific quantities of offsite fuel that DOE would manage are subj selection of an interim storage technology will be the subject of separate NEPA doc to the SRS.

Figure 3-2 is a matrix showing the types of facilities that would be required f and option. The list includes those facilities already operating at the SRS (e.g., Offsite Fuels) as well as potential facilities (e.g., fuel characterization facilit facilities in its evaluation of the consequences of each alternative, as described

The alternatives described below address interim storage to 2035; further treat nuclear fuel would be necessary before DOE obtained a final disposable waste form. not address this additional treatment. However, DOE would carry out a full NEPA do any decision on final disposition of spent nuclear fuel.

Table 3-2. Actions required under each of the five alternatives at the SRS.

Alternative	Transportation	Stabilization
1. No Action	No shipments to or from the Site. Limit onsite transfers to those required for safe storage.	Place aluminum-clad f are badly corroded an danger of cladding fa containers and return wet storage.
2. Decentralization	Receive about 13.6 MTHM (15.0	Can aluminum-clad fue

	tons) of aluminum-clad and nonaluminum-clad fuels. Limit onsite transfers to those required for safe storage, consolidation, and research and development. Later relocate fuels to new wet or dry storage facility or move aluminum-clad fuels to F- and H-Canyons for processing.	place them in wet or storage or process ex through F- and H-Cany Can stainless-steel a Zircaloy fuels and pl or dry storage.
3. 1992/1993 Planning Basis	Receive about 16.5 MTHM (18.2 tons) of aluminum-clad and nonaluminum-clad fuels. Limit onsite transfers to those required for safe storage, consolidation, and research and development. Later relocate fuels to new wet or dry storage facility, or move aluminum-clad fuels to F- and H-Canyon for processing.	Can aluminum-clad fue place them in wet or storage or process ex through F- and H-Cany Can stainless steel a Zircaloy fuels and pl or dry storage.
4. Regionalization - A (by fuel type at the SRS)	Receive about 28.7 MTHM (31.6 tons) of aluminum-clad fuel. Ship to Idaho National Engineering Laboratory about 21.9 MTHM (24.1 tons) of stainless steel and Zircaloy fuel. Relocate aluminum-clad fuels to Receiving Basin for Offsite Fuels, as necessary; then to new wet or dry storage facilities, or move aluminum-clad fuels to F- and H-Canyon for processing.	Can aluminum-clad fue place them in wet or storage; or process e fuel through F- and H-Canyons.
4. Regionalization - B (by location at the SRS)	Receive approximately 50.4 MTHM (55.6 tons) of spent fuel from other locations. Limit onsite transfers to those required for safe storage, consolidation, and research and development. Relocate fuels to new dry or wet storage facility or move aluminum-clad fuel to F- and H-Canyons for processing.	Can aluminum-clad fue place them in wet or storage; or process e aluminum-clad fuels t F- and H-Canyons and remaining fuel. Char and can fuel received offsite that is not i suitable for direct p into storage.
4. Regionalization - B (by location at another site)	Move all fuels to new characterization facility prior to shipment offsite. Ship out about 206.3 MTHM (227.4 tons) of spent fuel.	Characterize and can fuel prior to shipmen
5. Centralization (at the SRS)	Receive about 2,535.5 MTHM (2,794.9 tons) of spent fuel from offsite. Limit onsite transfers to those required for safe storage, consolidation, and research and development. Relocate fuels to new dry or wet storage facility or move aluminum-clad fuel to F- and H-Canyons for processing.	Can aluminum-clad fue place them in wet or storage; or process e aluminum-clad fuels t F- and H-Canyons and remaining fuels. Cha and can fuel received offsite that is not i suitable for direct p storage.
5. Centralization (at another site)	Move all fuels to new characterization facility prior to shipment offsite. Ship out about 206.3 MTHM (227.4 tons) of spent fuel.	Characterize and can fuel prior to shipmen

Figure 3-2. Types of facilities required for each alternative. 3.2.2 Alternative 1 - No Action

3.2.2.1 Overview. This alternative deals only with the minimum actions that DOE would

deem necessary for the continued safe and secure management of spent nuclear fuel. quo condition. Rather, across its complex of facilities, DOE would maintain spent to generation or current storage locations with no shipment between sites. Facilit replacements and onsite fuel transfers would occur only to support safe and secure DOE would continue existing and new research and development activities for spent f management. Stabilization activities would be limited only to those minimum action spent nuclear fuel safely.

3.2.2.2 SRS Alternative 1 - Wet Storage. DOE would initiate the various SRS programs

and activities necessary to obtain optimum use of existing spent nuclear fuel facil storage of existing Site inventories totalling 206.3 metric tons (227.4 tons) of he the following quantities:

- 184.4 MTHM (203.3 tons) of Savannah River Defense Production [highly enrich (HEU) aluminum-clad fuels], including plutonium target material, and other fuels
- 4.6 MTHM (5.1 tons) of commercial spent nuclear fuel (primarily zirconium-c
- 5.4 MTHM (6.0 tons) of test and experimental reactor stainless steel-clad f
- 11.9 MTHM (13.1 tons) of test and experimental reactor Zircaloy-clad fuel

The goal of this program would be to relocate some aluminum-clad fuels to the R for Offsite Fuels where precisely maintained water quality would prolong the storag types. In addition, DOE would relocate a portion of the stainless steel- and Zirca reactor basin, where their more resistant cladding would maintain fuel containment period. These actions would be accomplished within the constraints of mission requ

The following describes one method that could be employed to improve the storag aluminum-clad fuel. Variations of this plan that would involve only the use of exi are also possible.

- Select a reactor basin for upgrading and for the interim storage of SNF.
- Relocate aluminum-clad fuels from the selected reactor basin to other onsit cleaning and repair of the basin chosen for upgrade to improve water qualit
- Consolidate fuels in the Receiving Basin for Offsite Fuels to the extent po
- After cleaning and renovating the selected reactor basin, move a portion of and Zircaloy-clad fuel assemblies now at the Receiving Basin for Offsite Fu renovated reactor basin.
- Move the aluminum-clad fuels temporarily stored at other locations to the R for Offsite Fuels or the renovated reactor basin.

DOE will continue to place heavily corroded aluminum-clad fuel elements that co danger of cladding failure into containers in the wet pool as required to minimize materials throughout the pool. This action would be much simpler than canning the would occur under the other alternatives.

This alternative would require no new facilities. DOE would continue existing fuel-related research and development.

3.2.3 Alternative 2 - Decentralization

3.2.3.1 Overview. Under this alternative, DOE would maintain existing spent nuclear fuel in

storage at the current locations, and the SRS would receive some shipments of unive foreign fuel. This alternative differs from the No Action alternative by allowing development and upgrades. DOE could transport fuel on the Site for safety, fuel co research and development activities. In addition, DOE could undertake actions it d though not essential, for safety and could perform spent nuclear fuel processing, t and development.

3.2.3.2 SRS Options 2a, 2b, and 2c. DOE analyzed three options specific to the SRS for

this alternative: Option 2a deals with dry storage, Option 2b deals with wet stora involves processing existing SRS aluminum-clad spent nuclear fuel and storing the r

The amount of spent fuel that the SRS would manage includes its current inventory, above for Alternative 1, plus:

- 11.0 MTHM (12.0 tons) of aluminum-clad fuel
- 1.1 MTHM (1.2 tons) of stainless steel-clad fuel
- 0.7 MTHM (0.8 ton) of Zircaloy-clad fuel
- 0.8 MTHM (0.9 ton) of other experimental fuel

Under this alternative, SRS would manage a total of about 219.9 MTHM (242.4 t nuclear fuel. The SRS would receive spent fuel from research reactors as existing as new storage was constructed.

3.2.3.2.1 Option 2a - Dry Storage - Under this option, DOE would store existing SRS

inventories in wet pools while developing the technology and constructing the neces examine, characterize, and can the fuels and transfer them to a new dry storage vau treatment for final disposition.

The SRS would proceed with the fuel rearrangement plan described above for Alternative 1 to provide acceptable storage conditions to minimize failur aluminum-clad material before its placement in a dry-storage container.

Placement in a dry-storage facility would require a technology development prog capabilities to examine, characterize, and can aluminum-clad fuel elements before p vault. In addition, the SRS would investigate technologies for the ultimate dispos fuel. In addition to a dry storage facility, the SRS would build new fuel receivin and dry canning facilities.

3.2.3.2.2 Option 2b - Wet Storage - Under this option, DOE could rearrange existing

spent nuclear fuel as described above for Alternative 1 to provide interim wet stor constructing new facilities.

SRS could also modify this rearrangement plan to accept shipments of spent fuel from offsite and place them directly into the Receiving Basin for Offsit circumstances warrant. The new wet storage facilities required under this option w capability to examine and characterize fuels and to can deteriorating fuels in a st for placement in the new pool. DOE would move all fuel to the new storage pool onc complete. SRS would build new fuel receiving, characterization, and wet-canning fa a new wet storage pool. SRS would investigate technologies for the ultimate dispos nuclear fuel.

3.2.3.2.3 Option 2c - Processing and Storage - Under this option, SRS would

process existing aluminum-clad spent nuclear fuel to consolidate and stabilize the storage in vaults, and would place the stainless steel- and Zircaloy-clad fuel and aluminum-clad fuel in dry storage.

The fuel would remain in the current wet pools while awaiting processing or the construction of new dry storage facilities. DOE would use existi facilities to process the aluminum-clad fuel to safe, stable, consolidated forms.

The new facilities that the SRS would require under this option would be simila described for dry storage (Option 2a), except they would be much smaller because th to be stored would be small: only about 11.0 MTHM (12.0 tons) of aluminum-clad and MTHM (27.0 tons) of nonaluminum-clad fuel.

The SRS would investigate technologies required for the ultimate disposition of

3.2.4 Alternative 3 - 1992/1993 Planning Basis

3.2.4.1 Overview. This alternative assumes the continued transportation, receipt, processing,

and storage of spent nuclear fuel. Foreign and university research reactor spent n sent to the INEL and the SRS. DOE would assess the construction of new facilities accommodate current and projected spent nuclear fuel storage requirements. This al include activities related to the treatment of spent nuclear fuel, including resear

and pilot programs to support future decisions on its ultimate disposition.

3.2.4.2 SRS Options 3a, 3b, and 3c. DOE analyzed the same three options for this

alternative as for Alternative 2: dry storage (Option 3a), wet storage (Option 3b) of existing SRS aluminum-clad fuel and storing the remaining fuel (Option 3c). The would be somewhat greater than those for Alternative 2 because the options assume t would manage its present inventory (see Alternative 1) plus approximately:

- 13.7 MTHM (15.1 tons) of aluminum-clad fuel
- 1.3 MTHM (1.4 tons) of stainless steel-clad fuel
- 0.7 MTHM (0.8 ton) of Zircaloy-clad fuel
- 0.8 MTHM (0.9 ton) of other experimental fuel
- a small amount (<0.1 ton) of commercial nonaluminum-clad fuel

The total spent nuclear fuel managed would equal about 222.8 MTHM (245.6 tons). would receive shipments of fuel from other locations as existing space allowed and were completed.

3.2.4.2.1 Option 3a - Dry Storage - The Site would store current inventories in

existing wet pools while developing technology and constructing facilities necessar characterize, and can the fuels and transfer them to a new dry storage vault to awa disposition.

The actions that SRS would undertake under this option and the new facilities t would be the same as those described for Option 2a - Dry Storage under Alternative (Decentralization) in Section 3.2.3.2.1.

3.2.4.2.2 Option 3b - Wet Storage - DOE could rearrange existing spent nuclear fuel

as described in Alternative 1 above to provide interim wet storage capacity while b facilities.

The Site could also accept new shipments directly into the Receiving Basin for Offs Fuels, as required. The actions that SRS would undertake under this option, and th be constructed, would be the same as those described for Option 2b - Wet Storage un (Decentralization) in Section 3.2.3.2.2.

3.2.4.2.3 Option 3c - Processing and Storage - Under this option, the SRS would

process existing aluminum-clad spent nuclear fuel and would place the stainless ste clad fuel and new receipts of aluminum-clad fuel in storage as described for Option under Alternative 2 (Decentralization) in Section 3.
2.3.2.3. The requirements for new facilities and for technology development would also be the same.

3.2.5 Alternative 4 - Regionalization

3.2.5.1 Overview. This alternative has two subalternatives. The first (Regionalization A)

would involve the distribution of existing and new spent nuclear fuel among DOE sit primarily on the similarity of fuel type, although DOE would also consider transpor available processing capabilities, available storage capabilities, or a combination Under this subalternative, SRS would receive all aluminum-clad fuel and would trans inventory of stainless steel- and Zircaloy-clad fuel to another DOE site. The SRS total of about 213.1 MTHM (234.9 tons) of spent fuel under the Regionalization A su

The second subalternative (Regionalization B) would require DOE to consolidate new spent fuel at two sites - one to the east of the Mississippi River and one to t depending on the location or generation site of the fuel. Under this alternative, receive all spent nuclear fuel in the east [approximately 256.6 MTHM (282.9 tons)] inventory offsite to the Oak Ridge Reservation in Tennessee. An additional option the Eastern Regional Site is for DOE to construct an Expended Core Facility at the some Naval fuel. This option is described in Appendix D of Volume 1 of this EIS.

Under either subalternative, DOE would undertake facility upgrades, replacement as appropriate. This alternative would include research and development and pilot current management and future decisions on spent fuel disposition.

3.2.5.2 SRS Options 4a, 4b, and 4c (Regionalization A). DOE analyzed three options

for the regionalization of fuels by fuel type: dry storage (Option 4a), wet storag processing of existing SRS aluminum-clad fuels and storing the remaining fuel (Opti subalternative assumes that the SRS would manage:

- Its current inventory of 184.4 MTHM (203.3 tons) of aluminum-clad fuels, plu
- Approximately 28.7 MTHM (31.6 tons) of research reactor aluminum-clad fuel f sites

The SRS would ship to the Idaho National Engineering Laboratory approximately:

- 5.4 MTHM (6.0 tons) of stainless steel-clad fuel
- 4.6 MTHM (5.1 tons) of commercial nonaluminum-clad fuel
- 11.9 MTHM (13.1 tons) of Zircaloy-clad spent fuel

DOE would manage a total of about 213.1 MTHM (234.9 tons) of spent nuclear fuel under this subalternative. The site would receive shipments from other locations a became available and as it shipped the nonaluminum-clad fuel.

3.2.5.2.1 Option 4a - Dry Storage - The actions that the SRS would undertake under

this option, and the new facilities to be constructed, would be the same as for tho Option 2a - Dry Storage under Alternative 2 (Decentralization) in Section 3. 2.3.2.1.

This option would require an extensive research and development program into ca examine, characterize, and can the SRS aluminum-clad fuel for dry storage.

3.2.5.2.2 Option 4b - Wet Storage - The SRS would carry out the same actions and

construct the same types of facilities under this option as it would for Option 2b Alternative 2 (Decentralization) as described in Section 3. 2.3.2.2. Research and development activities would also be similar to those conducted under this Decentralization alternative, e not perform studies on nonaluminum-clad fuels.

3.2.5.2.3 Option 4c - Processing and Storage - Under this option, the SRS would

process the existing aluminum-clad fuel as described for Option 2c - under Alternat (Decentralization) and place the aluminum-clad fuel received from offsite into wet The requirements for new construction would be different than in Option 2c, in that dry would not be required because the nonaluminum-clad fuels would be shipped off the s amount of aluminum-clad fuel to be received could be more readily stored in pools r developing new dry storage. Therefore, Option 4c would require DOE to construct a receiving, wet canning and wet storage facility to manage the fuel received after t operations are completed. These facilities would be much smaller than those requir alternatives.

3.2.5.3 SRS Options 4d, 4e, 4f, and 4g (Regionalization B). DOE analyzed the same

three options for the regionalization of spent fuel on the basis of geographic loca alternatives: dry storage (Option 4d), wet storage (Option 4e), and processing of aluminum-clad fuel and storing the remaining fuel (Option 4f). In addition, it ass shipping all SRS inventory offsite (Option 4g).

The amount of material that the SRS would manage if all the spent fuel in the E to the Site would total about 256.6 MTHM (282.9 tons). This would include the curr inventory of about 206.3 MTHM (227.4 tons) as detailed in Section 3.2.2 plus:

- 19.9 MTHM (21.9 tons) of aluminum-clad fuel
- 26.7 MTHM (29.4 tons) of commercial nonaluminum-clad fuel

- 1.0 MTHM (1.1 ton) of stainless steel-clad fuel
- 1.3 MTHM (1.4 tons) of experimental Zircaloy-clad fuel
- 1.4 MTHM (1.5 tons) of other experimental fuel

The activities that DOE would have to undertake at the SRS, and the facilities to build, under the dry storage, wet storage, or processing options would be very s required for the Decentralization alternative (Section 3.2.3). The difference woul the storage facilities would be somewhat greater because the amount of fuel to be m larger [256.6 MTHM (282.9 tons) versus 219.9 MTHM (242.4 tons)]. In addition, DOE conduct additional research and development on the other fuel types that SRS would these options.

3.2.5.3.1 Option 4d - Dry Storage - The actions that the SRS would undertake under

this option, and the new facilities to be constructed, would be similar to those de Option 2a - Dry Storage under Alternative 2 (Decentralization) in Section 3. 2.3.2.1. This option would require an extensive research and development program into capabilities to ex characterize, and can the SRS aluminum-clad fuel for dry storage.

3.2.5.3.2 Option 4e - Wet Storage - The SRS would carry out the same actions and

construct the same types of facilities under this option as it would for Option 2b Alternative 2 (Decentralization) as described in Section 3. 2.3.2.2. Research and development activities would also be similar to those conducted under this Decentralization alternative.

3.2.5.3.3 Option 4f - Processing and Storage - Under this option, the SRS would

process the existing aluminum-clad fuel and place nonaluminum-clad fuel and aluminu received from offsite in dry storage as described for Option 2c - Processing with s Alternative 2 (Decentralization). The requirements for new facilities and for research and development would also be similar.

3.2.5.3.4 Option 4g - Shipment Off the Site - Under this option, the SRS would ship

its current inventory of about 206. 3 MTHM (227.4 tons) to the Oak Ridge Reservation. The activities and facilities required for this option are the same as those described below for O Centralization alternative (Section 3.2.6.2.4).

3.2.6 Alternative 5 - Centralization

3.2.6.1 Overview. Under this alternative, DOE would collect all current and future spent

nuclear fuel inventories from DOE sites, the Navy, and other sources at a single lo management until final disposition. DOE would construct new facilities at the cent accommodate the increased inventories. The originating sites would characterize an spent nuclear fuel before shipping. They would then close their spent fuel facilit would include the centralization of activities related to the treatment of spent nu research and development and pilot programs to support future decisions on its disp

3.2.6.2 SRS Options 5a, 5b, 5c, and 5d. DOE analyzed four options for this alternative.

Three deal with shipping all DOE spent nuclear fuel to the SRS for disposition and dry storage (Option 5a), wet storage (Option 5b), or by processing existing aluminu storing the remaining fuel (Option 5c). The fourth case involves the shipment of a Site to another location (Option 5d). Options 5a, 5b, and 5c concern the following

- 65.2 MTHM (71.7 tons) of naval fuel

- 213.1 MTHM (234.9 tons) of aluminum-clad fuel
- 2103.2 MTHM (2,318.4 tons) of Hanford defense fuel
- 27.6 MTHM (30.4 tons) of graphite fuel
- 156.5 MTHM (172.5 tons) of commercial nonaluminum-clad fuel
- 96.5 MTHM (106.4 tons) of experimental stainless steel-clad fuel
- 78.0 MTHM (86.0 tons) of Zircaloy-clad fuel
- 1.7 MTHM (1.9 tons) of other fuel types

DOE would manage a total of about 2,741.8 MTHM (3,022.3 tons) of spent nuclear SRS under the first three options. Options 5a and 5b would involve storing all the Option 5c would require processing the existing aluminum-clad fuel [184.4 MTHM (203 placing the remaining nonaluminum-clad SRS fuels and all fuel received from other l [2,557.4 MTHM (2,819.0 tons)] into dry storage. The SRS could accept shipments fro sources and place them in storage as it built new facilities and transferred the on

Under Option 5d, shipments leaving the Site would amount to about 206.3 MTHM (2 which is equal to the inventory of spent nuclear fuel at the SRS under Alternative

3.2.6.2.1 Option 5a - Dry Storage - The actions that the SRS would undertake under

this option would be the same as those described for Option 2a - Dry Storage under (Decentralization) in Section 3.
2.3.2.1. However, the number and size of the new facilities needed to implement this centralization option would be much greater because of the larger vo the Site would manage. In addition, DOE would have to build a new Expended Core Fa SRS to examine and characterize the naval fuels.

This option would require an extensive research and development program into ca examine, characterize, and can SRS and other fuel types before their placement in a DOE would also carry out research and development into other aspects of the managem spent fuels, including those related to its ultimate disposition.

3.2.6.2.2 Option 5b - Wet Storage - Under this option, DOE would undertake actions

similar to those described in Section 3.
2.3.2.2 for Option 2b - Wet Storage under Alternative 2. As with Option 5a (Dry Storage), the SRS would have to build major new facilities to m volume of fuel it would receive. DOE would also have to build a new Expended Core SRS. Research and development would be greatly expanded as well.

3.2.6.2.3 Option 5c - Processing and Storage - DOE would process the current

inventory of aluminum-clad spent fuel under this option in the same manner as descr alternatives.
All other fuel onsite and all fuel received from elsewhere would be canned and plac new dry storage facilities. The SRS would shut down the F- and H-Area separations processing the existing inventory of aluminum-clad fuel. Thereafter, any aluminum- the SRS would be placed in dry storage.

This option would require major new facilities, including a new Expended Core F would also conduct extensive research and development in spent fuel management.

3.2.6.2.4 Option 5d - Shipment Off the Site - DOE would consolidate and prepare

all spent nuclear fuel on the SRS for shipment to another DOE site; this would requ of a new fuel characterization facility.
Some fuels could require canning before shipment. SRS would use existing facilities to accomplish this. DOE would then close all SRS spent nuc facilities.

DOE would conduct research and development into methods of stabilizing, canning transporting aluminum-clad fuels, particularly that which is corroded or otherwise

3.3 Comparison of Alternatives

Table 3-3 summarizes the environmental consequences of the five alternatives. presents detailed descriptions of these consequences.

In general, the levels of impacts associated with Alternatives 1 through 4 woul because the amounts of spent nuclear fuel that DOE would manage at the SRS under th would be approximately the same [e.g., about 206 to 257 MTHM (227 to 283 tons)] and would extend throughout the full 40-year management period. The lowest level of im would occur under Option 4g or Option 5d (Regionalization or Centralization at anot DOE would ship the SRS spent fuel off the Site well before the management period en Alternative 5, under which DOE would ship all spent nuclear fuel to the SRS, would greatest onsite impacts; the Site would have to manage approximately 2,741.8 MTHM (of spent fuel.

Table 3-3. Comparison of impacts for the five alternatives.

	ALTERNATIVE 1 - NO ACTION Option 1 Wet Storage
Land Use	No new facilities would be required.
Socioeconomics	No new operations jobs and only about 50 construction jobs would be created.
Cultural Resources	No new construction would be carried out. No impacts are anticipated.
Aesthetics and Scenic Resources	Facilities are in an existing industrial area not visible from public access roads or from off the Site. No impacts are anticipated. Emissions would not impact visibility.
Geology	No minerals of economic value are in affected area. No impacts are anticipated.
Air Resources	Emissions of criteria air pollutants and toxic air pollutants would be only a small fraction of air quality standards.
Water Resources	This option would not require use of additional surface water beyond the 75.7 billion liters (20 billion gallons) per year that the SRS withdraws at present. This option would not require withdrawals of additional groundwater beyond the 14.0 billion liters (3.7 billion gallons) per year the SRS uses. Activities related to this option currently use about 35.1 million liters (9.3 million gallons) of groundwater per year. Impacts would be minimal. No perennial streams or other surface waters would be affected. Accidental releases could contaminate shallow groundwater that is not a source for drinking water or domestic use. Releases would not affect surface streams or drinking water aquifers.
Ecological Resources	Minor disturbance of wildlife due to traffic would occur. No wetlands or threatened or endangered species would be affected.
Noise	The only noise experienced by offsite populations would be generated by employee traffic and by truck and rail deliveries. There would be no change in traffic noise impacts.
Traffic and Transportation	This option would not increase site traffic. Number of LCFf, normal transport: Worker: 6.0 x 10-4 Public: 7.0 x 10-5
Occupational and	Maximum LCFf probabilities:

Public Health and Safety (Radiological)	Worker: 4 x 10-5 Offsite population: 4 x 10-14 (air) 1 x 10-14 (water) Annual LCFf incidences: Worker: 8 x 10-5 Offsite population: 2 x 10-9

Table 3-3. (continued).

	Option 1 Wet Storage
Occupational and Public Health and Safety (Nonradiological)	Hazard index: Worker: 2 x 10-6 Maximally exposed individual: 2 x 10-7
Utilities and Energy	Minimal changes in demand for electricity, steam, domestic water and wastewater treatment would occur. Current SRS capacities are adequate for these additions. Impacts would be minimal.
Materials and Waste Management	Annual average volume of waste generated (cubic meters)b: LLW: 400 TRU: 17 HLW: 0.4 No impact on site waste management capacities.
Accidentsc	Greatest point estimate of riskd: Worker: Data not calculatede Colocated worker: 7.7 x 10-7 Maximally exposed individual: 1.6 x 10-7 Offsite population: 1.4 x 10-3

a. Not applicable.
b. LLW = low-level waste; TRU = transuranic waste; HLW = high-level waste.
c. Data is provided as adjusted point estimates of risk by receptor group to demonstrate a relative comparison of each alternative on an option-by-option basis. The adjusted values were taken from Tables 5-27 through 5-29.
d. Units for adjusted point estimates of risk are given in terms of potential fatal cancers per year.
e. The safety analysis reports from which information was extracted written before issuance of DOE Order 5480.23; previous orders di require the inclusion of workers.
f. LCF = latent cancer fatalities.

Table 3-3. (continued).

ALTERNATIVE 2 - DECENTRALIZATION

	Option 2a Dry Storage	Option 2b Wet Storage	Option 2c Processing
Land Use	Most new construction would be in parts of F- and H-Areas already dedicated to industrial use. Impacts would be minimal.	Same as Option 2a.	Same as Option 2a.
Socioeconomics	Operations jobs would be filled by current employees. A maximum of about 600 construction jobs would be	Same as Option 2a.	Operations jobs would be filled by current employees. A maximum of about 550 construction jobs would be

	created.		created.
Cultural Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Aesthetics and Scenic Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Geology	Same as Option 1.	Same as Option 1.	Same as Option 1.
Air Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Water Resources	New withdrawals of approximately 6.1 million liters (1.6 million gallons) per year of cooling water from Savannah River would be required. Impacts would be minimal. Additional groundwater withdrawals would total about 48.7 million liters (12.9 million gallons) per year. Impacts would be minimal. No perennial streams or other surface waters would be affected. Accidental releases could contaminate shallow groundwater that is not used as a source for drinking water or domestic use. Releases would not affect surface streams or drinking water aquifers.	New withdrawals of approximately 7.2 million liters (1.9 million gallons) per year of cooling water from Savannah River would be required. Impacts would be minimal. Additional groundwater withdrawals would total about 50.6 million liters (13.4 million gallons) per year. Impacts would be minimal. No perennial streams or other surface waters would be affected. Accidental releases could contaminate shallow groundwater that is not used as a source for drinking water or domestic use. Releases would not affect surface streams or drinking water aquifers.	New withdrawals of approximately 311 million liters (82.2 million gallons) per year of cooling water from Savannah River would be required. Impacts would be minimal. Same as Option 2a. No perennial streams or other surface waters would be affected. Accidental releases could contaminate shallow groundwater that is not used as a source for drinking water or domestic use. Releases would not affect surface streams or drinking water aquifers.

Table 3-3. (continued).

	Option 2a Dry Storage	Option 2b Wet Storage	Option 2c Processing
Ecological Resources	Small increase in traffic would cause slight increase in road kills and in disturbance of wildlife due to noise. Impacts would be minimal. No wetlands or threatened or endangered species would be affected.	Same as Option 2a. Same as Option 2a.	Small increases in traffic would cause small increase in road kills and in disturbance of wildlife due to noise. Impacts would be minimal. Same as Option 2a.
Noise	Only noise experienced by communities would be	Same as Option 2a.	Same as Option 2a.

	generated by employee traffic and by truck and rail deliveries. Changes in traffic levels are expected to result in only very small changes in noise impacts.		
Traffic and Transportation	This option would increase site traffic slightly. Number of LCFg, normal transport: Worker: 1.0 x 10-3 Public: 1.2 x 10-4	Same as Option 2a.	This option would increase site traffic slightly. Number of LCFg, normal transport: Worker: 2.1 x 10-4 Public: 1.9 x 10-5
Occupational and Public Health and Safety (Radiological)	Maximum LCFg probabilities: Worker: 3 x 10-5 Offsite population: 4 x 10-14 (air) 1 x 10-14 (water) Annual LCFg incidences: Worker: 7 x 10-5 Offsite population: 2 x 10-9	Maximum LCFg probabilities: Worker: 4 x 10-5 Offsite population: 5 x 10-14 (air) 2 x 10-14 (water) Annual LCFg incidences: Worker: 8 x 10-5 Offsite population: 2 x 10-9	Maximum LCFg probabilities: Worker: 6 x 10-5 Offsite population: 2 x 10-7 (air) 6 x 10-8 (water) Annual LCFg incidences: Worker: 3 x 10-2 Offsite population: 8 x 10-3
Occupational and Public Health and Safety (Nonradiological)	Same as Option 1.	Same as Option 1.	Hazard index: Worker: 6 x 10-3 Maximally exposed individual: 5 x 10-4
Utilities and Energy	Requirements would increase 3 to 7 percent above present levels. Current SRS capacities are adequate for these increases.	Same as Option 2a.	Very similar to Option 2a.
Materials and Waste Management	Annual average volume of waste generated (cubic meters)b: LLW: 400 TRU: 18 HLW: 0.4 No impact on site capacities.	Same as Option 2a.	Annual average volume of waste generated (cubic meters)b: LLW: 800 TRU: 19 HLW: 2.3c No impact on site capacities.

Table 3-3. (continued).

	Option 2a Dry Storage	Option 2b Wet Storage	Option 2c Processing
Accidentsd	Greatest point estimate of riske: Worker: Data not calculatedf Colocated worker: 1.6 x 10-6	Greatest point estimate of riske: Worker: Data not calculatedf Colocated worker: 1.7 x 10-6	Greatest point estimate of riske: Worker: Data not calculatedf Colocated worker: 7.7 x 10-7

	Maximally exposed individual: 3.3 x 10-7 Offsite population: 2.8 x 10-3	Maximally exposed individual: 3.5 x 10-7 Offsite population: 3.0 x 10-3	Maximally exposed individual: 1.6 x 10-7 Offsite population: 1.4 x 10-3

a. NA = not applicable.
b. LLW = low-level waste; TRU = transuranic waste; HLW = high-level waste.
c. High-level waste will be generated only during approximately the first 10 years.
d. Data is provided as adjusted point estimates of risk by receptor gr to demonstrate a relative comparison of each alternative on an opti by-option basis. The adjusted values were taken from Tables 5-27 through 5-29.
e. Units for adjusted point estimates of risk are given in terms of potential fatal cancers per year.
f. The safety analysis reports from which information was extrac written before issuance of DOE Order 5480.23; previous orders require the inclusion of workers.
g. LCF = latent cancer fatalities.

Table 3-3. (continued).

ALTERNATIVE 3 - 1992/1993 PLANNING BASIS

	Option 3a Dry Storage	Option 3b Wet Storage	Option 3c Processing
Land Use	Same as Option 2a.	Same as Option 2a.	Same as Option 2a.
Socioeconomics	Same as Option 2a.	Operations jobs would be filled by current employees. A maximum of about 650 construction jobs would be created.	Same as Option 2c.
Cultural Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Aesthetics and Scenic Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Geology	Same as Option 1.	Same as Option 1.	Same as Option 1.
Air Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Water Resources	Same as Option 2a.	Same as Option 2b.	Same as Option 2c.
Ecological Resources	Same as Option 2a.	Same as Option 2a.	Same as Option 2c.
Noise	Same as Option 2a.	Same as Option 2a.	Same as Option 2a.
Traffic and Transportation	Same as Option 2a.	Same as Option 2a.	Same as Option 2c.
Occupational and Public Health and Safety (Radiological)	Same as Option 2a.	Same as Option 2b.	Same as Option 2c.
Occupational and Public Health and Safety (Nonradiological)	Same as Option 1.	Same as Option 1.	Same as Option 2c.
Utilities and Energy	Same as Option 2a.	Same as Option 2a.	Very similar to Option 2a.

Materials and Waste Management	Same as Option 2a.	Same as Option 2a.	Annual average volume of waste generated (cubic meters)a: LLW: 750 TRU: 19 HLW: 1.7b No impact on site capacities.
Accidentsc	Greatest point estimate of riskd: Worker: Data not calculatede Colocated worker: 1.9 x 10-6 Maximally exposed individual: 4.0 x 10-7 Offsite population: 3.4 x 10-3	Same as Option 3a.	Greatest point estimate of riskd: Worker: Data not calculatede Colocated worker: 1.1 x 10-6 Maximally exposed individual: 2.3 x 10-7 Offsite population: 2.0 x 10-3

a. LLW = low-level waste; TRU = transuranic waste; HLW = high-level waste.

b. High-level waste will be generated only during approximately the first 10 years.

c. Data is provided as adjusted point estimates of risk by receptor group to demonstrate a relative comparison of each alternative on an option-by-option basis. The adjusted values were taken from Tables 5-27 through 5-29.

d. Units for adjusted point estimates of risk are given in terms of potential fatal cancers per year.

e. The safety analysis reports from which information was extracted written before issuance of DOE Order 5480.23; previous orders di require the inclusion of workers.

Table 3-3. (continued).

ALTERNATIVE 4 - REGIONALIZATION A (By Fuel Type)

	Option 4a Dry Storage	Option 4b Wet Storage	Option 4c Processing
Land Use	Same as Option 2a.	Same as Option 2a.	Same as Option 2a.
Socioeconomics	Same as Option 3b.	Same as Option 3b.	Same as Option 2c.
Cultural Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Aesthetics and Scenic Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Geology	Same as Option 1.	Same as Option 1.	Same as Option 1.
Air Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Water Resources	Same as Option 2a.	Same as Option 2b.	Very similar to Option 2c.
Ecological Resources	Same as Option 2a.	Same as Option 2a.	Same as Option 2c.
Noise	Same as Option 2a.	Same as Option 2a.	Same as Option 2a.
Traffic and Transportation	Same as Option 2a.	Same as Option 2a.	Same as Option 2c.
Occupational and Public Health and Safety	Same as Option 2a.	Same as Option 2b.	Maximum LCFa probabilities: Same as Option 2c. Annual LCFa

(Radiological)			incidences: Worker: 3 x 10-2 Offsite population: 9 x 10-3
Occupational and Public Health and Safety (Nonradiological)	Same as Option 1.	Same as Option 1.	Same as Option 2c.
Utilities and Energy	Very similar to Option 2a.	Same as Option 2a.	Very similar to Option 2a.
Materials and Waste Management	Same as Option 1.	Same as Option 1.	Annual average volume of waste generated (cubic meters)[b]: LLW: 790 TRU: 18 HLW: 2.3[c] No impact on site capacities.

Table 3-3. (continued).

	Option 4a Dry Storage	Option 4b Wet Storage	Option 4c Processing
Accidents[d]	Greatest point estimate of risk[e]: Worker: Data not calculated[f] Colocated worker: 2.1 x 10-6 Maximally exposed individual: 4.4 x 10-7 Offsite population: 3.7 x 10-3	Same as Option 3a.	Greatest point estimate of risk[e]: Worker: Data not calculated[f] Colocated worker: 1.3 x 10-6 Maximally exposed individual: 2.8 x 10-7 Offsite population: 2.4 x 10-3

a. LCF = latent cancer fatalities.

b. LLW = low-level waste; TRU = transuranic waste; HLW = high-level waste.

c. High-level waste will be generated only during approximately the first 10 years.

d. Data is provided as adjusted point estimates of risk by receptor gr to demonstrate a relative comparison of each alternative on an opti by-option basis. The adjusted values were taken from Tables 5-27 through 5-29.

e. Units for adjusted point estimates of risk are given in terms of potential fatal cancers per year.

f. The safety analysis reports from which information was extrac written before issuance of DOE Order 5480.23; previous orders require the inclusion of workers.

Table 3-3. (continued).

ALTERNATIVE 4 - REGIONALIZATION B (By Location)[a]

	Option 4d Dry Storage	Option 4e Wet Storage	Option 4f Processing
Land Use	Same as Option 2a.	Same as Option 2a.	Same as Option 2a.
Socioeconomics	Operations jobs would be filled by current employees. A maximum of about 700 construction jobs would be	Operations jobs would be filled by current employees. A maximum of about 800 construction jobs would be	Same as Option 3b.

	created.	created.	
Cultural Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Aesthetics and Scenic Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Geology	Same as Option 1.	Same as Option 1.	Same as Option 1.
Air Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Water Resources	Same as Option 2a.	Same as Option 2b.	Very similar to Option 2c.
Ecological Resources	Same as Option 2a.	Same as Option 2a.	Same as Option 2c.
Traffic and Transportation	Same as Option 2a.	Same as Option 2a.	Same as Option 2c.
Occupational and Public Health and Safety (Radiological)	Maximum LCFe probabilities: Worker: 4 x 10-5 Offsite population: 5 x 10-14 (air) 2 x 10-14 (water)	Maximum LCFe probabilities: Worker: 5 x 10-5 Offsite population: 6 x 10-14 (air) 2 x 10-14 (water)	Maximum LCFe probabilities: Worker: 7 x 10-5 Offsite population: 2 x 10-7 (air) 6 x 10-8 (water)
	Annual LCFe incidences: Worker: 8 x 10-5 Offsite population: 2 x 10-9	Annual LCFe incidences: Worker: 1 x 10-4 Offsite population: 2 x 10-9	Annual LCFe incidences: Worker: 3 x 10-2 Offsite population: 9 x 10-3
Occupational and Public Health and Safety (Nonradiological)	Hazard index: Worker: 2 x 10-6 Maximally exposed individual: 3 x 10-7	Same as Option 4d.	Hazard index: Worker: 8 x 10-3 Maximally exposed individual: 6 x 10-4
Utilities and Energy	Same as Option 2a.	Very similar to Option 2a.	Very similar to Option 2a.
Materials and Waste Management	Same as Option 1.	Same as Option 1.	Same as Option 4c.

Table 3-3. (continued).

	Option 4d Dry Storage	Option 4e Wet Storage	Option 4f Processing
Accidentsb	Greatest point estimate of riskc: Worker: Data not calculatedd Colocated worker: 2.0 x 10-6 Maximally exposed individual: 4.1 x 10-7 Offsite population: 3.5 x 10-3	Same as Option 4d	Greatest point estimate of riskc: Worker: Data not calculatedd Colocated worker: 1.2 x 10-6 Maximally exposed individual: 2.5 x 10-7 Offsite population: 2.1 x 10-3

a. Impacts for Option 4g, Ship Offsite, would be the same as for Option 5d as described in the last entry in this table.

b. Data is provided as adjusted point estimates of risk by receptor group to demonstrate a relative comparison of each alternative on an option-by-option basis. The adjusted values were taken from Tables 5-27 through 5-29.

c. Units for adjusted point estimates of risk are given in terms of potential fatal cancers per year.

d. The safety analysis reports from which information was extracted we

written before issuance of DOE Order 5480.23; previous orders did n
require the inclusion of workers.
e. LCF = latent cancer fatalities.

Table 3-3. (continued).

ALTERNATIVE 5 - CENTRALIZATION

	Option 5a Dry Storage	Option 5b Wet Storage	Option 5c Processing
Land Use	Most new construction would be in parts of F- and H-Areas already dedicated to industrial use. Additional maximum of 0.4 square kilometer (100 acres) would be converted from pine plantation to industrial use. Impacts would be minimal.	Same as Option 5a.	Same as Option 5a.
Socioeconomics	Operations jobs would be filled by present employees. A maximum of about 2,550 construction jobs would be created.	Operations jobs would be filled by present employees. A maximum of about 2,700 construction jobs would be created.	Operations jobs would be filled by present employees. A maximum of about 2,550 construction jobs would be created.
Cultural Resources	No known historical, archeological, or paleontological resources are in areas to be affected. All areas are classified as having low or moderate probability of containing archeological site. Impact is unlikely.	Same as Option 5a.	Same as Option 5a.
Aesthetics and Scenic Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Geology	Same as Option 1.	Same as Option 1.	Same as Option 1.
Air Resources	Same as Option 1.	Same as Option 1.	Same as Option 1.
Water Resources	Same as Option 2a.	Same as Option 2b.	Same as Option 2c.
	Additional groundwater withdrawals would total about 67.7 million liters (17.9 million gallons) per year. Impacts would be minimal.	Additional groundwater withdrawals would total about 69.6 million liters (18.4 million gallons) per year. Impacts would be minimal.	Same as Option 5a. Same as Option 5a.
	No perennial streams or other surface waters would be affected.	Same as Option 5a.	Accidental releases could contaminate shallow groundwater that is not used as

	Accidental releases could contaminate shallow groundwater that is not used as a source for drinking water or domestic use. Releases would not affect surface streams or drinking water aquifers.	Accidental releases could contaminate shallow groundwater that is not used as a source for drinking water or domestic use. Releases would not affect surface streams or drinking water aquifers.	a source for drinking water or domestic use. Releases would not affect surface streams or drinking water aquifers.

Table 3-3. (continued).

	Option 5a Dry Storage	Option 5b Wet Storage	Option 5c Processing
Ecological Resources	Same as Option 2a, plus Loss of up to 0.4 square kilometer (100 acres) of loblolly pine. Impacts would be minor.	Same as Option 5a.	Same as Option 5a, plus Increased disturbance due to more worker traffic. Impacts would be minor.
Noise	Same as Option 2a.	Same as Option 2a.	Same as Option 2a.
Traffic and Transportation	Same as Option 2a.	This option would increase site traffic by about 17 percent. Impacts would be small. Number of LCFsg would be same as for Option 2b for normal transport.	Same as Option 2c.
Occupational and Public Health and Safety (Radiological)	Maximum LCFg probabilities: Worker: 4 x 10-4 Offsite population: 5 x 10-13 (air) 2 x 10-13 (water) Annual LCFg incidences: Worker: 9 x 10-4 Offsite population: 2 x 10-8	Maximum LCFg probabilities: Worker: 5 x 10-4 Offsite population: 6 x 10-13 (air) 2 x 10-13 (water) Annual LCFg incidences: Worker: 1 x 10-3 Offsite population: 3 x 10-8	Maximum LCFg probabilities: Worker: 6 x 10-4 Offsite population: 2 x 10-7 (air) 6 x 10-8 (water) Annual LCFg incidences: Worker: 3 x 10-2 Offsite population: 9 x 10-3
Occupational and Public Health and Safety (Nonradiological)	Same as Option 1.	Same as Option 1.	Same as Option 2c.
Utilities and Energy	Similar to Option 2a.	Similar to Option 2a.	Requirements for electricity would increase by about 17 percent. Other increases would be similar to Option 2c. Impacts would be minor.
Materials and Waste Management	Annual average volume of waste generated (cubic	Annual average volume of waste generated (cubic	Annual average volume of waste generated (cubic

	meters)b: LLW: 400 TRU: 16 HLW: 0	meters)b: LLW: 400 TRU: 20 HLW: 2.3c	meters)b: LLW: 800 TRU: 20 HLW: 2.3c
	No impact on site capacities.	No impact on site capacities.	No impact on site capacities.

Table 3-3. (continued).

	Option 5a Dry Storage	Option 5b Wet Storage	Option 5c Processing
Accidentsd	Greatest point estimate of riske: Worker: Data not calculatedf Colocated worker: 4.0 x 10-6 Maximally exposed individual: 8.4 x 10-7 Offsite population: 7.2 x 10-3	Same as Option 5a.	Greatest point estimate of riske: Worker: Data not calculatedf Colocated worker: 3.3 x 10-6 Maximally exposed individual: 6.8 x 10-7 Offsite population: 5.8 x 10-3

a. NA = not applicable.
b. LLW = low-level waste; TRU = transuranic waste; HLW = high-level waste.
c. High-level waste will be generated only during approximately the first 10 years.
d. Data is provided as adjusted point estimates of risk by receptor gr to demonstrate a relative comparison of each alternative on an opti by-option basis. The adjusted values were taken from Tables 5-27 through 5-29.
e. Units for adjusted point estimates of risk are given in terms of potential fatal cancers per year.
f. The safety analysis reports from which information was extrac written before issuance of DOE Order 5480.23; previous orders require the inclusion of workers.
g. LCF = latent cancer fatalities.

Table 3-3. (continued).

ALTERNATIVE 5 - CENTRALIZATION
ALTERNATIVE 4 - REGIONALIZATION B

	Option 4g and Option 5db Ship Out
Land Use	Same as Option 1.
Socioeconomics	No new operations jobs and only about 200 constru jobs would be created.
Cultural Resources	Same as Option 1.
Aesthetics and Scenic Resources	Same as Option 1.
Geology	Same as Option 1.
Air Resources	Same as Option 1.
Water Resources	This option would require new withdrawals of approximately 3.0 million liters (790 thousand ga per year of cooling water from the Savannah River Impacts would be minimal. It also would require additional groundwater with of about 38.1 million liters (10.1 million gallon year. Impacts would be minimal. Impacts to surface water and groundwater would be similar to those from Option 1.
Ecological Resources	Same as Option 1.

Noise	Same as Option 2a.
Traffic and Transportation	NA[a]
Occupational and Public Health and Safety (Radiological)	Less than Option 1.
Occupational and Public Health and Safety (Nonradiological)	Same as Option 1.
Utilities and Energy	Requirements would increase 2 to 6 percent above levels during first 10 years. Current SRS capaci are adequate for these increases.
Materials and Waste Management	Annual average volume of waste generated initial years only (cubic meters)[c]: LLW: 400 TRU: 18 HLW: 0

Table 3-3. (continued).

	Option 4g and Option 5d[b] Ship Out
Accidents[d]	Greatest point estimate of risk[e]: Worker: Data not calculated[f] Colocated Worker: Option 4g: 8.1×10^{-7} Option 5d: 8.2×10^{-7} Maximally exposed individual: Option 4g: 1.7×10^{-7} Option 5d: 1.7×10^{-7} Offsite population: Option 4g: 1.4×10^{-3} Option 5d: 1.4×10^{-3}

a. NA = not applicable.
b. Impacts for Option 4g (Regionalization-B) are the same as for Option 5d.
c. LLW = low-level waste; TRU = transuranic waste; HLW = high-level waste.
d. Data is provided as adjusted point estimates of risk by receptor group to demonstrate a relative comparison of each alternative on an option-by-option basis. The adjusted values were taken from Tables 5-27 through 5-29.
e. Units for adjusted point estimates of risk are given in terms of potential fatal cancers per year.
f. The safety analysis reports from which information was extracted were written before issuance of DOE Order 5480.23; previous orders did not require the inclusion of workers.

4. AFFECTED ENVIRONMENT

4.1 Overview

This section describes the existing environment at the Savannah River Site (SRS areas. Its purpose is to support the assessment of environmental consequences of t actions regarding spent nuclear fuels described in Chapter 3. Chapter 5 describes consequences in detail.

4.2 Land Use

The SRS occupies an area of approximately 198,000 acres (800 square kilometers) South Carolina, in a generally rural area about 25 miles (40 kilometers) southeast The SRS, which is bordered by the Savannah River to the southwest, includes portion Barnwell, and Allendale Counties (Figure 2-1).

Land use on the SRS falls into three major categories: forest/undeveloped, wat developed facilities. About 181,500 acres (735 square kilometers) of the SRS area (USDA 1991a). Approximately 90 percent of this undeveloped area is forested (Cummi In 1952, an interagency agreement between the U.S. Department of Energy [DOE, which Atomic Energy Commission (AEC)] and the Forest Service, U.S. Department of Agricult an SRS forest management program. In 1972, the AEC designated the SRS as a Nationa Environmental Research Park (NERP); at present, approximately 14,000 acres (57 squa 7 percent) of the SRS area are designated as "Set-Asides," areas specifically prote environmental research activities that are coordinated either through the Universit Savannah River Ecology Laboratory (SREL) or the Savannah River Technology Center (S 1994). Administrative, production, and support facilities occupy approximately 5 p SRS land area.

DOE is considering decisions that could affect the long-range land use of the S Programmatic decisions on the reconfiguration of the nuclear weapons complex, spent interim strategies, and waste management and environmental restoration activities t significant changes in the SRS mission are in the early stages of discussion. In t however, a Land Use Technical Committee consisting of representatives from DOE, Wes Savannah River Company, and various stakeholder groups is evaluating alternative la and potential future uses. These activities are consistent with the guidelines for contained in DOE Order 4320.1B, "Site Development Planning," and in the Resource Co and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, Liability Act (CERCLA).

Land use bordering SRS is primarily forest and agricultural. There is also a s of open water and nonforested wetlands along the Savannah River valley. Incorporat areas are the only other significant use of land in the vicinity (Figure 4-1). Non in which the SRS is located has zoned any of the Site land. The only adjacent area the Town of New Ellenton, which has two zoning categories for lands that bound SRS development and residential development. The closest residences to the SRS boundar within 200 feet (61 meters) of the Site perimeter to the west, north, and northeast

Various industrial, manufacturing, medical, and farming operations are conducte surrounding the Site. Major industrial and manufacturing facilities in the area in plants producing polystyrene foam and paper products, chemical processing plants, a nuclear power plant. Farming is diversified in the region and includes crops such watermelon, cotton, soybeans, corn, and small grains.

There is a wide variety of public outdoor recreation facilities in the SRS regi Federal outdoor recreation facilities include portions of the Sumter National Fores (75 kilometers) to the northwest of the Site], the Santee National Wildlife Refuge (80 kilometers) to the east], and the Clarks Hill/Strom Thurmond Reservoir, a U.S. Engineers impoundment [43 miles (70 kilometers) to the northwest]. There are also county, and local parks in the region, most notably Redcliffe Plantation, Rivers Br Aiken County State Parks in South Carolina, and Mistletoe State Park in Georgia (HN

The SRS is a controlled area with public access limited to through traffic on S Highway 125 (SRS Road A), U.S. Highway 278, SRS Road 1, and the CSX railway. The S not contain any public recreation facilities. However, the SRS conducts controlled fall, from mid-October through mid-December; hunters can also kill feral hogs durin

Figure 4-1. Generalized land use at the Savannah River Site and vicinity. Figu

animal-vehicle accidents on SRS roads.

No onsite areas are subject to Native American treaty rights. The SRS does not prime farmland.

4.3 Socioeconomics

This section discusses baseline socioeconomic conditions within a region of inf approximately 90 percent of the SRS workforce lived in 1992. The SRS region of inf Aiken, Allendale, Bamberg, and Barnwell Counties in South Carolina, and Columbia an Counties in Georgia (Figure 4-2).

4.3.1 Employment and Labor Force

The labor force living in the region of influence increased from about 150,550 between 1980 and 1990. In 1990, approximately 75 percent of the total labor force influence lived in Richmond and Aiken Counties. Assuming a constant unemployment r percent, the regional labor force is likely to increase to approximately 257,000 by

Between 1980 and 1990, total employment in the region of influence increased fr 199,161, an average annual growth rate of approximately 5 percent. Table 4-1 lists employment data for the six-county region of influence. As shown, by 1995 employme should increase 22 percent to approximately 242,000. The unemployment rates for 19 were 7.3 percent and 4.7 percent, respectively (HNUS 1992a).

In 1990, employment at the SRS was 20,230 (DOE 1993a), representing 10 percent employment in the region of influence. In Fiscal Year 1992, employment at the SRS approximately 15 percent to 23,351, with an associated payroll of more than $1.1 bi planned budget reductions, Site employment could decline by as many as 4,200 jobs (shown in Table 4-1, this would reduce Site employment to approximately 15,800 by 19

Table 4-1. Forecast employment and population data for the Savannah River Site and influence.

Year	Labor Force (Region)	Employment (Region)	SRS Employmentb	Population (Region)
1994	254,549	239,785	21,500	456,892
1995	256,935	242,033	20,000	461,705
1996	258,500	243,507	15,800	465,563
1997	260,680	245,561	15,800	468,665
1998	263,121	247,860	15,800	471,176
1999	265,694	250,284	15,800	473,186
2000	268,430	252,861	15,800	474,820
2001	271,265	255,532	15,800	476,179
2002	274,238	258,332	15,800	477,332
2003	277,318	261,234	15,800	478,340
2004	280,415	264,151	15,800	479,182

a. Source: HNUS (1993).
b. Sources: Turner (1994), Fiori (1995).

4.3.2 Personal Income

Personal income in the six-county region has doubled during the past two decades approximately $3.4 billion in 1970 to almost $6.9 billion by 1989 (in constant 1991 Together, Richmond and Aiken Counties accounted for 75.4 percent of the personal in region of influence in 1989, because these two counties provide most of the employm in the region. Personal income in the region is likely to increase 3 percent to ap $7.1 billion by 1995 and to almost $8.2 billion by 2000 (HNUS 1992a).

4.3.3 Population

Between 1980 and 1990, the population in the region of influence increased 13 p 376,058 to 425,607. More than 88 percent of the 1990 population lived in Aiken (28 Columbia (15.5 percent), and Richmond (44.6 percent) Counties. Table 4-1 also list for the region of influence forecast to 2004. According to census data, in 1990 th number of persons per household in the six-county region was 2.72, and the median a population was 31.2 years (HNUS 1992a).

4.3.4 Housing

From 1980 to 1990, the number of year-round housing units in the six-county reg 23.2 percent from 135,866 to 167,356. In 1990, approximately 68 percent of the tot were single-family units, 18 percent were multifamily units, and 14 percent were mo the same year, the region had a 4.7-percent vacancy rate with 7,818 available unocc units. Of the available unoccupied units, 29 percent (2,267) were available for sa

(5,551) were available for rent (HNUS 1992a).

4.3.5 Community Infrastructure and Services

Public education facilities in the six-county region include 95 elementary and schools and 25 high schools. Aside from the public school systems, 42 private scho secondary facilities are available to residents in the region (HNUS 1992a).

Based on a combined average daily attendance for elementary and high school stu region of influence in 1988, the average number of students per teacher was 16. Th in Columbia County high schools where there were 19 students per teacher (1987-1988 ratio occurred in Barnwell County's District 29 high school, which had only 12 stud (1988-1989) (HNUS 1992a).

The six-county region has 14 major public sewage treatment facilities with a co capacity of 302.2 million liters (79.8 million gallons) per day. In 1989, these sy at approximately 56 percent of capacity, with an average daily flow of 170 million gallons) per day. Capacity utilization ranged from 45 percent in Aiken County to 8 Barnwell County (HNUS 1992a).

There are approximately 120 public water systems in the region of influence. A county and municipal systems are major facilities, while the remainder serve indivi water districts, trailer parks, and miscellaneous facilities. In 1989, the 40 majo combined total capacity of 576.3 million liters (152.2 million gallons) per day. W flow rate of approximately 268.8 million liters (71 million gallons) per day, these operating at 47 percent of total capacity in 1989. Facility utilization rates rang Allendale County to 84 percent in the City of Aiken (HNUS 1992a).

Eight general hospitals operate in the six-county region with a combined bed ca 2,433 (5.7 beds per 1,000 population). Four of the eight general hospitals are in Aiken, Allendale, Bamberg, and Barnwell Counties each have one general hospital. C has no hospital. In 1989, there were approximately 1,295 physicians serving the re which represents a physician-to-population ratio of 3 to 1,000. This ratio ranged per 1,000 people in Aiken and Allendale Counties to 5.4 physicians per 1,000 people County (HNUS 1992a).

Fifty-six fire departments provide fire protection services in the region of in seven of these are classified as municipal fire departments, but many provide prote outside municipal limits. The average number of firefighters in the region in 1988 1,000 people, ranging from 1.6 per 1,000 in Richmond County to 10.2 per 1,000 in Ba (HNUS 1992a).

The county sheriff departments and municipal police departments provide most la services in the region of influence. In addition, state law enforcement agents and assigned to each county provide protection and assist county and municipal law enfo In 1988, the average ratio in the region of full-time police officers employed by s local agencies per 1,000 population was 2.0. This ratio ranged from 1.4 per 1,000 County to 2.5 per 1,000 in Richmond County (HNUS 1992a).

4.3.6 Government Fiscal Structure

This section discusses the fiscal structure of Aiken and Barnwell Counties beca counties would have the greatest potential for fiscal impacts from changes at SRS.

Public services provided by Aiken County are funded principally through the cou fund. In Fiscal Year 1988, revenues and expenditures of this fund were $15.5 milli $18 million, respectively. The current property tax rate is 55.8 mills for county 8.0 mills for debt service. Long-term general obligation bond indebtedness was $9. end of Fiscal Year 1988, and reserve general obligation bond indebtedness was $5.5 assessed value of property in the county was $182.5 million in Fiscal Year 1988 (HN

Assuming revenues and expenditures increase in proportion to projected growth i employment and population, estimated revenues and expenditures for Aiken County ove from Fiscal Year 1990 to Fiscal Year 2000 will be $15.6 million to $17.0 million (i dollars) (HNUS 1992a).

Public services provided by Barnwell County also are funded principally through general fund. In Fiscal Year 1988, revenues and expenditures of this fund were $4. $4.9 million, respectively. The property tax rate is 23.9 mills of assessed valuat Year 1990 revenues were approximately $4.5 million (HNUS 1992a).

4.4 Cultural Resources

4.4.1 Archeological Sites and Historic Structures

Field studies conducted under an ongoing program over the past two decades by t Carolina Institute of Archeology of the University of South Carolina, under contrac consultation with the South Carolina State Historic Preservation Officer, have prov information about the distribution and content of archeological and historic resour the end of Fiscal Year 1992, approximately 60 percent of the Site had been examined archeological (historic and prehistoric) sites had been identified; these include 7 350 historic components, some of which are mixed (i.e., contain elements of both). 53 have been determined to be eligible for the National Register of Historic Places evaluated. Approximately 21 of the 53 (40 percent) are historic sites, such as bui none are standing structures. These sites provide knowledge of the area's history remainder are primarily prehistoric sites and some are mixed (historic and prehisto facilities have been nominated for eligibility to the National Register for Histori no plans for such a nomination at this time (Brooks 1993; Brooks 1994). The existi production facilities are not likely to be eligible for the National Register, eith lack architectural integrity, might not represent a particular architectural style, to the broad historic theme of the Manhattan Project and initial nuclear materials (DOE 1993a).

Archeologists have divided areas of the SRS into three sensitivity zones relate for containing sites with multiple archeological components or dense or diverse art potential for eligibility to the National Register of Historic Places (SRARP 1989).

- Zone 1 is the zone of the highest archeological site density with a high pr encountering large archeological sites with dense and diverse artifacts, an nomination to the National Register of Historic Places.
- Zone 2 covers areas of moderate archeological site density that should cont similar composition. Activities in this zone have a moderate probability o archeological sites, but a low probability of encountering large sites with prehistoric components. All areas within the zone are conducive to site pr zone has moderate potential for encountering sites that would be eligible f the National Register of Historic Places.
- Zone 3 covers areas of low archeological site density. Activities in this probability of encountering archeological sites and virtually no chance of sites with more than three prehistoric components; potential for site prese Some exceptions to this definition have been discovered in Zone 3, so some zone could be considered eligible for nomination to the National Register o

4.4.2 Native American Cultural Resources

In conjunction with 1991 studies related to a proposed New Production Reactor, an investigation of Native American concerns over religious rights in the Central S Valley. During this study three Native American groups - the Yuchi Tribal Organiza Council of Muskogee Creek, and the Indian People's Muskogee Tribal Town Confederacy concerns over sites and items of religious significance on the SRS. DOE has includ organizations on its environmental mailing list and sends them documents about SRS activities (NUS 1991a).

Native American resources in the region include villages or townsites, ceremoni sites, cemeteries, and areas containing traditional plants for certain rituals. Vi contain a variety of sensitive features associated with different ceremonies and ri Muskogee Creek tribes have expressed concerns that the area might contain several p used in tribal ceremonies (DOE 1993a).

4.4.3 Paleontological Resources

Invertebrate fossil remains occur within the McBean, Barnwell, and Congaree for Eocene Age (54 million to 39 million years ago) on the SRS. Relatively large quant invertebrate fossils have been recorded for the McBean and Barnwell Formations. Re

of fossil localities is difficult because the South Carolina Geological Survey has for, or registry of, important paleontological locations (DOE 1991b).

4.5 Aesthetics and Scenic Resources

The dominant aesthetic setting in the vicinity of the SRS consists mainly of ag forest, with some limited residential and industrial areas. Because of the distanc the rolling terrain, normally hazy atmospheric conditions, and heavy vegetation, SR generally visible from off the Site. The few locations that have views of some of are quite distant from the facility [5 miles (8 kilometers) or more].

SRS land is heavily wooded, and developed areas occupy only approximately 5 per total land area. The facilities are scattered across the SRS and are brightly lit reactors and principal processing facilities are large concrete structures as much (30 meters) high and usually colocated with lower administrative and support buildi lots. The facilities are visible in the direct line-of-sight when approaching them roads. A 500-foot cooling tower is located in K-Area. Otherwise, heavily wooded a the SRS road system and public highways that cross the Site limit views of the faci

4.6 Geology

The SRS is on the Upper Atlantic Coastal Plain of South Carolina, which consist 366 meters (700 to 1,200 feet) of sands, clays, and limestones of Tertiary and Cret sediments are underlain by sandstones of Triassic age and older metamorphic and ign (Arnett et al. 1993). There are no known capable faults on the SRS or volcanic act 800 kilometers (500 miles) of the Site.

4.6.1 General Geology

The SRS is in the Coastal Plain physiographic province of western South Carolin approximately 32 kilometers (20 miles) southeast of the Fall Line, which separates Coastal Plain provinces (Figure 4-3). The Coastal Plain province is underlain by a seaward-dipping and thickening unconsolidated and semiconsolidated sediments that e Fall Line to the Continental Shelf (Figure 4-4).

In South Carolina, the Coastal Plain province is divided into the Upper Coastal Lower Coastal Plain. Subdivisions of the Coastal Plain in the State include the Ai Congaree Sand Hills in the Upper Coastal Plain, and the Coastal Terraces in the Low The Congaree Sand Hills trend along the Fall Line northeast and north of the Aiken Savannah and Congaree Rivers bound the Aiken Plateau, on which the SRS is located; extends from the Fall Line to the Coastal Terraces. The surface of the plateau is characterized by broad interfluvial areas with narrow steep-sided valleys. The pla drained, although poorly drained depressions (Carolina bays) do exist (DOE 1991b). proximity of the SRS to the Piedmont province, it has more relief than areas that a coast, with onsite elevations ranging from 27 to 128 meters (89 to 420 feet) above

The sediments of the Atlantic Coastal Plain of South Carolina overlie a basemen composed of Paleozoic crystalline and Triassic sedimentary rocks. These sediments seaward from the Fall Line and range in age from Late Cretaceous to Recent. The se sequence thickens from essentially zero at the Fall Line to more than 1,219 meters coast. Regional dip is to the southeast. Coastal Plain sediments underlying the S clays and clayey sands, although occasional beds of clean sand, gravel, clay, or ca (Figure 4-5). Two clastic limestone zones occur within the Tertiary age sequence. zones vary in thickness from about 0.6 meter (2 feet) to approximately 24 meters (8 the clastic sediments are unconsolidated, but thin semiconsolidated beds also occur Underlying sediments are dense crystalline igneous and metamorphic rock or younger sediments of the Triassic Period. The Triassic formations and older igneous and me are separated hydrologically from the overlying Coastal Plain sediments by a region Appleton Confining System (Arnett et al. 1993). Section 4.8.2 contains a detailed hydrogeology on the SRS.

Figure 4-3. Location of the Savannah River Site in the southern United States. Figure 4-4. Generalized subsurface cross-section. Figure 4-5. Stratigraphy of the SRS region. 4.6.2

Geologic Resources

SRS construction activities have used clay, sand, and gravel to a limited exten are not of major economic value due to their abundance throughout the region. The has been a major user of groundwater in the region, withdrawing about 33 million li gallons) per day. Section 4.8.2 describes the groundwater resources at the SRS.

4.6.3 Seismic and Volcanic Hazards

The closest offsite fault system of significance is the Augusta Fault Zone, app 40 kilometers (25 miles) from the SRS. In this fault zone, the Belair Fault has ex recent movement, but it is not considered capable of generating major earthquakes (There is no conclusive evidence of recent displacement along any fault within 320 k miles) of the SRS, with the possible exception of the buried faults in the epicentr earthquake at Charleston, South Carolina, approximately 145 kilometers (90 miles) a 1991b). Faulting in the subsurface Coastal Plain sediments in the Charleston vicin suggested, based on structure contour mapping of the Eocene-Oligocene unconformity, depth of about 30 to 61 meters (100 to 200 feet) below ground surface (WSRC 1994a). because it is not known if these faults offset sediments younger than Eocene-Oligoc faults cannot be related to modern earthquakes that occur at depths greater than ab (1.2 miles). Figure 4-6 shows the geologic structures within 150 kilometers (95 mi some of which are discussed above.

Several Triassic-Jurassic basins, 140 to 230 million years old, have been ident Plain province of South Carolina and Georgia. The Dunbarton Triassic basin, which portion of the SRS, was formed by fault movement resulting from extensional forces the formation of the Atlantic Ocean. After the erosion of basin margins and infill Triassic age sediments, possible movement of an opposite sense to that during basin occurred along the fault during the Late Cretaceous age. Geophysical data indicate on faults at the basement-Coastal Plain interface, with the exception of possible r along the Pen Branch Fault up into the Tertiary (WSRC 1994a).

Figure 4-6. Geologic structures within 150 km of SRS (Source: DOE 1991b). Resea central portion of the SRS (Snipes et al. 1993). This fault is probably a continua boundary fault of the Triassic age Dunbarton basin and is interpreted as being at l Cretaceous/Tertiary (144-1.6 million years) reactivation of that fault (WSRC 1994a) displacements of the Coastal Plain sediments range from about 26 meters (85 feet) a Basement/Cretaceous contact to about 9 meters (30 feet) in the shallower sediments Based on the available data, there is no evidence to indicate that the Pen Branch i defined by the U.S. Nuclear Regulatory Commission (NRC). Under the NRC definition, capable if it has moved within the last 35,000 years, has had recurring movement wi 500,000 years, is related to any earthquake activity, or is associated with another recent study (Snipes et al. 1993) examined a Quaternary light tan soil horizon in S The soil horizon, which has a thickness of 3 to 6 meters (10 to 20 feet), revealed indicating that there has been no recent Pen Branch Fault activity. Figure 4-7 sho the Pen Branch Fault and other known or suspected faults within the Paleozoic and T (DOE 1991b).

Seismicity in the Coastal Plain of South Carolina occurs in three distinct seis Charleston area (WSRC 1994a): Middleton Place-Summerville, about 19 kilometers (12 northwest of Charleston; Bowman, about 59 kilometers (37 miles) northwest of the Mi Place-Summerville; and Adams Run, about 30 kilometers (19 miles) southwest of the M Place-Summerville (WSRC 1994a). Of the distinct seismic zones within the Coastal P the Charleston area has been and remains the most seismically active. The Charlest most significant source of seismicity affecting the SRS, both in terms of maximum h intensity and the number of earthquakes felt in the area (WSRC 1994a).

Tables 4-2 and 4-3 summarize the historic information on earthquakes that have SRS region. Two notable earthquakes have occurred within 320 kilometers (200 miles The first was a major earthquake in 1886 centered in the Charleston area about 145 (90 miles) from the Site; it had an estimated Richter magnitude of 6.8. DOE estima would have felt a tremor with an estimated Modified Mercalli Intensity (MMI) of VI estimated peak horizontal acceleration of 10 percent of gravity, or 0.10g, due to t (WSRC 1994a). The second earthquake was the Union County, South Carolina, earthqua which had an estimated Richter magnitude of 6.0 and occurred about 160 kilometers (the SRS (WSRC 1994a). This earthquake, which is the closest significant event to t

Figure 4-7. Geologic faults of the Savannah River Site. Table 4-2. Earthquakes

Dateb	Location	Coordinates Lat. (yN)	Long. (yW)	Maximum Intensity	Distance from SRS (km)c
1811 Jan 13	Burke Co., Ga.	33.2	82.2	V	55
1811-1812 (3 shocks)	New Madrid, Mo.	36.3	89.5	XI-XII	850
1875 Nov 02	Lincolnton, Ga.	33.8	82.5	VI	100
1886 Sep 02	Charleston, S.C.	32.9	80.0	X	145
1886 Oct 22	Charleston, S.C.	32.9	80.0	VII	155
1897 May 31	Giles Co., Va.	33.0	80.7	VIII	455
1913 Jan 01	Union Co., S.C.	34.7	81.7	VII-VIII	160
1920 Aug 01	Charleston, S.C.	33.1	80.2	VII	135
1972 Feb 03	Bowman, S.C.	33.5	80.4	V	115
1974 Aug 02	Willington, S.C.	33.9	82.5	VI	105
1974 Nov 22	Charleston, S.C.	32.9	80.1	VI	145

a. Source: DOE (1991b).
b. Based on Greenwich mean time.
c. Conversion factor: 1 kilometer = 0.6214 mile.
d. NA = data not available.
e. Estimated.

Table 4-3. Earthquakes in the SRS region with a Modified Mercalli Intensity greate

Dateb	Coordinates Lat. (yN)	Long. (yW)	Maximum Intensity	Distance from SRS (km)c	Reporte Estimat Intensi SRS
1811 Jan 13d	33.2	82.2	V	55	III-IV
1853 May 20	34.0	81.2	VI	102	NA
1945 Jul 26	33.8	81.4	V	77	NA
1964 Mar 07	33.7	82.4	NA	85	NA
1964 Apr 20	33.8	81.1	V	96	NA
1968 Sep 22	34.1	81.5	IV	102	NA
1972 Aug 14	33.2	81.4	NA	27	NA
1974 Oct 28	33.8	81.9	IV	72	NA
1974 Nov 05	33.7	82.2	III	77	NA
1976 Sep 15	33.1	81.4	NA	25	NA
1977 Jun 05	3.1	81.4	NA	35	NA
1982 Jan 28	32.9	81.4	NA	40	NA
1985 Jun 08	33.2	81.7	III	Onsite	III
1988 Feb 17f	33.6	81.7	III	45	NA
1988 Aug 05	33.1	81.4	NA	Onsite	II
1993 Aug 08	NA	NA	NA	NA	NA

a. Source: DOE (1991b).
b. Based on Greenwich mean time.
c. Conversion factor: 1 kilometer = 0.6214 mile.
d. Located in Burke County, Ga.
e. NA = data not available.
f. Located at Aiken, S.C.

the Charleston-area earthquake, produced an estimated intensity of II to III (MMI) Aiken, which is approximately 19 kilometers (12 miles) north of the Site (DOE 1991b

Two earthquakes have occurred on the SRS during recent years (see Figure 4-7). 1985, onsite instruments recorded an earthquake with a Richter magnitude of 2.6 and about 1.0 kilometer (0.6 mile) (WSRC 1994a). The epicenter was just west of the C- The ground acceleration from this event did not activate instrumentation in the rea limits of 0.002g). On August 5, 1988, an earthquake with a Richter magnitude of 2. depth of approximately 2.7 kilometers (1.7 miles) occurred (Stephenson 1988); earth magnitude 2.0 are normally detected only by specialized instrumentation. The epice was just northeast of K-Area. Although this event was not felt by workers on the S recorded by sensors within 96 kilometers (60 miles) of the Site. A report on the A earthquake (Stephenson 1988) also reviewed the latest earthquake history for the re

predicts recurrence period of 1 year for a magnitude 2.0 event for the southeast Co However, the report notes that historic data to calculate recurrence rates accurate workers did feel the effects of two other events that occurred in the area within t Richter magnitude 2.6 earthquake occurred in the City of Aiken, approximately 19 ki (12 miles) north of the SRS on February 17, 1988. Reports indicate that this event Aiken area and on the SRS (DOE 1991b). Most recently, a Richter magnitude 3.2 eart occurred on August 8, 1993, approximately 16 kilometers (10 miles) east of the City Couchton, South Carolina. Residents reported feeling this earthquake in Aiken, New (immediately north of the SRS), North Augusta (approximately 40 kilometers [25 mile the SRS), and the Site.

Based on seismic activity information in the past 300 years, this analysis does earthquakes greater than a Richter magnitude 6.0, which corresponds to a Modified M of VII, to occur on the SRS. The design-basis earthquake for the SRS is a Modified Intensity VIII event, which corresponds to a horizontal peak ground acceleration of current technology, as applied in various probabilistic evaluations of the seismic region, the 0.2g peak ground acceleration can be associated with a 2 x 10-4 annual exceedance (5,000-year return period). DOE Standards 1020 (DOE 1994a) and 1024 (DO summarize the results of recent seismic analyses at DOE sites and show that maximum ground accelerations for the Savannah River Site for 500 year, 1,000 year, 2,000 ye seismic events are 0.10g, 0.13g, 0.18g, and 0.19g respectively. The seismic hazard presented in this EIS is for general seismic hazard comparisons across DOE sites. hazards for existing and new facilities should be evaluated on a facility-specific DOE Orders and standards and site-specific standards.

Historically, DOE has generally selected the more conservative 0.20g as the pea acceleration for the 5,000 year seismic event when preparing safety analysis report impact statements for the SRS. For consistency with these existing analyses, this impact statement assumes 0.20g to be the peak horizontal ground acceleration that w the 5,000 year seismic event. Figure 4-8 shows seismic hazard curves for the SRS.

A number of paleoliquefaction sites have been identified in Beaufort County, So some 50 miles (80 kilometers) southeast of the SRS, indicating a likelihood of preh events outside of the currently-active Charleston seismic zone (Rajendran and Talwa no evidence to suggest that seismically-induced liquefaction of soils represents a however. Weak subsurface zones are encountered occasionally during drilling. Thes associated with carbonate materials and appear to be related to dissolution of thes

Engineering investigations have been conducted on granular soils underlying the Processing Facility [in S-Area just north of H-Area (see Figure 2-3)] to evaluate t (liquefaction under cyclic stresses) of these soils (WSRC 1992b). These investigat the sands and clayey sands throughout the subgrade will not experience liquefaction leading to bearing capacity failures) and will not develop cyclic mobility (signifi accumulate deformations) under the safe shutdown earthquake with a peak horizontal acceleration of 0.20g (9.8 meters/second2 or 32.1 feet/second2).

4.7 Air Resources

4.7.1 Meteorology and Climatology

The SRS collects wind data from instruments mounted on seven onsite 61-meter (2 meteorological towers. Figure 4-9 shows a wind rose that represents annual wind di and wind speeds for the SRS from 1987 through 1991. The maximum wind directional f are from the northeast and west-southwest. The average wind speed for this 5-year 3.8 meters per second (8.5 miles per hour). Calm winds (less than 1 meter per sec per hour) occurred less than 10 percent of the time during the 5-year period. Seas Figure 4-8. Seismic hazard curves for the SRS. Figure 4-9. Wind Rose. were gr summer at 3.4 meters per second (7.6 miles per hour) (WSRC 1994a).

The annual average temperature at the SRS is 18 degrees C (64 degrees F); month range from a low of 7 degrees C (45 degrees F) in January to a high of 27 degrees C in July. Relative humidity readings taken four times each day range from 36 percen 98 percent in August (DOE 1991a).

The average annual precipitation at the SRS is approximately 122 centimeters (4 Precipitation distribution is fairly even throughout the year, with the highest pre summer [36.1 centimeters (14.2 inches)] and the lowest in autumn [22.4 centimeters Snowfall has occurred in the months of October through March, with the average annu

3.0 centimeters (1.2 inches). Large snowfalls are rare (DOE 1991a).

Winter storms in the SRS area occasionally bring strong and gusty surface winds high as 32 meters per second (72 miles per hour). Thunderstorms can generate winds high as 18 meters per second (40 miles per hour) and even stronger gusts. The fast speed recorded at Augusta between 1950 and 1986 was 37 meters per second (83 miles (DOE 1991a).

4.7.1.1 Occurrence of Violent Weather. The SRS area experiences an average of 56

thunderstorm days per year. From 1954 to 1983, 37 tornadoes were reported for a 1-latitude and longitude that includes the SRS (DOE 1991a). This frequency of occurr to an average of about one tornado per year. The estimated probability of a tornad on the SRS is 7 x 10-5 per year (DOE 1991a). Since operations began at the SRS in confirmed tornadoes have occurred on or near the Site. They caused nothing more th with the exception of a tornado in October 1989 that caused considerable damage to an undeveloped southeastern sector of the SRS (WSRC 1994a).

From 1700 to 1992, 36 hurricanes occurred in South Carolina, resulting in an av of about one hurricane every 8 years. Three hurricanes were classified as major. about 160 kilometers (100 miles) inland, the winds associated with hurricanes have below hurricane force [i.e., equal to or greater than a sustained wind speed of 33. (75 miles per hour)] before reaching the SRS. Winds exceeding hurricane force have only once at SRS (Hurricane Gracie in 1959) (WSRC 1994a).

4.7.1.2 Atmospheric Stability. Based on measurements at onsite meteorological stations, the

atmosphere in the SRS region is unstable approximately 56 percent of the time, neut the time, and stable about 21 percent of the time. On an annual basis, inversion c 21 percent of the time at the SRS (WSRC 1994a).

4.7.2 Nonradiological Air Quality

4.7.2.1 Background Air Quality. The SRS is in the Augusta (Georgia) - Aiken (South

Carolina) Interstate Air Quality Control Region (AQCR). This Air Quality Control R designated as a Class II area, is in compliance with National Ambient Air Quality S for criteria pollutants. The criteria pollutants include sulfur dioxide, nitrogen nitrogen dioxide, particulate matter (less than or equal to 10 microns), carbon mon lead (CFR 1993a). The closest nonattainment area to the SRS is the Atlanta, Georgi region, 233 kilometers (145 miles) to the west, which is in nonattainment of the st

The SRS will have to comply with Prevention of Significant Deterioration (PSD) requirements if there is a significant increase in emissions of criteria air pollut modification at the Site (CFR 1993b). Development at the SRS has not yet triggered Significant Deterioration permitting requirements. If a permit were required, the address several requirements, including impacts on the air quality of Class I areas (6.2 miles) of the Site (CFR 1993b). The nearest Class I area to the SRS is the Co National Monument in South Carolina, approximately 73 kilometers (45 miles) to the the Site. Therefore, a Prevention of Significant Deterioration permit, if require not have to address Class I areas.

4.7.2.2 Air Pollutant Source Emissions. The SRS utilized the 1990 comprehensive

emissions inventory data to establish the baseline year for showing compliance with air quality standards - calculating both maximum potential and actual emission rate compliance demonstration also included sources forecast for construction or operati (for which the SRS had obtained air quality construction permits through December 1 based its calculated emission rates for the sources on process knowledge, source te operating capacity, material balance, and U.S. Environmental Protection Agency (EPA Emission Factors (AP-42; EPA 1985).

4.7.2.3 Ambient Air Monitoring. At present, the SRS performs no onsite ambient air quality

monitoring. State agencies operate ambient air quality monitoring sites in Barnwel Richmond Counties. These areas, which include the SRS, are in attainment with Nati Air Quality Standards for sulfur dioxide, nitrogen oxides, carbon monoxide, particu and lead (CFR 1993a).

4.7.2.4 Atmospheric Dispersion Modeling. The SRS has performed atmospheric

dispersion modeling for criteria and toxic air pollutants for both maximum potentia emissions for the base year 1990, using the EPA Industrial Source Complex Short Ter The SRS used 1991 meteorological data collected at the Site meteorological stations model.

4.7.2.5 Summary of Nonradiological Air Quality. The SRS is in compliance with

National Ambient Air Quality Standards and with the gaseous fluoride and total susp standards required by South Carolina Department of Health and Environmental Control Regulation R.61-62.5, Standard 2, "Ambient Air Quality Standards" (AAQS) (see Table

The SCDHEC has non-radiological air quality regulatory authority over the SRS. Department determines SRS ambient air quality compliance based on SRS air pollutant modeled at the Site perimeter (excluding SC Highway 125, which crosses the southwes the SRS).

The SRS is in compliance with SCDHEC Regulation R.61-62.5, Standard 8, "Toxic A Pollutants," which regulates the emission of 257 toxic substances. The SRS has ide sources for 139 of the 257 regulated substances; the modeled results indicate that applicable Department of Health and Environmental Control standards (WSRC 1993a). SRS emissions of toxic air pollutants of concern related to the SRS spent nuclear f based on 1990 baseline data and the potential sources of air pollution permitted fo operation in December 1992.

4.7.3 Radiological Air Quality

4.7.3.1 Background and Baseline Radiological Conditions. In the SRS region, airborne

radionuclides originate from natural resources (terrestrial or cosmic), worldwide f operations. The SRS maintains a network of air monitoring stations on and around t

Table 4-4. Estimated ambient concentration contributions of criteria air pollutant sources and sources planned for construction or operation through 1995 (-g/m3). ,b

Pollutantc	Averaging time	SRS Maximum Potential Concentration	Actual	Most string AAQSd (Fede or state)
SO2	Annual	18	10	80f
	24-hour	356	185	365f,g
	3-hour	1,210	634	1,300f,g
NOx	Annual	30	4	100f
CO	8-hour	818	23	10,000f,g
	1-hour	3,553	180	40,000f,g
Gaseous fluorides	12-hour	2.40	0.62	3.7e
(as HF)	24-hour	1.20	0.31	2.9e
	1-week	0.6	0.15	1.6e
	1-month	0.11	0.03	0.8e
PM10	Annual	9	3	50f
	24-hour	93	56	150f
O3	1-hour	NA	NA	235f,g
TSP	Annual geometric mean	20	11	75e
Lead	Calendar	0.0015	0.0003	1.5e

quarter
mean

a. Source: WSRC (1994b).
b. The contributions listed are the maximum values at the SRS boundary.
c. SO2 = sulfur dioxide; NOx = nitrogen oxides; CO = carbon monoxide; PM10 = partic 10-m in diameter; TSP = Total Suspended Particulates, O3 = Ozone.
d. AAQS = Ambient Air Quality Standard.
e. Source: SCDHEC (1976).
f. Source: 40 CFR Part 50.
g. Concentration not to be exceeded more than once a year.
NA = Not available.

Table 4-5. Baseline 24-hour average modeled concentrations at the SRS boundary - t pollutants regulated by South Carolina from existing SRS sources and sources planne or operation through 1995 (yg/m3).

Pollutantb	Regulatory Limit	Maximum Potential Concentrationc	Actual Concentrationd	Maximum Potential Concentra Percent o
Nitric acid	125	51	4.0	41
1,1,1-Trichloroethane	9,550	81	22	1
Benzene	150	32	31	21
Ethanolamine	200	<0.01	<0.01	<0.1
Ethyl benzene	4,350	0.58	0.12	<0.1
Ethylene glycol	650	0.20	0.08	<0.1
Formaldehyde	7.5	<0.01	<0.01	<0.1
Glycol ethers	Pending	<0.01	<0.01	-
Hexachloronapthalene	1	<0.01	<0.01	<0.1
Hexane	200	0.21	0.072	<0.1
Manganese	25	0.82	0.10	3
Methyl alcohol	1,310	2.9	0.51	0.2
Methyl ethyl ketone	14,750	6.0	0.99	<0.1
Methyl isobutyl ketone	2,050	3.0	0.51	<0.1
Methylene chloride	8,750	10.5	1.8	<0.1
Naphthalene	1,250	0.01	0.01	<0.1
Phenol	190	0.03	0.03	<0.1
Phosphorus	0.5	<0.001	<0.001	<0.1
Sodium hydroxide	20	0.01	0.01	<0.1
Toluene	2,000	9.3	1.6	<0.1
Trichloroethylene	6,750	4.8	1.0	<0.1
Vinyl acetate	176	0.06	0.02	<0.1
Xylene	4,350	39	3.8	0.9

a. Source: WSRC (1994b).
b. Pollutants listed include compounds of interest regarding spent nuclear fuel alt
c. Maximum potential emissions from all SRS sources for 1990 plus maximum potential for sources permitted in 1991 and 1992.
d. Actual emissions from all SRS sources plus maximum potential emissions for sourc construction through December 1992.
e. AAQS = Ambient Air Quality Standard.

determine concentrations of radioactive particulates and aerosols in the air (Arnet Table 4-6 lists average and maximum atmospheric radionuclide concentrations at the **and background [160-kilometer (100-mile) radius] monitoring locations during 1991.** the average concentrations of tritium in the atmosphere, as measured at on- and off locations.

Table 4-6. Radioactivity in air at SRS perimeter and at 160-kilometer (100-mile) r

Location	Gross Alpha	Nonvolatile Beta	Sr-89,90b	Pu-238b
Site perimeter				
Average	2.61x10-3	1.78x10-2	4.90x10-5	1.22x10-6
Maximum	1.07x10-2	4.63x10-2	5.11x10-4	1.94x10-5
Background (160-kilometer radius)				
Average	2.60x10-3	1.76x10-2	2.00x10-4	1.44x10-6

Maximum	9.31x10-3	5.26x10-2	2.08x10-3	2.39x10-5

a. Source: Arnett et al. (1992).
b. Monthly composite.

Table 4-7. Average atmospheric tritium concentrations on and around the Savannah R (pCi/m3).

Location	1991	1990	1989
Onsite	250	430	640
Site perimeter	21	32	37
40-kilometer radius	11	12	14
160-kilometer radius	8.5	8.8	9

a. Source: Arnett et al. (1992).

4.7.3.2 Sources of Radiological Emissions. Table 4-8 lists groups of facilities that

released radionuclides to the atmosphere in 1992; the facilities are grouped accord function that resulted in the release of radioactive materials.

Table 4-9 lists both the identified radionuclides that contributed to the SRS d contribution of each radionuclide to the total site effective dose equivalent.

Table 4-8. Operational groupings and function of radionuclide sources.

Group	Function
Reactor Materials	Production of fuel and targets
Reactors	Irradiation of fuel and targets
Separations	Separation of useful radionuclides (other than t
Analytical Laboratories	Process Control Laboratories
Tritium	Extraction, purification, and packaging
Waste Management	Management of radioactive waste
Savannah River Technology Center	Research and development to support SRS processe

4.8 Water Resources

4.8.1 Surface Water

The Savannah River bounds the SRS on its southwestern border for about 20 miles (32 kilometers), approximately 160 river miles (260 kilometers) from the Atlantic O river flow averages about 10,000 cubic feet (283 cubic meters) per second. River f 3,960 cubic feet (112 cubic meters) per second to 71,700 cubic feet (2,030 cubic me

Five upstream reservoirs - Jocassee, Keowee, Hartwell, Richard B. Russell, and - minimize the effects of droughts and the impacts of low flow on downstream water and wildlife resources in the river.

At the SRS, a swamp occupies the floodplain along the Savannah River for a dist approximately 10 miles (17 kilometers); the swamp is about 1.5 miles (2.5 kilometer natural levee separates the river from the swampy floodplain. Figure 4-10 shows th floodplain of the Savannah River in the vicinity of the SRS as well as the floodpla tributaries draining the SRS. A 500-year floodplain map of the SRS has not been co would be required prior to the siting of any spent nuclear fuel management faciliti with DOE regulations (CFR 1979). These regulations require DOE to evaluate the pot flooding to proposed "critical actions" (for example, the storage of highly toxic o materials), which it defines as those for which even a slight chance of flooding wo

The five principal tributaries to the river on the SRS are Upper Three Runs Cre Branch, Pen Branch, Steel Creek, and Lower Three Runs Creek (Figure 4-10). These t

Table 4-9. Annual quantity of radionuclide emissions from the Savannah River Site.

Radionuclide	Annual Quantity (curies)	Percent of Total Site Dose
H-3 (oxide)	1.00x105	98.0
Pu-239	7.45x10-4	0.6
U-235,238	1.58x10-3	0.4
Pu-238	4.46x10-4	0.3
Ar-41	2.51x102	0.3
I-129	3.50x10-3	0.2
Am-241,243	1.13x10-4	0.1
Sr-89,90 (Y-90)	2.03x10-3	0.02
Cm-242,244	2.31x10-5	0.01
Cs-137 (Ba-137m)	2.50x10-4	0.01

C-14	1.86x10-1	0.01
H-3 (elemental)	5.59x104	<0.01
I-135	1.34x10-1	<0.01
Kr-85	4.99x101	<0.01
I-131	9.99x10-5	<0.01
Ru-106 (Rh-106)	1.81x10-6	<0.01
I-133	1.15x10-3	<0.01
Co-60	3.60x10-7	<0.01
Xe-135	2.43x10-3	<0.01
Cs-134	3.75x10-8	<0.01
Ce-144 (Pr-144,144m)	1.16x10-7	<0.01
Eu-154	3.44x10-13	<0.01
Eu-155	1.63x10-13	<0.01
Sb-125	7.27x10-15	<0.01
Zr-95 (Nb-95)	2.39x10-14	<0.01

a. Source: Arnett et al. (1993).
b. Includes emissions to the atmosphere and surface water.

Figure 4-10. Savannah River Site, showing major stream systems and facilities. a descends 50 to 200 feet (15 to 60 meters) before discharging into the river. The s historically have received varying amounts of effluent from various SRS operations, commercial sources of water. The natural flow of SRS streams ranges from less than (1 cubic meter) per second in smaller streams such as Pen Branch to 240 cubic feet per second in Upper Three Runs Creek.

4.8.1.1 SRS Streams. This section describes the pertinent physical and hydrologic properties

of Upper Three Runs Creek and Fourmile Branch, which are the streams closest to mos nuclear fuel management locations (Figure 4-10). These two streams are among the l SRS, and they border the areas where DOE is most likely to locate new spent nuclear

Upper Three Runs Creek is a large, cool [annual maximum temperature of 26.1 deg (79 degrees F)] blackwater stream in the northern part of the SRS. It drains an ar 210 square miles (545 square kilometers), and has an average discharge of 330 cubic meters) per second at the mouth of the creek. Upper Three Runs Creek is approximat (40 kilometers) long, with its lower 17 miles (28 kilometers) inside the boundaries creek receives more water from underground sources than the other SRS streams and, low conductivity, hardness, and pH values. Upper Three Runs Creek is the only majo the SRS that has never received thermal discharges.

Fourmile Branch is about 15 miles (24 kilometers) long and drains an area of ap 34 square miles (89 square kilometers). In its headwaters, Fourmile Branch is a sm stream that receives relatively few impacts from SRS operations. The water chemist headwater area of the creek is very similar to that of Upper Three Runs Creek, with nitrate concentrations, which are an order of magnitude higher than those in Upper (WSRC 1994a). These elevated nitrate concentrations are probably the result of gro and outcropping from the F- and H-Area seepage basins. In its lower reaches, Fourm broadens and flows through a delta formed by the deposition of sediments. Although through the delta is in one main channel, the delta has many standing dead trees, l cypress trees that provide structure and reduce the water velocity in some areas. delta, the creek flows in one main channel and most of the flow discharges into the River Mile 152 (kilometer 245), while a small portion of the creek flows west and e Creek, a small onsite tributary.

4.8.1.2 Surface Water Quality. The Savannah River, which forms the boundary between the

States of Georgia and South Carolina, supplies potable water to several users. Ups the river supplies domestic and industrial water needs for Augusta, Georgia, and No Carolina. The river also receives sewage treatment plant effluent from Augusta, Ge Augusta, Aiken, and Horse Creek Valley, South Carolina; and as described above from SRS operations via onsite stream discharges. Approximately 130 river-miles (210 ki downstream of the SRS, the river supplies domestic and industrial water needs for S and Beaufort and Jasper Counties in South Carolina through intakes located at about and River Mile 39. In addition, Georgia Power's Vogtle Electric Generating Plant w average of 1.3 cubic meters per second (46 cubic feet per second) for cooling and r of 0.35 cubic meters per second (12 cubic feet per second) of cooling tower blowdow

Urquhart Steam Generating Station at Beech Island, South Carolina withdraws approxi meters per second (265 cubic feet per second) for once-through cooling water.

The South Carolina Department of Health and Environmental Control regulates the properties and concentrations of chemicals and metals in SRS effluents under the Na Discharge Elimination System (NPDES) program. This agency also regulates chemical water quality standards for SRS waters. On April 24, 1992, the agency changed the the Savannah River and SRS streams from "Class B waters" to "Freshwaters." The def Class B waters and Freshwaters are the same, but the Freshwaters classification imp stringent set of water quality standards (Arnett et al. 1993). Tables 4-10 and 4-1 characteristics of SRS surface-water quality upstream and downstream, respectively, contributions from SRS and possibly other sources. A comparison of these results i influences from SRS or other sources are not seriously degrading Savannah River wat

4.8.2 Groundwater Resources

4.8.2.1 Hydrostratigraphic Units. There are two hydrogeologic provinces in the subsurface

beneath SRS (WSRC 1994a). The first, referred to as the Piedmont hydrogeologic pro (Figure 4-11), includes Paleozoic metamorphic and igneous basement rocks and Triass mudstone, sandstone, and conglomerate contained within the Dunbarton Basin. The se to as the Southeastern Coastal Plain hydrogeologic province, represents the major a consists of a wedge of unconsolidated Coastal Plain sediments of Late Cretaceous an (Figure 4-11). These two units are overlain by the vadose or unsaturated zone, whi

Table 4-10. Water quality in the Savannah River above the confluence with Upper Th the Savannah River Site in 1990. ,b

Parameter	Unit of Measure	MCL c,d or DCGe	Existing Water Average
Aluminum	mg/L	0.05-0.2g	NCi
Ammonia	mg/L	NAj	0.1
Cadmium	mg/L	0.005g	NC
Calcium	mg/L	NA	NC
Cesium-137	pCi/L	120e	0.0088
Chemical oxygen demand	mg/L	NA	9.7
Chloride	mg/L	250h	7.8
Chromium	mg/L	0.1d	NC
Copper	mg/L	1.0d	NC
Dissolved oxygen	mg/L	>5	8.0
Fecal coliform	Colonies per 100/ml	1,000g	54
Gross alpha	pCi/L	15g	0.04
Ironc	mg/L	0.3h	NC
Lead	mg/L	0.015g	NC
Magnesium	mg/L	NA	NC
Manganesec	mg/L	0.05g	NC
Mercury	mg/L	0.002d	NC
Nickel	mg/L	0.1c	NC
Nitrite/Nitrate	mg/L	10g	0.32
Nonvolatile beta (dissolved)	pCi/L	50g	1.9
pH	pH Units	6.5-8.5g	Not reported
Phosphate	mg/L	N/A	0.09
Plutonium-238	pCi/L	1.6e	0.0006
Plutonium-239	pCi/L	1.2e	0.0005
Sodium	mg/L	NA	NC
Strontium-89	pCi/L	800e	0.23
Strontium-90	pCi/L	8c	0.09
Sulfate	mg/L	250h	7.8
Suspended solids	mg/L	NA	13
Temperature	Degrees Celsius	32.2k	18.0
Total dissolved solids	mg/L	500h	62
Tritium	pCi/L	20,000c	150
Zinc	mg/L	5h	NC

a. Source: Cummins et al. (1991).
b. Parameters are those for which DOE routinely measures as a regulatory requiremen
c. Maximum Contaminant Level (MCL), EPA National Primary Drinking Water Regulations

d. Maximum Contaminant Level (MCL); South Carolina (1976).
e. U.S. Department of Energy Derived Concentration Guides (DCGs) for Water (DOE 199 effective dose of 100 millirem per year; however, because drinking water MCL is percent of DCG.
f. Average concentration of samples taken at downstream monitoring station. Maximu river potentially affected by site activities. Less than (<) indicates concentr
g. Concentration exceeded water quality criteria; however, these criteria are liste and DOE DCGs are listed. Water Quality Criteria (WQCs) and secondary standards
h. Secondary Maximum Contaminant Level (SMCL), EPA National Secondary Drinking Wate
i. NC = Not calculated due to insufficient number of samples.
j. NA = None applicable.
k. Shall not exceed weekly average of 32.2 degrees Celsius after mixing nor rise mo temperature criterion mixing zone has been established.

Table 4-11. Water quality in the Savannah River below the confluence with Lower Th the Savannah River Site in 1990. ,b

Parameter	Unit of Measure	MCL c,d or DCGe	Existing Water Average
Aluminum	mg/L	0.05-0.2g	NCi
Ammonia	mg/L	NAj	0.1
Cadmium	mg/L	0.005g	NC
Calcium	mg/L	NA	NC
Cesium-137	pCi/L	120e	0.028
Chemical oxygen demand	mg/L	NA	9.8
Chloride	mg/L	250h	8
Chromium	mg/L	0.1d	NC
Copper	mg/L	1.0d	NC
Dissolved oxygen	mg/L	>5	7.7
Fecal coliform	Colonies per 100/ml	1,000g	54
Gross alpha	pCi/L	15g	0.08
Ironc	mg/L	0.3h	NC
Lead	mg/L	0.015g	NC
Magnesium	mg/L	NA	NC
Manganesec	mg/L	0.05h	NC
Mercury	mg/L	0.002d	NC
Nickel	mg/L	0.1c	NC
Nitrite/Nitrate	mg/L	10g	0.28
Nonvolatile beta (dissolved)	pCi/L	50g	2.1
pH	pH Units	6.5-8.5h	Not reported
Phosphate	mg/L	N/A	0.1
Plutonium-238	pCi/L	1.6e	0.0006
Plutonium-239	pCi/L	1.2e	0.0014
Sodium	mg/L	NA	NC
Strontium-89	pCi/L	800e	0.25
Strontium-90	pCi/L	8c	0.13
Sulfate	mg/L	250h	8.5
Suspended solids	mg/L	NA	12
Temperature	Degrees Celsius	32.2k	18.0
Total dissolved solids	mg/L	500h	63
Tritium	pCi/L	20,000c	900
Zinc	mg/L	5h	NC

a. Source: Cummins et al. (1991).
b. Parameters are those for which DOE routinely measures as a regulatory requiremen
c. Maximum Contaminant Level (MCL), EPA National Primary Drinking Water Regulations
d. Maximum Contaminant Level (MCL); South Carolina (1976).
e. U.S. Department of Energy Derived Concentration Guides (DCGs) for Water (DOE 199 effective dose of 100 millirem per year; however, because drinking water MCL is percent of DCG.
f. Average concentration of samples taken at downstream monitoring station. Maximu river potentially affected by site activities. Less than (<) indicates concentr
g. Concentration exceeded water quality criteria; however, these criteria are liste and DOE DCGs are listed. Water Quality Criteria (WQCs) and secondary standards
h. Secondary Maximum Contaminant Level (SMCL), EPA National Secondary Drinking Wate
i. NC = Not calculated due to insufficient number of samples.
j. NA = None applicable.

k. Shall not exceed weekly average of 32.2 degrees Celsius after mixing nor rise mo temperature criterion mixing zone has been established.

Figure 4-11. Comparison of lithostratigraphy and hydrostratigraphy for the SRS r

or silty sand through which recharge takes place.

The sediments that make up the Southeastern Coastal Plain hydrogeologic provinc west-central South Carolina are grouped into three major aquifer systems divided by confining systems, all of which are underlain by the Appleton confining system (Fig Appleton system separates the Southeastern Coastal Plain hydrogeologic province fro Piedmont hydrogeologic province. Locally, each of the major aquifer systems contai aquifer and confining units. Figure 4-11 shows the regional lithostratigraphy of t with the attendant primary hydrostratigraphic subdivision of the province. The com strata that form the three aquifer systems consist primarily of fine- to coarse-gra gravel and limestone deposited under relatively high energy conditions in fluvial t environments (WSRC 1994a).

Figure 4-11 shows the current aquifer/aquitard terminology at the SRS. Aquifer order, include the McQueen Branch, the Crouch Branch, and the Steed Pond. For comp figure also includes the corresponding aquifer terminology used on the Georgia side River. These include the Midville, Dublin, and Floridan aquifer systems. In addit aquifers are separated by confining layers which include, in ascending order, the A and Meyers Branch confining systems (WSRC 1994a).

4.8.2.2 Groundwater Flow. Excellent quality groundwater is abundant in this region of

South Carolina from many local aquifer units. As a result, the South Carolina Depa and Environmental Control has classified all aquifers in the state as Class GB (Sou or U.S. Environmental Protection Agency (EPA) Class II, meaning that the aquifers c resource-quality water, but are not the sole source of supply (South Carolina Class aquifers) (DOE 1991b).

The main source of recharge to the vadose zone is rainfall. The annual precipi is 48 inches (121.9 centimeters), with an estimated 16 inches (41 centimeters) desi recharge at the center of the SRS, in bare and grass-covered areas (WSRC 1994a). T groundwater flow in the vadose zone is predominantly downward. However, given the and clay that exist, there is significant lateral spread in some areas. In general thickness ranges from approximately 130 feet (40 meters) in the northernmost portio 0 feet where the water table intersects wetlands, streams, or creeks.

The following discussion of groundwater flow in the Coastal Plain hydrogeologic begins with the deepest aquifers at the SRS and proceeds to shallower units. It do in the confining units because few hydraulic head measurements are available for th good approximation, flow in aquitards is limited predominantly to vertical flow bet The Midville or McQueen Branch aquifer (which has also been called the Middendorf, Cretaceous, the Tuscaloosa, and Aquifer IA) is highly transmissive and, therefore, production aquifer for much of the SRS. This aquifer flows horizontally, predomina Savannah River. In the past, groundwater production wells at the SRS were screened Midville (McQueen Branch) and Dublin (Crouch Branch) aquifers. In 1985 DOE committ South Carolina Department of Health and Environmental Control to complete productio the McQueen Branch aquifer to minimize the potential for contamination to reach suc spread in the deeper aquifers.

Flow in the Dublin or Crouch Branch aquifer (which has also been called the Bla Tuscaloosa, the Upper Cretaceous, and Aquifer IB) is more complicated than flow in McQueen Branch aquifer because of the apparent communication with Upper Three Runs SRS. Nonetheless, horizontal flow in the Dublin (Crouch Branch) aquifer is predomi Savannah River. However, there is an upward vertical flow component near the river Three Runs Creek. Recharge to the Dublin-Midville aquifer system occurs in areas e ground surface near the Fall Line (see Figure 4-3).

Horizontal flow in the Gordon aquifer (previously called the Congaree, the Tert Aquifer II) is toward Upper Three Runs Creek and the Savannah River, depending on t SRS. Both the river and Upper Three Runs Creek intercept this aquifer. The Gordon most of its recharge from groundwater that originates on the SRS.

Previous SRS studies have called the Upper Three Runs aquifer the "water table have defined it as both the Barnwell/McBean and water table aquifers in the central where those aquifers were thought to be separated by a "tan clay." The Upper Three the shallowest aquifer at the SRS. The horizontal groundwater flow is generally to surface-water feature that is in communication with the water table. Most SRS stre Branch in the northeastern part of the Site, are in communication with the water ta

a "losing stream," meaning it provides, or "loses," water to the Upper Three Runs a the Upper Three Runs aquifer receives most of its recharge from precipitation. The aquifer is not a source of domestic or production water on the SRS because the lowe a more abundant supply of higher quality water (WSRC 1994a).

4.8.2.3 Groundwater Quality. The quality of groundwater in the principal hydrologic

systems beneath the SRS depends on both the source of the water and the inorganic a reactions that take place along its flowpath. Quality is strongly influenced by th composition and mineralogy of the enclosing geologic materials (WSRC 1994a).

In general, the quality of the groundwater in the Coastal Plain sediments at th surrounding areas is suitable for most domestic and industrial purposes. The water concentrations of total dissolved solids (TDS), ranging from less than 10 milligram 150 to 200 milligrams per liter. The pH values range from 4.9 to 7.7 (where the gr contact with limestone). Much of the groundwater is corrosive to metal surfaces du content and frequently low pH values. High dissolved iron concentrations can also some groundwater units. The SRS uses degasification and filtration processes to ra remove iron in domestic water supplies where necessary (WSRC 1994a).

Table 4-12 summarizes groundwater quality data from 85 existing waste sites on compared to drinking water standards; Table 4-13 lists similar information for sele constituents. The data in these tables are from ongoing monitoring programs on the EPA-accepted methods and guidelines for sampling and analysis are an integral part program. Several of the facilities discussed below have state-approved sampling an

The shallow aquifers beneath 5 to 10 percent of the SRS have been contaminated solvents, metals, tritium, or other constituents used or generated on the Site. Fi locations of facilities where the SRS monitors groundwater and areas with constitue drinking water standards in 1992; the concentrations shown on Figure 4-12 represent data from one monitoring well on at least one occasion at a given area. Contaminat the shallow aquifers, with one exception (see next paragraph). Most contaminated g SRS is beneath a few facilities; contaminants reflect the operations and chemical p facilities perform. For example, contaminants in the groundwater beneath A- and M- chlorinated volatile organics, radionuclides, metals, and nitrate. At F- and H-Are the groundwater include tritium and other radionuclides, metals, nitrate, chlorinat values much smaller than those found at A- and M-Areas, and sulfate. The groundwat Sanitary Landfill contains chlorinated volatile organics, radionuclides, and metals

Table 4-12. Representative groundwater quality data for nonradioactive constituent Savannah River Site.

Parameter (Unit)	Standard	Maximum Value
Alkalinity (as CaCO3) (mg/L)	100	1,360b
pH (pH units)	8.5c	13b
Antimony (mg/L)	0.005	0.013
Arsenic (mg/L)	0.05	0.1
Beryllium (mg/L)	0.011d	0.0043
Cadmium (mg/L)	0.005c	0.34
Chromium (mg/L)	0.1c	0.82
Mercury (mg/L)	0.002c	0.12
Lead (mg/L)	0.015e	1.0
Nitrate-N (mg/L)	10c	278b
Sulfate (mg/L)	400c	73,500b
Pentachlorophenol (mg/L)	0.001c	0.0032
Lindane (mg/L)	0.0002c	0.00048
Carbon tetrachloride (mg/L)	0.005	0.43
1,2-Dichloroethane (mg/L)	0.005c	0.27
1,1,1-Trichloroethane (mg/L)	0.2c	0.21
1,1-Dichloroethylene (mg/L)	0.007c	0.15
Trichlorethylene (mg/L)	0.005c	147
Tetrachloroethylene (mg/L)	0.005c	101

a. Data compiled from 85 existing wastes sites (Arnett et al. 1993).
b. The elevated values for alkalinity and pH might be due to faulty well installati sulfate and nitrate values might be due to acid spills near wells.
c. National secondary drinking water regulations (CFR 1991).
d. National primary drinking water regulations (CFR 1974).
e. Action level at which providers of public drinking water apply treatment techniq

levels (CFR 1991).

Table 4-13. Representative groundwater data for radioactive constituents from the Site (pCi/liter).

Constituent	Standardb	Maximum Concentration
Gross alpha	15	2,700
Nonvolatile beta	50	19,000
Tritium	20,000	1.8 x 108
Cesium-137	200	980
Cobalt-60	100	290
Iodine-129	1	72
Ruthenium-106	30	170
Total radium (radium-226 and radium-228)	5	50
Strontium-90	8	5,300

a. Source: Arnett et al. (1993).

b. National Primary Drinking Water Regulations (CFR 1974), (56 FR 33052).

beneath all the reactor areas except R-Area contains tritium, other nuclides, metal volatile organics. At R-Area, groundwater contaminants include radionuclides and c groundwater beneath D-Area contains metals, radionuclides, sulfate, and chlorinated At TNX-Area, the groundwater contains chlorinated volatile organics, radionuclides, et al. 1993). None of these cases indicated the presence of groundwater contaminat boundaries. With the ongoing and expanding "pump and treat" system at the A-/M-Are (Figure 4-12), concentrations in the volatile organic compound plume are likely to

Contamination of groundwater in a drinking water aquifer has been found in only small area north of A-Area, in the northwest portion of the site. In the early 198 found low concentrations of trichloroethylene (11.7 microgram per liter) in water f well (53A) completed to the Dublin-Midville Aquifer System (formerly called the Tus Formation) in M-Area. The monitors found the contamination only at 430 and 480 fee 146 meters) in this well, which is 670 feet (204 meters) deep. The well is screene from 387 feet (118 meters) to the bottom. DOE concluded that the contamination is migrating down the outside well casing from soils near the surface that are contami trichloroethylene. This contaminated water enters the well through screens set in

Figure 4-12. Groundwater contamination at the Savannah River Site. System (Du Po above Primary Drinking Water Standards in cretaceous zone (Dublin-Midville) well MS which is approximately 3,500 feet west of well 53A and 1,500 feet north of A-Area (1993).

4.8.2.4 Groundwater Use. The McQueen Branch aquifer, which becomes shallower toward

the Fall Line, forms the base for most municipal and industrial water supplies in A Toward the coast, in Allendale and Barnwell Counties, this aquifer exists at increa depths. As a consequence, the shallower Gordon aquifer supplies some municipal, in agricultural users (Arnett et al. 1993).

DOE has identified 56 major municipal, industrial, and agricultural groundwater 20 miles (32 kilometers) of the center of the SRS (DOE 1987a). The total pumpage f about 49 billion liters (13 billion gallons) per year. The SRS withdraws approxima liters (3.7 billion gallons) of groundwater per year for domestic and industrial us

4.9 Ecological Resources

The U.S. Government acquired the SRS in 1951. At that time, the Site was appro two-thirds forested and one-third cropland and pasture (Dukes 1984). At present, m 90 percent of the SRS is forested. An extensive forest management program conducte Savannah River Forest Station, which is operated by the U.S. Forest Service, has co pastures and croplands to pine plantations. With the exception of the SRS producti areas, natural succession has reclaimed previously disturbed areas. Table 4-14 lis other than the land used for nuclear reactors and support facilities.

The SRS is important to maintaining the biodiversity of the region. Satellite shows a circle of wooded habitat within a matrix of cleared uplands and narrow fore corridors. The SRS provides more than 734 square kilometers (181,000 acres) of con cover broken only by unpaved secondary roads, transmission line corridors in variou

succession, and a few paved primary roads. Carolina bays, the Savannah River swamp relatively intact longleaf pine-wiregrass communities provide important contributio biodiversity of the SRS and of the entire region.

Table 4-14. Land cover of undeveloped areas on the Savannah River Site.

Land cover types	Square kilometer	Percent of total
Longleaf pine	150	20
Loblolly pine	258	35
Slash pine	117	16
Mixed pine/hardwood	23	3
Upland hardwood	20	3
Bottomland hardwood	117	16
Savannah River swamp	49	7
Total	734	100.0

a. Source: USDA (1991a).

b. To convert square kilometers to acres, multiply by 247.1.

F- and H-Areas, located near the center of the SRS and approximately 1.6 kilome southeast of Upper Three Runs Creek, are heavily industrialized with little natural remaining inside the fenced areas. These areas are dominated by buildings, paved p gravelled construction areas, and laydown yards. While some grassed areas occur ar administration buildings and some vegetation is present along the ditches that drai majority of the site contains no vegetation. Wildlife is absent except for occasio brachyrhynchos) and nesting barn swallows (Hirundo rustica) around the buildings.

Figure 2-3 shows the location of a representative host site at the SRS for pote fuel activities. F- and H-Areas (and developed areas immediately adjacent to them) spent nuclear fuel management facilities, while the undeveloped area south and east be used for the construction of new facilities that F- and H-Areas could not accomm undeveloped area, which was 98 percent cleared fields in 1951, is now almost comple the most part with 5- to 40-year-old upland pine stands that are actively managed b River Forest Station. Most of these stands are loblolly pine (Pinus taeda), but th of slash pine (P. elliottii), upland hardwoods (predominantly oaks and hickories), hardwoods (most commonly sweetgum, Liquidambar styraciflua, and yellow poplar, Liri tulipifera) associated with two small Carolina bays located south of H-Area. The a lies in the Fourmile Branch watershed, while the area east of H-Area is in the McQu tributary of Upper Three Runs Creek) watershed. Neither area is likely to contain endangered species or their habitats.

The general area of the representative host site contains suitable habitat for feral hogs as well as other faunal species common to the mixed pine/hardwood forest Carolina. Additional wildlife species found in the area include gray squirrel (Sci squirrel (S. niger), wild turkey (Meleagris gallopovo), cottontail rabbit (Sylvilag (Procyon lotor), bobcat (Felix rufus), and gray fox (Urocyon cinereoargenteus).

4.9.1 Terrestrial Ecology

The SRS is near the transition area between the oak-hickory-pine forest and the forest. As a consequence, species typical of both associations occur (Dukes 1984). farming, fire, soil features, and topography have strongly influenced existing SRS

A variety of vascular plant communities occurs in the upland areas (Dukes 1984) scrub oak communities occur on the drier, sandier areas. Longleaf pine (Pinus palu (Quercus laevis), bluejack oak (Q. incana), blackjack oak (Q. marilandica), and dwa (Q. margaretta) dominate these communities, which typically have understories of wi stricta) and huckleberry (Vaccinium sp.). Oak-hickory communities occur on more fe uplands; characteristic species are white oak (Q. alba), post oak (Q. stellata), so (Q. falcata), mockernut hickory (Carya tomentosa), pignut hickory (C. glabra), and an understory of sparkleberry (Vaccinium arboreum), holly (Ilex sp.), greenbriar (S poison ivy (Rhus radicans).

The removal of human residents in 1951 and the subsequent restoration of forest provided the wildlife of the SRS with excellent habitat. Furbearers such as gray f opossum (Didelphis virginiana), bobcat, beaver (Castor canadensis), and otter (Lutr relatively common throughout the Site. Game species such as gray squirrel and fox white-tailed deer (Odocoileus virginianus), cottontail rabbit, and wild turkey are Savannah River Ecology Laboratory has conducted numerous studies of reptile and amp

the wetlands and adjacent uplands of the SRS.

DOE allows carefully regulated public hunting for white-tailed deer and feral h on most of the SRS to reduce the incidence of animal/vehicle collisions and maintai populations within the carrying capacity of the range. SRS personnel monitor all a from the Site for contamination before releasing them to the hunters (WSRC 1992a).

Before releasing any animal to a hunter, SRS technicians perform field analyses at the hunt site. In 1992, hunters collected 1,519 deer and 168 hogs. The maximum field measurement for deer was 22.4 picocuries per gram; the average was 6.4 picocu (Arnett et al. 1993). For hogs, the maximum value was 22.9 picocuries per gram and 3.5 picocuries per gram. The field technicians determine estimated doses from cons 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 ye for this unique hypothetical maximum dose, which was for a hunter who harvested eig hog, is the assumption that the hunter consumed the entire edible portion of each a additional hypothetical model involved a hunter whose total meat consumption for th of SRS deer [81 kilograms (179 pounds) per year] (Arnett et al. 1993). Based on th low-probability assumptions and on the average concentration of cesium-137 (6.4 pic harvested on the SRS), the estimated potential maximum dose from this pathway is 26 26 percent of the annual 100-millirem DOE Derived Concentration Guide. Although a percentage of this hypothetical dose is probably due to cesium-137 from worldwide f estimated total contains this background cesium-137 for conservatism.

4.9.2 Wetlands

The SRS has extensive, widely distributed wetlands, most of which are associate floodplains, creeks, and impoundments. In addition, approximately 200 Carolina bay Site (Shields et al. 1982; Schalles et al. 1989).

The southwestern SRS boundary adjoins the Savannah River for approximately 32 k (20 miles). The river floodplain supports an extensive swamp, covering about 49 sq (12,148 acres) of the Site; a natural levee separates the swamp from the river. Ti swamp in the late 1800s. At present, the swamp forest consists of second-growth ba (Taxodium distichum), black gum (Nyssa sylvatica), and other hardwood species (Work McLeod 1990; USDA 1991a).

Five major streams drain the SRS and eventually flow into the Savannah River. floodplains characterized by bottomland hardwood forests or scrub-shrub wetlands in succession. Dominant species include red maple (Acer rubrum), box elder (A. negund water tupelo (Nyssa aquatica), sweetgum, and black willow (Salix nigra) (Workman an 1990).

Carolina bays are unique wetland features of the southeastern United States. T wetland habitat dispersed throughout the uplands of the SRS. The approximately 200 exhibit extremely variable hydrology and a range of plant communities from herbaceo forested wetland (Shields et al. 1982; Schalles et al. 1989). SRS scientists have ecology extensively, particularly in relation to the construction of the Defense Wa Facility (DWPF; SREL 1980).

4.9.3 Aquatic Ecology

The aquatic resources of the SRS have been the subject of intensive study for m 30 years. Research has focused on the flora and fauna of the Savannah River and th of the river that drain the Site. Section 4.8.1.1 describes those portions of the spent nuclear fuel management activities could affect. In addition, several monogr 1967; Dahlberg and Scott 1971; Bennett and McFarlane 1983), the eight-volume Compre Cooling Water Study (Du Pont 1987), and three EISs (DOE 1984; DOE 1987b; DOE 1990) evaluated operations of SRS production reactors describe the aquatic biota and aqua SRS.

4.9.4 Threatened and Endangered Species

Threatened, Endangered, and Candidate Plant and Animal Species of the Savannah (HNUS 1992b) describes threatened, endangered, and candidate plant and animal speci known to occur or that might occur on the SRS. Table 4-15 lists these species.

The following Federally listed endangered animals are known to occur on the SRS Savannah River adjacent to the Site: the red-cockaded woodpecker (Picoides boreali bald eagle (Haliaeetus leucocephalus), the wood stork (Mycteria americana), and the sturgeon (Acipenser brevirostrum) (HNUS 1992b). Researchers have found one Federal endangered plant species, the smooth coneflower (Echinacea laevigata), on the Site,

Table 4-15. Threatened, endangered, and candidate plant and animal species of the

Common Name (Scientific Name)	Status
Animals	
Rafinesques (= Southeastern) big-eared bat (Plecotus rafinesquii)	FC2
Loggerhead Shrike (Lanius ludovicianus)	FC2
Bachman's sparrow (Aimophila aestivalis)	FC2
Carolina crawfish (= Gopher) frog (Rana areolata capito)	FC2
Southern hognose snake (Heterodon simus)	FC2
Northern pine snake (Pituophis melanoleucus melanoleucus)	FC2
Bald eagle (Haliaeetus leucocephalus)	E
Wood stork (Mycteria americana)	E
Red-cockaded woodpecker (Picoides borealis)	E
American alligator (Alligator mississippiensis)	T/SA
Shortnose sturgeon (Accipenser brevirostrum)	E
Plants	
Smooth coneflower (Echinacea laevigata)	E
Bog spice bush (Lindera subcoriacea)	FC2
Boykin's lobelia (Lobelia boykinii)	FC2
Loose watermilfoil (Myriophyllum laxum)	FC2
Nestronia (Nestronia umbellula)	FC2
Awned meadowbeauty (Rhexia aristosa)	FC2

Key: E = Federal endangered species.
T/SA = Threatened due to Similarity of Appearance.
FC2 = Under review (a candidate species) for listing by the Federal government

listed Category 2 species, and several state listed species (Knox and Sharitz 1990) SRS is implementing strategies for the protection of these species.

F- and H-Areas and the representative host site contain no habitat suitable for Federally listed threatened or endangered species found on the SRS. The Southern b wood stork feed and nest near wetlands, streams, and reservoirs, and thus would not host site, a densely forested upland area. Shortnose sturgeon, typically residents and estuaries, have never been collected in Fourmile Branch or any of the tributari River that drain the SRS.

Red-cockaded woodpeckers prefer open pine forests with mature trees (older than foraging and nesting. The pines of the undeveloped host site are 5 to 40 years old woodpeckers probably would not forage or nest in the area.

The Red-cockaded Woodpecker Management Standards and Guidelines, Savannah River (USDA 1991b) describes the SRS management strategy for the red-cockaded woodpecker. significant element of this management strategy is the conversion of slash (and som a designated red-cockaded woodpecker management area to longleaf pine, with a harve 120 years.

4.10 Noise

The major noise sources at the SRS occur primarily in developed operational are various facilities, equipment, and machines (e.g., cooling towers, transformers, en steam vents, paging systems, construction and materials-handling equipment, and veh noise sources outside the operational areas consist primarily of vehicles and railr Previous studies have assessed noise impacts of existing SRS operational activities 1991b; DOE 1990; DOE 1993a). These studies concluded that, because of the remote l SRS operational areas, there are no known conditions associated with existing onsit adversely affect individuals at offsite locations. Some disturbance of wildlife ac the SRS as a result of operational and construction activities.

Existing SRS-related noise sources of importance to the public are those result transportation of people and materials to and from the Site. These sources include vehicles, helicopters, and freight trains. In addition, a portion of the air cargo using commercial air transport through the airports at Augusta, Georgia, and Columb Carolina, are attributable to SRS operations.

The States of Georgia and South Carolina and the counties in which the SRS is l

established any regulations that specify acceptable community noise levels with the County. A provision of the Aiken County Nuisance Ordinance limits daytime and nigh frequency band (Aiken County 1991).

During a normal week in 1995, about 20,000 employees are likely to travel to th in private vehicles from surrounding communities. Both government-owned and privat and deliver materials at the Site. Most private vehicles and trucks traveling to a day use South Carolina Highways (SC) 125 and 19. The contribution of SRS operation volumes along SC 125 and SC 19, especially during peak traffic periods, affects noi the towns of New Ellenton and Jackson and the City of Aiken.

Noise measurements taken during 1989 and 1990 along SC 125 in the Town of Jacks point about 15 meters (50 feet) from the roadway indicate that the 1-hour equivalen traffic ranged from 48 to 72 decibels (A-weighted). The estimated day/night averag along this route was 66 decibels for summer and 69 decibels for winter. Similarly, measurements along SC 19 in the town of New Ellenton at a point about 15 meters (50 roadway indicate that the 1-hour equivalent sound level from traffic ranged from 53 The estimated day/night average sound level along this route was 68 decibels for su 67 decibels for winter (NUS 1990). Employment at the SRS has increased slightly si potentially causing small increases in traffic noise, especially during peak traffi (approximately between 6:30 and 8:30 a.m. and between 3:30 and 5:30 p.m., correspon major shift changes). Because some residences and at least two schools are within these routes, some annoyance to members of the public residing along these highways based on the relationship between the day/night average sound level and the "percen (Schultz 1978; Fidell et al. 1989; FICON 1992).

Noise sources from rail transport include diesel engines, wheel-track contact, whistle-warnings at rail crossings.

4.11 Traffic and Transportation

4.11.1 Regional Infrastructure

The SRS is surrounded by a system of Interstate highways, U.S. highways, state railroads. The regional transportation networks service the four South Carolina co Allendale, Bamberg, and Barnwell) and two Georgia counties (Columbia and Richmond) about 90 percent of SRS commuter traffic (HNUS 1992a). Two major railroads - CSX T and Norfolk Southern Corporation - also serve the SRS vicinity. Although barge tra the Savannah River, neither the SRS nor commercial shippers normally use barges. F the regional transportation infrastructure.

4.11.1.1 Regional Roads. Two Interstate highways serve the SRS area. Interstate 20 (I-20)

provides a primary east-west corridor and I-520 links I-20 with parts of Augusta, G U.S. Highways 1 and 25 are principal north-south routes and U.S. 78 provides east-w Several other highways - U.S. 221, U.S. 301, U.S. 321, and U.S. 601 - provide addit routes in the region.

Several state routes provide direct access to the SRS. Running northwest/south Access to the Site is provided from the north by SC 19, from the northeast by SC 39 east by SC 64.

U.S. 278 bisects the northern part of the SRS and is available to public access The SRS maintains barricades at site entries and exits on SC 125 to control public although it is generally open to unrestricted public travel. The public also has d Road 1. All other site roads have restricted access.

4.11.1.2 Regional Railroads. Norfolk Southern serves Augusta and Savannah, Georgia, as

well as Columbia and Charleston, South Carolina. CSX serves the same locations and

4.11.2 SRS Infrastructure

The SRS transportation infrastructure consists of more than 143 miles (230 kilo primary roads, 1,200 miles (1,931 kilometers) of unpaved secondary roads, and 103 k

(64 miles) of railroad track (WSRC 1993b). These roads and railroads provide conne various SRS facilities and to offsite transportation linkages. Figure 4-14 shows t primary roadways and access points. Figure 4-15 shows the SRS railway system.

4.11.2.1 SRS Roads. Two major public highways traverse the Site: SC 125 and U.S. 278.

SC 125 connects Allendale, South Carolina, to Augusta, Georgia, by crossing the Sit northwest-to-southeast direction. U.S. 278 also connects Augusta and Allendale, bu approximately follows the northern and eastern SRS boundaries.

Figure 4-13. Regional transportation infrastructure. Figure 4-14. Major SRS r from SC 125; three limit access from SC 19, SC 39, and SC 64; and two limit access areas of the administrative complex near the northern SRS boundary (A-Area).

In general, the primary SRS roadways are in good condition and are smooth and f potholes. Typically, wide, firm shoulders border roads that are either straight or turns. Intersections are well marked for both traffic and safety identification an cleared of trees and brush that might obstruct a driver's view of oncoming traffic. side of the roadways offer protection at appropriate locations from dropoffs or oth general, the roadways are lighted only at gate areas and near major facilities. Th overpasses, one at the cloverleaf intersection of Roads 2 and C, and the other wher overpasses the CSX railroad tracks in the southern part of the Site. The 60 bridge been inspected and evaluated for safe loading, with some bridges rated as high as 2 tons) under controlled conditions. The steepest roadway gradient is on Road C at t Upper Three Runs Creek, where the road drops more than 100 feet (30 meters) in abou (0.4 kilometer). At the base of the dropoff is a bridge over the creek and an imme road. This area presents a relatively hazardous roadway condition.

In general, heavy traffic occurs early in the morning and late in the afternoon surrounding communities commute to and from the Site. During working hours, offici logging trucks constitute most of the traffic. At any time, as many as 60 logging impede traffic, might be operating on the Site, with an annual average of about 25 Table 4-16 provides data on traffic counts for various roads and access points arou

4.11.2.2 SRS Railroads. Railroads on the Site include both CSX tracks and SRS rolling

stock and tracks. Two routes of the CSX distribution system run through the Site: Florence, South Carolina, and Augusta, Georgia, and a line between Yemassee, South Augusta, Georgia. The two lines join on the Site just south of L-Lake (Figure 4-15 CSX discontinued service on the line from the SRS junction to Florence.

The 64 miles (103 kilometers) of SRS railroads are well maintained. The rails in good condition, and the track lines are clear of vegetation and debris. Signifi the tracks on both sides. Intersections of railroads and roadways are marked by ra with lights where appropriate.

Table 4-16. SRS traffic counts - major roads.

Measurement point	Date	Direction	Day Total	Peakb	Peak timec	Average speed (mph)d
Road 2 between Roads C and D	2-23-93	East	3,031	800	1530	47
	4-21-93	West	3,075	864	0630	NAe
Road 4 between Roads E and C	12-9-92	East	1,624	352	1530	NA
	12-9-92	West	1,553	306	0615	NA
Road 8 at Pond C	2-23-92	East	634	274	1530	58
	2-23-92	West	662	331	0615	56
Road C between landfill and R	12-16-92	North	6,931	2,435	1530	53
	12-16-92	South	6,873	2,701	0630	58
Road C north of Road 7	1-20-93	North	742	288	0630	53
	1-20-93	South	763	223	1530	54
Road D	9-29-93	North	1,779	218	1500	43
	9-29-93	South	1,813	220	0845	52
Road E at E-Area	8-25-93	North	3,099	669	1530	35
	8-25-93	South	3,054	804	0630	38
Road F at Upper Three Runs Cr	2-2-93	North	3,239	1,438	1530	53
	2-2-93	South	3,192	1,483	0630	51

H-Area Exit	12-2-92	Outbound	2,181	406	1530	12

a. Source: Swygert (1993).
b. Number of vehicles in peak hour.
c. Start of peak hour.
d. mph = miles per hour; to convert to kilometers per hour multiply by 1.6093.
e. NA = data not available.

The SRS rail classification yard is east of P-Reactor. This eight-track facili rail cars. Deliveries of SRS shipments occur at two onsite rail stations at the fo and Dunbarton. From these stations, an SRS engine moves the railcars to the approp facility. The Ellenton station, which is on the main Augusta-Yemassee line, is the point. The Dunbarton station, which is on the discontinued portion of the Augusta- receives less use.

4.12 Occupational and Public Radiological Health and Safety

The sources of radiation exposure to individuals consist of natural background cosmic, terrestrial, and internal body sources; radiation from medical diagnostic a practices; and radiation from manmade sources, including consumer and industrial pr facilities, and weapons test fallout.

All radiation doses discussed in this document are effective dose equivalents (equivalents weighted for biological effect and summed to yield a whole-body dose eq same risk as irradiation of individual organs) as defined by the International Comm Radiological Protection, Publication 26 (ICRP 1977), unless specifically identified thyroid dose, bone dose).

Natural background radiation contributes about 83 percent of the annual dose of received by an average member of the population within 50 miles (80 kilometers) of on national averages, medical exposure accounts for 14 percent of the annual dose, doses from weapons test fallout, consumer and industrial products, and air travel a approximately 3 percent (Arnett et al. 1993).

4.12.1 Occupational Health and Safety

SRS maintains a network of air monitoring stations on and around the Site to de concentrations of radioactive particulates and aerosols in the air (Arnett et al. 1 average and maximum radionuclide particulate concentrations found in 1992 in air at H-Areas, SRS boundary, and background [100-mile (160-kilometer) radius] monitoring Table 4-18 lists average and maximum concentrations of tritium in atmospheric moist for the F- and H-Areas, SRS boundary, and background monitoring locations.

Gamma radiation levels measured by thermoluminescent dosimeters in 1992 at the **fences averaged 70 and 74 millirem per year, respectively.** Gamma radiation levels, background (terrestrial and cosmic) radiation, measured at the Site perimeter in 19 average dose of 35 millirem per year (Arnett et al. 1993).

Table 4-17. Radioactivity in air at the Savannah River Site and vicinity (pCi/m3).

Location	Gross Alpha	Nonvolatile Beta	SR-89,90b
F-Area			
Average	1.80x10-3	1.94x10-2	0.62x10-4
Maximum	3.55x10-3	5.56x10-2	6.02x10-4
H-Area			
Average	1.80x10-3	1.93x10-2	2.69x10-4
Maximum	4.24x10-3	5.39x10-2	2.83x10-3
Site perimeter			
Average	1.80x10-3	2.30x10-2	0.13x10-4
Maximum	4.04x10-2	4.95x10-2	4.54x10-4
Background (100-mile radius)			
Average	1.67x10-3	1.73x10-2	0.49x10-4
Maximum	3.83x10-3	4.37x10-2	6.89x10-4

a. Arnett et al. (1993).
b. Monthly composite.

Table 4-18. Tritium measured in air at the Savannah River Site (pCi/cc).

Location	Average	Maximum

F-Area	8.67x10-5	2.98x10-4
H-Area	0.99x10-3	6.77x10-3
Site boundary	2.65x10-5	1.03x10-4
Background (100-mile radiu	8.32x10-6	1.08x10-5

a. Arnett (1993).

Soil samples from uncultivated areas provide a measure of the quantity of partic deposited from the atmosphere. Table 4-19 lists maximum measurements of radionucli for 1992 at F- and H-Areas, SRS boundary, and background [100-mile (160-kilometer)- monitoring locations. The SRS measured elevated concentrations of plutonium-238 an around F- and H-Areas, reflecting releases from these areas. From 1955 through 199 atmospheric plutonium releases from the F- and H-Areas were approximately 0.7 curie plutonium-238 and 3 curies of plutonium-239 (Arnett et al. 1992; 1993).

The SRS workers investigated for purposes of assessing occupational radiation ex the group of involved workers assigned to F- and H-Area facilities. The investigat facilities because they process materials with radiological characteristics similar

Table 4-19. Maximum radioactivity concentrations in soil at the Savannah River Sit

Location	Sr-90	Cs-137	Pu-238	Pu-239
F-Area	2.16x10-2	7.19x10-1	4.03x10-1	5.31x10-1
H-Area	2.89x10-2	8.22x10-1	2.13x10-2	5.54x10-2
Site perimeter	(b)	4.84x10-1	2.19x10-3	1.36x10-2
Background (100-mile radius)	1.46x10-2	(b)	2.34x10-4	1.93x10-2

a. Arnett et al. (1992).
b. None detected.

analyzed in this EIS. The dosimetry results for these two involved worker groups a because they depict occupational impacts that are directly relevant to each alterna investigation selected two dosimetry periods of record for this analysis: 1983 - 1 earlier 5-year period included times when materials processing was occurring at a r accelerated in comparison with recent years. The later period includes processing reflect near-term DOE mission initiatives.

Tables 4-20 and 4-21 list the involved worker dosimetry data for 1983 - 1987 and respectively. This analysis adapted these data from monitoring data statistics (Ma Matheny 1994b) for operations, maintenance, laboratory, and health protection perso the F- and H-Area Canyons and the associated B-Line facilities. The calculated inc fatal cancer attributable to each facility's collective worker dose are approximate the earlier and later time periods, respectively. Similarly, the highest calculate probabilities attributable to average individual worker doses are approximately 0.0 respectively. The analysis estimated these health effects using risk coefficients (DOE 1993).

4.12.2 Public Health and Safety

Table 4-22 summarizes the major sources of exposure for the population within 50 (80 kilometers) of the SRS and for the Savannah River water-consuming population in Jasper Counties, South Carolina, and Port Wentworth, Georgia. Most of the sources, background dose and medical dose, are independent of the presence of the SRS.

Atmospheric releases of radioactive material to the environment from SRS operati 1992 resulted in an average dose of approximately 0.02 millirem per year to individ

Table 4-20. Annual involved worker doses, 1983 - 1987.

Facility	Average Worker Dose (rem)	Total Collective Worker Dose (person-rem)
H-Canyon	0.41	36.28
HB-Line	0.49	21.84
F-Canyon	0.48	87.25
FB-Line	0.74	124.68
Facilities Average	0.53	NA
Facilities Total	NA	270.05

NA = Not applicable.

Table 4-21. Annual involved worker doses, 1993.

Facility	Average Worker Dose (rem)	Total Collective Worker Dose (person-rem)
H-Canyon	0.17	11.07

HB-Line	0.24	21.97
F-Canyon	0.22	9.16
FB-Line	0.24	51.16
Facilities Average	0.22	NA
Facilities Total	NA	93.36

NA = Not applicable.

Table 4-22. Major sources of radiation exposure to the public in the vicinity of t Site.

Source of Exposure	Dose to average individual (mrem/yr)	P e
Natural background radiation	315	8
Medical radiation	54	1
Consumer and industrial products, fallout, air travel	10	3
Savannah River Site operations	0.22	0.0
Grand Total	380	1

a. Arnett et al. (1993).

(80-kilometer)-radius population. The collective effective dose equivalent due to from 1992 SRS operations to the population of 620,100 within 50 miles (80 kilometer approximately 6.4 person-rem per year. Atmospheric releases of tritium accounted f 90 percent of the offsite population dose; tritium is the only radionuclide of SRS routinely detected in offsite air (Cummins et al. 1991; Arnett et al. 1992, 1993). average annual atmospheric tritium concentrations in the vicinity of SRS for the th 1992.

Table 4-23. Average atmospheric tritium concentrations in the vicinity of the Sava (pCi/m3).

Location	1992	1991	1990
Onsite	340	250	430
Site perimeter	27	21	32
25-mile radius	11	11	12
100-mile radius	8.3	8.5	8.8

a. Arnett et al. (1993).

From 1990 to 1992, the calculated maximum individual average annual dose from a releases to a hypothetical individual residing at the SRS boundary was 0.12 millire 1991; Arnett et al. 1992, 1993).

In general, liquid releases of tritium account for more than 99 percent of the introduced into the Savannah River from SRS activities (Arnett et al. 1993). The c annual dose to the maximally exposed individual resulting from liquid releases from 0.21 millirem (Cummins et al. 1991; Arnett et al. 1992; 1993). From 1990 to 1992 l radioactive material to the environment from SRS operations resulted in an average millirem per year and 0.05 millirem per year to downstream consumers of drinking wa Beaufort-Jasper and Port Wentworth water treatment plants, respectively. These dos Beaufort-Jasper river-water-consuming population of about 51,000 and the current Po river-water-consuming population of about 20,000 would yield a collective effective these populations of approximately 3 person-rem per year (Cummins et al. 1991; Arne 1993).

The SRS analyzes samples from other environmental media that onsite releases mi that might provide a pathway for radiation exposure to the public and Site employee samples of milk, food products, drinking water, wildlife, rainwater, soil, sediment The 1992 SRS Environmental Report (Arnett et al. 1993) describes the sampling progr locations, and monitoring results for each of these media.

Major nuclear facilities within 50 miles (80 kilometers) of the SRS include a l burial site operated by Chem-Nuclear Systems, Inc., near the eastern SRS boundary i Carolina, and the Georgia Power Company Alvin W. Vogtle Electric Generating Plant, the Savannah River from the SRS. Plant Vogtle began commercial operation in 1987, are controlled to meet U.S. Nuclear Regulatory Commission requirements.

4.13 Utilities and Energy

This section describes SRS electricity consumption, water consumption, fuel usa and industrial wastewater treatment. Table 4-24 contains information on the curren items at SRS.

Table 4-24. Current capacities and usage of utilities and energy at SRS.

ELECTRICITY		
	Consumption	659,000 megawatt hour
	Load	75 megavolt-amperes
	Peak Demand	130 megavolt-amperes
	Capacity	340 megavolt-amperes
WATER		
	Groundwater usage	12,490 million liters
	Surface water usage (cooling)	75,700 million liters
FUEL		
	Oil	28.4 million liters (
	Coal	210,000 metric tons (
	Gasoline	4.7 million liters (1
WASTEWATER		
	Domestic capacity	3.97 million liters (
	Domestic load	1.89 million liters (
	Industrial capacitya,b	1.64 million liters (
	Industrial loada	44,000 liters (11,580

a. F/H Effluent Treatment Facility only.
b. Design capacity; permitted capacity is about 67 percent of this value.

4.13.1 Electricity

The SRS purchases electric power from the South Carolina Electric and Gas Compa through three purchased power-line interconnects to the SRS transmission grid. The annual power consumption for the SRS was approximately 659,000 megawatt-hours. The was 75 megavolt-amperes and the peak demand was about 130 megavolt-amperes. South Electric and Gas sources can supply as much as 340 megavolt-amperes to the SRS grid direct connections. The SRS generating station in D-Area can produce an additional 80 megavolt-amperes capacity, although that plant currently produces only process s transmission grid that would provide power to any spent nuclear fuel facilities con 145 kilometers (90 miles) of 115-kilovolt lines, four switching stations, and 15 su service to all major production areas provides parallel redundant capacity to ensur availability and reliability (WSRC 1993c).

4.13.2 Water Consumption

Groundwater from a deep confined aquifer supplies domestic and process water fo through approximately 100 production wells. The aquifer system sustains single wel 10.2 million liters (2.7 million gallons) per day. Current usage from this source liters (3.7 billion gallons) per year (DOE 1990). The SRS withdraws cooling water from the Savannah River at an annual rate of about 75.7 billion liters (20 billion (WSRC 1993c).

4.13.3 Fuel Consumption

Fuels consumed at SRS include oil, coal, and gasoline. SRS facilities and equi approximately 28.4 million liters (7.5 million gallons) of oil each year. This tot No. 6 oil, and No. 2 oil. The SRS burns coal and some waste oils in the D-Area pow produce steam for Site facilities. Current coal usage is about 208,655 metric tons year. SRS vehicles use approximately 4.7 million liters (1.24 million gallons) of Under the provisions of the Energy Policy Act of 1992, natural gas will replace gas within the next 10 years. At that time, SRS usage of natural gas would be approxim cubic meters (429 million cubic feet) per year. At present, the SRS consumes no na (WSRC 1993c).

4.13.4 Wastewater Treatment

By 1995, the SRS Centralized Sanitary Wastewater Treatment Facility will proces

domestic effluent on the Site. This centrally located facility has a design capaci (1.05 million gallons) per day. Once operational, the plant will use about 50 perc In addition, five smaller sanitary treatment plants serve more remote areas of the spent nuclear fuel management would use the centralized facility.

The F/H Effluent Treatment Facility (ETF), which decontaminates routine process accidental radioactive releases from operations, treats industrial wastewater in th where the spent fuel management activities would occur.

Effluent Treatment Facility process operations performed on the waste liquids i neutralization (adjusts pH), submicron filtration (removes suspended solids), activ absorption (removes dissolved organic chemicals), reverse osmosis membrane deioniza salts), ion exchange (removes heavy metals), and evaporation (separates radionuclid condensate). This facility releases two different streams. The treated water stre analyzed to ensure that it meets discharge requirements and then is released to Upp Creek via a permitted outfall. The waste concentrate (i.e., bottoms from the evapo transferred to the H-Area waste tank farm for treatment and disposal in the Z-Area

The design capacity for the Effluent Treatment Facility is approximately 600 mi million gallons) per year. The maximum permitted treatment capacity is about 400 m (105.7 million gallons) per year. Under normal operating conditions, the facility 16,000 cubic meters (26 million gallons) of liquid waste per year (WSRC 1993d).

The influent water load to processes discharging to the permitted outfall inclu million liters (54 million gallons) per year of F-Area Canyon process wastewater, 1 (32 million gallons) per year of H-Area Canyon process wastewater, 34 million liter gallons) per year from the F-Area collection and retention basins, 34 million liter per year from the H-Area collection and retention basins, 68 million liters (18 mil of Effluent Treatment Facility acid, caustic, flush and rinse water, and similar wa SRS facilities.

4.14 Materials and Waste Management

The historic national defense mission of the SRS has resulted in the generation radioactive waste, transuranic waste, low-level radioactive waste (low-activity and hazardous waste, mixed waste (radioactive and hazardous combined), and sanitary was (nonhazardous, nonradioactive solid waste). This section discusses the treatment, of waste at the SRS. Section 4.13 discusses domestic and industrial wastewater tre

DOE is preparing an environmental impact statement on Waste Management at the S River Site (DOE 1995). The purpose of the EIS is to provide a basis for DOE to sel strategic approach to managing present and future SRS waste generated as a result o operations, environmental restoration activities, transition from nuclear productio and decontamination and decommissioning programs. The Waste Management EIS will su project-level decisions on the operation of specific treatment, storage, and dispos near term (10 years or less). In addition, the EIS will provide a baseline for ana management activities and a basis for the evaluation of the specific waste manageme The Waste Management EIS will not include management of spent nuclear fuel which is this document.

DOE treats and stores waste generated from onsite operations in waste managemen located primarily in E-, F-, H-, N-, S-, and Z-Areas (Figure 4-16). These faciliti H-Area Effluent Treatment Facility, the High-Level Waste Tank Farms, and the Solid Facility. The Defense Waste Processing Facility is nearly operational and the Cons Incineration Facility is under construction. The SRS places sanitary and inert was Sanitary Landfill and the Burma Road Landfill, respectively.

DOE continues to reduce the amount of waste generated and disposed of at the SR waste minimization and treatment programs. DOE accomplishes waste minimization by volume, toxicity, or mobility of waste before storing or disposing of it. These ac more intensive surveying, waste segregation, and use of administrative and engineer

The waste that DOE presently stores on the SRS includes high-level, transuranic mixed waste and some low-level waste. The Site stores high-level waste in undergro that have received South Carolina Department of Health and Environmental Control in wastewater permits, and manages them in accordance with Clean Water Act, Resource C and Recovery Act, and DOE requirements. The SRS stores transuranic mixed waste on storage pads in accordance with South Carolina Department of Health and Environment requirements and DOE Orders. Hazardous and mixed waste is placed in permitted or i Figure 4-16. Waste management facilities at the Savannah River Site. storage in

storage buildings.
Figure 4-17 shows the high-level liquid waste management process at the SRS. F shows the process for handling all other forms of solid waste at the Site.
Table 4-25 is a forecast of annual waste generation for all waste forms except high-level waste (WSRC 1994c). The volumes listed do not include waste related to and decommissioning because DOE has not yet completed the planning of these activit Section 5.14 discusses potential consequences of spent nuclear fuel activities as t alternative interim storage and treatment scenarios.

4.14.1 High-Level Waste

The SRS generated high-level waste from the recovery of nuclear materials from target processing in the F- and H-Areas. It is stored in 50 underground tanks. Th other radioactive waste effluents (primarily low-level radioactive waste such as aq including purge water from storage basins for irradiated reactor fuel or fuel eleme waste is stored to permit the decay of short-lived radionuclides and allow separati from soluble waste. Evaporators concentrate soluble waste to reduce original volum immobilize it as crystallized salt by successive evaporations of the liquid superna the evaporator overheads in cesium removal columns before transferring them to the Effluent Treatment Facility. The SRS processes the sludge and salt to prepare them the Defense Waste Processing Facility (high-level waste), when it becomes operation at the Z-Area Saltstone Facility (low-level waste). DOE has prepared a Supplementa Defense Waste Processing Facility operations (DOE 1994d).
By December 31, 1991, DOE had stored approximately 127.9 million liters (33.8 m of high-level radioactive waste on the Site. Estimates of current tank capacity an forecasts should be available in 1995. In general, however, due to a number of fac important of which has been the extended outage of the evaporators, the estimated i in the high-level tanks is greater than 90 percent of existing capacity (WSRC 1994d constructing a replacement high-level waste tank evaporator to augment or replace e evaporators.
Figure 4-17. Flow diagram for high-level radioactive waste. Figure 4-18. Flow

Waste Type	FY94	FY95	FY96
Transuranic	670	860	760
Low-Level			
Low-Activity	21,350	17,680	17,970
Intermediate-Level	940	580	740
Hazardous	140	130	100
Mixed	120	130	110

a. Source: WSRC (1994c).
b. To convert cubic meters to cubic feet, multiply by 35.314.

4.14.2 Transuranic Waste

At present, DOE uses three methods of retrievable storage for transuranic waste a the time of generation. Transuranic waste generated before 1974 is buried in appro 120 belowgrade concrete culverts in the Solid Waste Disposal Facility. Transuranic from 1974 to 1985 is stored on five concrete pads and one asphalt pad that have bee approximately 1.2 meters (4 feet) of native soil. DOE stores waste generated since 13 additional concrete pads that are not covered with soil. Pads 1 through 17 oper Status approved by the South Carolina Department of Health and Environmental Contro Pads 18 through 19, which are not required to have interim status, to manage nonhaz wastes only.
The SRS stores wastes containing 10 to 100 nanocuries per gram of transuranic mat transuranic waste until it can complete Site-specific radiological performance asse provide disposal limits for transuranic isotopes. SRS transuranic waste inventorie include both transuranic waste and the 10- to 100-nanocuries-per-gram transuranic w
At the end of 1993, the SRS had approximately 9,900 cubic meters (350,000 cubic f transuranic waste in storage (WSRC 1994e). Based on the 1994-to-1996 average annua rate forecast, the Site generates approximately 760 cubic meters (27,000 cubic feet waste annually. Transuranic mixed waste (transuranic and hazardous combined) accou approximately 110 cubic meters (3,900 cubic feet) of this volume (WSRC 1994c). DOE available storage space for transuranic mixed waste to alleviate any storage capaci

4.14.3 Mixed Low-Level Waste

The SRS mixed waste program consists primarily of providing safe storage until tr disposal facilities are available. The current volume of mixed low-level waste at 1,700 cubic meters (60,000 cubic feet) (WSRC 1994e). Based on the 1994-to-1996 ave generation forecast, the Site generates approximately 118 cubic meters (4,170 cubic low-level waste annually (WSRC 1994c). DOE is evaluating available storage space t when the SRS will exceed its capacity. However, DOE is constructing a Consolidated Facility in H-Area, which will treat mixed, hazardous, and low-level waste. When t operational, existing inventory will be reduced and more storage capacity will beco

4.14.4 Low-Level Waste

The SRS packages low-level waste for disposal on the Site in accordance with the and its estimated surface dose rate. The Site places low-activity waste in carbon deposits it in an Engineered Low-Level Trench (ELLT). The trenches are several acr 6 meters (20 feet) deep and have sloped sides and floor, allowing drainage to a col When the trenches are full, DOE backfills and covers them with at least 1.8 meters The Site packages intermediate-level wastes according to the waste form and dispose trenches. DOE will store long-lived wastes, such as resins, until the Long-Lived W Building, currently under construction, becomes operational. This building will pr DOE develops treatment and disposal technologies.

The SRS is developing a new disposal facility, known as the E-Area Vault (EAV). will include vaults for low-activity waste, intermediate-level non-tritium waste, a tritium waste.

Based on the 1994-to-1996 average annual generation forecast, the Site generates 19,000 cubic meters (671,400 cubic feet) of low-activity waste and 750 cubic meters feet) of intermediate-level waste annually. DOE expects that the Consolidated Inci will begin operations by the second quarter of Fiscal Year 1996; this facility will of annually processing as much as 15,850 cubic meters (560,000 cubic feet) of boxed waste and approximately 186 cubic meters (6,600 cubic feet) of hazardous and mixed

4.14.5 Hazardous Waste

DOE stores hazardous wastes generated at various SRS facilities in buildings in t N-Areas, and on the Solid Waste Storage Pads. The Resource Conservation and Recove regulates these wastes.

The inventory of hazardous waste in storage at the SRS is about 1.6 million kilog pounds), occupying a volume of about 2,430 cubic meters (86,000 cubic feet) (WSRC 1 on the 1994-to-1996 average annual generation rate forecast, the Site generates app 124 cubic meters (4,370 cubic feet) of hazardous waste annually (WSRC 1994c).

4.14.6 Sanitary Waste

The SRS disposes of most of its solid sanitary waste in onsite landfills, the mos began operation in 1985. Current disposal operations include the Interim Sanitary 30 trucks per work day arrive at this facility carrying approximately 18,125 kilogr of waste that, after compaction, occupies approximately 115 cubic meters (150 cubic space. The recent implementation of SRS paper and aluminum can recycling programs office waste off the Site in a commercial landfill has increased the projected life fourth quarter of 1996 (WSRC 1994e).

DOE also maintains an inert material landfill on the Site near Burma Road. This demolition and construction debris. DOE is evaluating the construction of a new SR or the use of a commercial landfill.

4.14.7 Hazardous Materials

The SRS 1993 Tier II emergency and hazardous chemical inventory lists 205 reporta

substances present on the Site in excess of the 10,000-pound (4,536-kilogram) thres (WSRC 1994f). The number and the total weight of any hazardous chemicals used on t daily in response to use. The annual Superfund Amendments and Reauthorization Act for the SRS include listings of hazardous materials used or stored on the Site duri

5. ENVIRONMENTAL CONSEQUENCES

5.1 Overview

This chapter discusses the potential environmental consequences for each spent management alternative described in Chapter 3. The representative host site locati Chapter 2, are the F- and H-Areas and an undeveloped site close to H-Area. These s representative of available areas that could support spent fuel management missions facility characteristics, this chapter analyzes representative consequences in term attributes of the potential host areas and the Savannah River Site (SRS) at large, Chapter 4. Table 3-2 compares the environmental consequences of each alternative. associated with the construction and operation of a Navy Expended Core Facility are this chapter, but are included in Appendix D of Volume 1 of this Environmental Impa

5.2 Land Use

Overall environmental impacts on land use by any of the alternatives would be s U.S. Department of Energy (DOE) would construct most new facilities in F- and H-Are already dedicated to industrial use and which previous activities have disturbed. the undeveloped representative host site near H-Area would probably be necessary on construction of a dry storage vault.

The Centralization Alternative (Alternative 5), under which DOE would transfer fuel to the SRS, would result in the greatest changes in land use. Under this alte would dedicate between 70 and 100 acres (0.3 and 0.4 square kilometer) for use in s management; the exact location and size of the area affected would depend on whethe use the wet storage, dry storage, or processing option. Of this affected area, a m approximately 100 acres (0.4 square kilometer) would change from managed pine fores use.

DOE would retain under its control any lands supporting the spent nuclear fuel program for the life of the project. No alternative would require the acquisition

5.3 Socioeconomics

Socioeconomic consequences resulting from the implementation of any of the alte relate primarily to changes in employment within the region of influence (ROI). DO analysis in the following section on estimated employment and population data for e nuclear fuel alternative, as listed in Table 5-1. The population within the region is estimated to be approximately 462,000. The labor force will be about 257,000 pe about 242,000 will be employed.

DOE expects the employment level at the Site to decline from about 20,000 (in 1 15,800 (in 2004) as the SRS mission is redefined. This anticipated decline would b by the jobs created by the spent nuclear fuel management activities. Therefore, no alternatives would require additional operations employees because the SRS could fi positions through the reassignment of existing workers. Consequently, this analysi employment impacts from construction activities. Given the natural variation in co employment levels, the analysis could not accurately determine the reassignment of construction workers. As a result, this assessment analyzed the maximum potential assumes that all construction employment would represent new jobs that in-migrating fill.

DOE estimated total employment impacts using the Regional Input-Output Modeling the U.S. Bureau of Economic Analysis developed for the SRS region of influence. Th also analyzed changes in population based on historic data that indicate that 90 pe employees live in the six-county region.

5.3.1 Potential Impacts

Table 5-1 lists direct increases in construction employment for each alternativ corresponding change in population. As listed, potential impacts to socioeconomic smallest under Alternative 1 (No Action) and would be greatest under Option 5b (Cen Storage). Therefore, Option 5b provides the bounding case for maximum potential im socioeconomic resources.

Table 5-1. Direct construction employment and total population changes by alternat

Alternative	1995a	1996a	1997a	1998a	1999a	2000	2001
Alternative 1- Employmenta Population	50 200	50 150	50 150	50 100	50 100	50 100	50 100
Option 2a- Employment Population	50 200	50 150	50 150	50 100	50 100	200 850	400 1,550
Option 2b- Employment Population	50 100	50 150	50 150	50 100	50 100	200 850	400 1,550
Option 2c- Employment Population	50 200	50 150	50 150	50 100	50 100	200 700	350 1,350
Option 3a- Employment Population	50 200	50 150	50 150	50 100	50 100	200 850	400 1,550
Option 3b- Employment Population	50 200	50 150	50 150	50 100	50 100	200 800	400 1,600
Option 3c- Employment Population	50 200	50 150	50 150	50 100	50 100	200 700	350 1,350
Option 4a- Employment Population	50 200	50 150	50 150	50 100	50 100	200 800	400 1,600
Option 4b- Employment Population	50 200	50 150	50 150	50 100	50 100	200 800	400 1,600
Option 4c- Employment Population	50 200	50 150	50 150	50 100	50 100	200 700	350 1,350
Option 4d- Employment Population	50 200	50 200	50 150	50 150	50 150	300 1,100	500 1,900
Option 4e- Employment Population	50 200	50 200	50 150	50 150	50 150	250 1,000	500 2,000
Option 4f- Employment Population	50 200	50 200	50 150	50 150	50 150	200 850	450 1,700
Option 4g- Employment Population	50 200	50 150	50 150	50 100	50 100	100 250	150 500
Alternative	1995a	1996a	1997a	1998a	1999a	2000	2001
Option 5a- Employment Population	50 200	50 150	50 150	50 100	50 100	900 3,500	1,750 6,800
Option 5b- Employment Population	50 200	50 150	50 150	50 100	50 100	1,000 3,850	1,900 7,450
Option 5c- Employment Population	50 200	50 150	50 150	50 100	50 100	900 3,500	1,750 6,800

Option 5d-	50	50	50	50	50	100	150
Employment	200	150	150	100	100	250	500
Population							

a. Construction is related to renovation of reactor basin and Receiving Basin for

Table 5-2 lists indirect employment and corresponding population changes associ construction phase activities under Option 5b. As listed, the number of full-time required to support the implementation of this option from 1995 to 2004 would range approximately 50 to 2,700. When added to the indirect employment of 1,600 jobs in (2002), the total employment impact in the region would be approximately 4,300 empl

Table 5-2. Estimated increases in employment and population related to constructio Option 5b, from 1995 to 2004. ROI refers to the six-county region of influence.

Factor	1995	1996	1997	1998	1999	2000
Direct employment	50	50	50	50	50	1,000
Secondary employment	30	30	30	30	30	600
Total employment change	80	80	80	80	80	1,600
% Change in ROI labor force	0.03	0.03	0.03	0.03	0.03	0.54
% Change in ROI employment	0.03	0.03	0.03	0.03	0.03	0.57
Population change (in region)	200	150	150	100	100	3,850
% Change in ROI population	0.04	0.03	0.03	0.02	0.02	0.81

Assuming in-migrating workers filled all jobs, the regional labor force and employm by 1.4 percent and 1.5 percent, respectively. These changes would be temporary and adverse impact on the region. After 2004, employment would gradually decline to a constant level of about 50 jobs.

Based on historic data, approximately 90 percent of new employees would live wi six-county region of influence. Assuming each new employee represented one househo persons per household, there would be approximately 10,550 additional people in the peak year (2002). These changes would be temporary and would represent an estimate increase in baseline population levels. Given this minor change in population, DOE impacts on the demand for community resources and services such as housing, schools care, and fire protection to be negligible.

Because all the other alternatives would require fewer employees, they would re changes than those listed in Table 5-2, and would have no adverse impacts on socioe resources in the region of influence.

5.4 Cultural Resources

A Programmatic Memorandum of Agreement (SRARP 1989) between the DOE Savannah Ri Operations Office, the South Carolina State Historic Preservation Office, and the A Historic Preservation, ratified on August 24, 1990, is the instrument for the manag resources at the SRS. DOE uses this memorandum to identify cultural resources, ass of eligibility for the National Register of Historic Places, and develop mitigation resources in consultation with the State Historic Preservation Officer. DOE would terms of the memorandum for all activities needed to support spent nuclear fuel man

The potential for adverse impacts on cultural resources would be smallest under (No Action) and would be greatest under Alternative 5 (Centralization). Any facili would construct in F- and H-Areas, north of Road E (Alternatives 1-5), would be in Zones 2 and 3. Section 4.4 describes these zones. The undeveloped representative east of H-Area (Alternative 5) is in Sensitivity Zone 3. Although there are no kno sites in the area, it has never been surveyed. Surveying being conducted near F-Ar Road C and west of Road 4 along Upper Three Runs Creek) has recorded some historic prehistoric sites. However, DOE expects no impacts in F- and H-Areas due to their industrial development. Until DOE has determined the precise locations of faciliti any of the alternatives, it cannot predict impacts on cultural resources in the und (Sassaman 1994). However, DOE would mitigate, through avoidance or removal, impact potentially significant resources that future site surveys might discover.

5.5 Aesthetic and Scenic Resources

None of the alternatives for spent nuclear fuel management at the SRS would hav consequences on scenic resources or aesthetics. Most new construction would be in both of which are already dedicated to industrial use. New construction on the und which would occur primarily under Alternative 5, would be adjacent to H-Area in an industrialized portion of the SRS. In all cases, new construction would not be vis from public access roads on the Site. No alternative would produce emissions to th would be visible or would indirectly reduce visibility.

5.6 Geologic Resources

The SRS contains no unique geologic features or minerals of economic value. Th anticipates no impacts to geologic resources at the SRS from any of the spent nucle management alternatives.

Other sections in this chapter consider the relationships of the Site's specifi region's historic and analyzed seismicity to the local environment and to SRS spent related structures and facilities. Section 5.8 discusses the consequences of analy both surface-water and groundwater resources. Section 5.15 describes estimates of both the probability of and the consequences from a wide range of seismic events, r and regional historically documented earthquakes to postulated lower probability, h events.

The accident analyses in this chapter, which DOE based on information from appr analysis reports for applicable facilities, address the frequency and consequences earthquakes, as well as postulated less likely, but more damaging, seismic events. the consequences from seismic challenges to the facilities and structures up to 0.2 acceleration.

5.7 Air Quality Consequences

The SRS is in compliance with both Federal and state ambient air quality standa and toxic air pollutants. As shown in the following tables, the predicted incremen impacts would not contribute to exceeding either the National Ambient Air Quality S Carolina's Ambient Air Quality Standards.

DOE performed analyses using computer models in order to assess the potential a impacts of operations under each of the spent nuclear fuel management alternatives. describes the results of these analyses. All the concentrations discussed below ar estimations based on results from the ISC2 and FDM models for nonradiological pollu MAXIGASP- and POPGASP SRS-climatology-specific models for radionuclides. The analy assume that facility operations would result in both radiological and nonradiologic assessed construction impacts qualitatively in relation to the land area to be dist alternative.

Nonradiological Emissions. DOE analyzed the potential incremental impacts of o substances for which it expects releases to the atmosphere during the normal operat fuel facilities. The nonradiological releases evaluated for each alternative inclu pollutants and 23 toxic pollutants. DOE selected the toxic substances for analysis anticipated chemical usage at the proposed spent nuclear fuel facilities to the lis pollutants in the South Carolina Air Pollution Regulations (SCDHEC 1976). The SRS potential emissions of the listed toxic chemicals that DOE anticipates would be use nuclear fuel activities. The following subsections discuss the results for both cr pollutants. Tables 5-3 and 5-4 list the estimated maximum incremental concentratio pollutants at the Site boundary, while Tables 5-5 and 5-6 contain the incremental r

Radiological Emissions. DOE evaluated the potential radiological releases to t from spent fuel management at the SRS using existing Site historical operations inf on the actual 1993 emissions data from the Receiving Basin for Offsite Fuels (WSRC estimates that emissions from any of the wet storage options under Alternatives 1 t

Table 5-3. Estimated incremental air quality impacts at the Savannah River Site bo criteria pollutants (-g/m3).

Pollutantb	Averaging Time	Regulatory Standardc	Maximum Potential Concentration	Actual Concen
CRITERIA POLLUTANTS (-g/m3)				
Carbon monoxide	8-hour	10,000	818	23
	1-hour	40,000	3,553	180
Ozone (as VOC)	1-hour	245	N/Ad	N/Ad
Nitrogen oxides	Annual geometric mean	100	30	4
Particulate matter (<10-m)	Annual	50	9	3
	24-hour	150	93	56
Total suspended particulates (TSP)	Annual	75	20	11
Sulfur dioxide	Annual	80	18	10
	24-hour	365	356	185
	3-hour	1,300	1,210	634
Lead	Calendar quarter mean	1.5	<0.01	<0.01
Gaseous Fluorides (as HF)	1-month	0.8	0.11	0.03
	1-week	1.6	0.6	0.15
	24-hour	2.9	1.20	0.31
	12-hour	3.7	2.40	0.62

Table 5-3. (continued).

Pollutantb	Averaging Time	Regulatory Standardc	Maximum Potential Concentration	Actual Concen
CRITERIA POLLUTANTS (-g/m3)				
Carbon monoxide	8-hour	10,000	818	23
	1-hour	40,000	3,553	180
Ozone (as VOC)	1-hour	245	N/Ad	N/Ad
Nitrogen oxides	Annual geometric mean	100	30	4
Particulate matter (<10-m)	Annual	50	9	3
	24-hour	150	93	56
Total suspended particulates (TSP)	Annual	75	20	11
Sulfur dioxide	Annual	80	18	10
	24-hour	365	356	185
	3-hour	1,300	1,210	634
Lead	Calendar quarter mean	1.5	<0.01	<0.01
Gaseous Fluorides (as HF)	1-month	0.8	0.11	0.03
	1-week	1.6	0.6	0.15
	24-hour	2.9	1.20	0.31
	12-hour	3.7	2.40	0.62

Table 5-3. (continued).

	Averaging Time	Regulatory Standardc	Maximum Potential Concentration	Ac Co
CRITERIA POLLUTANTS (-g/m3)				

Carbon monoxide	8-hour	10,000	818	23
	1-hour	40,000	3,553	18
Ozone (as VOC)	1-hour	245	N/Ad	N/
Nitrogen oxides	Annual geometric mean	100	30	4
Particulate matter	Annual	50	9	3
(<10-m)	24-hour	150	93	56
Total suspended particulates (TSP)	Annual	75	20	11
Sulfur dioxide	Annual	80	18	10
	24-hour	365	356	18
	3-hour	1,300	1,210	63
Lead	Calendar quarter mean	1.5	<0.01	<0
Gaseous Fluorides (as HF)	1-month	0.8	0.11	0.
	1-week	1.6	0.6	0.
	24-hour	2.9	1.20	0.
	12-hour	3.7	2.40	0.

- = No impact.
a. Maximum modeled ground-level concentration at SRS perimeter unless higher offsit
b. Major pollutants of concern regarding spent nuclear fuel management activities.
c. Most stringent Federal and state regulatory standards (CFR 1991a), (SCDHEC 1976)
d. Measurement data currently unavailable.
e. Maximum operational air pollutant emissions projected for baseline year 1995. C
plus maximum potential emissions for sources permitted through December 1992.

Table 5-4. Estimated incremental air quality impacts at the Savannah River Site bo toxic pollutants (-g/m3).

Pollutantb	Averaging Time	Regulatory Standardc	Maximum Potential Concentration	Actual Concentrationd
TOXIC POLLUTANTS (-g/m3)				
Nitric acid	24-hour	125	51	6.7
1,1,1,- Trichloroethane	24-hour	9,550	81	22
Benzene	24-hour	150	32	31
Ethanolamine	24-hour	200	<0.01	<0.01
Ethyl benzene	24-hour	4,350	0.58	0.12
Ethylene glycol	24-hour	650	0.20	0.08
Formaldehyde	24-hour	7.5	<0.01	<0.01
Glycol ethers	24-hour	+	<0.01	<0.01
Hexachloronapthalene	24-hour	1.0	<0.01	<0.01
Hexane	24-hour	200	0.21	0.07
Manganese	24-hour	25	0.82	0.10
Methyl alcohol	24-hour	1,310	2.9	0.51
Methyl ethyl ketone	24-hour	14,750	6.0	0.99
Methyl isobutyl ketone	24-hour	2,050	3.0	0.51
Methylene chloride	24-hour	515	10.5	1.8
Naphthalene	24-hour	1,250	0.01	0.01
Phenol	24-hour	190	0.03	0.03
Phosphorus	24-hour	0.5	<0.001	<0.001
Sodium hydroxide	24-hour	20	0.01	0.01
Toluene	24-hour	2,000	9.3	1.6
Trichloroethylene	24-hour	6,750	4.8	1.0
Vinyl acetate	24-hour	176	0.06	0.02
Xylene	24-hour	4,350	39	3.8

Table 5-4. (continued).

Pollutantb	Averaging Time	Regulatory Standardc	Maximum Potential Concentration	Actual Concentrationd

TOXIC POLLUTANTS (-g/m3)				
Nitric acid	24-hour	125	51	6.7
1,1,1,- Trichloroethane	24-hour	9,550	81	22
Benzene	24-hour	150	32	31
Ethanolamine	24-hour	200	<0.01	<0.01
Ethyl benzene	24-hour	4,350	0.58	0.12
Ethylene glycol	24-hour	650	0.20	0.08
Formaldehyde	24-hour	7.5	<0.01	<0.01
Glycol ethers	24-hour	+	<0.01	<0.01
Hexachloronapthalene	24-hour	1.0	<0.01	<0.01
Hexane	24-hour	200	0.21	0.07
Manganese	24-hour	25	0.82	0.10
Methyl alcohol	24-hour	1,310	2.9	0.51
Methyl ethyl ketone	24-hour	14,750	6.0	0.99
Methyl isobutyl ketone	24-hour	2,050	3.0	0.51
Methylene chloride	24-hour	515	10.5	1.8
Naphthalene	24-hour	1,250	0.01	0.01
Phenol	24-hour	190	0.03	0.03
Phosphorus	24-hour	0.5	<0.001	<0.001
Sodium hydroxide	24-hour	20	0.01	0.01
Toluene	24-hour	2,000	9.3	1.6
Trichloroethylene	24-hour	6,750	4.8	1.0
Vinyl acetate	24-hour	176	0.06	0.02
Xylene	24-hour	4,350	39	3.8

Table 5-4. (continued).

Pollutantb	Averaging Time	Regulatory Standardc	Maximum Potential Concentration	Actual Concentrationd
TOXIC POLLUTANTS (-g/m3)				
Nitric acid	24-hour	125	51	6.7
1,1,1,- Trichloroethane	24-hour	9,550	81	22
Benzene	24-hour	150	32	31
Ethanolamine	24-hour	200	<0.01	<0.01
Ethyl benzene	24-hour	4,350	0.58	0.12
Ethylene glycol	24-hour	650	0.20	0.08
Formaldehyde	24-hour	7.5	<0.01	<0.01
Glycol ethers	24-hour	+	<0.01	<0.01
Hexachloronapthalene	24-hour	1.0	<0.01	<0.01
Hexane	24-hour	200	0.21	0.07
Manganese	24-hour	25	0.82	0.10
Methyl alcohol	24-hour	1,310	2.9	0.51
Methyl ethyl ketone	24-hour	14,750	6.0	0.99
Methyl isobutyl ketone	24-hour	2,050	3.0	0.51
Methylene chloride	24-hour	515	10.5	1.8
Naphthalene	24-hour	1,250	0.01	0.01
Phenol	24-hour	190	0.03	0.03
Phosphorus	24-hour	0.5	<0.001	<0.001
Sodium hydroxide	24-hour	20	0.01	0.01
Toluene	24-hour	2,000	9.3	1.6
Trichloroethylene	24-hour	6,750	4.8	1.0
Vinyl acetate	24-hour	176	0.06	0.02
Xylene	24-hour	4,350	39	3.8

\- No impact.
\+ Not available.
a. Maximum modeled ground-level concentration at SRS perimeter unless higher offsit
b. Major pollutants of concern regarding spent nuclear fuel.
c. Most stringent Federal and state regulatory standards (CFR 1991a), (SCDHEC 1976)
d. Maximum operational air pollutant emissions projected for baseline year 1995. C
1990 plus maximum potential emissions for sources permitted through December 199

Table 5-5. Incremental air quality pollutant emission rates related to spent nucle

Baseline Alternatives

Pollutant	Maximum Design Capacity	Actualb	No Action 1	D 2
CRITERIA POLLUTANTS (TONS PER YEAR)				
NOx	2.22x104	2.62x103	-	6
Particulates				
TSP	3.62x103	9.80x102	-	4
PM10	2.66x103	4.97x102	-	2
CO	6.77x103	1.99x102	-	1
SO2	6.42x104	6.68x103	1.6x10-3	4
Gaseous Fluorides	2.14x10-2	1.07x10-2	-	-
Ozone (as VOC)	N/Ac	N/Ac	-	6
CRITERIA POLLUTANTS (TONS PER YEAR)			Regionalization A 4a	4
NOx	2.22x104	2.62x103	8.5x100	8
Particulates				
TSP	3.62x103	9.80x102	6.0x10-2	6
PM10	2.66x103	4.97x102	1.45x101	1
CO	6.77x103	1.99x102	2.0x100	2
SO2	6.42x104	6.68x103	5.5x10-2	5
Gaseous Fluorides	2.14x10-2	1.07x10-2	-	-
Ozone (as VOC)	N/Ac	N/Ac	8.5x10-1	8

Table 5-5. (continued).

Pollutant	Maximum Design Capacity	Actualb	Alternatives Centralization 5a	
CRITERIA POLLUTANTS (TONS PER YEAR)				
NOx	2.2x104	2.6x103	5.6x101	5
Particulates				
TSP	3.62x103	9.8x102	2.1x100	2
PM10	2.66x103	4.97x102	1.4x100	1
CO	6.77x103	1.99x102	2.7x101	2
SO2	6.42x104	6.68x103	8.1x100	8
Gaseous Fluorides	2.14x10-2	1.07x10-2		
Ozone (as VOC)	N/Ac	N/Ac	4.6x100	4

a. Source: WSRC (1994a).
b. Maximum operational air pollutant emissions projected for baseline year 1995. C year 1990 plus maximum potential emissions for sources permitted through Decembe
c. Emissions data currently unavailable.
- No proposed incremental emissions.

Table 5-6. Incremental air quality pollutant emission rates related to spent nucle

Pollutant	Baseline: Maximum Design Capacity	Actualb	Alternatives: No Action 1	Decentral 2a
TOXIC POLLUTANTS (TONS PER YEAR)				
Nitric Acid	1.13x103	2.56x100	5.1x10-2	5.1x10-2
1,1,1-Trichloroethane	8.0x101	NAc	-	-
Benzene	2.9x101	4.48x100	-	-
Ethanolamine	2.21x10-2	5.35x10-3	1.46x10-3	1.46x10-3
Ethyl Benzene	2.56x100	1.07x100	-	-
Ethylene Glycol	6.83x10-1	4.17x10-1	2.25x10-2	2.25x10-2
Formaldehyde	4.55x10-2	4.8x10-4	3.6x10-6	3.6x10-6

Glycol Ethers	4.36x10-3	1.99x10-4	4.06x10-3	4.06x10-3
Hexachloronaphthalene	<0.01	NAc	3.65x10-5	3.65x10-5
Hexane	3.54x100	2.22x10-1	3.28x10-3	3.28x10-3
Manganese	2.84x10-1	3.43x10-1	-	-
Methyl Alcohol	6.62x10-1	3.46x10-1	6.84x10-2	6.84x10-2
Methyl Ethyl Ketone	6.41x100	3.17x100	2.19x10-3	2.19x10-3
Methyl Isobutyl Ketone	8.25x100	2.25x100	-	-
Methylene Chloride	1.53x100	1.19x100	-	-
Naphthalene	7.22x10-2	3.08x10-2	5.84x10-4	5.84x10-4
Phenol	8.07x10-2	1.37x10-2	-	-
Phosphorus	2.97x10-3	1.65x10-4	-	-
Sodium Hydroxide	1.26x10-1	1.26x10-1	-	-
Toluene	3.91x100	7.66x10-1	5.0x10-2	5.0x10-2
Trichloroethylene	2.52x101	9.8x100	-	-
Vinyl Acetate	4.38x10-2	5.9x10-3	-	-
Xylene	1.46x103	1.22x101	1.58x10-1	1.58x10-1

Table 5-6. (continued).

Pollutant	Baseline		Alternatives	
	Maximum Design Capacity	Actualb	Regionalization A	
			4a	4b
TOXIC POLLUTANTS (TONS PER YEAR)				
Nitric Acid	1.1x103	2.6x100	5.1x10-2	5.1x
1,1,1-Trichloroethane	8.0x101	NAc	-	-
Benzene	2.9x101	4.5x100	-	-
Ethanolamine	2.2x10-2	5.4x10-3	1.5x10-3	1.5x
Ethyl Benzene	2.6x100	1.1x100	-	-
Ethylene Glycol	6.8x10-1	4.2x10-1	2.3x10-2	2.3x
Formaldehyde	4.6x10-2	4.8x10-4	3.6x10-6	3.6x
Glycol Ethers	4.4x10-3	2.0x10-4	4.1x10-3	4.1x
Hexachloronapthalene	<0.01	NAc	3.7x10-5	3.7x
Hexane	3.5x100	2.2x10-1	3.3x10-3	3.3x
Manganese	2.8x10-1	3.4x10-1	-	-
Methyl Alcohol	6.6x10-1	3.5x10-1	6.8x10-2	6.8x
Methyl Ethyl Ketone	6.4x100	3.2x100	2.2x10-3	2.2x
Methyl Isobutyl Ketone	8.3x100	2.3x100	-	-
Methylene Chloride	1.5x100	1.2x100	-	-
Naphthalene	7.2x10-2	3.1x10-2	5.8x10-4	5.8x
Phenol	8.1x10-2	1.4x10-2	-	-
Phosphorus	3.0x10-3	1.7x10-4	-	-
Sodium Hydroxide	1.3x10-1	1.3x10-1	-	-
Toluene	3.9x100	7.7x10-1	5.0x10-2	5.0x
Trichloroethylene	2.5x101	9.8x100	-	-
Vinyl Acetate	4.4x10-2	5.9x10-3	-	-
Xylene	1.5x103	1.2x101	1.6x10-1	1.6x

Table 5-6. (continued).

Pollutant	Maximum Design Capacity	Actualb	Alternatives	
			Centralization	
			5a	5b
TOXIC POLLUTANTS (TONS PER YEAR)				
Nitric Acid	1.1x103	2.6x100	5.1x10-2	5.1x
1,1,1-Trichloroethane	8.0x101	NAc	-	-
Benzene	2.9x101	4.5x100	-	-
Ethanolamine	2.2x10-2	5.4x10-3	1.5x10-3	1.5x
Ethyl Benzene	2.6x100	1.1x100	-	-
Ethylene Glycol	6.8x10-1	4.2x10-1	2.3x10-2	2.3x
Formaldehyde	4.6x10-2	4.8x10-4	3.6x10-6	3.6x

Glycol Ethers	4.4x10-3	2.0x10-4	4.1x10-3	4.1x
Hexachloronapthalene	<0.01	NAc	3.7x10-5	3.7x
Hexane	3.5x100	2.2x10-1	3.3x10-3	3.3x
Manganese	2.8x10-1	3.4x10-1	-	-
Methyl Alcohol	6.6x10-1	3.5x10-1	6.8x10-2	6.8x
Methyl Ethyl Ketone	6.4x100	3.2x100	2.2x10-3	2.2x
Methyl Isobutyl Ketone	8.3x100	2.3x100	-	-
Methylene Chloride	1.5x100	1.2x100	-	-
Naphthalene	7.2x10-2	3.1x10-2	5.8x10-4	5.8x
Phenol	8.1x10-2	1.4x10-2	-	-
Phosphorus	3.0x10-3	1.7x10-4	-	-
Sodium Hydroxide	1.3x10-1	1.3x10-1	-	-
Toluene	3.9x100	7.7x10-1	5.0x10-2	5.0x
Trichloroethylene	2.5x101	9.8x100	-	-
Vinyl Acetate	4.4x10-2	5.9x10-3	-	-
Xylene	1.5x103	1.2x101	1.6x10-1	1.6x

a. Source: WSRC (1994a).
b. Maximum operational air pollutant emissions projected for baseline year 1995. C year 1990 plus maximum potential emissions for sources permitted through Decembe
c. NA= Emissions data currently unavailable.
- No proposed incremental emissions.

consist of about 2 y 10-7 curies per year of cesium-137. Releases from dry storage these alternatives would be somewhat less. For Alternative 5 where SRS would manag MTHM (3,020 tons) of spent fuel (versus about 206 to 257 MTHM [227 to 283 tons] for alternatives), the atmospheric releases of cesium-137 would be proportionally highe

DOE used actual emissions from F- and H-Areas during 1985 and 1986, a period wh was processing material through the separations facilities at close to maximum capa potential releases from spent nuclear fuel management activities. DOE believes tha released during this period, and their emission rates, represent maximum emissions under any of the alternatives (Table 5-7). The results of the analyses are present the human health consequences are discussed in Section 5.12. Section 5.15 presents the consequences of accidents.

Construction Emissions. Potential impacts to air quality from construction act include fugitive dust from the clearing of land, as well as exhaust emissions from (e.g., earth-moving vehicles, diesel generators). The amount of dust produced woul to the land area disturbed for the new facilities, all of which would be located ne Site. The areas affected by each alternative would be as follows:

- No Action - 0 acres
- Decentralization, 1992/1993 Planning Basis and Regionalization A (by fuel t 9 acres

- Regionalization B (by location) - 7 to 11 acres
- Centralization - 70 to 100 acres
- Shipping fuel offsite - 1 acre

DOE anticipates that overall construction impacts to air quality would be minim duration (6 months to 3 years). The SRS sitewide compliance with state and Federal quality standards would not be affected by any construction-related activities asso management.

Table 5-7. Estimated maximum annual emissions (in curies) of radionuclides to the spent nuclear fuel management activities.

Radionuclide	Annual Emissionsa,b
Tritium (elemental)	1.88x105,c
Cesium-134	3.60x10-4
Cesium-137	4.07x10-3
Curium-244	2.00x10-4
Cerium-141	1.83x10-3
Cerium-144	3.11x10-2
Americium-241	2.27x10-4
Cobalt-60	4.00x10-6
Plutonium-238	1.28x10-3
Plutonium-239	4.01x10-4
Strontium-90	1.39x10-2

Rubidium-103	7.25x10-3
Uranium-235	2.00x10-3
Osmium-185	3.60x10-4
Nibium-95	2.89x10-2
Selenium-75	1.52x10-5
Zirconium-95	1.68x10-2
Rubidium-106	5.12x10-3
Krypton-85	6.80x105
Carbon-14	2.80x101

a. Source: Hamby (1993).
b. Source terms are taken from 1985/86 F-/H-Area releases.
c. Historically, less than 10 percent of the atmospheric tritium releases have been operations in the F-/H-Area Canyons.

5.7.1 Alternative 1 - No Action

The SRS would not process any spent nuclear fuel under the No Action alternativ baseline emissions would continue (Tables 5-3, 5-4, 5-5, 5-6 and 5-7). DOE would n new facilities under this alternative.

5.7.2 Alternative 2 - Decentralization

Atmospheric emissions under two of the Decentralization options (dry storage an would be similar to those for No Action. Those from the processing of the spent fu would be of somewhat higher concentrations (Tables 5-3, 5-4, 5-5, 5-6 and 5-7). Th originate from existing facilities involved in the management of spent fuel under t well as new ones that DOE would construct (Figure 3-2).

5.7.3 Alternative 3 - 1992/1993 Planning Basis

Emissions to the atmosphere would be similar to those for Alternative 2 because fuel managed would be similar [223 and 220 MTHM (246 and 243 tons), Alternative 3 a Alternative 2 respectively] and the facilities required would be the same (Figure 3

5.7.4 Alternative 4 - Regionalization

Regionalization A (by fuel type). Atmospheric emissions would be similar to th Alternative 2 because of the similarity in volumes of fuel managed [213 and 220 MTH 243 tons), respectively] and in the facilities involved (Figure 3-2).

Regionalization B (by location). Emissions would be somewhat higher than for Regionalization A for both dry and wet storage options if the SRS receives all the eastern portion of the country, because the Site would manage about 20 percent more Atmospheric emissions from processing would not change from those under other alter the amount of aluminum-clad fuel involved would be the same. Facility requirements similar (Figure 3-2).

Shipping all of the current SRS inventory off the Site (Option 4g) would result emissions to the atmosphere of any of the options under this alternative. These re from the characterization and canning of the fuel prior to shipment.

5.7.5 Alternative 5 - Centralization

The atmospheric emissions resulting from centralizing all the spent nuclear fue be the greatest of all the alternatives. The Site would manage about 2,740 MTHM (3 fuel. Releases from storage activities for centralization would be proportionally other alternatives where the SRS would manage about 206 to 257 MTHM (227 to 283 ton fuel. However, emissions from processing under Alternative 5 would be similar to t other alternatives because the same amount of aluminum-clad fuel would be processed The facilities required under all three options would be similar in function (Figur

larger capacity than for other alternatives.
Shipping all the SRS fuel to another site (Option 5d) would result in the lowes atmospheric releases of any alternative, similar to those under Regionalization B,

5.8 Water Quality and Related Consequences

SRS use of surface-water and groundwater resources under any of the alternative substantially increase the volumes currently used for process, cooling, and domesti Table 5-8 summarizes the groundwater and surface water usage requirements for each option, and compares them to current SRS usages.

The Centralization Alternative (Option 5c), under which DOE would transfer all fuel to the SRS, would result in the largest amount of water use [approximately 378 (100 million gallons) per year], which is a small amount compared to current SRS wa **of approximately 89.7 billion liters (23.7 billion gallons) per year.** This represe approximately 0.4 percent above current usage. Therefore, DOE anticipates that wat of the alternatives would have minimal impact on the water resources of the Site.

The impact on water quality of the operation of any of the alternatives would a Existing SRS treatment facilities could accommodate all new spent fuel-related dome wastewater streams. The expected total SRS flow volumes would still be well within capacities of the Site treatment systems. Because these plants would continue to m Pollutant Discharge Elimination System limits and reporting requirements, DOE expec the water quality of the receiving streams. The increased cooling water flows woul discharge permit limits and would have minimal impacts on the receiving water.

Each of the alternatives would contribute to the very small releases of radionu SRS operations discharge to the surface water through federally permitted wastewate

Table 5-8. Annual groundwater and surface water usage requirements for each altern

Alternative	Groundwater Usage per Year	Surface Water Usage per Year	Total
Current SRS Usage	14.0 billion liters	75.7 billion liters	89.7
No Action			
Option 1 - Wet Storage	35.1 million liters	None	35.1 m
Decentralization			
Option 2a - Dry Storage	48.7 million liters	6.1 million liters	54.8 m
Option 2b - Wet Storage	50.6 million liters	7.2 million liters	57.8 m
Option 2c - Processingc	48.7 million liters	310.8 million liters	359.5
Planning Basis			
Option 3a - Dry Storage	48.7 million liters	6.1 million liters	54.8 m
Option 3b - Wet Storage	50.6 million liters	7.2 million liters	57.8 m
Option 3c - Processingc	48.7 million liters	310.8 million liters	359.5
Regionalization - A			
Option 4a - Dry Storage	48.7 million liters	6.1 million liters	54.8 m
Option 4b - Wet Storage	50.6 million liters	7.2 million liters	57.8 m
Option 4c - Processingc	47.6 million liters	308.8 million liters	356.5
Regionalization - B			
Option 4d - Dry Storage	48.7 million liters	6.1 million liters	54.8 m
Option 4e - Wet Storage	50.6 million liters	7.2 million liters	57.8 m
Option 4f - Processingc	48.7 million liters	310.8 million liters	356.5
Option 4g - Ship Outc	38.1 million liters	3.0 million liters	41.1 m
Centralization			
Case 5a - Dry Storage	67.7 million liters	6.1 million liters	73.8 m
Case 5b - Wet Storage	69.6 million liters	7.2 million liters	76.8 m
Case 5c - Processingc	67.7 million liters	310.8 million liters	378.5
Case 5d - Ship Outc	38.1 million liters	3.0 million liters	41.1 m

a. Source: WSRC (1994b).
b. To convert liters to gallons, multiply by 0.26418.
c. First 10 years only.

Table 5-9 summarizes the estimated maximum amounts of radioactivity that could be r **Savannah River in liquid effluents from normal spent nuclear fuel management activi** actual liquid releases from F- and H-Area during 1985 and 1986 to estimate potentia could occur during spent fuel management activities. DOE believes the isotopes and during this period are representative of releases that could occur during processin alternatives. This is because 1985 and 1986 represent periods when the F- and H-Ar facilities operated at or near peak capacity to process spent nuclear fuel. Estima

or dry storage would be less than these amounts. Consequently, the estimated relea Table 5-9 represent the upper limit of liquid radiological releases that DOE expect

Table 5-9. Estimated maximum liquid radiological releases (in curies) to the Savan spent nuclear fuel management activities.

Radionuclide	Annual Releasea,b
Tritium	1.3x104,c
Strontium-90	2.4x10-1
Iodine-129	2.2x10-2
Cesium-137	1.1x10-1
Plutonium-239	7.0x10-3

a. Source: Hamby (1993).
b. Source terms are taken from 1985/86 F-/H-Area releases.
c. Less than 1 percent of this quantity was from processing operations in F-/H-Are

nuclear fuel management activities. The consequences to human health due to these discussed in Section 5.12, Occupational and Public Health and Safety.

Construction of new facilities under any alternative would require amounts of w be only a very small percentage of the current daily water use at the SRS. Good en measures would prevent sediment runoff or spills of fuel or chemicals. Therefore, activities should have no impact on surface or groundwater quality at the Site.

DOE also analyzed the potential impacts of accidents in F- and H-Areas on surfa groundwater quality. The analysis evaluated two types of accidental releases: one surface (e.g., overflow of a wet storage pool) and another directly to the subsurfa pool liner). Because pool water could contain some radionuclides, but would not co harmful chemicals, the following evaluation addresses only the consequences of radi

A release of pool water onto the ground from the Receiving Basin for Offsite Fu would not flow directly into any stream or other surface-water body. The building gravel-covered area among other buildings and alongside a railroad spur and access surrounded by an earthen berm is immediately to the south. A channelized drainage approximately 244 meters (800 feet) west of the basin building and passes through c railroad line and Road E before emptying into a tributary of Fourmile Branch about (1,650 feet) from the Receiving Basin. The grading at the Site would contain a sma overflowing the basin in the immediate area of the building. In the unlikely event reached the drainage ditch to the west, DOE could contain the water by blocking eit culverts through which the drainage ditch passes. After containing the spilled wat remove and properly dispose of it. DOE would design and construct new facilities c pools in a manner that would confine any overflow or other surface release of pool DOE believes that there will be no direct release to surface water from spills of p existing or potential facility.

An overflow from a pool could reach the groundwater by slowly flowing downward surface through the unsaturated zone until it reached the water table, which is 9 t 50 feet) below the grade in the F- and H-Areas. Overflow water would take several water table, based on a vertical velocity of between 0.9 and 2.1 meters (3 to 7 fee 1987). As discussed in the following paragraphs, once in the groundwater, a plume years to reach either of the closest surface-water bodies, Fourmile Branch to the s Runs Creek to the north.

DOE has calculated the travel times of groundwater in the F- and H-Areas based information on the hydraulic conductivity, the hydraulic gradient, and the effectiv in this area (WSRC 1993a) and on the use of Darcy's Law. Water would take between years to travel 1.6 kilometers (1 mile) toward Fourmile Branch or Upper Three Runs estimates of travel time agree with values obtained from the results of DOE modelin performed on the F- and H-Areas (Geotrans 1993; appended to WSRC 1993a). The reaso wide range of potential travel time is that the hydraulic conductivity of aquifer m variable and can vary in the same aquifer by several orders of magnitude. This slo through the subsurface, either vertically through the unsaturated zone or horizonta aquifer, would facilitate the removal of radionuclides from the spill plume through processes. These include radioactive decay, trapping of particulates in the soil, adsorption by the soil (Hem 1989). DOE believes that travel time of a contaminant subsurface in the F- or H-Area or in the adjacent representative host site would be radionuclides would reach Fourmile Branch, Upper Three Runs Creek, or any other sur by this route. For the same reasons, no radioactive contaminants introduced into t these areas would move off the Site in groundwater.

DOE does not believe that releases of radionuclides such as those described abo SRS drinking-water sources that lie in deep aquifers under the Site. These aquifer

hundred feet below the ground surface, and a number of thick aquifers and aquitards from the water table aquifer (see Section 4.8). In addition to the distances and t confining layers, vertical flow in the intervening stratified sedimentary aquifers to horizontal flow. Radionuclide contamination of offsite drinking water sources unlikely given the depth of their source aquifers, the distances involved, and the contaminants in the soils, as described above.

DOE also evaluated a second kind of unintentional release in the F- or H-Area, the subsurface from a breach in a storage pool during routine operations. The anal 19-liter (5-gallon)-per-day leak as a result of secondary containment or piping fai the-art wet storage and fuel transfer facility (Creed 1994). The analysis assumed would go undetected for 1 month, a conservative assumption given the sensitivity of equipment that these new facilities would require. The reliability and sensitivity devices would be equal to or superior to those required by the U.S. Nuclear Regulat (NRC 1975) for spent nuclear fuel storage facilities in commercial nuclear power pl require spent nuclear fuel storage pools (whether fuel unloading pools or storage b detection monitoring devices, pool water level monitors, and radiation monitors des locally and in a continuously staffed central location. Constant process monitorin facility design (including double-walled containment of vessels and piping) would a DOE to limit operational releases from new wet storage facilities, including fuel u storage basins, to near zero.

To provide a common basis for analysis of spent nuclear fuel alternatives at it DOE developed a generic infrastructure design for a hypothetical spent nuclear fuel 1994). This design includes proposed criteria for temporary wet storage basins, fu unloading pools, and transfer canals.

Based on the design criteria in Hale (1994), a leak from one of these basins if F- or H-Area could result in the introduction of radionuclide-contaminated water in depths as much as 13.4 meters (44 feet) below grade. Such a release would go direc table aquifer or to the unsaturated zone above it, depending on the depth of the w case, the processes governing the slow plume movement (i.e., the hydraulic conducti gradient, and effective porosity of aquifers in the F- and H-Areas) and the process attenuation of contaminants and radionuclides (i.e., radioactive decay, trapping of soil, ion exchange in the soil, and adsorption to soil particles) described in the would also prevent or mitigate impacts to surface-or groundwater resources from rel There could be localized contamination of groundwater in the surface aquifer in the of the storage facilities. This aquifer is not used as a source of drinking water. radionuclide contamination of deeper confined aquifers that are sources of onsite o water could occur from a release of this type. And, as noted earlier, these wet st be equipped with state-of-the-art leak detection devices, pool level monitors, and that would limit and mitigate any subsurface releases.

5.8.1 Alternative 1 - No Action

5.8.1.1 Option 1 - Wet Storage. During operations under this alternative, current levels of

water usage would not change. Nor would changes occur in thermal discharges from c the quantity or quality of radioactive and nonradioactive wastewater effluents.

The viable accidents under this alternative would be a release of pool water on surface or a breach of the liner of the wet storage basins in which the spent nucle stored. As discussed above, radionuclides in the released water would enter the wa would not reach any surface-water or any drinking water aquifer on or off the SRS. contains no toxic or hazardous chemicals. Therefore, accidental releases from the minimal impacts on surface- and groundwater resources.

Spills of chemicals would not reach surface- or groundwater due to existing pro design and environmental controls, and to rapid containment and cleanup.

5.8.2 Alternative 2 - Decentralization

Operations under either the dry or wet storage option for the Decentralization increase Site water usage by less than 0.1 percent above current levels. Processin by about 0.4 percent. Release of nonradioactive and radioactive materials to surfa increase only slightly and would be well within discharge permit limits and DOE dos would be no releases to groundwater during normal operations. Overall impacts to w

water quality would be minimal.

Impacts to water resources due to accidental releases onto the ground or into t would also be minimal as explained above. Potential contamination would be limited aquifer.

5.8.3 Alternative 3 - 1992/1993 Planning Basis

DOE expects that the impacts to water resources under the dry storage, wet stor processing cases for this alternative would be similar to those described for the s Alternative 2, Decentralization. Overall impacts would be minimal.

5.8.4 Alternative 4 - Regionalization

DOE expects that the impacts to water resources under the three options for reg fuel type (Regionalization A) would be similar to those described for the same opti Alternative 2, Decentralization. Regionalization B (by geographic location) would somewhat greater than those for Alternative 2 because the SRS would have to manage MTHM (41 tons) of spent fuel. In either case, overall impacts would be minimal. F shipping all SRS fuel to Oak Ridge Reservation, impacts to water resources would be any alternative, similar to those for Option 5d - Centralization.

5.8.5 Alternative 5 - Centralization

The first three options for this alternative - dry storage (Option 5a), wet sto processing (Option 5c) - assume that DOE would transfer all spent nuclear fuel to t management. The impacts of operations to water resources under these options would nature to the impacts for the same options under Alternative 2, Decentralization, a Section 5.8.2. However, the extent of the impacts would be greater because the num facilities that DOE would construct and operate and the quantities of fuel it would larger than those for any other alternative. Even so, DOE expects the overall impa and operation to be minor. For example, the total volume of water that the SRS wou construction, cooling, processing, and domestic use under any of these three option approximately 378.5 million liters (100 million gallons) per year. This requiremen approximately 0.4 percent of the 89.7 billion liters (23.7 billion gallons) that th annually.

Similarly, DOE believes that the overall impacts of accidents under any of thes would be minor, even though the number and size of the facilities would be greater alternative than for any other. Radionuclides released during an accident would no surface-water or any drinking water aquifer. However, surface aquifer resources wo contamination in the area of any release.

For Option 5d (shipping the spent nuclear fuel off the Site), impacts to water smaller than those for any other alternative or option. DOE would have to build on (for fuel characterization) and the spent fuel would remain at SRS only for the fir management period. Overall impacts would be minimal.

5.9 Ecology

DOE expects that construction impacts, which would include loss of some wildlif land clearing, would be greatest under the Centralization Alternative, Dry Storage Representative impacts from operations would include disturbance and displacement o by movement and noise of personnel, equipment, and vehicles; however, these impacts minor under all the proposed alternatives. Construction and operation would not di sensitive habitat, nor would they affect any wetland areas. Releases of radionucli environment from any of the proposed alternatives would be small and would not be e accumulate in aquatic or terrestrial ecosystems or measurably affect the health or animal communities.

5.9.1 Alternative 1 - No Action

Under this alternative, DOE could refurbish or modify existing wet storage faci confine any activity to these facilities. As a consequence, DOE expects no impacts resources. Impacts of operations under this alternative would be minimal, limited disturbance of animals by vehicular traffic.

5.9.2 Alternative 2 - Decentralization

5.9.2.1 Option 2a - Dry Storage. This option would require some new construction, but any

construction activity would occur either within the boundaries of F- and H-Areas, w heavily developed, or adjacent to them. As a result, this construction would have on ecological resources. There would be no impacts to wetlands, threatened or enda socially or commercially important species (such as the eastern wild turkey), or di species (such as wood warblers and vireos). Impacts of operations under this optio to some minor disturbance of animals by slight increases in vehicular traffic. No endangered, or candidate species occur in the area of operations. Species likely t killed by vehicles (e.g., cotton rat, gray squirrel, opossum, and white-tailed deer ubiquitous in the area. Overall impact to ecological resources would be minimal.

5.9.2.2 Option 2b - Wet Storage. Construction impacts would be similar to those described

for dry storage (Option 2a). Impacts of operations under this option would also be described for dry storage (Option 2a). Overall impacts to ecological resources wou

5.9.2.3 Option 2c - Processing and Storage. Construction and operations impacts for this

option would also be similar to those for dry storage (Option 2a). Overall impacts minimal.

5.9.3 Alternative 3 - 1992/1993 Planning Basis

Both construction and operational impacts for the three options under this alte similar to those described for Alternative 2 - Decentralization. Overall impacts w

5.9.4 Alternative 4 - Regionalization

Under the Regionalization A alternative, impacts to ecological resources would described for Alternative 2. Impacts due to the Regionalization B options would be due to the larger volume of spent fuel that the SRS would manage. Overall impacts minimal, however.

The smallest impacts would occur under Option 4g because DOE would ship all spe the Site.

5.9.5 Alternative 5 - Centralization

5.9.5.1 Option 5a - Dry Storage. The discussion that follows assumes that any facility

development would take place in an area that does not contain any pristine wetlands timber, threatened and endangered species, or designated critical habitat. More sp the upland areas south and east of H-Area are dominated by planted pine (primarily stands, the discussion of impacts assumes that any facility development in support fuel management would take place in an area of 5- to 40-year-old pines. Finally, t that any facility development would require a site-specific National Environmental review as required under 10 CFR Part 1021 and in accordance with the Council on Env Quality's NEPA implementing regulations (CFR 1991b).

The proposed interim dry storage facility and support facilities, requiring app 0.28 square kilometers (70 acres) to 0.4 square kilometer (100 acres) of land, woul

somewhere within the largely wooded roughly 2.8 square kilometer (700-acre) area so H-Area west of F-Road, and north of Fourmile Branch. This area has a number of adv them: it would be relatively easy to connect with existing utilities (gas, water, minimize the amount of supporting infrastructure (e.g., railroad spurs, access road lines) that would have to be built; and it would enable DOE to consolidate spent nu management activities in an area that has been altered many times over the years by 1951) and timber management activities (after 1951).

Construction activities would result in the clearing of as much as approximatel kilometer (100 acres) of planted 5- to 40-year-old loblolly or slash pine for new f undeveloped representative host site south and east of H-Area. This land clearing relatively small number of loggers and heavy equipment operators, but probably woul birds and larger, more mobile animals from the area. Some smaller, less mobile ani turtles, toads, lizards, mice, and voles, probably would be killed. Aside from the 0.4 square kilometer (70-100 acres) of planted pines that provide habitat for a lim reptiles, birds, and mammals, construction impacts would be minor.

Any land clearing and timber harvesting conducted on the undeveloped host site carefully planned and conducted according to widely accepted Best Management Practi erosion and soil loss and to prevent impacts to downgradient wetlands and streams. policy is to achieve "no net loss" of wetlands. DOE has issued a guidance document Mitigation of Wetlands Impacts at the Savannah River Site (DOE 1992), for project p forth a practical approach to wetlands protection that begins with avoidance of imp moves to minimization of impacts (if avoidance is impossible), and requires compens (wetlands restoration, creation, enhancement, or acquisition) in the event that imp avoided.

In the event that new facility development was required, DOE would perform pred surveys to ensure that its activities would not affect threatened and endangered sp habitats. To the extent practicable, land clearing and timber harvesting would be the year when songbirds and game birds were not nesting or rearing young. In South songbirds nest, rear, and fledge young from March to September (Sprunt and Chamberl Quail, dove, and wild turkey in the region normally nest and fledge young during th summer (Sprunt and Chamberlain 1970).

No threatened or endangered plants or animals are known to be present in the ar consideration for development. Construction activities probably would not affect t (Carolina bays) lying in the east-central portion of the undeveloped host site. Co would not affect plant and animal diversity locally or regionally, because the mana slash pine stands that would be removed are not unique, nor do they provide habitat sensitive, unusual, or Federally listed plant or animal species.

Impacts of operations under this option would be similar to, but slightly great described for Option 2a. Overall impacts to ecological resources would be minor.

5.9.5.2 Option 5b - Wet Storage. Construction impacts under this option would be less than

those described for Option 5a because less land area would be required for new faci operations under this case would be similar to those described for Option 5a. Over ecological resources would be minor.

5.9.5.3 Option 5c - Processing and Storage. Construction impacts under this case would

be similar to those described for Option 5a. This case would require the largest n all the cases under consideration. It would result in more noise, more traffic, an level of disturbance to terrestrial wildlife (specifically reptiles, songbirds, and mammals) accustomed to feeding, foraging, perching, hunting, nesting, or denning in animals would be driven from the area permanently, while others probably would beco to the increased noise and activity levels, and would return to the area. Overall resources would be minor.

5.9.5.4 Option 5d - Shipment off the Site. Construction impacts under this case would be

smaller than those for any other alternative, excluding Alternative 1 - No Action. under this case would also be minimal, limited to some minor disturbances of animal traffic. Overall impacts to ecological resources would be minimal.

5.10 Noise

As described in Section 4.10, noises generated on the SRS do not travel off the affect the general population. Therefore, SRS noise impacts for each alternative w noise resulting from the transportation of personnel and materials to and from the nearby communities and from onsite sources that could affect some wildlife near the would address the effects of noise on wildlife near spent nuclear fuel management f alternative in a project-specific NEPA evaluation.

Transportation noises would be a function of the size of the workforce (i.e., a workforce would produce increased employee traffic and corresponding increases in d and rail and a decreased workforce would produce decreased employee traffic and cor decreases in deliveries). The analysis of traffic noise took into account railroad the major roadways that provide access to the SRS. DOE does not expect the number per day in the region and through the Site to change as a result of any of the alte some trains could be dedicated to the transport of spent nuclear fuel. Rail shipme fuel, regardless of the alternative, would not substantially increase the rail traf through the SRS. Therefore, vehicles used to transport employees and personnel on be the principal sources of community noise impacts. This analysis used the day-ni level (DNL) to assess community noise, as suggested by the Environmental Protection (EPA 1974; 1982) and the Federal Interagency Committee on Noise (FICON 1992). The based its estimate of the change in day-night average sound level from the baseline each alternative on the projected changes in employment and traffic levels. The ba those for 1995. The analysis also considered the combination of construction and o employment. The traffic noise analysis considered SC 125 and SC 19, both of which access the SRS. Changes in noise level below 3 decibels would not be likely to res community reaction (FICON 1992).

DOE projects no new employment due to operations for any of the alternatives. construction jobs may be required but overall SRS employment would not exceed the 1 levels, except for Alternatives 5a, 5b, and 5c. The maximum Site employment of abo would occur in 1995 for all alternatives except 5a, 5b, and 5c for which the peak w 2002 due to a peak in construction employment. The general decrease in employment could result in some decrease in vehicle trips to and from the Site. There would b truck trips per day to and from the Site carrying spent nuclear fuel under any of t increase in truck trips would not result in a perceptible increase in traffic noise to the SRS. The day-night average sound level along SC 125 and SC 19 and other acc would probably decrease slightly except in the peak construction years under Altern 5c, as a result of the overall decrease in employment levels at the SRS after 1995. change in the community reaction to noise along these routes. Consequently, no mit necessary.

5.11 Traffic and Transportation

This section discusses the consequences of both the onsite transportation of sp and the increased traffic patterns due to construction activities at the SRS. Traf spent nuclear fuel facilities will remain at or below current Site levels because w activities will be drawn from the existing SRS workforce. The consequences of the spent fuel between the SRS and other DOE sites are described in Appendix I of Volum Environmental Impact Statement (EIS).

5.11.1 Traffic

Traffic impacts would be bound by Alternative 5b (Centralization - Wet Storage) result in the greatest number of additional construction workers (and vehicles) ons service, a measure of traffic flow, was estimated for each road to and from the SRS could be experienced at SC 19 and SC 230 intersections during peak hours. However, construction vehicles in support of spent nuclear fuel construction activities woul 17 percent (HNUS 1994) to the total traffic flow. Therefore, the change in level o Alternative 5b would be minimal.

5.11.2 Transportation

This section discusses the potential radiological consequences due to incident and accidents during transport. All SRS onsite shipments are carried out by rail.

5.11.2.1 Onsite Spent Nuclear Fuel Shipments. DOE based the number of fuel

shipments on the amount and type of spent nuclear fuel stored at various SRS locati storage location or disposition specified in the spent nuclear fuel alternatives. shipments from each location was determined by dividing the amount of spent nuclear location by the capacity of the shipping cask. Individual shipments from the vario summed to obtain the total number of shipments for each alternative (HNUS 1994).

Onsite shipments are those that originate and terminate at the SRS. Movements fuel within functional areas (e.g., H-Area or F-Area) are operational transfers, no therefore, this analysis does not consider them.

5.11.2.2 Incident-Free Transportation Analysis. Under each alternative, DOE analyzed

incident-free (normal transport) radiological impacts to transport vehicle crews an general public from onsite rail shipments. The analysis calculated occupational ra transport vehicle crew members (four locomotive operators). Because the general pu immediate access to areas where the SRS would transport spent nuclear fuel, the ana any general public dose is to escorted individuals on the Site waiting at any of se at the time a fuel shipment passed. The analysis calculated radiological doses to t using the Riskind (Yuan et al. 1993) computer code. The results are presented in T

The magnitude of incident-free consequence depends on the dose rate on the exte the transport vehicle, the exposure time, and the number of people exposed. For ea analysis assumed the external dose rate 2 meters (6.6 feet) from the shipping cask per hour (HNUS 1994), which is the SRS procedurally-allowed maximum dose rate durin shipments. Actual receptor dose rates would depend on receptor distance from the s [5 meters (16.4 feet) for the general public]. The duration of exposure would depe vehicle speed and the number of shipments. In addition, occupational exposure time the distance of each shipment.

The analysis calculated health effects measured as the number of latent cancer by multiplying the resultant occupational and general public doses by risk factors 5 x 10-4 latent cancer fatalities per person-rem (DOE 1993a), respectively.

Table 5-10 summarizes the collective doses (person-rem) and health effects (lat fatalities) associated with the incident-free onsite shipment of spent nuclear fuel

Table 5-10. Collective doses and health effects for onsite, incident-free spent nu by alternative.

Option	Occupational (person-rem)	General Public (person-rem)	Number of LCFs Occupational
No Action			
Option 1b -Wet Storage	1.5x100	1.4x10-1	6.0x10-4
Decentralization			
Option 2a - Dry Storage	2.5x100	2.3x10-1	1.0x10-3
Option 2b - Wet Storage	2.5x100	2.3x10-1	1.0x10-3
Option 2c - Processing	5.3x10-1	3.7x10-2	2.1x10-4
Planning Basis			
Option 3a - Dry Storage	2.5x100	2.3x10-1	1.0x10-3
Option 3b - Wet Storage	2.5x100	2.3x10-1	1.0x10-3
Option 3c - Processing	5.3x10-1	3.7x10-2	2.1x10-4
Regionalization			
Option 4a - Dry Storage	2.5x100	2.3x10-1	1.0x10-3
Option 4b - Wet Storage	2.5x100	2.3x10-1	1.0x10-3
Option 4c - Processing	5.3x10-1	3.7x10-2	2.1x10-4
Option 4d - Dry Storage	2.5x100	2.3x10-1	1.0x10-3
Option 4e - Wet Storage	2.5x100	2.3x10-1	1.0x10-3
Option 4f - Processing	5.3x10-1	3.7x10-2	2.1x10-4
Option 4g - Ship Out	NAb	NAb	NAb

Centralization			
Option 5a - Dry Storage	2.5x100	2.3x10-1	1.0x10-3
Option 5b - Wet Storage	2.5x100	2.3x10-1	1.0x10-3
Option 5c - Processing	5.3x10-1	3.7x10-2	2.1x10-4
Option 5d - Ship Out	NAb	NAb	NAb

a. LCF = latent cancer fatality.
b. NA = not applicable.
doses and latent cancer fatalities for members of the public would be approximately than those for the occupational worker. The data indicate that the lowest collecti latent cancer fatality would be associated with the Processing option under the Dec Planning Basis, Regionalization, and Centralization alternatives.

5.11.2.3 Transportation Accident Analysis. DOE analyzed radiological impacts from

potential accidents to both the onsite maximally exposed individual (MEI), and offs general public from onsite rail shipments. The analysis calculated doses using the et al. 1993) computer code with site-specific meteorology, demographics, and spent was calculated using site-specific rail accident rates and accident probabilities (

The magnitude of accident consequence would depend on the amount of radioactive which the individual(s) was exposed, the exposure time, and the number of people ex analysis assumed that the maximum reasonably foreseeable amount of radioactive mate of spent fuel shipped on the SRS was released (HNUS 1994). The assumed duration of each receptor was 2 hours. The assumed maximally exposed individual was an SRS wor downwind of the accident at distances of 50 and 100 meters (164 and 330 feet).

The analysis calculated offsite exposure using both rural and suburban populati census data. The rural and suburban population densities have an average of 6 pers kilometer and 244 persons per square kilometer, respectively. The west-northwest s highest population density within 80 kilometers (50 miles) of the SRS.

The analysis used site-specific meteorology at the 50th and 95th percentile to consequences. Joint probability includes both the event frequency and the probabil reasonably foreseeable type of accident occurring.

The analysis calculated health effects measured as the number of latent cancer multiplying the resultant occupational and general public doses by the risk factors 5 x 10-4 latent cancer fatalities per person-rem (DOE 1993a), respectively. Risk w multiplying the resultant doses by the joint probability of 1 x 10-4 (HNUS 1994).

Tables 5-11 and 5-12 summarize the collective doses and associated latent cance postulated onsite rail accidents with subsequent releases of radioactive material t The dose consequences of an accidental release of radioactive material was assessed typical 50th percentile meteorological conditions (i.e., those that would result in percent of the time, respectively). In all cases the estimated number of latent ca be low.

5.11.3 Onsite Mitigation and Preventative Measures

All onsite shipments must be in compliance with DOE Savannah River Directive Im Instruction 5480.3, "Safety Requirements for the Packaging and Transportation of Ha Hazardous Substances, and Hazardous Wastes." DOE, DOE-SR, or the Nuclear Regulator Commission (NRC) must approve packages used for onsite shipments with a certificate

Table 5-11. Impacts on maximally exposed individual from spent nuclear fuel transp on the Savannah River Site.

Dose Percentile	Distance (meters)	Dose to MEIa (rem)	Number of LCFsb per year	Risk
50 percent	100	0.16	6.4x10-5	1.6x10-
95 percent	50	0.37	1.5x10-4	3.7x10-

a. MEI = maximally exposed individual.
b. LCF = latent cancer fatality.

Table 5-12. Impacts on offsite population from spent nuclear fuel transportation a Savannah River Site.

Population Density Category	Dose Percentile	Offsite Population Dose (person-rem)	Number of LC per year
Rural	50th	1.7	8.7x10-4
Rural	95th	7.1	3.6x10-3

Suburban	50th	5.2	2.6x10-3
Suburban	95th	21.3	1.1x10-2

a. LCF = latent cancer fatality.

compliance. If DOE or NRC has not certified an onsite package as Type B, the shipp administrative controls and site-mitigating circumstances that will ensure package administrative and emergency response considerations must provide sufficient contro would not result in loss of containment, shielding, or criticality; or the uncontro radioactive material would not create a hazard to the health and safety of the publ

In the event of an accident, SRS has established an emergency management progra program incorporates activities associated with emergency planning, preparedness, a

5.12 Occupational and Public Health and Safety

5.12.1 Radiological Health

This human health effects analysis relied principally on data on F- and H-Area documented for the 1985, 1986, and 1993 operating years (Marter 1986; 1987; WSRC 19 the 1985-1986 period, F- and H-Areas processing facilities operated at high capacit therefore, that these emissions represent conservative estimates as to the emission from spent nuclear fuel management activities at the SRS. This air and surface-wat information defined the source terms for the baseline evaluation (No Action alterna effects discussed in this section. To estimate health effects, this analysis defin groups:

- The F- and H-Area workers assigned to F- and H-Area operations involving nu materials
- The F- and H-Area workers assigned to the Receiving Basin for Offsite Fuels operations
- The maximally exposed individual residing at the SRS boundary
- The projected 1994 offsite population of 628,200 persons residing within an (50-mile) radius of F- and H-Areas
- The maximally exposed individual potentially affected by SRS surface-water
- The approximate offsite population of 65,000 persons whom SRS surface-water could affect.

With the exception of the worker group, this analysis calculated exposures for receptor groups using the baseline source terms as input data to automated atmosphe water transport, human intake, and human dosimetry models configured for routine us (Hamby 1994). The analysis estimated worker exposures using averaged dosimetry dat F- and H-Area workers from 1983 through 1987 and Receiving Basin for Offsite Fuels 1993 (Matheny 1994), corrected for an assumed occupancy factor of 0.25 (i.e., a wor potentially exposed during one-quarter of his/her shift). This correction was appl data only. At the SRS, the waterborne exposure pathway does not exist for the work because Site drinking water is drawn from deep aquifers unaffected by any radiologi

The analysis developed incremental receptor group exposure estimates (millirem rem per year; effective dose equivalent) based on spent fuel quantities for each of alternatives (i.e., Alternatives 2 through 5) and their options by applying calcula tons of heavy metal (MTHM) for each alternative and option compared to the No Actio DOE used these ratios as incremental scaling factors to estimate exposures under ea calculation of the MTHM ratios used the data presented in Table 3-1. Table 5-13 li the exposure estimate calculations. Since these incremental exposures include cont effective dose equivalent from existing (No Action) spent fuel management at the SR health effects for each alternative can be estimated as the difference between the

The analysis calculated the potential health effects expressed in the exposed r consistent with risk determination guidance issued by the DOE Office of NEPA Oversi 1993a) and International Commission on Radiological Protection Publication 60 (ICRP exposed individuals and populations, the potential health effect (detriment) of int cancer. For exposed individuals, this analysis presents the health effect as the m probability for detriment expression; for exposed populations, it presents the annu detriment incidence. For completeness, it also provides the "project life" (i.e., incidence as the annual incidence multiplied by 40. Table 5-14 (worker) and Table exposed individual and offsite population) summarize the health effects calculation

The Centers for Disease Control and Prevention is conducting a comprehensive re historic offsite doses associated with SRS operations. The results of this investi

available.

5.12.2 Nonradiological Health

DOE used the operations air quality data listed in Tables 5-3, 5-4, 5-5 and 5-6 WSRC 1994a) to evaluate health impacts associated with potential exposure to the fo compound classes: criteria pollutants and toxic pollutants. The analysis evaluate receptor locations: (1) a worker in S-Area and (2) a maximally exposed individual boundary. However, it was unnecessary to postulate an intake of criteria pollutant by these receptors because airborne concentration standards are available for these

Tables 5-3 and 5-4 list 8 criteria pollutants and 23 toxic compounds. The toxi classified as carcinogens and noncarcinogens consistent with Environmental Protecti carcinogenicity group (weight of evidence) designations published in the Integrated

Table 5-13. Incremental radioactive contaminant annual exposure summary.

	Onsite Workersa	
Alternative	(mrem/ year)c	(person- rem/ year)
No Action - Wet Storage (Option 1)	100	0.2
Decentralization - Dry Storage (Option 2a)	83	0.2
Decentralization - Wet Storage (Option 2b)	104	0.2
Decentralization - Processing (Option 2c)	145	70
Planning Basis - Dry Storage (Option 3a)	84	0.2
Planning Basis - Wet Storage (Option 3b)	105	0.2
Planning Basis - Processing (Option 3c)	147	71
Regionalization A - Dry Storage (Option 4a)	83	0.2
Regionalization A - Wet Storage (Option 4b)	103	0.2
Regionalization A - Processing (Option 4c)	148	76
Regionalization B - Dry Storage (Option 4d)	105	0.2
Regionalization B - Wet Storage (Option 4e)	131	0.3
Regionalization B - Processing (Option 4f)	175	74
Regionalization B - Ship Out (Option 4g)	<100	<0.2
Centralization - Dry Storage (Option 5a)	1,102	2.2
Centralization - Wet Storage (Option 5b)	1,377	2.8
Centralization - Processing (Option 5c)	1,422	79
Centralization - Ship Out (Option 5d)	<100	<0.2

a. Insignificant digits are displayed for comparison purposes only.
b. MEI = maximally exposed individual.
c. The DOE administrative dose limit is 2,000 mrem (DOE 1994a).
d. Data is provided separately for the air and water exposure pathways because the co-located.

Table 5-14. Incremental fatal cancer incidence and maximum probability for workers

Alternative	Annual Incidencea	40-Year Incidence

No Action - Wet Storage (Option 1)	8x10-5	3x10-3
Decentralization - Dry Storage (Option 2a)	7x10-5	3x10-3
Decentralization - Wet Storage (Option 2b)	8x10-5	3x10--3
Decentralization - Processing (Option 2c)	3x10-2	1
Planning Basis - Dry Storage (Option 3a)	7x10-5	3x10-3
Planning Basis - Wet Storage (Option 3b)	8x10-5	3x10--3
Planning Basis - Processing (Option 3c)	3x10-2	1
Regionalization A - Dry Storage (Option 4a)	7x10-5	3x10-3
Regionalization A - Wet Storage (Option 4b)	8x10-5	3x10--3
Regionalization A - Processing (Option 4c)	3x10-2	1
Regionalization B - Dry Storage (Option 4d)	8x10-5	3x10-3
Regionalization B - Wet Storage (Option 4e)	1x10-4	4x10--3
Regionalization B - Processing (Option 4f)	3x10-2	1
Regionalization B - Ship Out (Option 4g)	<8x10-5	<3x10-3
Centralization - Dry Storage (Option 5a)	9x10-4	4x10-2
Centralization - Wet Storage (Option 5b)	1x10-3	4x10--2
Centralization - Processing (Option 5c)	3x10-2	1
Centralization - Ship Out (Option 5d)	<8x10-5	<3x10-3

a. Number of latent fatal cancers over a lifetime which could be attributed to one nuclear fuel management activities.

System (IRIS) data base (DOE 1994b). For purposes of health effects analysis, carc compounds designated Group A (human carcinogens), Group B1 (probable human carcinog evidence in human studies), Group B2 (probable human carcinogen, inadequate evidenc from human studies), and Group C (possible human carcinogen). Using this designati 23 toxic compounds are carcinogens: benzene (Group A), formaldehyde (Group B1), an chloride (Group B2).

Carcinogen health effects are expressed as the incremental probability of an in developing cancer, assuming a lifetime (70 years) of exposure to the carcinogen. D risk (slope) factors published in IRIS (Integrated Risk Information System) to obta (risk per concentration) needed to calculate incremental probability. Carcinogens incomplete or unavailable carcinogen assessment data) information listed in the Int Information System data base precluded a quantitative risk assessment; this analysi noncarcinogens.

Table 5-15. Incremental fatal cancer incidence and maximum probability for the max individual and offsite population (air and water pathways).

Alternative	Population Annual Incidencea	Population 40-Year Incidence
No Action - Wet Storage (Option 1)		
Air	2x10-9	7x10-8
Water	3x10-10	1x10-8
Decentralization - Dry Storage (Option 2a)		
Air	2x10-9	6x10-8
Water	2x10-10	9x10-9
Decentralization - Wet Storage (Option 2b)		
Air	2x10-9	8x10-8
Water	3x10-10	1x10-8
Decentralization - Processing (Option 2c)		
Air	7x10-3	0.3
Water	1x10-3	4x10-2
Planning Basis - Dry Storage (Option 3a)		
Air	2x10-9	6x10-8
Water	2x10-10	9x10-9
Planning Basis - Wet Storage (Option 3b)		
Air	2x10-9	8x10-8
Water	3x10-10	1x10-8
Planning Basis - Processing (Option 3c)		
Air	7x10-3	0.3
Water	1x10-3	4x10-2

Regionalization A - Dry Storage (Option 4a)		
Air	2x10-9	6x10-8
Water	2x10-10	9x10-9
Regionalization A - Wet Storage (Option 4b)		
Air	2x10-9	8x10-8
Water	3x10-10	1x10-8
Regionalization A - Processing (Option 4c)		
Air	8x10-3	0.3
Water	1x10-3	5x10-2
Regionalization B - Dry Storage (Option 4d)		
Air	2x10-9	8x10-8
Water	3x10-10	1x10-8
Regionalization B - Wet Storage (Option 4e)		
Air	2x10-9	1x10-7
Water	4x10-10	1x10-8
Regionalization B - Processing (Option 4f)		
Air	8x10-3	0.3
Water	1x10-3	5x10-2
Regionalization B - Ship Out (Option 4g)		
Air	<2x10-9	<7x10-8
Water	<3x10-10	<1x10-8

Table 5-15. (continued).

Alternative	Population Annual Incidence[a]	Population 40-Year Incidence
Centralization - Dry Storage (Option 5a)		
Air	2x10-8	8x10-7
Water	3x10-9	1x10-7
Centralization - Wet Storage (Option 5b)		
Air	3x10-8	1x10-6
Water	4x10-9	2x10-7
Centralization - Processing (Option 5c)		
Air	8x10-3	0.3
Water	1x10-3	5x10-2
Centralization - Ship Out (Option 5d)		
Air	<2x10-9	<7x10-8
Water	<3x10-10	<1x10-8

a. Number of latent fatal cancers over a lifetime that could be attributed to one management activities.

This analysis evaluated noncarcinogenic and priority pollutant compound health hazard quotients to obtain a hazard index. The hazard quotient is the ratio of com or dose to a Reference Concentration (RfC) or Dose (RfD) (EPA 1989). The regulator in this analysis was the more stringent of the following: (1) Occupational Safety Administration (OSHA) 8-hour permissible exposure limit (PEL), (2) American Confere Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV), or (3) Stat Carolina air quality standards. The use of the noncancer hazard index assumed a le (i.e., RfC) below which adverse health effects are unlikely. The hazard index is n probability; therefore it cannot be interpreted as such.

Table 5-16 summarizes nonradiological health effects attributable to atmospheri toxic and criteria pollutant compounds. Because no hazard index value would exceed adverse health effects are unlikely under any alternative.

5.12.3 Industrial Safety

This section describes the following measures of impact for workplace hazards: reportable injuries and illnesses and (2) fatalities in the work force. This analy injury/illness and fatality incidence rates for construction workers separately bec

Table 5-16. Nonradiological annual incremental health effects summary.

Alternative	Worker Cancer Probability[a]	Worker Hazard Index
No Action - Wet Storage (Option 1)	Insufficient data	2x10-6

Decentralization - Dry Storage (Option 2a)	Insufficient data	2x10-6
Decentralization - Wet Storage (Option 2b)	Insufficient data	2x10-6
Decentralization - Processing (Option 2c)	Insufficient data	6x10-3
Planning Basis - Dry Storage (Option 3a)	Insufficient data	2x10-6
Planning Basis - Wet Storage (Option 3b)	Insufficient data	2x10-6
Planning Basis - Processing (Option 3c)	Insufficient data	6x10-3
Regionalization A - Dry Storage (Option 4a)	Insufficient data	2x10-6
Regionalization A - Wet Storage (Option 4b)	Insufficient data	2x10-6
Regionalization A - Processing (Option 4c)	Insufficient data	6x10-3
Regionalization B - Dry Storage (Option 4d)	Insufficient data	2x10-6
Regionalization B - Wet Storage (Option 4e)	Insufficient data	2x10-6
Regionalization B - Processing (Option 4f)	Insufficient data	8x10-3
Regionalization B - Ship Out (Option 4g)	Insufficient data	2x10-6
Centralization - Dry Storage (Option 5a)	Insufficient data	2x10-6
Centralization - Wet Storage (Option 5b)	Insufficient data	2x10-6
Centralization - Processing (Option 5c)	Insufficient data	6x10-3
Centralization - Ship Out (Option 5d)	Insufficient data	2x10-6

a. Insufficient data exists in the IRIS data base to perform a quantitative inhalat
b. MEI = maximally exposed individual.

more hazardous nature of construction work. Table 5-17 lists the incidence of inju fatalities for construction and non-construction workers. These data are for the h year (i.e., maximum hours worked in any year from 1994 through 2035, assuming 2,000 worker) (WSRC 1994b). This analysis used the average occupational injury/illness a incidence rates experienced by DOE and its contractors from 1988 through 1992 to ca incidence of industrial hazards listed in Table 5-17 (DOE 1993b).

Table 5-17. Incremental industrial hazard maximum annual incidence summary.

Alternative	Construction Injuries and Illnesses	Construction Fatalities
No Action - Wet Storage (Option 1)	92	<1
Decentralization - Dry Storage (Option 2a)	71	<1
Decentralization - Wet Storage (Option 2b)	71	<1
Decentralization - Processing (Option 2c)	66	<1
Planning Basis - Dry Storage (Option 3a)	71	<1
Planning Basis - Wet Storage (Option 3b)	82	<1
Planning Basis - Processing (Option 3c)	66	<1
Regionalization A - Dry Storage (Option 4a)	82	<1
Regionalization A - Wet Storage (Option 4b)	82	<1

Regionalization A - Processing (Option 4c)	66	<1
Regionalization B - Dry Storage (Option 4d)	89	<1
Regionalization B - Wet Storage (Option 4e)	102	<1
Regionalization B - Processing (Option 4f)	82	<1
Regionalization B - Ship Out (Option 4g)	22	<1
Centralization - Dry Storage (Option 5a)	316	1
Centralization - Wet Storage (Option 5b)	337	1
Centralization - Processing (Option 5c)	316	1
Centralization - Ship Out (Option 5d)	22	<1

5.13 Utilities and Energy

The existing capacities and distribution systems at the SRS for electricity, st domestic wastewater treatment are adequate to support any of the five alternatives. summarizes estimates of the annual requirements for electricity, steam, and domesti treatment for each alternative and case, and compares them to current SRS usage of **Table 5-8 lists information on water usage by alternative.** The utility and energy

Table 5-18. Estimates of annual electricity, steam, and domestic wastewater treatm for each alternative. ,b

Alternative	Electricity Usage (megawatt hours per year)	Ste (ki
Current SRS Usage	659,000	1.7
1. No Action		
Option 1 - Wet Storage	1,400	11.
2. Decentralization		
Option 2a - Dry Storage	19,400	16.
Option 2b - Wet Storage	22,400	14.
Option 2c - Processing	56,400	19.
3. 1992/1993 Planning Basis		
Option 3a - Dry Storage	19,400	16.
Option 3b - Wet Storage	22,400	14.
Option 3c - Processing	56,400	19.
4. Regionalization - A		
Option 4a - Dry Storage	24,400	16.
Option 4b - Wet Storage	27,400	14.
Option 4c - Processing	67,400	16.
Regionalization - B		
Option 4d - Dry Storage	24,400	16.
Option 4e - Wet Storage	27,400	14.
Option 4f - Processing	56,400	19.
Option 4g - Ship Out	11,400	11.
5. Centralization		
Option 5a - Dry Storage	44,400	16.

Option 5b - Wet Storage	47,400	14.
Option 5c - Processing	110,400	19.
Option 5d - Ship Out	11,400	11.

a. Source: WSRC (1994b).
b. Water requirements are shown in Table 5-8.
c. To convert kilograms to pounds, multiply by 2.2046.
d. To convert liters to gallons, multiply by 0.26418.

the alternatives represent a small percentage of current requirements. No new gene facilities would be necessary; connections to existing networks would require only Increases in SRS fuel consumption would be minimal because overall activity on the increase due to changes in the SRS mission and the general reduction in employment overall impacts of any of the alternatives on the SRS utilities and energy resource

The smallest increase in demand would result from the No Action alternative, wh similar to current spent nuclear fuel-related requirements at the SRS. The largest due to the centralization of spent nuclear fuel at the SRS (Alternative 5). Altern a maximum additional electrical demand of about 110,400 megawatt-hours annually (Op an increased steam consumption of about 19.1 million kilograms (42.1 million pounds (Option 5c). Water requirements would also be greatest under this Alternative (Tab withdrawals of Savannah River water for cooling purposes would reach about 310.8 mi (82.1 million gallons) and groundwater usage for domestic and processing purposes w approximately 69.6 million liters (18.4 million gallons). The volume of domestic w treatment would range from approximately 35 to 70 million liters (9 to 18 million g This additional water usage amounts to an increase of about 10 percent over current requirements.

Among the three management options, processing would result in the greatest inc on utilities and energy in comparison to either the dry or wet storage options. In storage would be similar in their requirements of these resources.

5.14 Materials and Waste Management

This section discusses potential impacts of the management of materials and was with the implementation of alternatives identified for spent nuclear fuel managemen 5.12 (Air Quality and Occupational and Public Health and Safety, respectively) disc hazardous and toxic materials as they relate to routine operations and accidents.

DOE has projected rates and volumes of waste and impacts of waste generation at level, transuranic, and high-level wastes for each of the alternatives for spent nu Table 5-19 summarizes the estimated annual average and total volume of these three **each alternative would produce during a 40-year management period.** The discussion

Table 5-19. Annual average and total volume (cubic meters)d of radioactive wastes each alternative during the 40-year interim management period.

Alternative	Low-level wasteb Average	Total	Transuranic waste Average	T
1. No Action				
Option 1 - Wet Storage	400	16,000	17	7
2. Decentralization				
Option 2a - Dry Storage	400	16,000	18	7
Option 2b - Wet Storage	400	16,000	18	7
Option 2c - Processing	800	32,000	19	7
3. 1992/1993 Planning Basis				
Option 3a - Dry Storage	400	16,000	18	7
Option 3b - Wet Storage	400	16,000	18	7
Option 3c - Processing	750	30,000	19	7
4. Regionalization - A				
Option 4a - Dry Storage	400	16,000	17	7
Option 4b - Wet Storage	400	16,000	17	7
Option 4c - Processing	790	31,600	18	7
4. Regionalization - B				
Option 4d - Dry Storage	400	16,000	17	7
Option 4e - Wet Storage	400	16,000	17	7
Option 4f - Processing	790	31,600	18	7
Option 4g - Ship Out	400	4,000	18	1
5. Centralization				

Option 5a - Dry Storage	400	16,000	16	6
Option 5b - Wet Storage	400	16,000	20	8
Option 5c - Processing	800	32,000	20	8
Option 5d - Ship Out	400	4,000	18	1

a. Based on WSRC (1994b).
b. Source: WSRC (1994c).
c. Figures are for the initial 10-year period when most processing would be comple
d. To convert cubic meters to cubic yards multiply by 1.307.

below also identifies the impacts that the waste produced by spent nuclear fuel act on the existing SRS capacity to manage each waste type.

DOE has not developed estimates of low-level mixed, hazardous, or solid sanitar spent nuclear fuel management activities at the SRS could generate, although it is these activities would produce these waste types only in limited quantities. Furth Section 5.14.2 related to the impacts of spent fuel management wastes on the SRS wa not include considerations of wastes that will result from Site cleanup because ass activities are still underway and will undergo NEPA review as part of the SRS Waste Environmental Impact Statement (DOE 1995).

Volume 1 of this spent nuclear fuel EIS provides information concerning the maj environmental laws and regulations, Executive Orders, and DOE Orders that apply to prevention at the Savannah River Site. The DOE views source reduction as the first pollution prevention program, followed by an increased emphasis on recycling. Sour reduce the waste management burden while eliminating the potential for future liabi Recycling and using recycled materials will conserve resources and landfill space. and disposal are considered only when prevention or recycling is not possible or pr creating a Savannah River Site waste minimization program (the precursor of the SRS prevention program) in 1990, the amounts of wastes of all types (excluding low-leve are a by-product of environmental restoration activities) generated have decreased, reductions in hazardous and mixed wastes (Hoganson and Miles 1994).

5.14.1 Alternative Comparison

The first four alternatives would generate similar amounts of radioactive waste activities that produce the wastes would be similar under each of the alternatives. level and transuranic wastes would be generated during the first part of the 40-yea period while DOE was transferring existing inventory and renovating the Receiving B Fuels and a reactor basin. The characterization and canning of the current invento placement into storage would also result in some waste generation. Once in storage activities would produce only small amounts of radioactive waste for the rest of th

The dry- and wet-storage options would both produce about 16,000 cubic meters (yards) of low-level waste and between 640 cubic meters (836 cubic yards) and 800 cu (1,046 cubic yards) of transuranic waste during the 40-year management period. Bot generate small amounts of high-level waste. The processing of the existing aluminu storage of the others (the third option under each alternative) would generate all low-level and high-level wastes in appreciably greater volumes, and transuranic was greater volumes.

Alternative 5 (excluding the Ship Out option) could result in somewhat larger v radioactive waste than the other four alternatives. However, any increase in waste directly proportional to the larger amounts of fuel that would be managed on the Si the originating sites would characterize and can their fuel prior to shipment so th directly into storage at the SRS. Therefore, the radioactive wastes produced durin the Site would come from the initial fuel transfer and pool renovations and from ch canning small amounts of new fuel. The processing of existing aluminum-clad fuels the same types and volumes of waste as for the other alternatives.

The option for shipping the SRS inventory off the Site for regionalization or c elsewhere would also result in the production of some radioactive waste. This woul characterization and canning prior to shipment and would generate the smallest volu any alternative action: 4,000 cubic meters (5,228 cubic yards) of low-level waste meters (235 cubic yards) of transuranic waste. This waste would be produced only d 10 years of the management period.

5.14.2 Impact on the SRS Waste Management Capacity

The impact of spent nuclear fuel activities on SRS waste management capacities minimal because the Site could accommodate the waste with existing and planned radi storage and disposal facilities. DOE would transfer high-level waste to the F/H Ta volume reduction and then to the Defense Waste Processing Facility (DWPF) for conve borosilicate glass form suitable for prolonged storage. The SRS would use the Cons Incineration Facility, once operational, to treat the low-level waste. This facili permitted capacity [105,500 cubic meters (137,889 cubic yards) per year] to treat t volume of these materials. However, actual through-put volume is dependent upon op variables and waste characteristics. The F/H Effluent Treatment Facility would tre waste. This facility has sufficient design process capacity [598 million liters (1 year] to treat the anticipated volumes of these materials. DOE would manage the tr with existing and planned storage capacity.

5.15 Accident Analysis

Operations involving the receipt, handling, processing, or storing of spent nuc involve radioactive materials or toxic chemicals. These materials would be receive transferred between facilities, disposed of on the Site, and shipped off the Site. circumstances, these materials could be involved in an accident.

An accident is a series of unexpected or undesirable events initiated by equipm error, or a natural phenomenon such as severe weather, earthquake, or volcanism. T cause the release of either radioactive or chemically toxic materials inside a faci environment.

This section summarizes analyses of possible accidents involving spent nuclear the SRS. To provide a perspective on potential accidents, this section summarizes associated with spent nuclear fuel activities that have occurred at the SRS (histor reviews previous accident analyses for Site operations. This section uses the resu analyses as a baseline for determining the impacts for the alternatives that involv each alternative, this section discusses the accidents with the largest point estim (radiological impacts in terms of potential fatal cancers x frequency of the initia

The facilities considered for each alternative are either existing facilities f safety analyses were used, or new facilities (WSRC 1994b) for which existing safety were substituted by evaluating the type of accident(s) that could be postulated to projected function of the facility. Two facilities that contain very small amounts spent nuclear fuel, Buildings 331-M and 773-A, were not included in this analysis b analyzed for the major facilities would bound the consequences of possible accident locations.

This section addresses historic accidents, facility radiological accidents, che accidents, and secondary impacts. Section 5.11 addresses onsite transportation acc

5.15.1 Historic Accidents at the Savannah River Site

Impacts from accidents can involve fatalities, injuries, or illness. Fatalitie (immediate) such as in construction accidents or latent (delayed) such as an increa cancers due to radiation exposure. Section 5.12 addresses worker injuries, illness for increased cancer risk anticipated from normal operations of the facilities. No have dominated impacts to workers at the SRS (Durant et al. 1987); impacts to the p historic SRS accidents have been negligible.

The SRS has maintained an operational event data base on its facilities since t data base currently contains approximately 450,000 entries including data on the Re Offsite Fuel, the principal wet storage pool facility at the SRS; and both F-and H- this EIS, DOE reviewed the data base to identify historic spent nuclear fuel-relate facilities. Fuel cutting events, fuel handling events, and various liquid releases fuel management over the 40-year operating history of the SRS were examined. The p data base review was to provide an historic perspective on the types of accidents t the SRS. Events representative of fuel failures include higher than expected conta fuel storage basin water and evidence of fuel canister cracking at a weld. Fuel ha due in large part to crane operator errors or crane and handling equipment failures includes reports of incorrect fuel cropping, where the active region of fuel was ex These historical events provided a basis for the selection of representative accide spectrum of spent nuclear fuel management activities. No significant offsite impac

from these historic occurrences.

5.15.2 Potential Facility Accidents

The SRS spent nuclear fuel alternatives have the potential for radiological acc Attachment A, Table A-2) that could affect the health and safety of workers and the concerns and characteristics that are common to these accidents would be common reg whether the cause were a natural phenomenon or human error. For health effects to must allow a release of hazardous material to, or an increase in radiation levels i environment. The released material must be transported to locations frequented by quantities of hazardous materials that reach locations where people are and the way people are important factors in the determination of health effects.

A number of studies have investigated the ways in which radioactivity reaches h body absorbs and retains it, and the resulting health effects. The International C Radiological Protection has made specific recommendations for estimating these heal (ICRP 1991). This organization is the recognized body for establishing standards f workers and the public from the effects of radiation exposure. Health effects incl (up to and including death) and latent effects, including cancers and genetic damag SRS-developed computer code, AXAIR89Q, estimates potential radiation doses to maxim individuals or population groups from accidental releases of radionuclides.

The AXAIR89Q code is a highly automated site-specific environmental dispersion code for postulated airborne releases. The environmental dispersion models used ar Regulatory Guide 1.145 (NRC 1983). The exposure pathways considered in the AXAIR89 include inhalation of radionuclides and gamma irradiation from the radioactive plum

Doses from the inhalation of radionuclides in air depend on the amount of radio the dispersion factor; the physical, chemical, and radiological characteristics of various biological parameters such as breathing rate and biological half-life. The uses a conservative breathing rate of 12,000 cubic meters (424,000 cubic feet) per dose commitment factors used in the environmental dosimetry code, as described in t section, are from Internal Dose Conversion Factors for Calculation of Dose to the P

External gamma radiation doses from the traveling plume depend on the spatial d the radionuclides in the air, the energy of the radiation, and the extent of shield code takes no credit for shielding in calculating doses. The code calculates gamma nonuniform Gaussian model, which has more realistic modeling than doses from the co uniform semi-infinite plume model.

In addition to using the worst sector, 99.5 percentile meteorology, conservativ and taking no credit for shielding, the AXAIR89Q code also takes no credit for the rise from stack releases. Therefore, the offsite maximum individual doses calculat provide conservative bounding estimates of radiological consequences to exposed ind populations from postulated accidental atmospheric releases.

AXAIR89Q has been validated for compliance to accepted standards for such softw Attachment A, Accident Analysis, discusses AXAIR89Q and its predecessor, AXAIR. Wh conjunction with models for predicting health effects, the results from AXAIR89Q ca with other site-specific codes such as RSAC-5, because both codes provide relative concentrations based on the guidance provided in NRC Regulatory Guide 1.145.

This section summarizes the potential for radiological accidents and their cons cases under each alternative. Attachment A describes the methodology and assumptio assessment; describes radiological accident scenarios in more detail; provides sour references used to estimate the doses and impacts for each alternative and case; an factors that the DOE decisionmaker can apply to the source term or dose for each fa with a case.

DOE assessed the potential impacts from a selected spectrum of radiological rel ranging from low (1 x 10-6 event per year) to high (more than 1 event per year) fre occurrence, along with the associated impacts (doses and potential latent fatal can result. The accidents used as references are attributed to individual facilities b and processes (see Attachment A, Table A-3), not to specific cases or alternatives. comparison of alternatives depending on which facilities support a specific case or Figure 5-1 is a flowchart for the preparation of accident analysis information. No occurred because existing documentation adequately supports a quantitative or quali potential impacts, as required by the National Environmental Policy Act of 1969. T postulated radiological accidents associated with spent nuclear fuel at the SRS ind highest point estimate of risk to the public within 80 kilometers (50 miles) of the 1.4 x 10-3 latent fatal cancer per year. The estimated dose to the same population

including natural background sources, would be about 19,000 person-rem per year (DO could cause about nine latent fatal cancers per year in the same population. For p background radiation sources would result in approximately 6,000 times the risk ass largest consequence accident postulated in this EIS for the various spent nuclear f alternatives.

DOE did not quantitatively analyze the potential health effects for SRS workers meters (328 feet) from radiological accidents. Computer codes used to calculate ra experience potentially large errors as a source disperses throughout a building. H carry out a qualitative evaluation of the potential radiological effects to SRS wor vicinity of an accident related to spent fuel management. DOE estimates that the c accident for the most part would result in higher than normal radiation doses. How would occur except in the event of an inadvertent criticality in FB-Line, where up may result. This evaluation is discussed in more detail in Section A.2.6.2 of Atta

5.15.2.1 Alternative 1 - No Action. This alternative identifies the minimum actions deemed

necessary for continued safe and secure management of spent nuclear fuel at the SRS Chapter 3, this is not a status quo condition. Spent nuclear fuel would be maintai defueling or current storage locations with minimal facility upgrade or equipment r local transport would occur. SRS activities required to safely store spent nuclear This alternative would require SRS to place corroded and pitted fuel elements in ca spread of material into the pool. DOE estimated potential radiological accident im occur under this alternative using existing DOE-approved safety analyses for the in Figure 5-1. Accident analysis process. spent nuclear fuel at SRS facilities. As under this alternative would consist of existing facilities, including necessary up interim wet storage. In addition, Attachment A, Table A-4, provides a reference ac associated with these facilities for this alternative. Attachment A, Table A-2, li the source terms considered in analyzing potential accidents under this alternative estimated frequencies. Table 5-20 lists the accident scenario with the highest poin the general public. Table 5-21 compares the potential radiological accidents and h interim wet storage (Option 1) of spent nuclear fuel for the No Action alternative.

Table 5-20. Highest point estimates of risk among receptor groups (Option 1).

	Receptor Groups Maximally Exposed Offsite Individual	Pop
Overall Point Estimate of Riska	1.6x10-7 (Fuel Assembly Breach)	1.4

a. Units of latent fatal cancers per year.

5.15.2.2 Alternative 2 - Decentralization. Accident assessments considered for this

alternative include those considered for the No Action alternative for wet storage assessments for the dry storage (Option 2a) of spent nuclear fuel and for the proce (Option 2c). Option 2c (processing) assumes the use of existing facilities to diss further stabilize spent nuclear fuel. For cases that include some treatment (e.g., nuclear fuel, such treatment is referred to as "stabilization," not processing. Th various types to be considered would include those quantities from the production r research fuel, foreign research reactor fuel, and fuel transported for safety or re

5.15.2.2.1 Option 2a - Dry Storage - DOE estimated potential radiological accident

impacts that could occur in this case using existing DOE-approved safety analysis r DOE by Westinghouse Savannah River Company for vault storage of special nuclear mat existing facilities.

DOE has not incorporated the technology to support interim dry storage of spent nuclear fuel at the SRS. To provide a basis for evaluating the potential impacts f case, this assessment used data from existing safety analyses for special nuclear m facilities and extrapolated these data to apply to spent nuclear fuel. DOE also co accidents associated with wet storage, at least in the near term, because the spent currently in wet storage. Similarly, this assessment includes fuel handling accide transition phase (i.e., until fuel is in interim dry storage). As indicated in Att

Table 5-21. Radioactive release accidents and health effects for spent nuclear fue

Alternative (by case)	Accident Scenario	Frequency (per year)
1. No Action		
Option 1 Wet Storage	A1 Fuel Assembly Breach	1.6x10-1
	A4 Material Release (Adjacent Facility)	2.4x10-3
	A5 Criticality in Water	3.1x10-3
	A7 Spill/Liquid Discharge (external)	2.0x10-4
	A8 Spill/Liquid Discharge (internal)	1.1x10-1
2. Decentralization		
Option 2a Dry Storage	A1 Fuel Assembly Breach	1.6x10-1
	A3 Material Release (Dry Vault)	1.4x10-3
	A4 Material Release (Adjacent Facility)	2.4x10-3
	A5 Criticality in Water	3.1x10-3
	A7 Spill/Liquid Discharge (external)	2.0x10-4
	A8 Spill/Liquid Discharge (internal)	1.1x10-1
Option 2b Wet Storage	A1 Fuel Assembly Breach	1.6x10-1
	A4 Material Release (Adjacent Facility)	2.4x10-3
	A5 Criticality in Water	3.1x10-3
	A7 Spill/Liquid Discharge (external)	2.0x10-4
	A8 Spill/Liquid Discharge (internal)	1.1x10-1
Option 2c Processing	A1 Fuel Assembly Breach	1.6x10-1
	A2 Material Release (Processing)	2.6x10-1
Option 2c (continued)	A3 Material Release (Dry Vault)	1.4x10-3
	A4 Material Release (Adjacent Facility)	2.4x10-3
	A5 Criticality in Water	3.1x10-3
	A6 Criticality in Processing	1.4x10-4
	A7 Spill/Liquid Discharge (external)	2.0x10-4
	A8 Spill/Liquid Discharge (internal)	1.1x10-3
3. 1992/1993 Planning Basis		
Option 3a Dry Storage	Same as Option 2a for Decentralization	
Option 3b Wet Storage	Same as Option 2b for Decentralization	
Option 3c Processing	Same as Option 2c for Decentralization	
4. Regionalization - A		
Option 4a Dry Storage	Same as Option 2a for Decentralization	
Option 4b Wet Storage	Same as Option 2b for Decentralization	
Option 4c Processing	Same as Option 2c for Decentralization	

4. Regionalization - B	
Option 4d Dry Storage	Same as Option 2a for Decentralization
Option 4e Wet Storage	Same as Option 2b for Decentralization
Option 4f Processing	Same as Option 2c for Decentralization
Option 4g Shipping Out	Same as Option 1 for No Action
5. Centralization	
Option 5a Dry Storage	Same as Option 2a for Decentralization
Option 5b Wet Storage	Same as Option 2b for Decentralization
Option 5c Processing	Same as Option 2c for Decentralization
Option 5d Shipping Out	Same as Option 1 No Action

a. The safety analysis reports from which information was extracted for these accid
b. The safety analysis reports from which information was extracted for these accid colocated workers.
c. Units for point estimates of risk are given in potential latent fatal cancers pe
d. ICRP 60 risk factor for the general public (5.0 x 10-4 fatal cancer per year) wa
e. ICRP 60 risk factor for workers (4.0 x 10-4 fatal cancer per year) was used to d
the facilities required under this alternative would consist of existing and new fa support the safe handling, stabilization, and dry storage of spent nuclear fuel. I identifies a potential accident spectrum associated with these facilities for this Table A-2, lists the references for the source terms considered in analyzing potent this alternative case, as well as the estimated frequency of occurrence for each ac lists the potential radiological accidents and health effects associated with dry s fuel for the Decentralization alternative. For the transition period of wet to dry lists the accident scenario with the highest overall point estimate of risk to the Table 5-22 lists the accident scenario with the highest point estimate of risk (aft general public when the fuel had been moved from wet storage (after approximately 1 **placed in interim dry storage.** This indicates a substantial reduction in risk (mor magnitude) when fuel handling events are no longer potential accident initiators.

Table 5-22. Highest point estimates of risk among receptor groups (Option 2a).

	Receptor Groups Maximally Exposed Offsite Individual	Populati
Overall Point Estimate of Riska	1.6x10-7 (Fuel Assembly Breach)	1.4x10-3 Breach)
Transitioned to Dry Storage Point Estimate of Riska	1.5x10-12 (Dry Vault Material Release)	4.9x10-9 Release)

a. Units of latent fatal cancers per year.

5.15.2.2.2 Option 2b - Wet Storage - DOE estimated potential radiological accident

impacts that could occur under this case using existing DOE-approved safety analysi amendments submitted to DOE by Westinghouse Savannah River Company for existing wet facilities.

As indicated in Attachment A, Table A-4, the facilities (modules as defined in the 1994b and Figure 3-2) would consist of existing facilities and specific upgrades ne safe interim wet storage. In addition, Table A-4 identifies the reference accident with these facilities for this option. Attachment A, Table A-2, lists the referenc considered in analyzing potential accidents under this alternative option, as well frequency of occurrence for each accident. Table 5-21 lists the radiological accid consequences of the wet storage (Option 2b) of spent nuclear fuel for the Decentral **Table 5-23 lists the accident scenario with the highest point estimate of risk to t** wet pool storage options, there are no transition phases.

Table 5-23. Highest point estimates of risk among receptor groups (Option 2b).

	Receptor Groups Maximally Exposed Offsite Individual	Populati
Overall Point Estimate of Riska	1.6x10-7 (Fuel Assembly	1.4x10-3

	Breach)	Breach)

a. Units of latent fatal cancers per year.

5.15.2.2.3 Option 2c - Processing and Storage - Processing for the SRS is defined

as the operation of the separations facilities in F- or H-Areas.
The H-Area facilities were designed to
recover uranium and plutonium from spent production reactor fuel, and the F-Area fa
designed to recover plutonium.

DOE estimated potential radiological accident impacts that could occur under th existing DOE-approved safety analysis reports submitted to DOE by Westinghouse Sava Company for processes and for vault storage of special nuclear material from existi also considered radiological accidents associated with wet storage, because the spe currently in wet storage. Similarly, it included fuel handling accidents throughou phase (i.e., until special nuclear material is in interim dry storage). As indicat Table A-4, the facilities required under this option would consist of existing and necessary to support safe handling and processing of spent nuclear fuel into specia for dry storage. In addition, Table A-4 identifies the reference accident spectrum facilities for this case. Attachment A, Table A-2, lists the references for the so in analyzing potential accidents under this alternative case, as well as the estima occurrence for each accident. Table 5-21 lists the radiological release accidents the processing of spent nuclear fuel to special nuclear material for the Decentrali Table 5-24 lists the accident scenario with the highest overall point estimate of r **public from the transition period of wet spent fuel storage into processing for spe** When the fuel had been processed from wet storage to special nuclear material and p interim dry storage, Table 5-24 lists the accident scenario with the highest point transition to the general public. This indicates a substantial reduction in risk (magnitude) when fuel handling events and processing events are no longer potential

Table 5-24. Highest point estimates of risk among receptor groups (Option 2c).

	Receptor Groups Maximally Exposed Offsite Individual	Populati
Overall Point Estimate of Riska	1.6x10-7 (Fuel Assembly Breach)	1.4x10-3 Breach)
Transitioned to Dry Storage Point Estimate of Riska	1.5x10-12 (Dry Vault Material Release)	4.9x10-9 Release)

a. Units of latent fatal cancers per year.

For this option, DOE assumes it could not process some fuel clad in stainless s into special nuclear material and, therefore, would dry-store it as fuel. The tech of nonaluminum-clad fuel has been demonstrated and is assumed to pose no greater ri monitored dry storage of special nuclear material.

5.15.2.3 Alternative 3 - 1992/1993 Planning Basis. Because this alternative would be

consistent with the status quo at the SRS, existing documents contain sufficient in examine its accident analysis impacts. The SRS would continue to receive the spent designated for the Site, and DOE would complete facilities already planned to accom existing inventory and the spent nuclear fuel receipts. This alternative would req facilities already used to support the cases discussed in the Section 5.15.2.2. Th would be the amount of fuel ultimately stored because this alternative assumes the fuel beyond that shipped to the SRS under the Decentralization alternative.

5.15.2.3.1 Option 3a - Dry Storage - DOE estimated potential radiological accident

impacts that could occur under this case using existing DOE-approved safety analysi storage from existing facilities and the study discussed for Option 2a.
DOE also considered
radiological accidents associated with wet storage, at least in the near term, beca fuel is currently in wet storage. Similarly, it included fuel handling accidents t phase (i.e., until the fuel is in interim dry storage). As indicated in Attachment facilities required under this option would consist of existing and new facilities the safe handling and stabilization of spent nuclear fuel for dry storage. In addi

identifies the reference accident spectrum associated with these facilities for thi Table A-2, lists the authorization basis references for the source terms considered potential accidents under this option, as well as the estimated frequency of occurr accident. Table 5-21 lists the radiological release accidents and health effects f spent nuclear fuel for the 1992/1993 Planning Basis alternative. For the entire pe scenarios with the highest point estimates of risk to the general public would be t Option 2a, as listed in Table 5-22.

5.15.2.3.2 Option 3b - Wet Storage - DOE estimated potential radiological accident

impacts that could occur under this case using existing DOE-approved safety analysi amendments submitted to DOE by Westinghouse Savannah River Company for wet storage existing facilities.

As indicated in Attachment A, Table A-4, the facilities required under this option would consist of existing facilities and upgrades necessary to support safe interim addition, Table A-4 identifies the reference accident spectrum associated with thes option. Attachment A, Table A-2, lists the references for the source terms conside potential accidents under this option, as well as the estimated frequency of occurr accident. Table 5-21 lists the radiological release accidents and health effects o (Option 3b) of spent nuclear fuel for the 1992/1993 Planning Basis alternative. Th with the highest point estimate of risk to the general public would be the same as as listed in Table 5-23.

5.15.2.3.3 Option 3c - Processing and Storage.

Table 5-21 lists the radioactive **release accidents and health effects for the processing of spent nuclear fuel for t** processing is complete, the accident scenario with the highest point estimate of ri associated with the storage of special nuclear materials, as discussed for Option 2 Table 5-24.

5.15.2.4 Alternative 4 - Regionalization. This alternative comprises Regionalization A and

Regionalization B subalternatives. Under the Regionalization A subalternative (Opt 4c), the SRS would receive all aluminum-clad fuel from the other sites considered i would transfer its existing inventory of stainless steel- and Zircaloy-clad fuel to appropriate. These proposed activities would reflect current and past activities, information and analyses are available to enable the scaling or other extrapolation accident impacts. The total amount of spent nuclear fuel to be managed under Regio would be slightly less than that for Alternatives 2 and 3; the decisionmaker could adjust the estimated point estimate of risk by the use of an appropriate adjustment discussed in Attachment A, Section A.2.9.

Under the Regionalization B subalternative (Options 4d, 4e, 4f, and 4g), the SR all existing and new spent nuclear fuel east of the Mississippi River. The decisio change in spent nuclear fuel inventories to adjust the estimated point estimate of appropriate adjustment (scaling) factor, as discussed in Attachment A, Section A.2. of this evaluation, Option 4g (Section 5.15.2.4.7) assumes that DOE would ship all the Oak Ridge Reservation.

5.15.2.4.1 Option 4a - Dry Storage - This case is similar to Option 2a, with the

exception of the quantity and type of fuel to be stored.
As with Option 2a, this assessment evaluated existing analyses; the point estimates of risk are the same as those for Option 2a.

5.15.2.4.2 Option 4b - Wet Storage - This case is similar to Option 2b, with the

exception of a slightly smaller quantity of fuel to be stored.
As with Option 2b, this assessment evaluated existing analyses, and the point estimates of risk are the same as those

5.15.2.4.3 Option 4c - Processing and Storage - For this option, the accident

analysis evaluation is similar to Option 2c.
DOE assumes that it could process spent nuclear fuel
associated with regionalization at SRS with existing facilities, because they are d
aluminum-clad fuel. However, the small amount of aluminum-clad fuel received after
processing options are completed would be placed in wet storage.

5.15.2.4.4 Option 4d - Dry Storage - The accident analysis evaluation for this option

is similar to that for Option 2a, with the exception of the increased inventories a
stored.

5.15.2.4.5 Option 4e - Wet Storage - The accident analysis evaluation for this option

is similar to that for Option 2b, with the exception of the increased inventories a
stored.

5.15.2.4.6 Option 4f - Processing and Storage - For this option, the accident

analysis evaluation is similar to Option 2c.
DOE assumes that it could process all the current SRS
aluminum-clad spent nuclear fuel with existing facilities. However, all receipts o
will be placed in dry storage as discussed for Option 4d.

5.15.2.4.7 Option 4g - Shipping Off Site - This option assumes that DOE would

characterize the fuel and ship it all off the Site.
Thus, the potential radiological accidents considered
are the same as those for Alternative 1.

5.15.2.5 Alternative 5 - Centralization. This alternative for the SRS would involve fuel

types and new facilities beyond those considered for any other alternative. For in
alternative, the SRS would receive spent nuclear fuel from the U.S. Navy. One of t
that would be necessary to support this type of spent nuclear fuel is the Expended
Volume 1, Appendix D, includes a detailed accident analyses for this proposed facil
SRS-specific parameters.

This alternative would bound the maximum number of spent nuclear fuel-related a
scenarios that DOE could expect at the SRS, due to the number of new facilities at
have to accommodate the diversity and the increased amount of the fuel to be manage
decisionmaker could use this maximum amount of spent nuclear fuel to adjust the est
the use of an appropriate scaling factor, as discussed in Attachment A, Section A.2
purposes of this evaluation, Option 5d (Section 5.15.2.5.4) assumes that DOE would
the Site to another DOE facility.

5.15.2.5.1 Option 5a - Dry Storage - The major difference in dry storage facilities

between this alternative and the others would be the addition of a facility for Nav
and the large quantity of spent fuel shipped to the SRS from the Hanford Site.
DOE estimated
potential radiological accident impacts that could occur under this option using DO
analysis reports submitted to DOE by Westinghouse Savannah River Company for vault
existing facilities at the SRS and the study discussed for Option 2a. In addition,
radiological accidents associated with wet storage, at least in the near term, beca
nuclear fuel is currently in wet storage. Similarly, it included fuel handling acc
transition phase (i.e., until fuel is in interim dry storage). As indicated in Att
the facilities required under this option would consist of existing and new facilit

support the safe handling and stabilization of spent nuclear fuel for dry storage. Table A-4 identifies the reference accident spectrum associated with these faciliti Attachment A, Table A-2, lists the references for the source terms considered in an accidents under this option, as well as the estimated frequency of occurrence for e Table 5-21 compares the radiological release accidents and health effects for the d **nuclear fuel for the Centralization alternative.** From the transition period of wet accident scenario with the highest point estimate of risk to the general public wou that for Option 2a, as listed in Table 5-22. When the fuel had been moved from wet approximately 25 years) and placed in interim dry storage, the accident scenario wi estimate of risk to the population would be the same as the Option 2a dry storage p

5.15.2.5.2 Option 5b - Wet Storage - The accident analysis evaluation for this option

is similar to that for Option 2b, with the exception of the amount and type of fuel

5.15.2.5.3 Option 5c - Processing and Storage - For this option, the accident

analysis evaluation is similar to Option 2c.
DOE assumes that it could process the current SRS
aluminum-clad spent nuclear fuel with existing facilities. However, the SRS would
of fuel in dry storage, as discussed for Option 5a.

5.15.2.5.4 Option 5d - Shipping Off Site - This option assumes that DOE would

perform the characterization of the fuel at the SRS, and then would ship all fuel o
Thus,
the potential radiological accidents considered are the same as those for the No Ac

5.15.3 Chemical Hazard Evaluation

For toxic chemicals, several government agencies recommend the quantification o as threshold values of concentrations in air or water that cause short-term effects health consequences of human exposure to toxic chemicals are not as well understood radiation. Thus, the potential health effects from toxic chemicals are more subjec radioactive materials.

This section provides a quantitative discussion for an analyzed chemical accide Receiving Basin for Offsite Fuel facility and qualitative discussions addressing ch each of the other existing SRS facilities involved in the receipt, processing, tran spent nuclear fuel.

5.15.3.1 Receiving Basin for Offsite Fuel. The maximum reasonably foreseeable chemical

hazard accident for the Receiving Basin for Offsite Fuel would involve the release vapor following the complete reaction of a drum of target cleaning solution (13.4 p with sodium nitrite (WSRC 1993b). The initiator for this accident is a leak from a the target cleaning solution and involves multiple failures or maloperations with a probability comparable to that of a natural phenomena accident. Table 5-25 shows t of nitrogen dioxide vapor that an individual at the SRS boundary and a maximally ex worker could receive.

Table 5-25. Results of analyzed chemical accident.

Receptor Group	Frequency (per year)	NO2 Conc (mg/m3)
Maximally Exposed Offsite Individual	1.0 x 10-3	0.083
Colocated Worker	1.0 x 10-3	0.64

To determine the potential health effects from this bounding chemical accident assessment was to compare the resulting airborne concentrations of nitrogen dioxide distances against Emergency Response Planning Guideline (ERPG) values, where availa there were no ERPG values available for nitrogen dioxide, the assessment substitute toxicity values as follows:

- For Emergency Response Planning Guideline 1, the assessment substituted thr

values/time-weighted average (TLV/TWA) values (ACGIH 1987). The time-weigh average is the average concentration for a normal 8-hour workday and a 40-h from which nearly all workers could receive repeated exposure, day-after-da adverse effect.

- For Emergency Response Planning Guideline 2, the assessment substituted lev (LOC) values [equal to 0.1 of the immediately dangerous to life or health (value; - see below]. The level of concern value is the concentration of a substance in the air above which there could be serious irreversible health a result of a single exposure for a relatively short period of time (EPA 19
- For Emergency Response Planning Guideline 3, the assessment substituted imm dangerous to life or health values. This value is the maximum concentratio person could escape within 30 minutes without a respirator and without expe impairment of escape or irreversible side effects (NIOSH 1990).

These values as they apply to nitrogen dioxide are as follows:

- Time-weighted average value = 5.6 milligrams per cubic meter
- Level of concern value = 9.4 milligrams per cubic meter
- Immediately dangerous to life or health value = 94.0 milligrams per cubi

5.15.3.2 Reactor Basins. There are no postulated chemical accidents for the reactor basins

that would cause an impact to an individual at the SRS boundary or a colocated work

5.15.3.3 H-Area. There are no postulated chemical accidents for the H-Area Canyon that

would cause an impact to an individual at the SRS boundary or a colocated worker. performed an accident analysis for the H-Area Canyon facility workers that indicate potential injuries due to chemical contamination or exposure to hazardous vapors at of concern exposure limit (Du Pont 1983a). The analysis does not project exposure vapors at or above the immediate danger to life and health level to occur.

The probability that a worker could be accidentally exposed to any of the hazar identified in Attachment A, Table A-14, is bounded by a frequency of 2.8 x 100 per 1983a). The most likely injury is an acid burn to the skin.

The probability for exposure to hazardous vapors at or above the level of conce is 8.5 x 10-1 per year (Du Pont 1983a). The potential for chemical uptakes and for depend on the safety measures taken before the exposure, the duration of the exposu mitigating actions taken after the exposure.

5.15.3.4 F-Area. There are no postulated chemical accidents for the F-Area Canyon that

would cause an impact to an individual at the SRS boundary or a colocated worker. performed an accident analysis for the F-Area Canyon facility workers that indicate potential injuries due to chemical contamination or exposure to hazardous vapors at of concern exposure limit (Du Pont 1983b). The analysis does not project exposure vapors at or above the immediate danger to life and health level to occur.

The probability that a worker could be accidentally exposed to any one of the h identified in Attachment A, Table A-15, is bounded by a frequency of 1.2 x 100 per 1983b). The most likely injury is an acid burn to the skin.

The probability for exposure to hazardous vapors at or above the level of conce is 3.2 x 10-1 per year (Du Pont 1983b). The potential for chemical uptakes and for depend on the safety measures taken before the exposure, the duration of the exposu mitigating actions taken after the exposure.

5.15.4 Secondary Impacts

The primary focus of the accident analysis is to determine the magnitude of the postulated accident scenarios on public and worker health and safety. However, DOE chemical and radiological accidents can also adversely affect the surrounding envir secondary impacts). Accordingly, DOE has qualitatively evaluated each of the eight accident scenarios considered in this analysis for potential secondary impacts. Th paragraphs discuss the results of the evaluation, and Table 5-26 summarizes expecte impacts for each accident scenario.

5.15.4.1 Biotic Resources. With the exception of a direct discharge of disassembly basin

water to an onsite stream, DOE does not expect radiological contamination resulting analyzed accidents to reach any onsite or offsite surface water. DOE previously ev a direct discharge of disassembly basin water (DOE 1990) and believes that impacts resources would be minor. Therefore, the impacts on aquatic biota from any of the would be minor. Small areas of minor surface contamination likely would be outside industrialized area of a postulated accident. Terrestrial biota in or near the con be exposed to small quantities of radioactive materials and ionizing radiation unti could be decontaminated. DOE believes that the impacts on biotic resources from th be minor.

5.15.4.2 Water Resources. DOE expects no adverse impacts on water quality from any of

the postulated accident scenarios. Accident A7 (External Spill/Liquid Discharge) w have the most significant impact. With the exception of the reactor disassembly ba and configuration of existing or potential facilities would prevent a direct releas contaminated water to surface water. However, contamination of the surface aquifer release would be likely. The processes governing the slow plume movement and atten contaminants described in Section 5.8 would prevent the contamination from reaching groundwater resources. Similarly, radionuclide contamination of onsite or offsite

Table 5-26. Qualitative summary of expected secondary impacts.

		Environmental or social factor		
Accident Scenario	Accident Description	Biotic Resources	Water Resources	Economic Impacts
A1	Fuel assembly breach	No adverse effects on biota expected.	No adverse effects expected to surface or groundwater resources.	Limited econo impacts are e Any required could be hand existing work
A2	Material release (processing)	Same as A1.	Same as A1.	Same as A1.
A3	Material release (dry vault)	Same as A1.	Same as A1.	Same as A1.
A4	Material release (adjacent facility)	Same as A1.	Same as A1.	Same as A1.
A5	Criticality in water	Same as A1.	Same as A1.	Same as A1.
A6	Criticality during processing	Same as A1.	Same as A1.	Same as A1.
A7	External spill/liquid discharge	Same as A1.	Surface-water table contamination expected in area of the release. No adverse effects expected to surface-water or drinking water aquifers.	Same as A1.
A8	Internal spill/liquid discharge	Same as A1.	No adverse impact to water resources. The spill is expected to be contained entirely within the building structure.	Same as A1.

water sources would be unlikely. DOE evaluated the effects of a direct discharge o water on water resources (DOE 1990) and believes that impacts on water resources wo

5.15.4.3 Economic Impacts. DOE expects limited economic impacts as a result of any of

the postulated accidents. Any cleanup required would be localized, and the existin equipment could perform it. Contamination should be contained within a small area boundaries for all eight postulated accident scenarios. The existing workforce cou required cleanup.

5.15.4.4 National Defense. None of the postulated accidents would affect the DOE national

defense mission. Spent nuclear fuel management activities do not involve the produ needed for national defense.

5.15.4.5 Environmental Contamination. DOE expects that none of the postulated accident

scenarios would result in large areas of contamination. Local contamination is lik of an accident, but in all scenarios should be contained within the SRS boundaries. contamination outside the immediate area of the accident is unlikely to require cle small area inside the Site boundary. Impacts in all cases should be minimal.

5.15.4.6 Endangered Species. There are no Federally listed threatened or endangered

species habitats in the immediate vicinity of existing or potential spent nuclear f processing facilities (see Section 4.9.4). None of the postulated accident scenario in large areas of surface contamination outside the immediate facilities, and DOE d adverse impacts to surface water. Therefore, none of the postulated accident scena impact threatened or endangered species.

5.15.4.7 Land Use. No accident scenario should result in large areas of contamination, nor

would the impacts be irreversible. DOE expects no change in land use.

5.15.4.8 Treaty Rights. The environmental impacts of each of the accident scenarios should

be contained within the SRS boundaries. Because there are no Native American or pu the site boundaries, treaty rights would not be affected.

5.15.5 Adjusted Point Estimate of Risk Summary

The accident scenarios described in Section 5.15.2 differ only slightly between alternatives. These scenarios did not account for variations in spent nuclear fuel onsite operational transfers) and spent fuel storage inventories across the alterna realistic comparison across alternatives, DOE developed adjustment factors to adjus consequences, depending on the specific circumstance of each alternative. Attachme Section A.2.9, provides the methodology and justifications used to develop appropri factors. This section provides the adjusted point estimates of risk for each accid receptor group to demonstrate a relative comparison of each alternative on a case-b Tables 5-27, 5-28, and 5-29 summarize the adjusted point estimates of risk for each maximally exposed individual, the general population to 80 kilometers, and the colo

5.16 Cumulative Impacts

The Savannah River Site (SRS) contains major U.S. Department of Energy (DOE) an facilities, unrelated to spent nuclear fuel, that would continue to operate through spent nuclear fuel management program. The activities associated with these existi produce environmental consequences that this document has included in the baseline conditions (Chapter 4) against which it assesses the consequences of the spent nucl Impacts of both the construction and operation of SRS spent nuclear fuel facilities

cumulative with the impacts of existing and planned facilities unrelated to spent n

This cumulative impact assessment considered the incremental and synergistic ef operation of the Defense Waste Processing Facility, which is nearing completion, an Incineration Facility, which is under construction, when appropriate and when data example, the Air Quality analysis factored in emissions from these two facilities w potential impacts of operations of spent nuclear fuel facilities. The small volume (treated sanitary wastes) currently entering the environment from the Defense Waste Facility, on the other hand, were considered part of the Water Quality baseline. T alone facilities scheduled to be built in the near future on the SRS are the Savann Laboratory Conference Center and the new Centralized Sanitary Wastewater Treatment number of other planned facilities have not been factored into the cumulative impac final funding approval has not been received or because decisions on these faciliti

Table 5-27. Adjusted point estimates of risk for the maximally exposed offsite ind

Accident Description	Attributed	No Action Option 1	Decentralization Option 2a	Option 2b	O 2
A1 - Fuel Assembly Breach	Adjusted Health Effectsa	1.0x10-6	1.0x10-6	1.0x10-6	1
	Adjusted Annual Frequency	1.6x10-1	3.3x10-1	3.5x10-1	1
	Adjusted Point Estimate of Riskb	1.6x10-7	3.3x10-7	3.5x10-7	1
A2 - Processing release	Adjusted Health Effectsa	(c)	(c)	(c)	3
	Adjusted Annual Frequency	(c)	(c)	(c)	2
	Adjusted Point Estimate of Riskb	(c)	(c)	(c)	9
A3 - Dry vault release	Adjusted Health Effectsa	(c)	1.1x10-9	(c)	1
	Adjusted Annual Frequency	(c)	1.4x10-3	(c)	1
	Adjusted Point Estimate of Riskb	(c)	1.6x10-12	(c)	1
A4 - Adjacent facility release	Adjusted Health Effectsa	3.0x10-6	3.0x10-6	3.0x10-6	3
	Adjusted Annual Frequency	2.4x10-3	5.0x10-3	5.3x10-3	2
	Adjusted Point Estimate of Riskb	7.2x10-9	1.5x10-8	1.6x10-8	7
A5 - Criticality in water	Adjusted Health Effecta	1.5x10-6	1.5x10-6	1.5x10-6	1
	Adjusted Annual Frequency	3.1x10-3	6.4x10-3	6.8x10-3	3
	Adjusted Point Estimate of Riskb	4.7x10-9	9.7x10-9	1.0x10-8	4
A6 - Criticality during processing	Adjusted Health Effectsa	(c)	(c)	(c)	3
	Adjusted Annual Frequency	(c)	(c)	(c)	1
	Adjusted Point Estimate of Riskb	(c)	(c)	(c)	5
A7 - External spill/liquid	Adjusted Health Effectsa	2.7x10-6	2.8x10-6	2.8x10-6	2

discharge					
	Adjusted Annual Frequency	2.0x10-4	2.0x10-4	2.0x10-4	2
	Adjusted Point Estimate of Riskb	5.4x10-10	5.4x10-10	5.4x10-10	5
A8 - Internal spill/liquid discharge	Adjusted Health Effectsa	1.2x10-13	1.2x10-13	1.2x10-13	1
	Adjusted Annual Frequency	1.1x10-1	1.1x10-1	1.1x10-1	1
	Adjusted Point Estimate of Riskb	1.3x10-14	1.3x10-14	1.3x10-14	1

Table 5-27. (continued).

		Regionalization - B	
Accident Description	Attributea	Option 4d	Option 4e
A1 - Fuel Assembly Breach	Adjusted Health Effectsa	1.0x10-6	1.0x10-6
	Adjusted Annual Frequency	4.1x10-1	4.1x10-1
	Adjusted Point Estimate of Riskb	4.1x10-7	4.1x10-7
A2 - Processing release	Adjusted Health Effectsa	(c)	(c)
	Adjusted Annual Frequency	(c)	(c)
	Adjusted Point Estimate of Riskb	(c)	(c)
A3 - Dry vault release	Adjusted Health Effectsa	1.4x10-9	(c)
	Adjusted Annual Frequency	1.4x10-3	(c)
	Adjusted Point Estimate of Riskb	2.0x10-12	(c)
A4 - Adjacent facility release	Adjusted Health Effectsa	3.0x10-6	3.0x10-6
	Adjusted Annual Frequency	6.2x10-3	6.2x10-3
	Adjusted Point Estimate of Riskb	1.9x10-8	1.9x10-8
A5 - Criticality in water	Adjusted Health Effecta	1.5x10-6	1.5x10-6
	Adjusted Annual Frequency	8.0x10-3	8.0x10-3
	Adjusted Point Estimate of Riskb	1.2x10-8	1.2x10-8
A6 - Criticality during processing	Adjusted Health Effectsa	(c)	(c)
	Adjusted Annual Frequency	(c)	(c)
	Adjusted Point	(c)	(c)

	Estimate of Riskb		
A7 - External spill/liquid discharge	Adjusted Health Effectsa	3.5x10-6	3.5x10-6
	Adjusted Annual Frequency	2.0x10-4	2.0x10-4
	Adjusted Point Estimate of Riskb	7.0x10-10	7.0x10-10
A8 - Internal spill/liquid discharge	Adjusted Health Effectsa	1.6x10-13	1.6x10-13
	Adjusted Annual Frequency	1.1x10-1	1.1x10-1
	Adjusted Point Estimate of Riskb	1.7x10-14	1.7x10-14

a. Units for adjusted health effects are given in terms of potential fatal cancers.
b. Units for adjusted point estimates of risk are given in terms of potential fatal
c. The accident scenario is not included in the spectrum of potential accidents for
d. Adjustment factors were calculated using March 1994 data and information. In-pr to these factors by more than 10 percent.

Table 5-28. Adjusted point estimates of risk for the colocated worker (radiologica

Accident Description	Attribute	No Action Option 1	Decentralization Option 2a	Option 2b	O 2
A1 - Fuel Assembly Breach	Adjusted Health Effectsa	4.8x10-6	4.8x10-6	4.8x10-6	4
	Adjusted Annual Frequency	1.6x10-1	3.3x10-1	3.5x10-1	1
	Adjusted Point Estimate of Riskb	7.7x10-7	1.6x10-6	1.7x10-6	7
A2 - Processing release	Adjusted Health Effectsa	(c)	(c)	(c)	3
	Adjusted Annual Frequency	(c)	(c)	(c)	2
	Adjusted Point Estimate of Riskb	(c)	(c)	(c)	9
A3 - Dry vault release	Adjusted Health Effectsa	(c)	(d)	(c)	(
	Adjusted Annual Frequency	(c)	(d)	(c)	(
	Adjusted Point Estimate of Riskb	(c)	(d)	(c)	(
A4 - Adjacent facility release	Adjusted Health Effectsa	2.0x10-5	2.0x10-5	2.0x10-5	2
	Adjusted Annual Frequency	2.4x10-3	5.0x10-3	5.3x10-3	2
	Adjusted Point Estimate of Riskb	4.8x10-8	1.0x10-7	1.1x10-7	4
A5 - Criticality in water	Adjusted Health Effectsa	5.6x10-5	5.6x10-5	5.6x10-5	5
	Adjusted Annual Frequency	3.1x10-3	6.4x10-3	6.8x10-3	3
	Adjusted Point Estimate of Riskb	1.7x10-7	3.6x10-7	3.8x10-7	1
A6 - Criticality during	Adjusted Health Effectsa	(c)	(c)	(c)	1

processing					
	Adjusted Annual Frequency	(c)	(c)	(c)	1
	Adjusted Point Estimate of Riskb	(c)	(c)	(c)	1
A7 - External spill/liquid discharge	Adjusted Health Effectsa	3.0x10-5	3.1x10-5	3.1x10-5	3
	Adjusted Annual Frequency	2.0x10-4	2.0x10-4	2.0x10-4	2
	Adjusted Point Estimate of Riskb	6.0x10-9	6.2x10-9	6.2x10-9	6
A8 - Internal spill/liquid discharge	Adjusted Health Effectsa	8.0x10-15	8.3x10-15	8.3x10-15	8
	Adjusted Annual Frequency	1.1x10-1	1.1x10-1	1.1x10-1	1
	Adjusted Point Estimate of Riskb	8.8x10-16	9.2x10-16	9.2x10-16	9

Table 5-28. (continued).

		Regionalization - B	
Accident Description	Attribute	Option 4d	Option 4e
A1 - Fuel Assembly Breach	Adjusted Health Effectsa	4.8x10-6	4.8x10-6
	Adjusted Annual Frequency	4.1x10-1	4.1x10-1
	Adjusted Point Estimate of Riskb	2.0x10-6	2.0x10-6
A2 - Processing release	Adjusted Health Effectsa	(c)	(c)
	Adjusted Annual Frequency	(c)	(c)
	Adjusted Point Estimate of Riskb	(c)	(c)
A3 - Dry vault release	Adjusted Health Effectsa	(c)	(c)
	Adjusted Annual Frequency	(c)	(c)
	Adjusted Point Estimate of Riskb	(c)	(c)
A4 - Adjacent facility release	Adjusted Health Effectsa	2.0x10-5	2.0x10-5
	Adjusted Annual Frequency	6.2x10-3	6.2x10-3
	Adjusted Point Estimate of Riskb	1.2x10-7	1.2x10-7
A5 - Criticality in water	Adjusted Health Effectsa	5.6x10-5	5.6x10-5
	Adjusted Annual Frequency	8.0x10-3	8.0x10-3
	Adjusted Point Estimate of Riskb	4.5x10-7	4.5x10-7
A6 - Criticality	Adjusted	(c)	(c)

during processing	Adjusted Health Effectsa		
	Adjusted Annual Frequency	(c)	(c)
	Adjusted Point Estimate of Riskb	(c)	(c)
A7 - External spill/liquid discharge	Adjusted Health Effectsa	3.9x10-3	3.9x10-3
	Adjusted Annual Frequency	2.0x10-4	2.0x10-4
	Adjusted Point Estimate of Riskb	7.8x10-7	7.8x10-7
A8 - Internal spill/liquid discharge	Adjusted Health Effectsa	1.0x10-14	1.0x10-14
	Adjusted Annual Frequency	1.1x10-1	1.1x10-1
	Adjusted Point Estimate of Riskb	1.2x10-15	1.2x10-15

a. Units for adjusted health effects are given in terms of potential fatal cancers.
b. Units for adjusted point estimates of risk are given in terms of potential fatal
c. The accident scenario is not included in the spectrum of potential accidents for
d. The safety analyses from which information was extracted for these accidents wer
require the inclusion of colocated workers.

Table 5-29. Adjusted point estimates of risk for the general population - 80 kilom

Accident Description	Attribute	No Action Option 1	Decentralization Option 2a	Option 2b
A1 - Fuel Assembly Breach	Adjusted Health Effectsa	8.5x10-3	8.5x10-3	8.5x10-3
	Adjusted Annual Frequency	1.6x10-1	3.3x10-1	3.5x10-1
	Adjusted Point Estimate of Riskb	1.4x10-3	2.8x10-3	3.0x10-3
A2 - Processing release	Adjusted Health Effectsa	(c)	(c)	(c)
	Adjusted Annual Frequency	(c)	(c)	(c)
	Adjusted Point Estimate of Riskb	(c)	(c)	(c)
A3 - Dry vault release	Adjusted Health Effectsa	(c)	3.6x10-6	(c)
	Adjusted Annual Frequency	(c)	1.4x10-3	(c)
	Adjusted Point Estimate of Riskb	(c)	5.0x10-9	(c)
A4 - Adjacent facility release	Adjusted Health Effectsa	2.5x10-2	2.5x10-2	2.5x10-2
	Adjusted Annual Frequency	2.4x10-3	5.0x10-3	5.3x10-3

	Adjusted Point Estimate of Riskb	6.0x10-5	1.2x10-4	1.3x10-4
A5 - Criticality in water	Adjusted Health Effectsa	4.4x10-3	4.4x10-3	4.4x10-3
	Adjusted Annual Frequency	3.1x10-3	6.4x10-3	6.8x10-3
	Adjusted Point Estimate of Riskb	1.4x10-5	2.8x10-4	3.0x10-4
A6 - Criticality during processing	Adjusted Health Effectsa	(c)	(c)	(c)
	Adjusted Annual Frequency	(c)	(c)	(c)
	Adjusted Point Estimate of Riskb	(c)	(c)	(c)
A7 - External spill/liquid discharge	Adjusted Health Effectsa	9.0x10-3	9.4x10-3	9.4x10-3
	Adjusted Annual Frequency	2.0x10-4	2.0x10-4	2.0x10-4
	Adjusted Point Estimate of Riskb	1.8x10-6	1.9x10-6	1.9x10-6
A8 - Internal spill/liquid discharge	Adjusted Health Effectsa	1.0x10-9	1.0x10-9	1.0x10-9
	Adjusted Annual Frequency	1.1x10-1	1.1x10-1	1.1x10-1
	Adjusted Point Estimate of Riskb	1.1x10-10	1.1x10-10	1.1x10-10

Table 5-29. (continued).

		Regionalization - B		
Accident Description	Attribute	Option 4d	Option 4e	Op 4
A1 - Fuel Assembly Breach	Adjusted Health Effectsa	8.5x10-3	8.5x10-3	8.
	Adjusted Annual Frequency	4.1x10-1	4.1x10-1	2.
	Adjusted Point Estimate of Riskb	3.5x10-3	3.5x10-3	2.
A2 - Processing Release	Adjusted Health Effectsa	(c)	(c)	2.
	Adjusted Annual Frequency	(c)	(c)	3.
	Adjusted Point Estimate of Riskb	(c)	(c)	8.
A3 - Dry vault Release	Adjusted Health Effectsa	4.6x10-6	(c)	4.
	Adjusted Annual Frequency	1.4x10-3	(c)	1.
	Adjusted Point Estimate of	6.4x10-4	(c)	6.

	Riskb			
A4 - Adjacent Facility Release	Adjusted Health Effectsa	2.5x10-2	2.5x10-2	2.
	Adjusted Annual Frequency	6.2x10-3	6.2x10-3	3.
	Adjusted Point Estimate of Riskb	1.6x10-4	1.6x10-4	9.
A5 - Criticality in water	Adjusted Health Effectsa	4.4x10-3	4.4x10-3	4.
	Adjusted Annual Frequency	8.0x10-3	8.0x10-3	4.
	Adjusted Point Estimate of Riskb	3.5x10-5	3.5x10-5	2.
A6 - Criticality during processing	Adjusted Health Effectsa	(c)	(c)	4.
	Adjusted Annual Frequency	(c)	(c)	1.
	Adjusted Point Estimate of Riskb	(c)	(c)	7.
A7 - External spill/liquid discharge	Adjusted Health Effectsa	1.2x10-2	1.2x10-2	1.
	Adjusted Annual Frequency	2.0x10-4	2.0x10-4	2.
	Adjusted Point Estimate of Riskb	2.4x10-6	2.4x10-6	2.
A8 - Internal spill/liquid discharge	Adjusted Health Effectsa	1.3x10-9	1.3x10-9	1.
	Adjusted Annual Frequency	1.1x10-1	1.1x10-1	1.
	Adjusted Point Estimate of Riskb	1.4x10-10	1.4x10-10	1.

a. Units for adjusted health effects are given in terms of potential fatal cancers
b. Units for adjusted point estimates of risk are given in terms of potential fata
c. The accident scenario is not included in the spectrum of potential accidents fo

unresolved DOE policy issues. For example, this cumulative impact assessment does long-term reconfiguration issues. Table 5-30 presents a summary of cumulative impa with the various spent fuel management alternatives.

5.16.1 Land Use

The land committed to spent nuclear fuel management activities at the SRS would most part, within existing onsite industrial compounds or undeveloped onsite areas continued mission of the Site. Under two of the alternatives - Regionalization by and Centralization (at SRS) - a new Expended Core Facility could be required to exa characterize spent nuclear fuels from naval installations east of the Mississippi. been proposed for the Expended Core Facility, one in the approximate center of the at the old Allied General Nuclear Services facility (or "Barnwell Nuclear Fuel Plan off Road G (and near SRS Barricade 4) just east of and adjacent to the Site.

Previously-undeveloped land committed to new spent nuclear fuel facilities (exc Expended Core Facility) would be limited to a maximum of approximately 100 acres (0

kilometer). Depending on the location chosen, an additional 30 acres (0.1 square k required for a new Expended Core Facility. Thus, a maximum of 130 acres (0.5 squar could be converted from woodlands or old fields to industrial facilities and suppor under the bounding options, Option 5a (Centralization - Dry Storage) and Option 5c Processing). Any site used for the support of spent nuclear fuel activities would control. With the exception of the Barnwell Nuclear Fuel facility, which the Navy from Allied General Nuclear Services for an offsite Expended Core Facility, DOE wou any additional land from the public domain for SRS spent nuclear fuel management fa

Ground was broken for the new Savannah River Ecology Laboratory Conference Cent 1994. The new facility will occupy a 70-acre area, but only 5 to 10 acres will be for the new conference center, parking areas, and an access road. The remaining 60 managed as a nature study area and preserve. Thus, the Savannah River Ecology Labo Conference Center will require conversion of 5 to 10 acres of planted pines or pine (depending on the exact location of the building) to light-industrial/public use.

Table 5-30. Cumulative impacts associated with construction and operation of spent alternatives at Savannah River Site.

ALTERNATIVE 1 - NO ACTION

	Option 1 Wet Storage
Land Use	No new land committed to new use.
Socioeconomics	A maximum of 50 new jobs created annually duri jobs created during operation.
Air Resources	Site emissions would not exceed any air qualit lists cumulative Site nonradioactive releases
Occupational and Public Health and Safety	Radioactive airborne releases, expressed as cu maximally exposed individual at the Site bound rem.
Materials and Waste Management	High-Level: Current generation levels Transuranic: Current generation levels Low-Level: Current generation levels Mixed: Current generation levels Hazardous: Current generation levels Sanitary: Current generation levels

ALTERNATIVE 2 - DECENTRALIZATION

	Option 2a Dry Storage	Option 2b Wet Storage	Option 2c Processing
Land Use	Small amount of land (<10 acres) committed to new use.	Small amount of land (<10 acres) committed to new use.	Small amount of (<10 acres) comm new use.
Socioeconomics	Construction jobs: 600 peak Operation: No new jobs	Construction jobs: 600 peak Operation: No new jobs	Construction jobs: 550 peak Operation: No ne
Air Resources	Site emissions would not exceed any air quality standard. Table 5-31 lists cumulative Site nonradioactive releases at the SRS boundary.	Site emissions would not exceed any air quality standard. Table 5-31 lists cumulative Site nonradioactive releases at the SRS boundary.	Site emissions w exceed any air q standard. Table lists cumulative nonradioactive r the SRS boundary
Occupational and Public Health and Safety	Radioactive airborne releases, expressed as cumulative dose to a maximally exposed individual at the Site boundary, would be 9.0x10-5 rem.	Radioactive airborne releases, expressed as cumulative dose to a maximally exposed individual at the Site boundary, would be 9.0x10-5 rem.	Radioactive airb releases, expres cumulative dose maximally expose individual at th boundary, would rem.
Materials and Waste Management	High-Level: No change Transuranic: 6% increase Low-Level: No change Mixed: No changea Hazardous: No changea Sanitary: No changeb	High-Level: No change Transuranic: 6% increase Low-Level: No change Mixed: No changea Hazardous: No changea Sanitary: No changeb	High-Level: 475% incr Transuranic: 12% inc Low-Level: 100% Mixed: No change Hazardous: No ch Sanitary: No cha

ALTERNATIVE 3 - 1992/1993 PLANNING BASIS

	Option 3a Dry Storage	Option 3b Wet Storage	Option 3c Processing
Land Use	Small amount of land (<10 acres) committed to new use.	Small amount of land (<10 acres) committed to new use.	Small amount of (<10 acres) comm new use.
Socioeconomics	Construction jobs: 600 peak Operation: No new jobs	Construction jobs: 650 peak Operation: No new jobs	Construction jobs: 550 peak Operation: No ne
Air Resources	Site emissions would not exceed any air quality standard. Table 5-31 lists cumulative Site nonradioactive releases at the SRS boundary.	Site emissions would not exceed any air quality standard. Table 5-31 lists cumulative Site nonradioactive releases at the SRS boundary.	Site emissions w exceed any air q standard. Table lists cumulative nonradioactive r the SRS boundary
Occupational and Public Health and Safety	Radioactive airborne releases, expressed as cumulative dose to a maximally exposed individual at the Site boundary, would be 9.0x10-5 rem.	Radioactive airborne releases, expressed as cumulative dose to a maximally exposed individual at the Site boundary, would be 9.0x10-5 rem.	Radioactive airb releases, expres cumulative dose maximally expose individual at th boundary, would rem.
Materials and Waste Management	High-Level: No change Transuranic: 6% increase Low-Level: No change Mixed: No changea Hazardous: No changea Sanitary: No changeb	High-Level: No change Transuranic: 6% increase Low-Level: No change Mixed: No changea Hazardous: No changea Sanitary: No changeb	High-Level: 325% incr Transuranic: 12% inc Low-Level: 87.5% Mixed: No change Hazardous: No ch Sanitary: No cha

ALTERNATIVE 4 - REGIONALIZATION

	Option 4a Dry Storage	Option 4b Wet Storage	Option 4c Processing
Land Use	Small amount of land (<10 acres) committed to new use.	Small amount of land (<10 acres) committed to new use.	Small amount of (<10 acres) comm new use.
Socioeconomics	Construction jobs: 650 peak Operation: No new jobs	Construction jobs: 650 peak Operation: No new jobs	Construction jobs: 550 peak Operation: No ne
Air Resources	Site emissions would not exceed any air quality standard. Table 5-31 lists cumulative Site nonradioactive releases at the SRS boundary.	Site emissions would not exceed any air quality standard. Table 5-31 lists cumulative Site nonradioactive releases at the SRS boundary.	Site emissions w exceed any air q standard. Table lists cumulative nonradioactive r the SRS boundary
Occupational and Public Health and Safety	Radioactive airborne releases, expressed as cumulative dose to a maximally exposed individual at the Site boundary, would be 9.0x10-5 rem.	Radioactive airborne releases, expressed as cumulative dose to a maximally exposed individual at the Site boundary, would be 9.0x10-5 rem.	Radioactive airb releases, expres cumulative dose maximally expose individual at th boundary, would rem.
	Option 4a Dry Storage	Option 4b Wet Storage	Option 4c Processing
Materials and Waste Management	High-Level: No change Transuranic: No change Low-Level: No change Mixed: No changea	High-Level: No change Transuranic: No change Low-Level: No change Mixed: No changea	High-Level: 475% incr Transuranic: 6% Low-Level: 97.5% Mixed: No change Hazardous: No ch

	Hazardous: No changea Sanitary: No changeb	Hazardous: No changea Sanitary: No changeb	Sanitary: No cha
	Option 4d Dry Storage	Option 4e Wet Storage	Option 4f Processing
Land Use	Approximately 40 acres committed to new use.	Approximately 35 acres committed to new use.	Approximately 35 committed to new
Socioeconomics	Construction jobs: 910 peak Operation: No new jobs	Construction jobs: 910 peak Operation: No new jobs	Construction jobs: 860 peak Operation: No ne
Air Resources	Site emissions would not exceed any air quality standard. Table 5-31 lists cumulative Site nonradioactive releases at the SRS boundary.	Site emissions would not exceed any air quality standard. Table 5-31 lists cumulative Site nonradioactive releases at the SRS boundary.	Site emissions w exceed any air q standard. Table lists cumulative nonradioactive r the SRS boundary
Occupational and Public Health and Safety	Radioactive airborne releases, expressed as cumulative dose to a maximally exposed individual at the Site boundary, would be 9.0x10-5 rem.	Radioactive airborne releases, expressed as cumulative dose to a maximally exposed individual at the Site boundary, would be 9.0x10-5 rem.	Radioactive airb releases, expres cumulative dose maximally expose individual at th boundary, would rem.
Materials and Waste Management	High-Level: No change Transuranic: No change Low-Level: No change Mixed: No changea Hazardous: No changea Sanitary: No changeb	High-Level: No change Transuranic: No change Low-Level: No change Mixed: No changea Hazardous: No changea Sanitary: No changeb	High-Level: 475% incr Transuranic: 6% Low-Level: 97.5% Mixed: No change Hazardous: No ch Sanitary: No cha
	Option 4g Ship Out		
Land Use	Less than one acre of land committed to new use.		
Socioeconomics	Construction jobs: 200 peak Operation: No new jobs		
Air Resources	Site emissions would not exceed any air quality standard. Table 5- cumulative site nonradioactive releases at the SRS boundary.		
Occupational and Public Health and Safety	Radioactive airborne releases, expressed as cumulative dose to a ma exposed individual at the Site boundary, would be (less than) <9.0x		
Materials and Waste Management	High-Level: Reduced volume of waste produced Transuranic: 6% increase Low-Level: No change Mixed: No changea Hazardous: No changea Sanitary: No changeb		
	ALTERNATIVE 5 - CENTRALIZATION		
	Option 5a Dry Storage	Option 5b Wet Storage	Option 5c Processing
Land Use	100-130 acres of land committed to new use.	70-80 acres of land committed to new use.	100-130 acres of committed to new
Socioeconomics	Construction: 2,550 peak Operation: No new jobs	Construction: 2,700 peak Operation: No new jobs	Construction: 2, Operation: No ne
Air Resources	Site emissions would not exceed any air quality standard. Table 5-31 lists cumulative Site	Site emissions would not exceed any air quality standard. Table 5-31 lists cumulative Site	Site emissions w exceed any air q standard. Table lists cumulative nonradioactive r

Occupational and Public Health and Safety	nonradioactive releases at the SRS boundary. Radioactive airborne releases, expressed as cumulative dose to a maximally exposed individual at the Site boundary, would be 9.0x10-5 rem.	nonradioactive releases at the SRS boundary. Radioactive airborne releases, expressed as cumulative dose to a maximally exposed individual at the Site boundary, would be 9.0x10-5 rem.	the SRS boundary Radioactive airb releases, expres cumulative dose maximally expose individual at th boundary, would rem.
Materials and Waste Management	High-Level: Reduced volume of waste produced Transuranic: Reduced volume of waste produced Low-Level: No change Mixed: No change[a] Hazardous: No change[a] Sanitary: No change[b]	High-Level: 475% increase Transuranic: 18% increase Low-Level: No change Mixed: No change[a] Hazardous: No change[a] Sanitary: No change[b]	High-Level: 475% incr Transuranic: 18% inc Low-Level: 100% Mixed: No change Hazardous: No ch Sanitary: No cha

	Option 5d Ship Out
Land Use	Less than one acre of land committed to new use.
Socioeconomics	Construction: 200 peak Operation: No new jobs
Air Resources	Site emissions would not exceed any air quality standard. Table 5 cumulative Site nonradioactive releases at the SRS boundary.
Occupational and Public Health and Safety	Radioactive airborne releases, expressed as cumulative dose to a m exposed individual at the Site boundary, would be 9.0x10-5 rem.
Materials and Waste Management	High-Level: Reduced volume of waste produced Transuranic: 6% increase Low-Level: No change Mixed: No change[a] Hazardous: No change[a] Sanitary: No change[b]

a. Not expected to change; no analysis conducted.
b. Not expected to change; based on projected employment levels at SRS.

Construction on the new Centralized Sanitary Wastewater Treatment Facility is scheduled to begin in 1994 and should be completed in 1995. This new facility will be built approximately 1 mile south of F-Area on Burma Road. Building the central facility will require clearing approximately 6 acres of planted pines. An 18 mile trunkline/collection system will also be required, using existing transmission line and steam line rights-of-way to the extent possible. This trunkline will be located in the northwest quadrant of the SRS, and will connect the new Centralized Sanitary Wastewater Treatment Facility to A-Area, F-/H-Areas, and C-Area.

Depending on the spent nuclear fuel management alternative chosen, a total of 150 acres of SRS land could be cleared and converted to facilities and infrastructure as a result of spent nuclear fuel management (including an Expended Core Facility), construction of the Savannah River Ecology Laboratory Conference Center, and completion of the Centralized Sanitary Wastewater Treatment Facility. This represents less than 0.1 percent of the undeveloped land on the SRS, and will have minimal cumulative impact on long-term land use locally and regionally.

5.16.2 Socioeconomics

There would be minimal cumulative impacts on the socioeconomic resources of the SRS region from any spent fuel management alternative. The greatest

change in employment would occur under the Centralization Alternative, which would include construction and operation of an Expended Core Facility at SRS. Construction of an Expended Core Facility would require an estimated 850 additional employees in the peak year (1999), while operation of the facility would add a maximum of approximately 500 full-time jobs. DOE anticipates that overall employment on the Site will decline during the first 5 years of the spent fuel management period and will stabilize thereafter as the SRS mission changes. Workers who might otherwise lose their jobs could be employed by SRS in spent fuel program activities. Therefore, DOE expects little or no direct increase in employment due to the program. The Site would fill any new jobs from the existing regional labor force.

5.16.3 Air Quality

Table 5-31 compares the cumulative emissions of nonradioactive pollutants from the SRS, including those from the proposed spent nuclear fuel alternatives, to the pertinent regulatory standards. The values provided are the maximum concentrations that would occur at ground level at the Site boundary. Not all maximum concentrations would occur at the same location.

Table 5-31. Total maximum ground-level concentrations (yg/cubic meter) of criteria and toxic air pollutants at SRS boundary resulting from normal operations and spent nuclear fuel management alternatives. ,b

Emissions	Averaging Time	Alternatives 1 through 4 Option a Dry Storage	Option b Wet Storage
Criteria Pollutants			
NOx		An4 (4%)	4 (4%)
SOx		An10 (12%)	10 (12%)
		24185.0 (50%)	185.0 (50%)
		3-634 (49%)	634 (49%)
PM10		An3 (6%)	3 (6%)
		2456.0 (37%)	56.0 (37%)
TSP		An11 (17%)	11 (17%)
Ozone (as VOC)		1-N/Ad	N/Ad
Gaseous fluoride (as HF)		1-0.03 (4%)	0.03 (4%)
		1-0.15 (9%)	0.15 (9%)
		240.31 (11%)	0.31 (11%)
		120.62 (17%)	0.62 (17%)
Lead		An<0.01 (<1%)	<0.01 (<1%)
CO		8-23.1 (0.2%)	23.1 (0.2%)
		1-181 (0.4%)	181 (0.4%)
Toxic Pollutants			
Nitric acid		246.7 (5%)	6.7 (5%)
1,1,1-Trichloroethane		2422 (0.2%)	22 (0.02%)
Benzene		2431 (21%)	31 (21%)
Ethanolamine		24<0.01 (<0.1%)	<0.01 (<0.1%)
Ethylbenzene		240.12 (<0.1%)	0.12 (<0.1%)
Ethylene glycol		240.08 (<0.1%)	0.08 (<0.1%)
Formaldehyde		24<0.01 (<0.1%)	<0.01 (<0.1%)
Glycol ethers		24<0.01 N/A	<0.01 N/A
Hexachloronaphthalene		24<0.01 (<1%)	<0.01 (<1%)
Hexane		240.07 (<0.1%)	0.07 (<0.1%)
Manganese		240.10 (0.4%)	0.10 (0.4%)
Methanol		240.51 (<0.1%)	0.51 (<0.1%)
Methyl ethyl ketone		240.99 (<0.1%)	0.99 (<0.1%)
Methyl isobutyl ketone		240.51 (<0.1%)	0.51 (<0.1%)
Methylene		241.8 (0.3%)	1.8 (0.3%)

Emissions	Averaging Time	Option a Dry Storage	Option b Wet Storage
chloride			
Napthalene		240.01 (<0.1%)	0.01 (<0.1%)
Phenol		240.03 (<0.1%)	0.03 (<0.1%)

Table 5-31. (continued).

Emissions	Averaging Time	Alternatives 1 through 4 Option a Dry Storage	Option b Wet Storage
Phosphorus		24<0.001 (<0.2%)	<0.001 (<0.2%)
Sodium hydroxide		240.01 (<0.1%)	0.01 (<0.1%)
Toluene		241.6 (8%)	1.6 (8%)
Trichloroethene		241.0 (0.3%)	1.0 (0.3%)
Vinyl acetate		240.02 (<0.1%)	0.02 (<0.1%)
Xylene		243.81 (<0.1%)	3.81 (<0.1%)

Alternative 5 - Centralization

Emissions	Averaging Time	Option 5a Dry Storage	Option 5b Wet Storage	Option 5c Processing	Option 5d Ship Out
Criteria Pollutants					
NOx		Ann4 (4%)	4 (4%)	15.1 (15%)	4 (4%)
SOx		Ann10 (12%) 24-185.0 (50%) 3-h634.5 (49%)	10 (12%) 185.0 (50%) 634.5 (49%)	10 (12%) 185.5 (52%) 637.5 (49%)	10 (12%) 185.0 (50% 634 (49%)
PM10		Ann3 (6%) 24-56.0 (37%)	3 (6%) 56.0 (37%)	3 (6%) 56.4 (38%)	3 (6%) 56.0 (37%)
TSP		Ann11 (17%)	11 (17%)	11 (17%)	11 (17%)
Ozone (as VOC)		1-hN/Ad	N/Ad	N/Ad	N/Ad
Gaseous fluoride (as HF)		1-m0.03 (4%) 1-w0.15 (9%) 24-0.31 (11%) 12-0.62 (17%)	0.03 (4%) 0.15 (9%) 0.31 (11%) 0.62 (17%)	0.05 (6%) 0.25 (16%) 0.41 (14%) 1.02 (28%)	0.03 (4%) 0.15 (9%) 0.31 (11%) 0.62 (17%)
Lead		Ann<0.01 (<1%)	<0.01 (<1%)	<0.01 (<1%)	<0.01 (<1%
CO		8-h24 (0.2%) 1-h187 (0.5%)	24 (0.2%) 187 (0.5%)	28.1 (0.3%) 217 (0.5%)	23.1 (0.2% 181 (0.4%)
Toxic Pollutants					
Nitric acid		24-6.7 (5%)	6.7 (5%)	7.7 (6%)	6.7 (5%)
1,1,1-Trichloroethane		24-22 (0.2%)	22 (0.02%)	22 (0.2%)	22 (0.2%)
Benzene		24-31 (21%)	31 (21%)	31 (21%)	31 (21%)
Ethanolamine		24-<0.01 (<0.1%)	<0.01 (<0.1%)	<0.01 (<0.1%)	<0.01 (<0.1%)
Ethylbenzene		24-0.12s (<0.1%)	0.12 (<0.1%)	0.12 (<0.1%)	0.12 (<0.1%)
Ethylene glycol		24-0.08s (<0.1%)	0.08 (<0.1%)	0.08 (<0.1%)	0.08 (<0.1%)
Formaldehyde		24-<0.01 (<0.1%)	<0.01 (<0.1%)	<0.01 (<0.1%)	<0.01 (<0.1%)
Glycol ethers		24-<0.01 (N/A)	<0.01 (N/A)	<0.01 (N/A)	<0.01 (N/A
Hexachloronaphthalene		24-<0.01 (<1%)	<0.01 (<1%)	<0.01 (<1%)	<0.01 (<1%

Table 5-31. (continued).

Alternative 5 - Centralization

Emissions	Averaging Time	Option 5a Dry Storage	Option 5b Wet Storage	Option 5c Processing	Option 5d Ship Out
Hexane		24-0.07s (<0.1%)	0.07 (<0.1%)	0.11 (<0.1%)	0.07 (<0.1%)

Manganese	24-0.10 (0.4%)	0.10 (0.4%)	0.10 (0.4%)	0.10 (0.4%
Methanol	24-0.51s (<0.1%)	0.51 (<0.1%)	0.51 (<0.1%)	0.51 (<0.1%)
Methyl ethyl ketone	24-0.99s (<0.1%)	0.99 (<0.1%)	0.99 (<0.1%)	0.99 (<0.1%)
Methyl isobutyl ketone	24-0.51s (<0.1%)	0.51 (<0.1%)	0.51 (<0.1%)	0.51 (<0.1%)
Methylene chloride	24-1.8 (0.3%)	1.8 (0.3%)	1.82 (0.4%)	1.8 (0.3%)
Napthalene	24-0.01s (<0.1%)	0.01 (<0.1%)	0.01 (<0.1%)	0.01 (<0.1%)
Phenol	24-0.03s (<0.1%)	0.03 (<0.1%)	0.03 (<0.1%)	0.03 (<0.1%)
Phosphorus	24-<0.001 (<0.2%)	<0.001 (<0.2%)	<0.001 (0.2%)	<0.001 (<0.2%)
Sodium hydroxide	24-0.01s (<0.1%)	0.01 (<0.1%)	0.01 (<0.1%)	0.01 (<0.1%)
Toluene	24-1.6 (8%)	1.6 (8%)	2.0 (10%)	1.6 (8%)
Trichloroethene	24-1.0 (0.3%)	1.0 (0.3%)	1.0 (0.3%)	1.0 (0.3%)
Vinyl acetate	24-0.02s (<0.1%)	0.02 (<0.1%)	0.02 (<0.1%)	0.02 (<0.1%)
Xylene	24-3.81s (<0.1%)	3.81 (<0.1%)	3.85 (<0.1%)	3.81 (<0.1%)

a. Source: WSRC (1994a).
b. Numbers in parentheses indicate the percentage of the regulatory standard that each concentration represents.
c. No standard for this chemical.
d. Measurement data currently unavailable.

The data demonstrate that, even with the emissions from the spent nuclear fuel management activities, releases of toxic air pollutants from the SRS would be only a small fraction of the regulatory standards. Therefore, DOE anticipates no cumulative impact.

The releases of some criteria air pollutants by SRS operations would approach regulatory standards. Site sulfur dioxide emissions would reach about 50 percent of both the 24-hour and 3-hour limits under all alternatives. In addition, the emissions of particulates less than 10 microns (PM10) would approach a concentration equal to about 38 percent of the standard. However, the contribution to both these pollutants concentrations made by spent nuclear fuel-related activities would be small, as explained in Section 5.7.

The SRS evaluated the cumulative impact of airborne radioactive releases in terms of cumulative dose to a maximally exposed individual at the Site boundary. Table 5-32 lists the results of this

Table 5-32. Annual cumulative health effects to workers and offsite population due to SRS radioactive releases during incident-free operations.

	Worker				Offsite Population		
	Average Individual		Total Collective		Maximally Exposed Individual		Total Collect
	Dosea	Fatal Cancerb	Dosec	Fatal Cancer sd	Dosea	Fatal Cancerb	Dosec
Alternative 1 - No Action							
Option 1 Wet Storage	3.2x10-1	1.3x10-4	9.4x101	3.7x10-2	9.0x10-5	4.5x10-8	8.9x100
Alternative 2 - Decentralization							
Option 2a Dry Storage	3.0x10-1	1.2x10-4	9.4x101	3.7x10-2	9.0x10-5	4.5x10-8	8.9x100
Option 2b Wet Storage	3.2x10-1	1.3x10-4	9.4x101	3.7x10-2	9.0x10-5	4.5x10-8	8.9x100
Option 2c	3.6x10-	1.5x10-	1.6x10	6.5x10-	4.4x10-	2.2x10-7	2.6x101

Processing	1	4	2	2	4		
Alternative 3 - 1992/1993 Planning Basis							
Option 3a Dry Storage	3.0x10-1	1.2x10-4	9.4x101	3.7x10-2	9.0x10-5	4.5x10-8	8.9x100
Option 3b Wet Storage	3.2x10-1	1.3x10-4	9.4x101	3.7x10-2	9.0x10-5	4.5x10-8	8.9x100
Option 3c Processing	3.7x10-1	1.5x10-4	1.6x102	6.6x10-2	4.5x10-4	2.2x10-7	2.6x101
Alternative 4 - Regionalization							
Option 4a Dry Storage	3.0x10-1	1.2x10-4	9.4x101	3.7x10-2	9.0x10-5	4.5x10-8	8.9x100
Option 4b Wet Storage	3.2x10-1	1.3x10-4	9.4x101	3.7x10-2	9.0x10-5	4.5x10-8	8.9x100
Option 4c Processing	3.7x10-1	1.5x10-4	1.7x102	6.8x10-2	4.7x10-4	2.3x10-7	2.7x101
Option 4d Dry Storage	3.2x10-1	1.3x10-4	9.4x101	3.7x10-2	9.0x10-5	4.5x10-8	8.9x100
Option 4e Wet Storage	3.5x10-1	1.4x10-4	9.4x101	3.7x10-2	9.0x10-5	4.5x10-8	8.9x100
Option 4f Processing	4.0x10-1	1.6x10-4	1.7x102	6.8x10-2	4.7x10-4	2.3x10-7	2.6x101
Option 4g Ship Out	<3.2x10-1	<1.3x10-4	<9.4x101	<3.7x10-2	<9.0x10-5	<4.5x10-8	<8.9x100

Table 5-32. (continued).

	Worker				Offsite Population		
	Average Individual		Total Collective		Maximally Exposed Individual		Total Collect
	Dosea	Fatal Cancers b	Dosec	Fatal Cancer sd	Dosea	Fatal Cancers b	Dosec
Alternative 5 - Centralization							
Option 5a Dry Storage	1.3	5.3x10-4	9.6x101	3.8x10-2	9.0x10-5	4.5x10-8	8.9x100
Option 5b Wet Storage	1.6	6.4x10-4	9.6x101	3.8x10-2	9.0x10-5	4.5x10-8	8.9x100
Option 5c Processing	1.6	6.6x10-4	1.7x102	6.9x10-2	4.7x10-4	2.3x10-7	2.7x101
Option 5d Ship Out	<3.2x10-1	<1.3x10-4	<9.4x101	<3.7x10-2	<9.0x10-5	<4.5x10-8	<8.9x100

a. Dose in rem.
b. Probability of fatal cancer.
c. Dose in person-rem.
d. Incidence of excess fatal cancers.

analysis. The highest dose would be 4.7x10-1 millirem, which would occur under the processing options of Alternatives 4 and 5. This dose is below the regulatory standard (CFR 1994) of 10 millirem.

Airborne emissions from the two-unit Vogtle Electric Generating Plant (approximately 10 miles southwest of the center of the SRS near Waynesboro, Georgia) were reported to have delivered an MEI total body dose of 1.14 x 10-3 millirem during 1992 (Georgia Power Company 1993). Since the SRS and Plant Vogtle are essentially proximal to the same 80 kilometer population, the ratio of SRS population and MEI doses was used as an estimator of the population dose due to Plant Vogtle emissions. Using this approach, the population dose attributable to Vogtle was estimated to have been about 8.3 x 10-2 person-rem

in 1992. Adding (1) the population dose from Plant Vogtle, (2) the total collective offsite population dose from all SRS activities in 1992 (both air and water source terms), and (3) the highest projected collective dose from spent nuclear fuel management activities (Options 4c and 5c) yields a total cumulative dose of 27.083 person-rem from all SRS sources and Plant Vogtle, which is only 0.3 percent higher than the dose from SRS alone. Note that the doses in Table 5-32 ("Total Collective Dose, Offsite Population") represent the sum of (2) and (3) above.

5.16.4 Water Resources

Approximately 82.1 million gallons per year of Savannah River water would be required for the two most water-intensive options, Option 4f (Regionalization at SRS - Processing) and Option 5c (Centralization - Processing). Because either of these options would probably require construction of an Expended Core Facility, this facility's projected surface water usage of 2.5 million gallons per year was factored into the cumulative impacts analysis. Thus, the two options with the highest surface water usage, both of which would require as much as 84.6 million gallons, represent approximately 0.4 percent of the current (baseline) SRS surface water usage of 20 billion gallons per year (see Table 5-8).

Operational impacts to surface water quality under any of the spent nuclear fuel management options examined would be minimal. Existing SRS treatment facilities could accommodate all new spent nuclear fuel-related domestic and process wastewater streams. Expected wastewater flows would be well within the design capacities of existing (or planned upgrades of) Site treatment systems. Sanitary wastewater from new spent nuclear fuel facilities would be routed to the new Centralized Sanitary Wastewater Treatment Facility. Liquid radioactive wastes would presumably be sent to the F-/H-Area Effluent Treatment Facility. Treated nonradioactive liquid releases from the new spent nuclear fuel facilities would likely be discharged to Upper Three Runs Creek or Fourmile Branch.

Water quality in the Savannah River downstream of the SRS is adequate to good, with most parameters analyzed showing values below state and Federal Maximum Contaminant Levels or DOE Derived Concentration Guides. Iron, present in soils in the region, is the only constituent of surface waters that routinely exceeds MCLs. Spent nuclear fuel management activities are not expected to result in higher concentrations of iron downstream of the SRS. As noted earlier, in Section 5.16, construction on the new Centralized Sanitary Wastewater Treatment Facility is scheduled to begin in 1994 and should be completed in 1995. The new Centralized Sanitary Wastewater Treatment Facility will replace 14 aging sanitary wastewater facilities with a single state-of-the-art facility which will treat sanitary wastes by an extended aeration-activated sludge process. Chlorine will not be used to treat sanitary wastes in the new facility. Use of non-chemical ultraviolet light disinfection systems will eliminate the use and handling of 32,000 gallons of sodium hypochlorite and 59,000 gallons of sodium sulfite per year. Eliminating these chemicals will essentially eliminate the potential for toxic chemical releases from the wastewater treatment process.

Operation of the new Centralized Sanitary Wastewater Treatment Facility and closure of the old A-, B-, S-Area, and Naval Fuel sanitary wastewater facilities would also eliminate wastewater discharges to Upper Three Runs Creek, the stream on the SRS least degraded by past operations. Treated effluent from the new Centralized Sanitary Wastewater Treatment Facility will discharge to Fourmile Branch. Overall stream quality in Fourmile Branch is expected to improve because the effluent from the new facility will be cleaner than the effluent from the old package plants in C-, F-, and H-Areas that presently discharge to Fourmile Branch. As a result, the cumulative effect of the new spent nuclear fuel management facilities (any alternative considered) and new Centralized Sanitary Wastewater Treatment Facility will probably be a net improvement in water quality in two SRS streams, Upper Three Runs Creek and Fourmile Branch, and may result in better water quality downstream in the Savannah River as well.

Sanitary wastewater from the new Consolidated Incineration Facility will be routed to the new Centralized Sanitary Wastewater Treatment Facility; there will be no direct process wastewater drains to the environment. Liquid wastes will be collected in storage tanks and periodically trucked to a permitted hazardous/mixed waste treatment and disposal facility. Sanitary wastes from the new Savannah River Ecology Laboratory Conference Center will be piped to a septic tank-drain field system and would not impact surface water in the area.

Sanitary wastes produced during construction of the Expended Core Facility would be treated through the use of portable chemical toilets or through an existing wastewater treatment facility. Depending on the location chosen by DOE and the Navy for the new Expended Core Facility, sanitary wastes from operation of the ECF would either be treated in an existing wastewater treatment facility (most likely the new Centralized Sanitary Wastewater Facility) or a new treatment facility designed to handle the facility's wastewater capacity. No process wastes from operation of the Expended Core Facility will be discharged to the environment.

5.16.5 Occupational and Public Health and Safety

Table 5-32 summarizes the cumulative health effects of incident-free SRS operations, including those projected for the spent nuclear fuel alternatives. The table lists potential cancer fatalities for workers and the public due to radiological exposures to airborne and waterborne releases from the Site. In addition, the table provides the (airborne) dose to the hypothetical maximally exposed individual in the offsite population. The evaluation used 1992 as the baseline year for normal operations, because it is the last year for which the SRS has complete information. DOE believes that this year gives a realistic depiction of current operational releases of radionuclides. The assessment added the estimated releases from each spent fuel alternative to this baseline to determine the cumulative impacts listed in Table 5-32.

5.16.6 Waste Management

The analysis of cumulative impacts of SRS waste management activities takes as its starting point the assumption that waste generation under the No Action Alternative represents the baseline condition for the entire Savannah River Site. Waste generation levels associated with the other proposed spent nuclear fuel management alternatives (see Table 5-19) thus represent positive and negative deviations from this baseline. Cumulative effects of the proposed spent nuclear fuel alternatives on the volume of low-level waste, transuranic waste, and high-level waste produced under each of the proposed alternatives are presented in Table 5-30.

In addition to baseline waste generation and wastes generated by spent nuclear fuel management activities, environmental restoration and cleanup activities are expected to become an increasingly important part of the DOE mission at the SRS in the future. These remediation activities are expected to produce large quantities of radioactive, hazardous, and mixed wastes. It is estimated that approximately 22,000 cubic meters (28,754 cubic yards) of low-level waste, 366,000 cubic meters (478,362 cubic yards) of hazardous waste, 82,000 cubic meters (107,174 cubic yards) of mixed wastes, and 900 cubic meters (1,176 cubic yards) of transuranic wastes would be produced by environmental restoration activities at the SRS over the 1995-2024 period (DOE 1995). Decontamination and decommissioning activities are expected to generate approximately 109,000 cubic meters (142,463 cubic yards) of low-level waste, 32,000 cubic meters (41,824 cubic yards) of hazardous waste, 95,000 cubic meters (124,165 cubic yards) of mixed wastes, and 4,000 cubic meters (5,228 cubic yards) of transuranic wastes over the same 30-year period (DOE 1995). High-level radioactive waste would not be generated by environmental restoration or decontamination and decommissioning activities.

5.17 Unavoidable Adverse Environmental Impacts

The construction and operation of facilities related to any of the five alternatives at the Savannah River Site (SRS) would result in some adverse impacts to the environment. Changes in project design and other measures could eliminate, avoid, or reduce most of these to minimal levels. The following paragraphs identify adverse impacts that mitigation could not reduce to minimal levels or avoid altogether.

The generation of some fugitive dust during construction would be unavoidable, but would be controlled by water and dust suppressants. This would occur under Alternatives 2 to 5, but greatest generation of dust would occur under Alternative 5 (excluding the offsite shipping option). Similarly, construction activities would result in some minor, yet unavoidable, noise impacts from heavy equipment, generators, and vehicles.

The maximum loss of habitat would involve the conversion of 70 to 100 acres (0.28 to 0.4 square kilometer) of managed pine forest to industrial land use; this would occur under Alternative 5 if DOE moved all spent nuclear fuel to the SRS.

The amount of radioactivity that normal operation of the spent nuclear fuel facilities would release under four of the five alternatives (Alternatives 1 to 4) would be a small fraction of the 1992 operational releases at the SRS and would be well below applicable regulatory standards.

For the alternative having the most impact (Alternative 5 - Centralization), DOE has calculated that the maximum probability for latent fatal cancer for the maximally exposed member of the public would be about 3 times higher than that calculated for 1992 at the SRS. For latent fatal cancer incidence in the offsite population, this comparison indicates an increase of about 2 times, but the number of cancers calculated is less than one.

The only socioeconomic impacts of the proposed spent nuclear fuel management facilities would be temporary increases in employment and expenditures in the region of influence during the construction phase. These would be unavoidable beneficial impacts.

5.18 Relationship Between Short-Term Use of the Environment and the

Maintenance and Enhancement of Long-Term Productivity

Implementation of any of the proposed alternatives would result in some short-term resource demands (e.g., fuel, construction materials, and labor) and would, under certain alternatives (notably the Centralization Alternative), reduce the natural productivity of a relatively small tract of land (less than .07 percent of total SRS area) currently committed to timber production. Depending upon the precise location selected for facility development, a small amount of marginal-to-good wildlife habitat (see Sections 4.9 and 5.9) would also be lost when the area is cleared, graded, and committed to facilities and supporting infrastructure. However, these short-term resource losses and land-use restrictions provide a basis for improved productivity and utility over the long term at the SRS because consolidating all spent nuclear fuel at a few onsite locations would free for other uses those locations presently committed to spent fuel management. On a national scale, the interim management plan described in this EIS would have the same impact of making locations throughout the DOE complex available for other long-term uses.

5.19 Irreversible and Irretrievable Commitments of Resources

The irreversible and irretrievable commitment of resources resulting from the construction and operation of facilities related to the spent nuclear fuel alternatives would involve materials that could not be recovered or recycled or that would be consumed or reduced to unrecoverable forms. The construction and operation of spent nuclear fuel facilities at the SRS would consume irretrievable amounts of electrical energy, fuel, concrete, sand, gravel, and miscellaneous chemicals. Other resources used in construction would probably

not be recoverable. These would include finished steel, aluminum, copper, plastics, and lumber. Most of this material would be incorporated in foundations, structures, and machinery. Construction and operation of facilities for spent nuclear fuel management would also require the withdrawal of water from surface- and groundwater sources, but most of this water would return to onsite surface streams or the Savannah River after use and treatment.

The Centralization alternative (Option 5c - Processing) would consume the greatest amount of electricity of any of the alternatives, about 110,400 megawatt-hours. The Processing option (excluding Option 4c, Regionalization by fuel type) would have the highest requirements for coal to produce steam, approximately 2,580 metric tons (2,843 tons) annually. The Centralization alternative (except Option 5d where all spent fuel would be shipped off the site) would involve the greatest irretrievable consumption of other resources, such as construction materials, chemicals, gases, and operating supplies. However, this demand would not constitute a permanent drain on local resources or involve any material that is in short supply in the region.

5.20 Potential Mitigation Measures

This section summarizes measures that DOE could use to avoid or reduce impacts to the environment caused by spent nuclear fuel management activities at the SRS. DOE would determine the extent to which any mitigation would be necessary and the selection of which measures would be implemented during a detailed site-specific NEPA review tiered from this Programmatic EIS. Consequently, the following sections in this chapter address impact avoidance and mitigation in general terms and describe typical measures that the SRS could implement. In addition, the analyses described in this appendix indicate that the environmental consequences of spent fuel management would be minimal in most environmental media.

5.20.1 Pollution Prevention

DOE is committed to comply with Executive Order 12856, "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements"; Executive Order 12780, "Federal Acquisition, Recycling and Waste Prevention"; and applicable DOE Orders and Guidance Documents in planning and implementing pollution prevention at the SRS. The pollution prevention program at the Site was initiated in 1990 as a waste minimization program. Currently, the program consists of four major initiatives: solid waste minimization; source reduction and recycling of wastewater discharges; source reduction of air emissions; and potential procurement of products manufactured from recycled materials. Since 1991, the waste of all types generated at the SRS has decreased, with greatest reductions in hazardous and mixed wastes. These reductions are attributable primarily to material substitutions.

All spent fuel management activities at the SRS would be subject to the Site pollution prevention program. Implementation of the program plan would minimize the amount of waste generated by these activities.

5.20.2 Socioeconomics

Spent nuclear fuel activities would have minimal impact on the socioeconomic environment in the region of influence because most employees would be drawn from the existing site workforce. The minor impacts of in-migrating construction workers could be minimized by DOE possibly informing local communities and county planning agencies as to scheduling of construction activities.

5.20.3 Cultural Resources

A Programmatic Memorandum of Agreement (SRARP 1989) between the DOE Savannah River Operations Office, the South Carolina State Historic Preservation Office, and the Advisory Council on Historic Preservation, ratified on August 24, 1990, is the instrument for the management of cultural resources at the SRS. DOE uses this memorandum to identify cultural resources and develop mitigation plans for affected resources in consultation with the State Historic Preservation Officer. DOE would comply with the terms of the memorandum for all measures needed to support spent nuclear fuel management at the Site. For example, DOE would survey sites prior to disturbance and could reduce impacts to any potentially-significant cultural resources discovered through avoidance or removal. Any artifacts discovered would be protected from further disturbance and the elements until removed.

DOE conducted an investigation of Native American concerns over religious rights in the Central Savannah River Valley in conjunction with studies in 1991 related to a New Production Reactor. During this study, three Native American groups expressed concern over sites and items of religious significance on the SRS (see Section 4.4.2). DOE has included these organizations on its environmental mailing list, solicits their comments on NEPA actions of the Site, and sends them documents about SRS environmental activities, including those related to these SNF management considerations. These Native American groups would be consulted on any actions that may follow subsequent site-specific environmental reviews.

5.20.4 Geology

DOE expects that there would be no impacts to geologic resources at the SRS under any alternative evaluated in this EIS. Potential soil erosion in areas of ground disturbance would be minimized through sound engineering practices such as implementing controls for stormwater runoff (e.g., sediment barriers), slope stability (e.g., rip-rap placement), and wind erosion (e.g., covering soil stockpiles). Re-landscaping would minimize soil loss after construction was completed. These measures would be included in a site-specific Storm Water Pollution Prevention Plan that the SRS would prepare prior to initiating any construction.

5.20.5 Air Resources

DOE would meet applicable standards and permit limits for all radiological and non-radiological releases to the atmosphere. In addition, the SRS would follow the DOE policy of maintaining radiological emissions to levels "as low as reasonably achievable" (ALARA). ALARA is an approach to radiation protection to control or manage exposures (both individual and collective) and releases of radioactive material to the environment as low as social, technical, economic, practical, and public policy considerations permit. ALARA is not a dose limit, but rather a process that has as its objectives the attainment of dose levels as far below the applicable limits as practicable.

5.20.6 Water Resources

DOE would minimize the potential for adverse impacts on surface water during construction through the implementation of a stormwater pollution prevention plan that details controls for erosion and sedimentation. The plan would also establish measures for prevention of spills of fuel and chemicals and for rapid containment and cleanup.

DOE could minimize water usage during both construction and operation of facilities by instituting water conservation measures such as instructing workers in water conservation (e.g., turn off hoses when not in use), installing flow restrictors, and using self-closing hose nozzles.

5.20.7 Ecological Resources

DOE does not anticipate that any of the spent fuel alternatives would impact any wetlands on the Site. In any case, DOE and SRS policy is to achieve "no net loss" of wetlands. Pursuant to this goal, DOE has issued a guidance document, Information for Mitigation of Wetlands Impacts at the Savannah River Site (DOE 1992), for project planners that puts forth a practical approach to wetlands protection that begins with avoidance of impacts (if possible), moves to minimization of impacts (if avoidance is impossible), and requires compensatory measures (wetlands restoration, creation, or acquisition) in the event that impacts cannot be avoided.

The analysis in this EIS indicates that there are no threatened and endangered species or sensitive habitats in the areas considered as representative of potential sites for spent nuclear fuel activities at the SRS. However, DOE would perform site-specific predevelopment surveys to ensure that development of new facilities would not impact any of these biological resources.

5.20.8 Noise

DOE anticipates that noise impacts both on and off the Site would be minimal. DOE does not foresee noise impacts from spent nuclear fuel management that would warrant mitigation measures beyond those consistent with good construction, engineering, operations, and management practices.

5.20.9 Traffic and Transportation

DOE has a system of onsite buses operating at the SRS. The Site would evaluate the need for upgrades or changes in service that might be required for the spent nuclear fuel management activities and would make changes, as necessary.

DOE would manage changes in traffic volume or patterns during construction through such measures as designating routes for construction vehicles, providing workers with safety reminders, and upgrading onsite police traffic patrols, if necessary.

5.20.10 Occupational and Public Health and Safety

The DOE program for maintaining radiological emissions to levels "as low as reasonably achievable" (ALARA) described in Section 5.20.5 above will minimize any impacts to workers and the public due to atmospheric releases. Likewise, the Site Pollution Prevention Plan and emergency preparedness measures will enhance safety both on and off the Site.

5.20.11 Utilities and Support Services

The utilities and support services at the SRS are sufficient to meet the requirements of any of the alternatives for the spent fuel management at the Site. Impacts on these services would be minimal. No mitigation measures would be required.

5.20.12 Accidents

The SRS has in place emergency action plans that would be activated in the case of an accident. These plans contain both onsite provisions (e.g., evacuation plans, response teams, medical and fire response, training and drills, communications equipment) and offsite arrangements (e.g., response

plans for medical and fire agencies, coordination with local and state agencies, communication plans). The SRS plans would be updated to include any new facilities or activities related to spent nuclear fuel management that would involve the Site. The execution of the plans in response to an accident would mitigate adverse effects both on the Site and in the surrounding areas.

ATTACHMENT A: ACCIDENT ANALYSIS

ATTACHMENT A: ACCIDENT ANALYSIS

A.1 Accident Evaluation Methodologies and Assumptions

The potential for facility accidents and the magnitude of their consequences is factor in the evaluation of the spent nuclear fuel alternatives addressed in this E health risk issues:

- Would accidents at any of the Savannah River Site (SRS) facilities that the of Energy (DOE) could build for spent nuclear fuel management activities po health risks to workers or the general public?
- Could alternative locations or facilities for the spent nuclear fuel altern public or worker health risks? Smaller risks could arise from such factors isolation of the facility from the public, a reduced frequency of such exte initiators as seismic events or aircraft crashes, reduced inventory, and pr

Guidance for the implementation of Council on Environmental Quality (CEQ) regul (CFR 1986), as amended (51 FR 15625), requires the evaluation of impacts that would probability of occurrence but high consequences if they did occur; this EIS, theref facility accidents to the extent feasible.

A.1.1 Radiological Accident Evaluation Methodology

The alternatives considered in this EIS provide an opportunity to incorporate n technology in new facilities, processes, and operations that would minimize the pos risk to the health and safety of plant workers and the public. Modifications and u mitigate accident consequences from existing facilities or reduce the likelihood of

Under normal circumstances, DOE would develop accident scenarios and calculate consequences using safety analyses, mitigation features, and design details on prop designs. However, the preliminary design information for the proposed facilities t during the preparation of this EIS does not contain sufficient detail to permit qua analyses. Therefore, for each spent nuclear fuel alternative, DOE has evaluated th proposed facilities for the type of radiological accidents it has determined to be

The radiological accident types fell into four categories: (1) fuel damage, (2 (3) nuclear criticalities, and (4) liquid spills or discharges. For each accident reference accidents by examining DOE-approved safety analysis reports (SARs) and ot documentation (e.g., previous EISs). In addition, DOE considered accidents from ad for their possible impacts related to spent nuclear fuel. DOE extracted the overal reference accident from the appropriate source, rather than attempting to calculate frequencies for all possible initiators; that is, DOE did not use the specific prob magnitude earthquake to determine the frequency of a criticality or spill, given th earthquake. If multiple initiators could lead to one of the reference accidents, o frequency of the initiators could lead to one of the reference accidents, DOE used frequency of the initiators, generally providing conservative results. For example for Offsite Fuel has a number of potential release initiators that could result in criticality, as listed in Table A-1. As listed, a number of incidents, all of whic assigned frequencies, can contribute to the initiation of an uncontrolled criticali

Table A-1. Potential release initiators at the Receiving Basin for Offsite Fuel.

Natural Phenomena	External Events	Operations Induced Events	Criticality

Temperature Extreme	Aircraft Crash	Fuel Cutting	Fuel Bundli
Snow	Helicopter Crash	Spill at Hose Rack	Cask Loadin
Rain	Surface Vehicle Crash	Fuel Rupture in Storage	Fuel Identi Problem
Lightning		Fire and Explosion	Fuel Moveme
Tornado		Fuel Near Basin Surface	Dropped Fue
Earthquake		Spills and Leaks	Crane or Ho
Meteorite Impact		Resin Regeneration	Cask Immers
		Facility Waste to Cell	

This evaluation results in qualitative comparisons for proposed facilities base that the facility function is similar to one already analyzed. In addition, an ide not considered in each safety analysis report for existing SRS facilities because t prepared over several years in accordance with requirements in effect at the time. includes a comparison of the similarities of possible facilities to an existing fac selection of reference accidents, and several tables containing data to support a c estimates of risk.

The qualitative comparison supports the National Environmental Policy Act (NEPA that the decisionmaker can assess the relative risk from each alternative at SRS an

A.1.1.1 Notable Accident Initiators. While there are many different types of accident

initiators of various frequencies that could lead to an accident, three notable ini earthquakes, and aircraft crashes - require additional discussion due to the public importance of these initiators and the public's familiarity with these types of ini

Because there has never been an uncontrolled criticality accident at the SRS, D historic experience related to the initiators to estimate the frequency for a criti Receiving Basin for Offsite Fuel. Storage basins for spent nuclear fuel have excel From 1945 through 1980, there were 40 known criticality accidents worldwide, none o occurred in a fuel storage facility. From 1975 to 1980, there were, conservatively storage basins in operation around the world, and no criticality incidents occurred assumes that the upper frequency limit for a criticality event is 3.1 x 10-3 per ye This figure is applicable to the extent that the storage basins and the operations similar to those of the Receiving Basin for Offsite Fuel. However, the frequency f criticality event was determined through a detailed fault tree analysis, as referen analysis report, to be an overall calculated limit of 1.4 x 10-4 per year. This va implementation of new administrative controls or equipment.

The SRS is in an area that has a relatively low seismic frequency. Based on th recorded seismic activity, an earthquake with a Richter magnitude greater than 6.0, to a Modified Mercalli Intensity Scale (MMI) of VII, would not be likely at the SRS basis earthquake for the SRS is a MMI VIII event with a corresponding horizontal pe acceleration of 0.2g. Based on current technology, as applied in various probabili the seismic hazard in the SRS region, the 0.2g peak ground acceleration can be asso 2 x 10-4 annual probability of exceedance (5,000-year return period). There are fo Receiving Basin for Offsite Fuel to which an earthquake of intensity MMI VIII or gr contribute:

- Deformation of the storage racks leading to a criticality incident.
- Derailment of the 100-ton (91-metric-ton) crane into the storage basin with of the storage rack leading to criticality.
- Damage to the basin walls leading to the release of contaminated basin wate
- Rupture of a waste tank or pipe in the Resin Regeneration Facility leading contaminated liquids.

An aircraft crash into a spent nuclear fuel facility is of concern because it c radioactive release of materials from the stored spent nuclear fuel. Appendix D co crash probability analysis based on the examination of large civilian and military airspace within a 10-mile (16-kilometer) radius of the SRS. It does not include th of general aviation aircraft because aircraft of this type generally do not possess attain sufficiently high velocities to produce a serious radiological threat in the into an area containing spent nuclear fuel. The analysis did not evaluate crash pr likelihood of occurrence of less than 10-7 per year because they would not signific the risk. This was the case for spent nuclear fuel facilities located at the SRS.

A.1.1.2 Use of DOE-Approved Safety Documents. The NEPA guidance issued by the

DOE Office of NEPA Oversight, dated May 1993, recommends that accident impact analy "reference Safety Assessments and Safety Analysis Reports, if available." This gu primary basis used to develop the approach used in the accident analysis section of Appendix uses several relevant safety analysis reports as well as a previously publ analysis reports are the primary source of information on reasonably foreseeable ac potential to cause a release of hazardous materials. These reports are required fo nuclear materials facilities with operations that potentially pose a significant ha personnel, offsite populations, or the environment. The referenced safety analysis approval/draft submittal dates encompass a range from 1983 to 1993. The 1983 safet was supplemented by a 1993 addendum; the next oldest safety analysis report was app

A.1.2 Chemical Hazard Evaluation Methodology

This analysis reviewed the appropriate safety analyses to assess the degree to addressed chemical accidents. It found that each of the safety analyses addressed a qualitative manner. To provide a quantitative discussion of chemical hazards, th a separate risk assessment (WSRC 1993c) for the storage risk of offsite research re Receiving Basin for Offsite Fuel to determine a bounding chemical accident. The an chemical inventories (see Section A.3) for the existing spent nuclear fuel faciliti "Savannah River Site Tier Two Emergency and Hazardous Chemical Inventory Report" (W 1994a) to determine the facilities total chemical inventory. This chemical invento screened using the EPA's "List of Lists" (EPA 1990).

A.1.3 SRS Emergency Plan

The SRS emergency plan (WSRC 1993b) defines appropriate response measures for t management of emergencies (e.g., accidents) involving the Site. It incorporates in description of the entire process designed to respond to and mitigate the consequen Emergencies that could cause activation of all or portions of this plan include:

- Events (operational, transportation, etc.) with the potential to cause rele limits of hazardous materials.
- Events such as fires, explosions, tornadoes, hurricanes, earthquakes, dam f affect or could affect safety systems designed to protect site and offsite environment.
- Events such as bomb threats, hostage situations, etc., that reduce the secu Site.
- Events created by proximity to other facilities, such as the Vogtle Electri a commercial nuclear powerplant located across the Savannah River from the

For radiological emergencies, protective actions in this plan are designed to k offsite exposures As Low As Reasonably Achievable (ALARA). This is accomplished by time spent in the vicinity of the hazard, keeping as far from the hazard as possibl advantage of available shielding. Protective actions that could be used on the Sit emergency include remaining indoors, sheltering, evacuation, and relocation. For e actual or projected radiological release, appropriate protective actions for on- an have been determined based on trigger points called Protective Action Guides (PAGs)

A.1.4 General Assumptions

This assessment applied the following key assumptions to examine existing accid to relate these analyses to the spent nuclear fuel alternatives.

- When a referenced accident scenario is used for a possible new facility, DO the new facility close to an existing referenced facility performing a simi resulting in consequences and health effects similar to the existing facili exception could be the proposed Expended Core Facility which Appendix D ana separately.
- For existing facilities to be modified, portions of the facility to be deco facilities to be added, potential accident initiators resulting from constr activities would be bounded by the referenced accident scenarios.
- Type 2 High Enriched Uranium fuel, the dominant type currently in storage o SRS, would provide a reference source term for other fuel types (i.e., Mark

- Spent nuclear fuel acceptance criteria would specify that all fuel must be indefinite suspension in air with no melting.
- The total frequency of an event (e.g., criticality) could be used to determ of risk, regardless of the type or specific frequencies of the individual c
- Adjustment (scaling) factors could be applied to reflect a best engineering of relative risk between the various alternatives.
- The point estimate of risk for a given accident scenario would be represent could, for the purposes of this programmatic EIS, represent a similar accid new facilities that perform similar functions.
- Reference accidents would be attributed to a facility based on its function or dry material storage) regardless of whether the facility currently exist design, or is in the conceptual design phase.
- Possible new facilities would be designed to pose no greater risk to the wo than existing facilities with similar functions.

This evaluation takes no credit for the upgraded design requirements for the pr Such facilities should have improved reliability or mitigative features and, theref aggregate frequency of accidents. Therefore, the application of values from existi reports would provide conservative results. In addition, the evaluation makes no a discriminate among similar existing facilities that might have slightly different f occurrence or source terms (i.e., an FB-Line event frequency was applied to HB-Line processing facilities).

For most accidents, the evaluation did not quantify consequences for workers. analysis reports from which information was extracted for the reference accidents w the issuance of DOE Order 5480.23 (DOE 1992); previous applicable Orders did not re inclusion of worker doses. The historic record indicates that DOE facilities have record. Figure A-1 compares the rate of worker fatalities in the DOE complex (DOE average rates compiled by the National Safety Council for various industry groups (Because the DOE worker accident fatality rate compares favorably to rates from such as agriculture and construction and is slightly less than trade and services group quantitative data regarding accident impacts to radiological workers should not imp decisionmaking process. The discussion presented in Volume 1 adequately addresses close-in workers (i.e., those directly involved in the activity or near the acciden

A.1.4.1 Receptor Group Assumptions. To ensure comparative results, the evaluation

assessed the measures of impacts among four receptor groups:

- Worker. An individual located 100 meters (328 feet) in the worst sector of location where the release occurs.
- Colocated Worker. An individual located 640 meters (2,100 feet) in the wor facility location where the release occurs.

Figure A-1. Comparison of fatality rates among workers in various industry group

Site boundary from the facility location where the release occurs.

- Offsite Population to 80 Kilometers. The collective sum of individuals loc 80-kilometer (50-mile) radius of the SRS.

As noted above, the worker is 100 meters (328 feet) from the facility where the This is because information quantifying accident impacts (i.e., dose and health eff less than 100 meters from an accidental release of radionuclides is unavailable. F accident scenarios considered in Appendix C of this EIS, there is some risk of work at distances closer than 100 meters. Furthermore, the safety analyses from which t extracted information for the accident scenarios often did not include any discussi impacts as a result of potential accidents. DOE Orders published before DOE 5480.2 did not require the inclusion of worker doses. However, Section A.2.6.2 includes a discussion regarding accident impacts for the worker at less than 100 meters (328 f radiological accident scenarios.

A.1.4.2 Code Assumptions. DOE's application of the AXAIR and AXAIR89Q (a validated

version) dose estimation models is acceptable for projecting health effects from ac comparing the results to results from other similar codes (RSAC-5 and GENII) used a AXAIR is a Gaussian model based on the methodology outlined in NRC Regulatory Guide (NRC 1983). AXAIR contains a meteorological data file specific to SRS that provide calculated doses for the radiological consequences of atmospheric releases. AXAIR include the following specific functions:

- Performs both environmental transport and radiation dosimetry calculations
- Bases environmental transfer models on NRC Reg Guide 1.145 guidelines
- Includes exposure pathways for inhalation of radionuclides and gamma radiat radioactive plume
- Calculates gamma shine doses using a non-uniform Gaussian model
- Uses worst sector and 99.5-percentile meteorology

Doses calculated with this code should bound the radiological consequences for atmo postulated.

A.1.4.3 Criticality Assumptions. An estimate of the consequences of a criticality incident

requires an estimate of the number of fissions that might occur. While U.S. Nuclea Commission (NRC) Regulatory Guide 3.34 specifies 1 x 1019 fissions as the upper ten experience, the SRS analyses are based on mean values, to the extent possible, for Criticality incidents have produced from 1014 to 4 x 1019 fissions with a mean of 2 incidents involving fissile solutions and a mean of 5 x 1017 fissions for incidents a consequence, two accident scenarios (Table A-2) address criticality - the wet poo and the processing criticality scenario. For the wet pool criticality scenario, th systems (5 x 1017) is assumed to apply to the source term used to determine the acc consequences, while the processing criticality scenario assumes that the mean value (2 x 1018) was applied to the source term to determine accident consequences.

A.2 Radiological Accident Scenarios

A.2.1 Selection of Reference Accidents

To support the examination of both existing and proposed facilities, this evalu spectrum of potential accident types. To develop a meaningful spectrum of potentia evaluation posed the following question:

"What could be done to spent nuclear fuel that would result in a radiological c to the receptor groups?"

In determining the answer to this question, the following four general types of eve (1) fuel damage, (2) material releases, (3) criticalities, and (4) liquid spills or applicable safety analysis reports for the SRS facilities that the spent nuclear fu likely to affect generated more than 20 accidents involving the transport, receipt, storage of spent nuclear fuel. A consolidation and subsequent "binning" of these accident type reflects an appropriate range of case-specific reference accidents.

Table A-2. Reference radiological accidents considered for spent nuclear fuel acti

Name and Reference		Reference for Source Term/Dose	C L
A1.	Fuel Assembly Breach Reference Accident: RBOF fuel cutting	Tables 1-3 DPSTSA-200-10-3, Addendum 1	1
A2.	Material Release (Processing) Reference Accident: F-Canyon Uncontrolled Reaction	Meehan 1995	2
A3.	Material Release (Dry Vault) Reference Accident: PSF release	Table 5-9 DPSTSA-200-10-19	1
A4.	Material Release (Adjacent Facility) Reference Accident: Release of Waste Tank Activity to Cell	Tables 1-3 DPSTSA-200-10-3, Addendum 1	2
A5.	Criticality in Water Reference Accident: RBOF criticality	Tables 1-3 DPSTSA-200-10-3, Addendum 1	3
A6.	Criticality During Processing Reference Accident: FB-Line	WSRC-RP-93-1102	1
A7.	Spill/Liquid Discharge (External) Reference Accident: Direct discharge of water from K-Reactor disassembly basin	Figure 3 Meehan 1994	2
A8.	Spill/Liquid Discharge (Internal) Reference Accident: RBOF hose rack	Tables 1-3 DPSTSA-200-10-3,	1

spill Addendum 1

The fuel damage event (type 1 accident) considered was physical damage or breac assembly. Three material (type 2 accidents) releases were considered; they represe could occur during processing from medium energetic events, those that could occur storage of special nuclear materials, and those that could occur from an adjacent f (type 3 accidents) can have different dose impacts and can occur with different fre on the physical or chemical characteristics of the material and the surroundings. events - in water and during processing - represent these accident scenarios. The considered a dry criticality accident scenario bounded by the wet pool criticality and bounded by the processing criticality accident in terms of number of fissions a discharges and spills (type 4 accidents) were considered - discharges of pool or ba contain tritium, cesium, and other radioactive constituents from the fuel in the po spills of slightly contaminated liquids inside a facility during fuel handling, spr unloading (internal spill).

These eight typical accidents form the set of accidents for the selection of a Each type has been assigned an alphanumeric designator, which is listed below and u this document:

- Type 1 - Fuel damage
  - A1 - Fuel assembly breach
- Type 2 - Material releases
  - A2 - Processing release
  - A3 - Dry vault release
  - A4 - Adjacent facility release
- Type 3 - Criticalities
  - A5 - Criticality in water
  - A6 - Criticality during processing
- Type 4 - Liquid discharges and spills
  - A7 - External spill/liquid discharge
  - A8 - Internal spill/liquid discharge

A second review of the safety analyses and the original list of accidents confi specific accident considered in DOE-approved safety analyses could be represented o of the eight "generic" accidents (i.e., a fire could result in material release or result in criticality or liquid release). The use of this approach with documented avoids the need for unique identification of all initiating precursor events or the

A.2.1.1 Externally Initiated Accidents. The accident analysis section of this EIS considered

accident scenarios from external events or adjacent facilities and their potential nuclear fuel activities and facilities. Three significant sources of externally in mechanisms were identified as potentially applicable to these facilities and activi adjacent fires, and adjacent explosions. As discussed above, an aircraft crash sce reasonably foreseeable event within the probability scope of this EIS. For the mos explosion in a facility adjacent to the spent nuclear fuel facilities described in have a significant impact on spent nuclear fuel facilities. However, the screening that a fire and explosion in the Resin Regeneration Facility, located immediately a Receiving Basin for Offsite Fuel, could result in the airborne release to the shiel included for completeness.

A.2.1.2 Nearby Industrial or Military Facility Accidents. Within a 40-kilometer

(25-mile) radius of the SRS, there are approximately 120 industrial facilities with employees (DOE 1990). Four of these facilities are within a 16-kilometer (10-mile) Other than those on the SRS, the only major storage facilities within a 40-kilomete facilities at Chem-Nuclear Systems, Inc., Vogtle Electric Generating Station, and a gas storage tanks near Beech Island. The facilities within a 16-kilometer radius o are still at least 10 kilometers (6 miles) from the nearest spent nuclear fuel faci negligible risk to spent nuclear fuel activities.

A.2.1.3 Common Cause Accident. DOE considered accident scenarios based on a common

cause accident during the screening process. A severe seismic event was the only c initiator identified with the potential to simultaneously impact multiple spent nuc

facilities at the SRS. A design basis earthquake, which has an estimated accelerat annual frequency of 2.0 x 10-4 per year (or one occurrence every 5,000 years), coul multiple facilities within a single facility area, resulting in the simultaneous re and/or toxic materials from these facilities to the environment. It is also consid probably less likely, than an earthquake of the same magnitude could damage facilit one facility area (e.g., F- and H-Areas; K-, L-, and P-Reactor Disassembly Basins), simultaneous releases to the environment.

A semi-quantitative evaluation of the cumulative impacts resulting from multiple re area caused by a severe seismic event was performed as part of the accident selecti described in Section A.2.1. A review of the safety analysis reports for the H-Cany Receiving Basin for Offsite Fuels was performed to determine the consequences and r individually by each facility following a design basis earthquake. The risks prese analysis report were then summed to approximate the risk that would be expected if releases occurred simultaneously from a single seismic initiator. The sum of these to the risks of the other accident scenarios presented within the EIS and were foun those accidents. A similar evaluation was performed for the spent nuclear fuel-rel F-Area, and the same conclusion was reached. For the reactor disassembly basins, m from a severe earthquake calculated for the K-Reactor Disassembly basin by three co as the outermost bounding estimate for the three reactor disassembly basins (K-, L- Disassembly Basins). This is considered an unrealistic estimate of the cumulative extremely conservative assumptions that were made in performing the K-Reactor Disas analysis (Meehan 1994). However, even if the risk is increased by a factor of thre considered to be bounded by other accidents already presented within the EIS. Ther with the accident methodology described in Section A.2.1, no further analysis of th was required. The SRS does maintain emergency plans that would provide protective mitigate consequences that could occur during a common cause accident scenario.

A.2.1.4 Accidents Resulting from Terrorism. DOE considered accident scenarios based

on a terrorist attack or an act of sabotage during the screening process and conclu resulting from such initiators would be bounded by or similar to the accident scena considered.

A.2.2 Reference Accident Descriptions

DOE established a reference accident for each of the eight generic or typical a following paragraphs outline the basis for selection of each reference accident by reference accident was included if it is analyzed in an SRS safety analysis report approved by the DOE or submitted to DOE for approval as part of the safety basis au operation of a facility, and if the facility is to be utilized as, or is similar in facilities included in the five alternatives and their subordinate cases. For exam assumed that the Receiving Basin for Offsite Fuel was representative of any spent n storage pool. If an accident could occur in any pool, the analysis selected a refe the Receiving Basin for Offsite Fuel Safety Analysis Report as the reference accide Table A-2. The following paragraphs provide the basis for each selection.

- A1. Fuel Assembly Breach - Physical damage to an assembly could occur from objects falling onto the assembly, or cutting into the fuel part of an asse Receiving Basin for Offsite Fuel Safety Analysis Report (WSRC 1993a) Addend a current analysis of a "fuel cutting accident." The inert, non-uranium-co of some spent nuclear fuel elements are cut off (cropped) in the repackagin the bundling of the elements. The spent nuclear fuel could be inadvertentl release of airborne or high water activity to the work area. Because of th of SRS fuel, only a very small fraction of the gases generated in an assemb released to the basin water in an accident. Consistent with the safety anal cooled for 90 days is used in the source term for this accident. With fore reactor spent nuclear fuel elements, the release of fission product gases w with the Mark-22 fuel assemblies previously considered. The physics of the from research reactor fuel is similar to SRS fuel because the fuel is const manner. Spent nuclear fuels that could release more fission gases than a M assembly would require an Unreviewed Safety Question analysis before the SR accept them in the Receiving Basin for Offsite Fuel. Air monitors in this personnel in the event of an airborne release. The fuel cutting operation fuel element at a time. This is representative for all cutting and droppin

cracking the cladding would release less than cutting into the fuel itself.

- A2. Material Release (Processing) - The primary activities associated with spent nuclear fuel include dissolving the fuel in acid in the F- or H-Area the radioactive and fissile isotopes, and forming those isotopes into a sol metal or powder. Because of the large volumes of liquid radioactive soluti during the dissolution process, uncontrolled reactions in the Canyons are t means of losing control of the material and inadvertently releasing potenti quantities of material to the environment. The most common uncontrolled re those considered in this scenario, include eructations, foaming, boilover, dissolving spent fuel. These types of uncontrolled reactions are typically chemical addition errors, procedural errors, or equipment failure. Althoug reactions can also include deflagrations and explosions (caused by excess h generation due to radiolytic decay and the presence of an ignition source), events are much less common, and because of their lower frequency, typicall lower risk to workers and members of the public. In developing this scenar assumed that the uncontrolled reaction causes a large release of material w building to the Canyon sumps which results in a greater than normal release material through the ventilation system and Canyon exhaust stack. In addit assumed that the uncontrolled reaction occurred in the F-Canyon facility si resulting from an inadvertent release of plutonium isotopes are expected to inadvertent releases of uranium isotopes from uncontrolled reactions in the facility.
- A3. Material Release (Dry Vault) - Accident types A1 and A2 cover material from fuel handling and processing. In addition, DOE considered a reference vault-type storage. The Plutonium Storage Facility (PSF) Safety Analysis R 1989) analyzed three medium energetic events (shipping container failure, c impact-type events) and an earthquake. As discussed above, medium energeti accidents that result in release of material from the primary container and energy to penetrate the secondary confinement barriers for a short period o report contains a total frequency of these four initiating events and provi value. Because the SRS has no long-term spent nuclear fuel dry storage fac evaluation assumes that the Plutonium Storage Facility vault is representat facilities, as are the activities and precursor events. A material release energetic event in the Plutonium Storage Facility was selected as the refer nonprocessing material releases.
- A4. Material Release (Adjacent Facility) - For completeness, DOE considere accident from a facility immediately adjacent to the Receiving Basin for Of (WSRC 1993a). This scenario includes a fire and explosion at the Resin Reg Facility in waste tank EP 38 during which the coolant of a received cask, w to the waste tank, results in a flammable or explosive concentration of vap Rupture of the tank by an explosion could release airborne activity to the accident occurred during one of the projected 150 times per year when regen portable columns takes place. While a fire and explosion have not occurred EP 38, one fire and pressure surge did occur when a shipping cask was being spent nuclear fuel remained intact and radionuclides were not released. Th been attributed to the ignition of a mixture of hydrogen, oxygen, and air e cask and created by reaction of hot aluminum fuel with water left in the ca
- A5. Criticality in Water - This scenario assumes that a wet pool storage f most likely to have a criticality in water. The Receiving Basin for Offsit capability for underwater receipt, handling, and storage of spent nuclear f radiation shielding is provided by the water covering the spent nuclear fue analysis report determined frequency and results from many initiating event to criticality. The following activities could ultimately lead to a critic Bundling, Cask Loading, Fuel Identification and Manifest Problems, Fuel Mov Dropped Fuel, Fuel Near Basin, Cask Immersion, and Cranes and Hoist. These representative for any wet storage pool.
- A6. Criticality During Processing - As noted in the discussion for acciden FB-Line events are representative for SRS processing facilities. The analy total of the frequencies for criticality initiators for all processing stag therefore, be conservative because not all processing stages would necessar a new facility and not all stages would necessarily occur simultaneously.
- A7. Spill/Liquid Discharge (External) - The reference accident selected fo event is the direct discharge of water (i.e., 3.4 million gallons) from the disassembly basin to the Savannah River and the exposure of fuel and target

air. Analyses performed by the DOE while developing the EIS for the Interi of Nuclear Materials at the SRS demonstrate that this scenario could be ini earthquake and would result in bounding airborne exposures (from exposed fu exposures (contaminated drinking water) to the general public. The selecti direct-discharge event is conservative for existing or possible new facilit the F- or H-Areas because no free-flowing surface streams would be near a d The use of the source term from the reactor disassembly basin is considered conservative for the spent nuclear fuel storage pools since its inventory c the fuel types with the largest source terms available for release (i.e., M Although the disassembly basin has water circulating systems to control rad chemistry, clarity, and temperature, these processes are less efficient tha Receiving Basin for Offsite Fuel, resulting in higher concentrations of tri other contaminants available for release.

- A8. Spill/Liquid Discharge (Internal) - DOE considered a second reference contaminated liquids spills or discharges to ensure the appropriate onsite discharge discussed for accident type A7 would be external to the building no measurable worker impact component because the reference accident occurr facility. The Receiving Basin for Offsite Fuel hose rack spill was selecte accident because it is representative of small, unplanned, but relatively f storage facility and could impact the worker. Minor releases of contaminat occur at the hose rack platform during the handling of portable deionizers areas.

A.2.3 Source Term and Frequency Determinations

Table A-2 lists source term references from existing documents approved by DOE by Westinghouse Savannah River Company to DOE for approval for each selected refere The same references nominally prescribed the frequency of accidents or initiating e directly available, the frequency was derived from information already contained in safety analysis report or EIS (e.g., if only a risk estimate and a dose were listed derived by dividing the risk by the dose). These frequencies fall into ranges asso events (more frequent than 1 x 10-3 per year), design-basis accidents (1 x 10-3 per year), or beyond-design-basis accidents (less than 1 x 10-6 per year to 10-7 per ye

This document does not analyze beyond-design-basis accidents or accidents with less than 1.0 x 10-6 explicitly because the accident analysis source material (DOE-analysis reports) considers these accidents to be incredible events. Beyond-design such as an airplane crash-induced criticality, have no different consequences (i.e. than the criticality estimated to occur with a frequency of 3.1 x 10-3 per year. B aggregate frequencies in some cases, the contribution to overall risk from 1.0 x 10 negligible, and the higher frequency initiators dominate the point estimate of risk precursor event frequencies from the safety analysis reports are at 10-7 per year o reports in fact consider events beyond the 10-6 frequencies.

Frequencies for reference accidents were determined as follows:

- A1. Fuel Assembly Breach - The frequency for this reference accident was o DPSTSA-200-10-3, Receiving Basin for Offsite Fuel (RBOF), Addendum 1, Table which lists the frequency as 1.6 x 10-1 per year (WSRC 1993a).
- A2. Material Release (Processing) - The frequency for this reference accid obtained from DPSTSA-200-10-4, Safety Analysis - 200 Area, Savannah River P F-Canyon Operations, Addendum 2, "Accident Analysis," Revision 1, Table A.5 which lists the frequency for an uncontrolled chemical reaction (the boundi accident) as 2.6 x 10-1 per year (Meehan 1995).
- A3. Material Release (Dry Vault) - The frequency for this reference accide from DPSTSA-200-10-19, Final Safety Analysis Report - 200 Area, Savannah Ri Separations Area Operations, Building 221F, B-Line, Plutonium Storage Facil Table 5-9, which lists the frequency as 1.4 x 10-3 per year (Du Pont 1989).
- A4. Material Release (Adjacent Facility) - The frequency for this referenc obtained from DPSTSA-200-10-3, Receiving Basin for Offsite Fuel (RBOF), Add Tables 1-5, which lists the frequency as 2.4 x 10-3 per year (WSRC 1993a).
- A5. Criticality in Water - The frequency for this reference accident was o DPSTSA-200-10-3, Receiving Basin for Offsite Fuel (RBOF), Addendum 1, Table which lists the frequency as 3.1 x 10-3 per year (WSRC 1993a).
- A6. Criticality During Processing - The frequency for this reference accid obtained from WSRC-RP-93-1102, FB-Line Basis for Interim Operation, Novembe

Figure 3, which lists a frequency of 1.4 x 10-4 per year (WSRC 1993d).

- A7. Spill/Liquid Discharge (External) - The frequency for this reference a derived from analyses provided in DOE/EIS-0147, Continued Operation of K-, P-Reactors, December 1990 (DOE 1990), as well as other safety analyses deve additional SRS facilities. The initiating event is a design basis earthqua horizontal ground accelerations equal to 0.2 times the force of gravity (i. occurs with an estimated frequency of 2.0 x 10-4 per year, and results in t basin water (3.4 million gallons) to the Savannah River.
- A8. Spill/Liquid Discharge (Internal) - The frequency for this reference obtained from DPSTSA-200-10-3, Receiving Basin for Offsite Fuel (RBOF), Add Tables 1 - 3, which lists the frequency as 1.1 x 10-1 per year for a repres hose rack (WSRC 1993a).

A.2.4 Applicability of Accidents to Facilities

This evaluation reviewed Section 1 of the reference document Technical Data Sum Supporting the Spent Nuclear Fuel Environmental Impact Statement (WSRC 1994b) to de matrix of the selected radiological accidents to the facilities (modules) being con alternatives and cases. For proposed new facilities, the analysis used best engine extrapolate from appropriate accident scenarios based on the descriptions provided document. Table A-3 lists the connection of facilities to accident scenarios. For Examination and Characterization Facility (module B) identifies a potential acciden defined in Table A-2), that should be considered when this facility is utilized to

Table A-3. Applicable accidents and facilities.

Facility	Modulea
Spent Fuel Receiving, Cask Handling and Fuel Unloading	A
Examination and Characterization	B
Naval Reactor Spent Fuel Examination and Characterization	C
Spent Fuel Repackaging	D
Canister Loading	E
Interim Dry Storage	F
Interim Spent Fuel Storage Pool	G
F-Canyon/F-Area Separations	H, I
H-Canyon/H-Area Separations	J, K, L
Reactor Disassembly Basins	M
Receiving Basin for Offsite Fuels	N

a. As defined in WSRC (1994b).

A.2.5 Facilities and Reference Accidents Associated with each Alternative Case

Table A-4 links alternatives, specific cases, supporting facilities (modules), scenarios. This table identifies the facilities that could be required to support specific case. The combined associated accident scenarios for each facility provid spectrum associated with the specific cases for each alternative.

A.2.6 Impacts from Radioactive Release Accidents

This section provides a quantitative discussion of potential consequences to th identified in Section A.1.4.1. It also provides a qualitative discussion on potent consequences for workers at less than 100 meters (328 feet) for each of the potenti scenarios.

Table A-4. Spent nuclear fuel facilities and accident spectrum by alternatives.

Alternative	Modulesa
1. NO ACTION	
Option 1 - Wet Storage	M, N
2. DECENTRALIZATION	
Option 2a - Dry Storage	B, D, E, F, G, M, N
Option 2b - Wet Storage	B, D, E, G, M, N
Option 2c - Processing	G, H, I, J, K, L, M, N

3. PLANNING BASIS	
Option 3a - Dry Storage	B, D, E, F, G, M, N
Option 3b - Wet Storage	B, D, E, G, M, N
Option 3c - Processing	G, H, I, J, K, L, M, N
4. REGIONALIZATION	
Option 4a - Dry Storage	A, B, D, E, F, G, M, N
Option 4b - Wet Storage	A, B, D, E, G, M, N
Option 4c - Processing	A, G, H, I, J, K, L, M, N
Option 4d - Dry Storage	A, B, C, D, E, F, G, M, N
Option 4e - Wet Storage	A, B, C, D, E, G, M, N
Option 4f - Processing	A, C, G, H, I, J, K, L, M, N
Option 4g - Ship Out	M, N
5. CENTRALIZATION	
Option 5a - Dry Storage	A, B, C, D, E, F, G, H, M, N
Option 5b - Wet Storage	A, B, C, D, E, G, M, N
Option 5c - Processing	A, C, G, H, I, J, K, L, M, N
Option 5d - Ship Out	M, N

a. Source: WSRC (1994b).

A.2.6.1 Radioactive Release Accidents and Consequences for Spent Nuclear Fuel

Alternatives. Table A-5 summarizes the information in Tables A-2 through A-4 and p individual consequences (doses) based on accident type for each case. The table li the four receptor groups as follows: Maximum Offsite Individual Dose, the Populati 80 kilometers (50 miles) Dose, the Worker Dose, and the Colocated Worker Dose.

Table A-5. Radioactive release accidents and consequences for spent nuclear fuel alternatives.

Description	Accident		Accident frequency (per year)
	1.	NO ACTION	
Option 1 Wet Storage	A1	Fuel Assembly Breach	1.6x10-1
	A4	Material Release (adjacent facility)	2.4x10-3
	A5	Criticality in Water	3.1x10-3
	A7	Spill/Liquid Discharge (external)	2.0x10-4
	A8	Spill/Liquid Discharge (internal)	1.1x10-1
	2.	DECENTRALIZATION	
Option 2a Dry Storage	A1	Fuel Assembly Breach	1.6x10-1
	A3	Material Release (dry vault)	1.4x10-3
	A4	Material Release (adjacent facility)	2.4x10-3
	A5	Criticality in Water	3.1x10-3
	A7	Spill/Liquid Discharge (external)	2.0x10-4
	A8	Spill/Liquid	1.1x10-1

		Discharge (internal)	
Option 2b Wet Storage	A1	Fuel Assembly Breach	1.6x10-1
	A4	Material Release (adjacent facility)	2.4x10-3
	A5	Criticality in Water	3.1x10-3
	A7	Spill/Liquid Discharge (external)	2.0x10-4
	A8	Spill/Liquid Discharge (internal)	1.1x10-1
Option 2c Processing	A1	Fuel Assembly Breach	1.6x10-1
	A2	Material Release (processing)	2.6x10-1
	A3	Material Release (dry vault)	1.4x10-3
	A4	Material Release (adjacent facility)	2.4x10-3
	A5	Criticality in Water	3.1x10-3
	A6	Criticality in Processing	1.4x10-4

Table A-5. (continued).

Description	Accident		Accident frequency (per year)
	2.	DECENTRALIZATION	
	A7	Spill/Liquid Discharge (external)	2.0x10-4
	A8	Spill/Liquid Discharge (internal)	1.1x10-1
	3.	PLANNING BASIS	
Option 3a Dry Storage	Same as Option 2a for Decentralization		
Option 3b Wet Storage	Same as Option 2b for Decentralization		
Option 3c Processing	Same as Option 2c for Decentralization		
	4.	REGIONALIZATION	
Option 4a and 4d Dry Storage	Same as Option 2a for Decentralization		
Option 4b and 4e Wet Storage	Same as Option 2b for Decentralization		
Option 4c and 4f Processing	Same as Option 2c for Decentralization		
Option 4g	Same as Alternative 1, No Action		

Ship Out	
	5. CENTRALIZATION
Option 5a Dry Storage	Same as Option 2a for Decentralization
Option 5b Wet Storage	Same as Option 2b for Decentralization
Option 5c Processing	Same as Option 2c for Decentralization
Option 5d Ship Out	Same as Alternative 1, No Action

a. The safety analysis reports from which information was extracted for these accidents were written before the issuance of DOE Orders 5480.23 (DOE 1992); previous orders did not require the inclusion of worker doses.

A.2.6.2 Impacts to Workers at Less than 100 Meters from Radiological

Releases. This section provides a qualitative discussion addressing the impacts due to potential radiological accident scenarios to workers at less than 100 meters (328 feet) involved in SRS spent nuclear fuel management. While worker fatalities may result from release initiators (i.e., plane crashes, seismic event, crane failure, etc.) and not as a direct consequence of a radiation release, this discussion considers only the radiological impacts of an accident, should it occur.

- A1. Fuel Assembly Breach - No fatalities to workers would be expected from radiological consequences because the release of the source term would be under water. Attenuation by the water would occur for most products, but the release of noble gases would cause a direct radiation exposure to workers in the area. However, because of the high metallic content of SRS spent nuclear fuel, only a very small fraction of the gases generated in an assembly would be released to the basin water. Air monitors in the area would warn personnel in the event of an airborne release. Timely evacuation would prevent substantial radiation exposures.

- A2. Material Release (Processing) - No fatalities to workers would be likely from radiological consequences (Meehan 1995). This scenario assumes that the material released from the process vessels would remain within the Canyon structure and be processed through the Canyon's ventilation and filtration system. Because of shielding effect from the thick concrete walls separating the vessels and areas occupied by workers, the exposures to workers are not expected to be significantly larger than those that would be received during routine operations.

- A3. Material Release (Dry Vault) - No fatalities to workers would be likely from radiological consequences. Medium energetic events resulting in the release of radioactive material from the Plutonium Storage Facility vault can result in the dispersal of radioactive materials. For these events, the radioactive material present would bypass the containment and disperse, but would result in a dose well below the lethal level. This assumes that a material release would be distributed into the volume of the smallest room for each unit of operation. It is further assumed that the operator is able to exit the room in 30 seconds (Du Pont 1989). This scenario presumes that the fractions of the plutonium volatized and transported are the same as those applied to the dispersal of the nonvolatile fission products of a criticality. Based on these assumptions, radiological exposure to the worker could occur.

- A4. Material Release (Adjacent Facility) - No fatalities to workers would be likely from radiological consequences. The rupture of a waste tank by an explosion could release airborne activity to the shielded cell if the accident occurred during one of the projected 150

times per year when regeneration of the portable columns took place (WSRC 1993a). Although some radiological exposure to the worker could occur, the risk to the worker from the initiating fire and explosion would predominate. Air monitors in the area would warn personnel in the event of an airborne release. Timely evacuation would prevent substantial radiation exposures.

- A5. Criticality in Water - No fatalities to workers would be likely from radiological consequences. The use of casks and the underwater handling of spent nuclear fuel greatly reduce the possibility of over-exposure of workers to radiation. The approximately 3 meters (10 feet) of water that covers all fuel provides an attenuation factor of 105 for intense gamma radiation and provides protection from direct radiation, even in the event of a criticality. However, a small chance of direct radiation exposure could result due to a floating fuel element or a fuel element inadvertently being raised too high. Strategically located radiation monitors reduce even this probability by alerting workers and sounding an evacuation alarm.

- A6. Criticality During Processing - The radiation field generated by a criticality incident could lead to fatalities among workers at the FB-Line facility. As discussed in Section A.2.2, FB-Line inadvertent criticality events are bounding for F- and H-Area spent fuel management processing facilities. This is assumed because workers involved in the FB-Line activities are in close proximity to plutonium metal. Of the 74 personnel that could be present during normal operations, 56 are expected to be within areas which the safety analysis report (WSRC 1993d) identifies as potential criticality accident locations. The shielding due to the concrete floors and walls, the distance between personnel, and the specific nature of the event reduce personnel dose so that only nearby personnel on the floor where the accident occurred would potentially receive a fatal dose. In the event of a criticality accident, DOE estimates that up to 4 deaths could occur, and as many as 50 other workers could receive non-fatal levels of direct radiation.

- A7. Spill/Liquid Discharge (External) - No fatalities to workers would be likely from radiological consequences because drainage of the water from the pool or basin would be expected to take several days, or under the most extreme circumstances, several hours, which provides sufficient time for workers to evacuate the area.

- A8. Spill/Liquid Discharge (Internal) - No fatalities to workers would be likely from radiological consequences. Minor releases of contaminated water have occurred at the Receiving Basin for Offsite Fuel hose rack platform during the handling of portable deionizers from the reactor areas. One such release was the result of an operator attempting to correct a small leak on a pressurized portable deionizer. The operator was subsequently sprayed with contaminated water, resulting in a radioactive exposure. A spill at the hose rack is not expected to release more than 378.5-liters (100 gallons) of contaminated water.

A.2.7 Point Estimates of Risk

Table A-6 lists the point estimate of risk for each reference accident considered for two receptors. The point estimate of risk is the product of frequency (in occurrences per year) and the number of potential latent fatal cancers. The number of potential latent fatal cancers is the product of dose (in rem for the individual or person-rem for the population) and the ICRP 60 risk factors (4.0 x 10-4 latent fatal cancer per rem for the worker or 5.0 x 10-4 latent fatal cancer per rem for the general public). These point

estimates were used to determine the relative risk for each case and to determine the accident that becomes dominant if DOE retires specific facilities during the total period under consideration. For example, all alternatives begin with the immediate storage of spent nuclear fuel in wet pools; however, for the alternative considering interim dry storage, the accident dominating risk will change as the configuration of facilities utilized changes and as spent nuclear fuel or special nuclear material is placed in and remains in interim storage rather than being handled.

A.2.8 Fuel Transition Staging Risk

Table A-7 facilitates the examination of the dominant reference accident during the fuel handling, processing, and storage stages. The use of stages enabled a realistic comparison of risk over the evaluated period. For example, when all fuel has been unloaded, characterized, canned, and put into an interim storage position, consideration of fuel handling events is no longer meaningful.

A.2.9 Adjustment Factors for Comparison Between Alternatives

The accident scenarios described in this document (i.e., Appendix C) differ only slightly between the various alternatives. The scenarios do not account for variations in spent nuclear fuel shipments (including onsite operational transfers) and spent nuclear fuel storage inventories across the alternatives. To provide a realistic comparison across alternatives, DOE developed factors to adjust

Table A-6. Point Estimates of Risk for Reference Accident Scenarios.

Accident Scenario	Descriptions	Frequency (per year)	Potential Fatal Cancersa		Point Est
			Maximally Exposed Individual	Population to 80 kilometers	Maximally Exposed Individua
A1	Fuel Assembly Breach	1.6x10-1	1.0x10-6	8.5x10-3	1.6x10-7
A2	Material Release (processing)	2.6x10-1	3.4x10-8	2.6x10-4	8.8x10-9
A3	Material Release (dry vault)	1.4x10-3	1.1x10-9	3.5x10-6	1.5x10-12
A4	Material Release (adjacent facility)	2.4x10-3	3.0x10-6	2.5x10-2	7.2x10-9
A5	Criticality in Water	3.1x10-3	1.5x10-6	4.4x10-3	4.7x10-9
A6	Criticality in Processing	1.4x10-4	3.5x10-6	4.3x10-3	4.9x10-10
A7	Spill/Liquid Discharge (external)	2.0x10-4	2.7x10-6	9.0x10-3	5.4x10-10
A8	Spill/Liquid Discharge (internal)	1.1x10-1	1.2x10-13	1.0x10-9	1.3x10-14

a. ICRP 60 risk factor (5.0 x 10-4) latent fatal cancer per rem was used to determine potential latent fatal cancers.
b. Units for point estimates of risk are given in potential fatal cancers per year.

Table A-7. Dominant risks based on fuel transition stages.

Fuel/Material Stage	Maximally Exposed Individual Risk	Populat 80 Kilo
Wet storage	1.6x10-7 potential fatal cancer/yr based on accident scenario A1.	1.4x10- cancer/ acciden
Dry storage	1.5x10-12 potential fatal cancers/yr based on accident scenario A3.	4.9x10- cancers acciden
Processing (fuel "in-process" by DOE definition)	1.6x10-7 potential fatal cancer/yr based on accident scenario A1.	1.4x10- cancer/ acciden

frequencies or consequences, depending on the specific circumstances of each alternative. This section describes the methodology and justification used to develop adjustment (scaling) factors for a relative comparison of adjusted point estimates of risk for each alternative on a case-by-case basis.

A.2.9.1 Classification of SRS Accident Scenarios for Applicability to

Adjustment Factors. This evaluation screened the SRS accident scenarios to determine which adjustment factor categories were applicable. Table A-8 lists the classification of the different SRS accident scenarios. These adjustment categories are as follows:

- Frequency sensitive due to spent nuclear fuel handling
- Frequency sensitive due to spent nuclear fuel inventories
- Consequence sensitive due to spent nuclear fuel inventories

Table A-8. Adjustment factor classification of SRS accidents.

Accident Scenarios	Accident Description	Frequency Sensitive (Handling)	Fr Se (I
A1	Fuel Assembly Breach	X	
A2	Material Release (Processing)		X
A3	Material Release (Dry Vault)		
A4	Material Release (Adjacent Facility)	X	
A5	Criticality in Water	X	
A6	Criticality during Processing		X
A7	Spill/Liquid Discharge (External)		
A8	Spill/Liquid Discharge (Internal)		

The following paragraphs provide the basis for each category selection:

- A1. Fuel Assembly Breach - The major initiator for this accident is the mishandling of a fuel assembly. For this reason, the accident frequency for this accident is adjusted to account for the annual number of fuel handling events. The amount of material involved in this accident is limited by the amount of damage that would occur due to the mishandling of a fuel assembly. Therefore, the bounding consequences of this accident are constant and independent of the amount of material available.

- A2. Material Release (Processing) - The probability that a release could occur during processing depends on the amount of material that would be processed. Therefore, the accident frequency for this accident is adjusted based on the spent nuclear fuel inventory. Because a maximum amount of material can be processed at any one time, the bounding consequences of this accident are independent of the amount of material on the site.

- A3. Material Release (Dry Vault) - The major contributor to the

probability of occurrence for this release was external initiators that did not involve material handling. This supports using the same frequency for each alternative. The consequences of this accident are proportional to the amount of material available for release. Therefore, the bounding consequences for this accident are based on the amount of material to be stored.

- A4. Material Release (Adjacent Facility) - The initiator for this accident involves the discharge of coolant from a cask into a waste tank. The frequency of occurrence for this accident depends on the number of casks received; therefore, the frequency is adjusted to account for the annual number of fuel shipments.

- A5. Criticality in Water - The probability of occurrence of this accident was determined by considering the probability of occurrence of several initiating events. Many of these initiating events involved a criticality due to the mishandling of fuel. Therefore, the frequency for this accident is adjusted to account for the annual number of fuel handling events. The magnitude of the criticality accident is not a function of the amount of material available because the criticality is a highly unlikely, localized event. The consequences for this accident are not adjusted to account for the amount of material available.

- A6. Criticality During Processing - The probability that a criticality could occur during processing depends on the amount of material that will be processed. Therefore, the frequency for this accident is adjusted based on the spent nuclear fuel inventory. The magnitude of the criticality accident is not a function of the amount of material available because the criticality is a highly unlikely, localized event. The consequences for this accident are not adjusted to account for the amount of material available.

- A7. Spill/Liquid Discharge (External) - The major contributor to the probability of occurrence for this release was external initiators that did not involve material handling. This supports using the same frequency for each alternative. The consequences depend on the amount of fuel in the basin because an increase in the amount of fuel will increase the source term in the basin water. Therefore, the bounding consequences are adjusted for the amount of fuel to be stored.

- A8. Spill/Liquid Discharge (Internal) - The major contributor to the probability of occurrence for this release was external initiators that did not involve material handling. This supports using the same frequency for each alternative. The consequences depend on the amount of fuel in the basin because an increase in the amount of fuel will increase the source term in the basin water. For this reason the bounding consequences are adjusted for the amount of fuel to be stored.

A.2.9.2 Methodology for Determination of Onsite Shipping Frequencies.

This section discusses the methodology for determining the onsite shipping frequencies of spent nuclear fuel on a case-by-case basis for each alternative. The annual frequency of handling accidents will vary in direct proportion to the annual number of handling events. However, the consequences of the accident will not vary as a result of spent nuclear fuel handling activities because the amount of material involved in each handling event does not vary. This evaluation assumes that onsite shipments of spent nuclear fuel are near-term shipments, averaged over 5 years. Table A-9 provides a breakdown of current spent nuclear fuel inventories at SRS facilities.

Table A-9. Spent nuclear fuel inventories.

	Number of	Number of	Number of	Number

Facility	Aluminum Assembliesb	Aluminum Slugs (Bucketsc)	Nonaluminum-Clad Assemblies	Aluminu Clad Assembl Shipmen
Receiving Basin for Offsite Fuel (RBOF)	234	107 (2)	261	20
K-Reactor Basin	1,783	349 (7)	0	149
L-Reactor Basin	861	13,840 (256)	0	72
P-Reactor Basin	577	61 (2)	0	48
Totals	3,455	14,477 (268)	261	289

a
. Basis for inventory numbers: (WSRC 1994c).
b
. Assemblies include targets and fuel assemblies. Assembly shipments are based on 12 assemblies per shipment.
c
. Number of buckets calculated using 54 slugs per bucket. Bucket shipments are based on 3 buckets per shipment.

A.2.9.2.1 Alternative 1 - No Action - The SRS would send the

following number of shipments of aluminum-clad fuel sent to the Receiving Basin for Offsite Fuel from:

- K-Reactor Basin - 152;
- L-Reactor Basin - 158;
- P-Reactor Basin - 49;
- Total - 359 shipments.

All nonaluminum-clad fuel would be sent from the Receiving Basin for Offsite Fuel to a reactor basin (a total of 22 shipments).

The number of shipments would be 380. Because fuel handling would occur at both origin and destination, this number would double (i.e., 760 total shipments). Therefore, over 5 years, this alternative would have an average shipping rate of 152 shipments per year.

A.2.9.2.2 Alternative 2 - Decentralization

- Option 2a - Dry Storage - For this option, initial shipments would be the same as those for Alternative 1 (760 shipments at a rate of 152 per year). Subsequent shipments from all storage locations to the new dry storage facilities would total 402 shipments. Because fuel handling would occur at both origin and destination, this number would double (i.e., 804 total shipments). Because all fuel would be moved to dry storage within a 5-year period, this total would have an average rate of 161 shipments per year. Adding all shipments would produce a total of 1,564 shipments at a rate of 313 per year.

- Option 2b - Wet Storage - For this option, initial shipments would be the same as those for Alternative 1 (760 shipments at a rate of 152 per year). Subsequent shipments from all storage locations to the new wet storage facilities would total 402 shipments for existing SRS fuel. Because the receipt of offsite fuel would continue prior to the relocation of fuel to the new wet storage facilities, an additional 50 shipments would occur [assuming receipt of five shipments per year of offsite fuel (per Volume 1, Appendix I "Offsite Transportation of

Spent Nuclear Fuel")] until 2005. The resulting fuel movement would total 452 shipments. Because fuel handling would occur at both origin and destination, this number would double (i.e., 904 total shipments). Therefore, over 5 years this option would have an average shipping rate of 181 shipments per year. Adding all shipments under this option would produce a total of 1,664 shipments at a rate of 333 per year.

- Option 2c - Processing - In this option, all aluminum-clad fuel would move from its present location to the process facilities. All nonaluminum-clad fuel would remain in its present storage locations. The result would be in a total of 380 shipments. As in the previous options, this number would double for a total of 760 shipments. Therefore, over 5 years this option would have an average shipping rate of 152 shipments per year.

A.2.9.2.3 Alternative 3 - Planning Basis

- Option 3a - Dry Storage - The movement of materials for this option would be identical to that for Option 2a, resulting in a total of 1,564 shipments at a rate of 313 per year.

- Option 3b - Wet Storage - The movement of materials for this option would be identical to that for Option 2b, with the exception of a delay in the receipt of foreign fuel until the new facilities are in operation. This would result in a total of 1,564 shipments at a rate of 313 per year.

- Option 3c - Processing - The movement of materials for this option would be identical to that for Option 2c, resulting in a total of 760 shipments at a rate of 152 shipments per year.

A.2.9.2.4 Alternative 4 - Regionalization

- Option 4a - Dry Storage - For this option, initial shipments would be the same as Alternative 1 (760 shipments at a rate of 152 per year). Subsequent shipments of the aluminum-clad fuel to the new dry storage facilities would total 380 shipments. (Note: Nonaluminum-clad fuel would be sent offsite from the reactor basins and would not contribute to any further onsite movements.). Because fuel handling would occur at both origin and destination, this number would double (i.e., 760 total shipments). Because all fuel would move to dry storage within about 5 years, this total would have an average shipping rate of 152 shipments per year. Adding all shipments would produce a total of 1,520 shipments at a rate of 304 per year.

- Option 4b - Wet Storage - The movement of materials for this option would be identical to that for Option 3b, with the exception of movement of the nonaluminum-clad fuel to the new wet storage facility. This fuel would move off the Site from the reactor basins and would not contribute to any further onsite movements. This would result in a total of 1,520 shipments at a rate of 304 per year.

- Option 4c - Processing - The movement of materials for this option would be identical to that for Options 2c and 3c, resulting in a total of 760 shipments at a rate of 152 per year.

- Option 4d - Dry Storage - The movement of materials for this option would be identical to those for Options 2a and 3a, resulting in a total of 1,564 shipments at a rate of 313 per year.

- Option 4e - Wet Storage - The movement of materials for this option would be identical to that for Option 3b, resulting in a total of 1,564 shipments at a rate of 313 per year.
- Option 4f - Processing - The movement of materials for this option would be identical to those for Options 2c, 3c, and 4c, resulting in a total of 760 shipments at a rate of 152 per year.
- Option 4g - Ship Out - This option would require the shipping of all spent nuclear fuel at the SRS to a selected regional location. The movement of materials for this option would include the entire spent nuclear fuel inventory at the SRS, resulting in a total of 402 shipments at a rate of 81 per year.

A.2.9.2.5 Alternative 5 - Centralization

- Option 5a - Dry Storage - The movement of materials for this option would be identical to those for Options 2a and 3a, resulting in a total of 1,564 shipments at a rate of 313 per year.
- Option 5b - Wet Storage - The movement of materials for this option would be identical to that for Option 3b, resulting in a total of 1,564 shipments at a rate of 313 per year.
- Option 5c - Processing - The movement of materials for this option would be identical to those for Options 2c, 3c, and 4c, resulting in a total of 760 shipments at a rate of 152 shipments per year.
- Option 5d - Ship Out - This option would require the shipping of all spent nuclear fuel at the SRS to a selected central location. The movement of materials for this option would include the entire spent nuclear fuel inventory at the SRS, resulting in a total of 402 shipments at a rate of 81 per year.

A.2.9.3 Methodology for Determination of Offsite Shipping Frequencies.

This evaluation determined the total number of offsite shipments using the data contained in Volume 1, Appendix I, "Offsite Transportation of Spent Nuclear Fuel." The total number of Naval Fuel shipments was determined from Table 3 of "Methodology for Adjusting SNF Facility Accident Probabilities and Consequences For Different EIS Alternatives" (dated March 18, 1994).

Naval, foreign, and university shipments would occur throughout the interim management period and could be averaged over the 40-year period **covered by this EIS.** All other shipments would be averaged over 5 years.

A.2.9.4 Frequency Adjustment Factors for Fuel Handling. For this

analysis, DOE assumed the baseline fuel handling rate (events per year) to be the No Action alternative. For the other alternatives, this evaluation divided the expected spent nuclear fuel handling rate by the baseline spent nuclear fuel handling rate (No Action) to obtain the adjustment factor (see Table A-10).

A.2.9.5 Frequency/Consequence Adjustment Factors Due to Inventory. The

No Action alternative for the SRS would require the storage of 206 MTHM (227 tons) of fuel. Using this amount as the baseline, this evaluation compared the amount of fuel for the other alternatives to the base number, as listed in Table A-11. These adjustment factors can be applied to either a

frequency or a consequence, depending on the classification of the accident scenario as listed in Table A-8.

A.3 Chemical Hazard Evaluation

A.3.1 Selection of Reference Chemical Hazard

A review of the same safety analyses used to generate the spectrum of radiological accident scenarios failed to identify a quantitative discussion of chemical hazards. However, each of the safety analyses provided a qualitative discussion of chemical hazards. Thus, Section 5.15.3 discusses chemical hazards associated with existing spent nuclear fuel facilities qualitatively. This qualitative evaluation was determined to be appropriate based on three criteria: sliding scale in proportion to significance, public perception of severity, and long-term effects of chemicals not known. For completeness, a separate risk assessment (WSRC 1993c) provided a quantitative discussion of chemical hazards for the Receiving Basin for Offsite Fuel facility. This assessment described a bounding chemical hazard accident involving the release of nitrogen dioxide vapor.

Table A-10. Fuel handling frequency adjustment factors.

Option Number	Estimated Annual Shipping Rate	Frequen Adjustm
Alternative 1 - No Action		
Option 1	152	Baselin
Alternative 2 - Decentralization		
Option 2a	316	2.08
Option 2b	333	2.19
Option 2c	157	1.03
Alternative 3 - Planning Basis		
Option 3a	375	2.47
Option 3b	375	2.47
Option 3c	216	1.42
Alternative 4 - Regionalization		
Option 4a	421	2.77
Option 4b	421	2.77
Option 4c	269	1.77
Option 4d	394	2.59
Option 4e	394	2.59
Option 4f	234	1.54
Option 4g	160	1.05
Alternative 5 - Centralization		
Option 5a	803	5.28
Option 5b	803	5.28
Option 5c	643	4.23
Option 5d	160	1.05

Table A-11. Inventory adjustment factors for each alternative.

Alternative	Inventorya (MTHMb)	Adjustm
No Action	206.27	Baselin
Decentralization	219.89	1.07
Planning Basis	222.76	1.08
Regionalization - A	213.09	1.03
Regionalization - B	256.62	1.24
Centralization	2,741.80	13.30

a. Source: Wichmann (1995).
b. Metric Tons Heavy Metal; to convert to tons, multiply by 1.1023.

A.3.2 Hazardous Chemical Inventories

The inventory of hazardous chemicals at each facility was determined by using the "Savannah River Site Tier Two Emergency and Hazardous Chemical Inventory Report" (WSRC 1994a) to get the facility's total chemical inventory, then listing those chemicals that also appeared on the EPA's "List of Lists" (EPA 1990). The chemical inventories listed in Tables A-12 through A-15 represent facilities used for wet storage and/or processing of spent nuclear fuel. The SRS maintains no large-scale dry storage facilities; thus, chemical inventories for dry storage facilities are not listed.

Table A-12. Hazardous chemical inventory for the Receiving Basin for Offsite Fuel.

Chemical	Maximum Daily Amount (Kg)a	Average Daily Amount (Kg)
Ethylene glycol	2,981	23
Methyl ethyl ketone	2	2
Nitric acid	4,731	2,365
Phosphoric acid	3,953	3,953
Sodium hydroxide (caustic soda)	5,800	2,900
Sodium nitrite	3,070	1,535

a. To convert kilograms to pounds, multiply by 2.2046.

Table A-13. Hazardous chemical inventory for the reactor basins (typical).

Chemical	Maximum Daily Amount (Kg)a	Average Daily Amount (Kg)
Aluminum sulfate (solution)	570	230
Ethylene glycol (thermal arc torch coolant concentrate)	2	2
Hydrogen peroxide	1	1
Nitric acid	75	75
Sodium hydroxide	454	454
Sodium hypochlorite	11	6
Zinc	0.5	0.5

a . To convert kilograms to pounds, multiply by 2.2046.

Table A-14. Hazardous chemical inventory for H-Area.

Chemical	Maximum Daily Amount (Kg)a	Average Daily Amount (Kg)
Dichlorodifluoromethane (Freon 12)	227	68
Dichlorodifluoromethane (Racon 12)	227	0
Ethylene glycol	4.0	2.0
Hydrofluoric acid	1	0.5
Hydrogen peroxide	0.5	0.0
Mercury	4,900	4,900
Methyl ethyl ketone	3	3
Nitric acid	10	5
Nitric oxide	1,300	1,300
Phosphorus pentoxide	1	1
Potassium permanganate (Cairox)	200	100
Sodium hydroxide	1	1
Sodium hypochlorite	41	29
Sulfuric acid	1	0.5
Trichlorofluoromethane (Freon 11)	1,150	1,000
Trichlorofluoromethane (Genetron 11)	450	0

a . To convert kilograms to pounds, multiply by 2.2048.

Table A-15. Hazardous chemical inventory for F-Area.

Chemical	Maximum Daily Amount (Kg)a	Average Daily Amount (Kg)
Dichlorodifluoromethane (Freon 12)	1	0.5
Dichlorodifluoromethane (Racon 12)	1	0
Ethylene glycol	4	2
Hydrofluoric acid	1,177	1,177
Potassium permanganate	3	1
Sodium hydroxide	0.5	-
Sodium hypochlorite	7	4
Sulfuric acid	30	-
Trichlorofluoromethane (Freon 11)	900	450

a . To convert kilograms to pounds, multiply by 2.2048.

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