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PROJECT TITLE:
DEA: Offsite Transportation of Certain Low-Level and Mixed Radioactive Waste from the Savannah River Site for Treatment and Disposal at Commercial and Government Facilities

NMED FILE NO.: 1402 ER

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(2) All deficiencies or inaccuracies in the information provided which prevent an adequate environmental assessment of the project;

(3) If applicable, whether the anticipated accomplishments of the proposal justify the requested funding;

(4) Other information which may be helpful to understand the environmental impact of the project (e.g., other environmental problems in the vicinity, other project impacts, problems which may develop for which no specific NMED law and regulations apply, and so on).

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DOE/EA-1308

DRAFT

ENVIRONMENTAL ASSESSMENT FOR THE OFFSITE TRANSPORTATION OF CERTAIN LOW-LEVEL AND MIXED RADIOACTIVE WASTE FROM THE SAVANNAH RIVER SITE FOR TREATMENT AND DISPOSAL AT COMMERCIAL AND GOVERNMENT FACILITIES

SEPTEMBER 2000

U. S. DEPARTMENT OF ENERGY
SAVANNAH RIVER OPERATIONS OFFICE
SAVANNAH RIVER SITE

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LIST OF ABBREVIATIONS/ACRONYMS

The following is an alphabetized list of the abbreviations and acronyms found within the text of this document:

CFR	-	Code of Federal Regulations
Ci	-	curie (a unit of measure of radioactivity)
CIF	-	Consolidated Incineration Facility
cm	-	centimeter
DC	-	District of Columbia
DOE	-	U. S. Department of Energy
DOT	-	U. S. Department of Transportation
dpm	-	disintegrations per minute
EA	-	environmental assessment
EDE	-	effective dose equivalent
EH	-	Environment, Safety, and Health
EIS	-	environmental impact statement
ER	-	Environmental Restoration
FRA	-	Federal Railroad Administration
ft	-	feet
g	-	gram
HIGHWAY 3.4	-	computerized road/highway routing model
HNUS	-	Halliburton NUS Corporation
ID	-	Idaho
INTERLINE	-	computerized railroad routing model
LCF	-	Latent Cancer Fatality
LDR	-	Land Disposal Requirement
LLW	-	low-level radioactive waste
LSA	-	Low Specific Activity
m	-	meter
MLLW	-	mixed low-level radioactive waste
mrem	-	millirem, i.e., 1/1000 roentgen equivalent man
mSv	-	millisievert
N/A	-	Not Applicable
nCi	-	nanocurie
NEPA	-	National Environmental Policy Act
NM	-	New Mexico
NRC	-	U. S. Nuclear Regulatory Commission
NV	-	Nevada
OSHA	-	Occupational, Health and Safety Administration
PCB	-	Polychlorinated biphenyl
Pu^{239}	-	Plutonium-239
QA/QC	-	Quality Assurance/Quality Control
RADTRAN 4	-	computerized model used to calculate radiological impacts resulting from transportation

LIST OF ABBREVIATIONS/ACRONYMS (continued)

RCRA	-	Resource Conservation and Recovery Act
rem	-	Unit of dose equivalent of radiation
ROD	-	Record of Decision
SC	-	South Carolina
SCDHEC	-	South Carolina Department of Health and Environmental Control
SRS	-	Savannah River Site
SRWMEIS	-	Final EIS, Savannah River Site, Waste Management
TN	-	Tennessee
TR	-	Technical Report
TSCA	-	Toxic Substance Control Act
U^{235}	-	Uranium-235
U^{236}	-	Uranium-236
USC	-	United States Code
UT	-	Utah
WA	-	Washington
WMPEIS	-	Final Programmatic EIS for Managing Treatment, Storage and Disposal of Radioactive and Hazardous Waste
WSRC	-	Westinghouse Savannah River Company
yr	-	year

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1.0 INTRODUCTION

The U. S. Department of Energy (DOE) prepared this environmental assessment (EA) to analyze the potential environmental impacts of the proposed offsite transportation of certain low-level radioactive waste (LLW) and mixed (i.e., hazardous and radioactive) low-level radioactive waste (MLLW) from the Savannah River Site (SRS), located near Aiken, South Carolina (Figure 1-1). DOE needs to take action because treatment and disposal capabilities for these wastes do not exist at the site and/or it is more beneficial to DOE to dispose of the waste at another location. DOE proposes to transport five forms of LLW or MLLW (Table 1-1) to offsite commercial and government facilities for treatment and/or final disposal.

This document was prepared in compliance with the National Environmental Policy Act (NEPA) of 1969, as amended; the requirements of the Council on Environmental Quality Regulations for Implementing NEPA (40 CFR 1500-1508); and the DOE Regulations for Implementing NEPA (10 CFR 1021). NEPA requires the assessment of environmental consequences of Federal actions that may affect the quality of the human environment. Based on the potential for impacts described herein, DOE will either publish a Finding of No Significant Impact or prepare an environmental impact statement (EIS).

1.1 Background

At SRS, operations, waste management, environmental restoration, and decontamination and decommissioning activities generate a variety of LLW and MLLW streams each year. By definition, LLW is radioactive waste that is not classified as high-level waste, transuranic waste, or spent nuclear fuel, and does not contain waste designated as hazardous by either the Resource Conservation and Recovery Act (RCRA) (42 USC 6901 *et seq.*) or the Toxic Substances Control Act (TSCA) (40 CFR 116 *et seq.*). LLW management is subject to the provisions of the Atomic Energy Act (42 USC 2011 *et seq.*), DOE Order 435.1 (Radioactive Waste Management), and the accompanying DOE manual (DOE 1999b). LLW is categorized as either contact-handled (i.e., external surface dose rate does not exceed 200 millirem per hour) or remote-handled (i.e., external surface dose rate exceeds 200 millirem per hour), and as alpha or nonalpha on the basis of the waste forms and levels of radioactivity present.

Most LLW consists of relatively large volumes of waste materials contaminated with small amounts of radionuclides, such as contaminated equipment, protective clothing, paper, rags, packaging material, and solidified sludges. Most LLW contains short-lived radionuclides and generally can be handled without shielding or remote handling equipment.

MLLW contains both hazardous waste subject to regulation under RCRA and LLW subject to regulations under the Atomic Energy Act. MLLW includes such materials as tritiated mercury, tritiated oil contaminated with mercury, other mercury-contaminated materials, radioactively contaminated solvents, radioactively contaminated

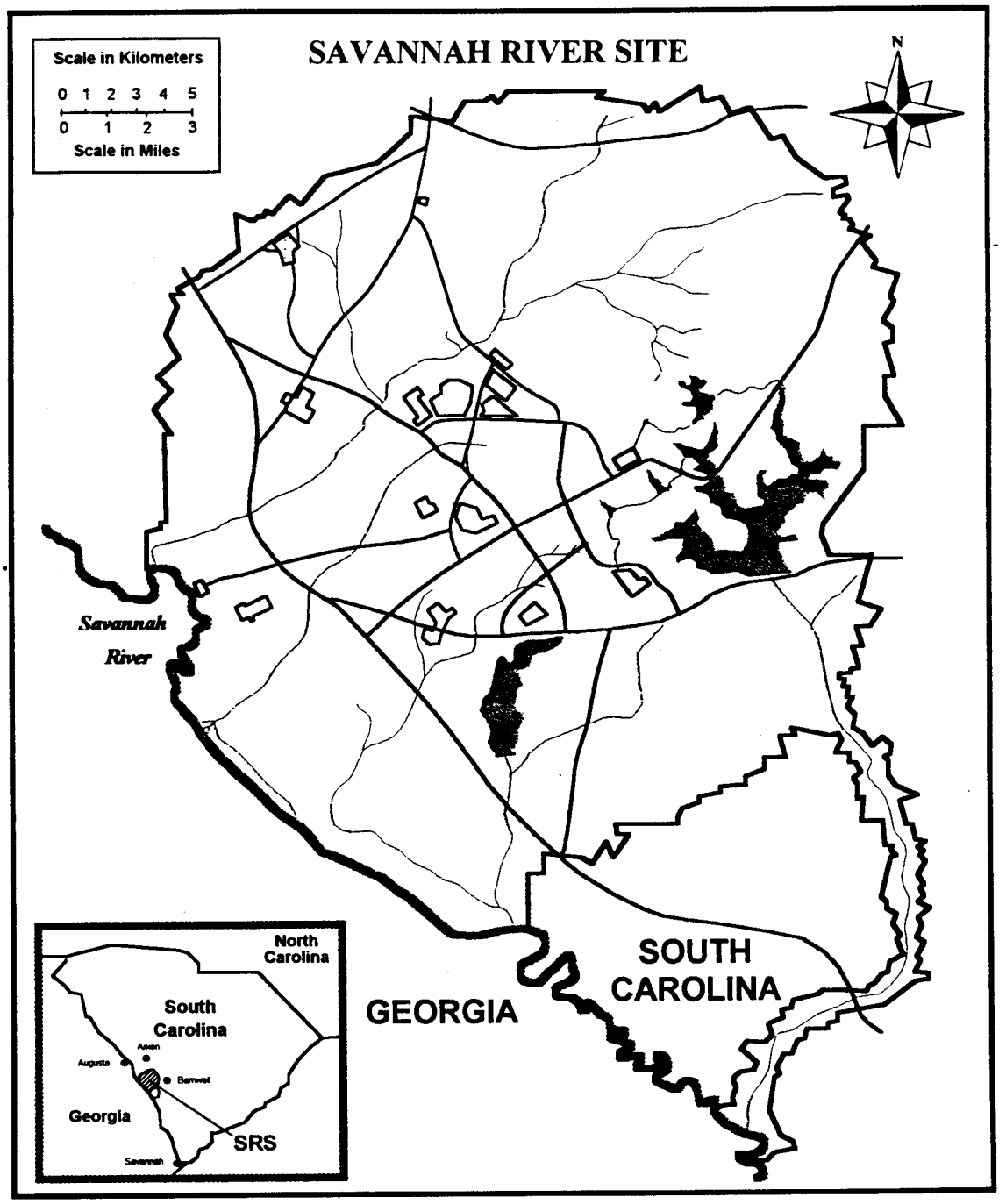

Figure 1-1. Location of the Savannah River Site (SRS), South Carolina.

Table 1-1. Low-level radioactive waste (LLW) and mixed low-level radioactive waste (MLLW) forms proposed for transportation to offsite commercial and government treatment and disposal facilities.

Case	Waste Form	Waste Volume[a]	Type of Waste	Example of SRS Waste	Current Disposal Option[b]
1	Vitrified Blended Uranium Sludge	2,850 drums	LLW & MLLW	Vitrified Blended Uranium Sludge from M Area	RCRA Disposal or Shallow Land Disposal
2	Misc. Debris with Activity Conc. $\leq$99 nCi/g of Pu^{239}	124,891 m^3 (4.41E+06 ft^3)	LLW & MLLW	Environmental Restoration (ER) Waste; Radioactive PCB Waste; Demolition Waste; Radioactive Waste Containing Metals; Consolidated Incineration Facility (CIF) Byproducts (e.g., ashcrete and blowdown); and Used Equipment and Machinery	Some Treatment followed by RCRA Disposal or Shallow Land Disposal
3	Misc. Debris with Activity Conc. $\leq$99 nCi/g of Pu^{239}	45,000 drums	LLW & MLLW	ER Waste; Radioactive Solids and Powder Residues; Radioactive PCB Waste; Demolition Waste; Radioactive Waste Containing Metals; CIF Byproducts (e.g., ashcrete and blowdown); and Used Equipment and Machinery	Some Treatment followed by RCRA Disposal or Shallow Land Disposal
4	Misc. Liquids with Activity Conc. $\leq$99 nCi/g of Pu^{239}	5,000 drums	LLW & MLLW	Radioactive Liquids and Sludges; and Radioactive PCB Waste	Some Treatment followed by RCRA Disposal or Shallow Land Disposal

Table 1-1. (Continued).

Case	Waste Form	Waste Volume[a]	Type of Waste	Example of SRS Waste	Current Disposal Option[b]
5	Misc. Liquids with Activity Conc. $\leq$99 nCi/g of Pu^{239}	10 tanker trailers, each containing 12,869 liters (3,400 gallons)	LLW & MLLW	Radioactive Liquids and Sludges; and Radioactive PCB Waste	Some Treatment followed by RCRA Disposal or Shallow Land Disposal

[a] Total waste volume to shipped over the ten-year period
[b] In the SRWMEIS ROD (DOE 1995b), DOE decided to dispose of the waste form in the manner indicated in this column.

polychlorinated biphenyls (PCBs), radioactively contaminated lead shielding, and equipment from the tritium facilities in H Area (DOE 1995a, 1997a).

The proposed management of the five waste forms included in this EA (Table 1-1) was previously addressed in two different EISs prepared and issued by DOE: the Final EIS, Savannah River Site, Waste Management, DOE/EIS-0217 (DOE 1995a) (SRWMEIS), and the Final Programmatic EIS for Managing Treatment, Storage and Disposal of Radioactive and Hazardous Waste, DOE/EIS-0200-F (DOE 1997a) (WMPEIS).

In the SRWMEIS, DOE's preferred alternative for managing these waste forms was through either shallow land or RCRA-licensed disposal at SRS. In addition, either onsite or offsite treatment preceded disposal for some specific wastes in four of the five general waste forms. However, treatment residuals were to be returned to SRS for onsite storage or disposal. DOE decided to implement this option and issued a Record of Decision (ROD) on October 30, 1995 (DOE 1995b).

In the WMPEIS, the five waste forms in this EA were encompassed in the two broad waste types of LLW and MLLW for evaluation. DOE's preferred alternative consisted of minimum treatment of LLW although each site may perform additional treatment if cost effective. The preferred alternative for disposal of LLW was to continue to the extent practicable onsite disposal as well as selection of Hanford Site and Nevada Test Site as regional disposal locations. DOE's preferred alternative for MLLW treatment consisted of onsite and regional treatment at Hanford Site, Idaho National Engineering and Environmental Laboratory, Oak Ridge Reservation and SRS consistent with Site Treatment Plans. The preferred alternative for MLLW disposal consisted of two regional disposal sites, Hanford Site and Nevada Test Site. DOE decided to implement the preferred alternative and issued a ROD on February 25, 2000 (DOE 2000a). The decisions did not preclude DOE's use of commercial treatment and disposal facilities, consistent with current DOE orders and policy.

While these two EISs addressed treatment and disposal of LLW and MLLW at SRS, the onsite treatment and disposal facilities for most of the five waste forms being addressed in this EA do not exist. For various reasons, the proposed projects that would have provided the facilities, such as new low-activity waste and RCRA disposal vaults, have been cancelled. Some of the reasons for cancellation include recognition of existing DOE complex capacity, inability to meet current South Carolina Department of Health and Environmental Control (SCDHEC) RCRA waste disposal facility requirements, and funding limitations. DOE has no plans to construct and operate such facilities at SRS. Therefore, DOE is proposing to use offsite commercial and government facilities for treatment and disposal of these wastes.

1.2 Purpose and Need for Action

DOE needs a viable near-term treatment and disposal option for the five LLW and MLLW forms listed in Table 1-1 that are generated at SRS. DOE needs to take action in

a cost-effective and timely manner because onsite treatment and disposal capabilities for these waste forms do not exist at SRS at this time and/or it is more beneficial to DOE to dispose of the waste at another location. In addition, these waste forms would comprise an estimated volume of approximately 136,057 cubic meters (4,804,282 cubic feet). The continued storage of this volume of waste would likely exceed RCRA and TSCA regulatory limits. Continued storage would not be consistent with the agreements between DOE and the State of South Carolina concerning MLLW management under the SRS Site Treatment Plan that was developed pursuant to the Federal Facility Compliance Act of 1992. Violating these agreements could result in fines and penalties for DOE as well as suspension of the site's RCRA Permit.

2.0 PROPOSED ACTION AND ALTERNATIVES

2.1 Proposed Action

DOE proposes to transport, by rail or truck, certain SRS LLW and MLLW forms (Table 1-1) to commercial and government facilities for treatment and disposal. SRS activities that would generate these waste forms have been evaluated in other NEPA reviews (e.g., DOE 1987, 1992, 1994, 1995a, 1998a, 1998b, 1998c, 1998d). Although the treatment and disposal operations at the commercial and government facilities are beyond the scope of this EA, the government facilities are separately covered through appropriate NEPA documentation. Additionally, DOE would ensure all commercial facilities are properly licensed to receive the radioactive material prior to shipment and perform reviews of the facility's operations. None of these wastes, or residuals or secondary waste generated during the offsite treatment, would be returned to SRS under the proposed action. The estimated volume that would be shipped under this proposed action on an annual basis would range from 5,664 to 12,744 cubic meters (200,000 to 450,000 cubic feet).

The shipping vendor (either rail or truck) would be responsible for providing the modes of transportation, equipment, security and health and safety requirements to ship the waste from SRS. The shipping containers would be provided by either DOE or the vendor. The vendors would also be responsible for all Federal, State, and local licenses, permits, and other required documentation to treat LLW and MLLW, and for ensuring that all U. S. Department of Transportation (DOT), and DOE regulations and orders are met for LLW and MLLW shipments. DOE would ensure that external contamination to the containers leaving SRS does not exceed DOT limits. SRS personnel would be responsible for loading the waste into the appropriate DOT-approved shipping containers. The vendor would take custody of the packaged waste at the SRS staging area.

The proposed action would include the transportation of the LLW and MLLW to 11 potential offsite-processing locations for treatment and disposal (Zecha 2000). The 11 commercial or government facilities located within a general area are grouped such that the calculations for six destinations cover the 11 potential offsite-processing locations, as well as future/additional locations that are near the six destinations (Table 2-1). The

Table 2-1. Listing of the offsite waste processing centers and the grouped destinations evaluated in this EA.

Name of Facility	Type of Facility	Waste Management Function(s)	Destination[a]
Nevada Test Site	Government	Disposal	Beatty, Nevada
Envirocare of Utah, Inc.	Commercial	Treatment and Disposal	Clive, Utah
Waste Control Specialists	Commercial	Treatment and Disposal	Eunice, New Mexico
Idaho National Environmental and Engineering Laboratory	Government	Treatment	Idaho Falls, Idaho
Diversified Scientific Services, Inc.	Commercial	Treatment	Oak Ridge, Tennessee
East Tennessee Materials and Energy Corporation	Commercial	Treatment	Oak Ridge, Tennessee
M4 Environmental	Commercial	Treatment	Oak Ridge, Tennessee
Nuclear Fuel Services	Commercial	Treatment	Oak Ridge, Tennessee
Oak Ridge Gaseous Diffusion Plant	Commercial	Treatment	Oak Ridge, Tennessee
Allied Technology Group	Commercial	Treatment	Richland, Washington
Hanford Site	Government	Treatment and Disposal	Richland, Washington

[a] Grouped destination locations for the RADTRAN 4 transportation assessment modeling in this EA

destinations chosen are: 1) Idaho Falls, Idaho; 2) Eunice, New Mexico; 3) Beatty, Nevada; 4) Oak Ridge, Tennessee; 5) Clive, Utah; and 6) Richland, Washington (Figure 2-1). All destination facilities are accessible by both rail and truck, except rail ends at Pocatello, Idaho, and Las Vegas, Nevada. Therefore, results are presented for two separate legs consisting of 1) rail from SRS to Pocatello, Idaho, and rail from SRS to Las Vegas, Nevada, and 2) truck from Pocatello to Idaho Falls, Idaho, and truck from Las Vegas to Beatty, Nevada.

Because DOE relinquishes ownership of the waste at the commercial facilities, the transportation of the treated waste from those facilities to the final disposal facility would be the responsibility of vendor. DOE does not evaluate transporting the treated waste from commercial treatment facilities to the final disposal facility in this EA. However, since the waste constituents would have been either immobilized, thermally treated, thermally encapsulated, solidified, amalgamated, volume reduced, or containerized at the commercial treatment facilities, and the radiation levels or hazard volumes of the waste have not been increased, the transportation impacts would be no greater than those that would result from transporting the untreated waste from SRS to final disposal facility, and those impacts are evaluated in this EA. The various commercial vendor facilities are accessible by either rail or truck. Each of these offsite facilities would be required by law to have in place all necessary U. S. Nuclear Regulatory Commission (NRC), State, and local licenses and/or permits to either treat or dispose of the waste forms in questions. DOE would ensure the receiving facility is properly licensed prior to shipment of the waste.

The facility's waste acceptance criteria are essential to the proper operation of the radiological waste treatment/disposal facility. SRS will comply with the facility's waste acceptance criteria through auditable waste characterization and certification activities. This would enable DOE Savannah River Operations Office and the facility's host State to ensure that all safety, health physics/radiation monitoring procedures, Quality Assurance/Quality Control (QA/QC) procedures, transportation procedures, volume reduction procedures, and laboratory procedures at the disposal facility would be met. Further, meeting the waste acceptance criteria for disposal of MLLW is driven by RCRA. These criteria must be met before these waste forms could be offered to any commercial or government facility for final disposal. Therefore, the additional expense for SRS in having to meet the disposal facility's waste acceptance criteria would be minimized. In the event that these criteria can't be met for a specific volume of waste to be shipped, then those materials would remain at SRS until an alternative management option can be determined.

The commercial facility's activities would be closely scrutinized by way of a number of controls and oversight mechanisms throughout the process as demonstrated by the following QA/QC requirements included in the terms of the contract:

- Current NRC and/or state radioactive materials licenses;
- Health Protection/radiation monitoring procedures;

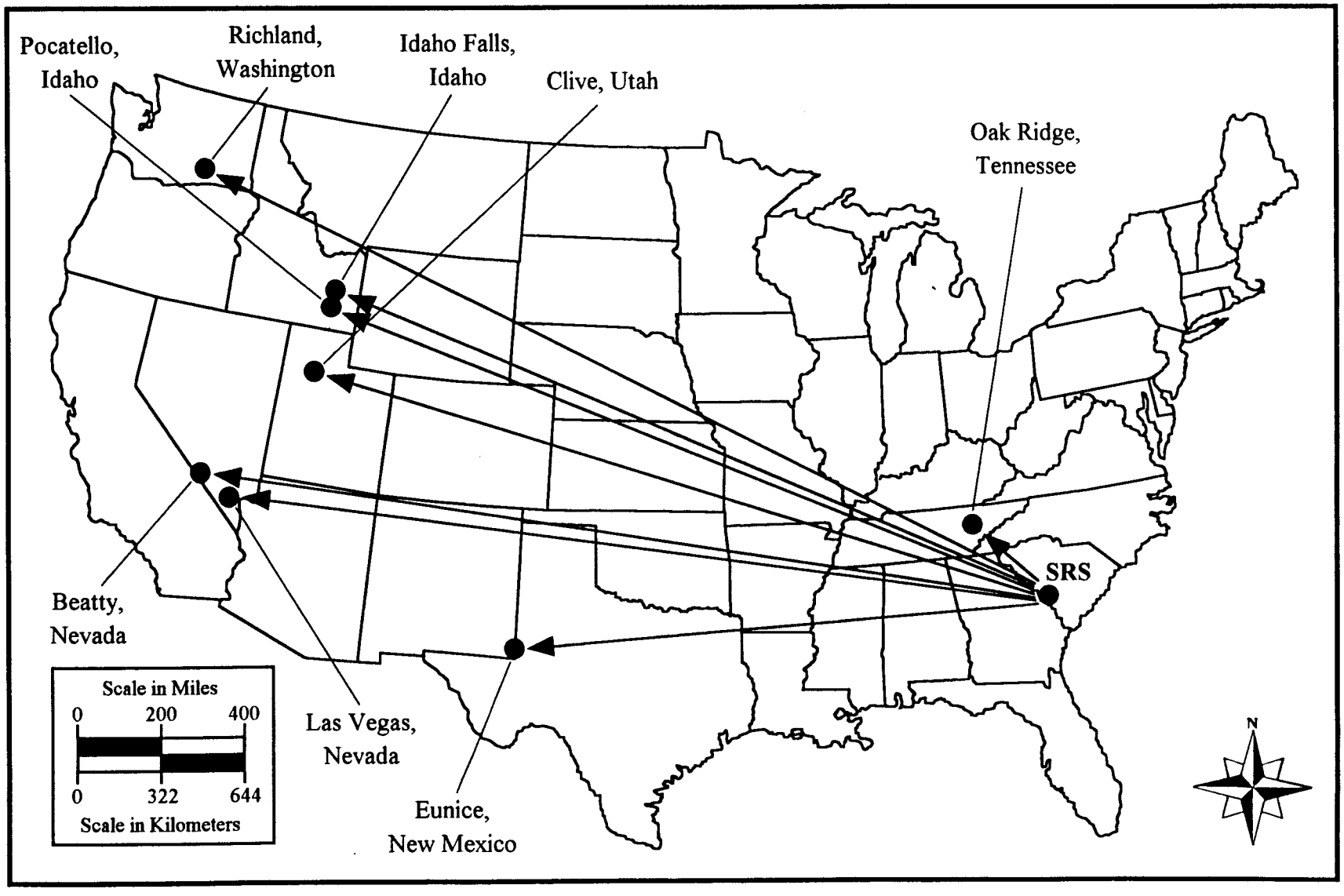

Figure 2-1. National map showing the locations of the Savannah River Site (SRS) and the six destinations being considered within the proposed action of this EA. The rail ends at Pocatello, Idaho, and Las Vegas, Nevada, are also depicted.

- QA/QC plans;
- Return of empty containers and equipment, as required;
- Shipping papers and manifests, as appropriate; and
- Record of waste treatment/disposal

Oversight on these activities at these facilities would be conducted by DOE, NRC, the U. S. Environmental Protection Agency, and State agencies that regulate the management of radiological and hazardous waste.

If the proposed action were selected, an amended ROD would have to be issued by DOE for the SRWMEIS. The decision in the ROD would be to modify the Moderate Treatment Configuration Alternative to include the proposed offsite transportation of certain LLW and MLLW for treatment and/or final disposal at commercial and government facilities.

2.2 Alternatives to the Proposed Action

In accordance with NEPA regulations, DOE examined the following alternatives to the proposed action:

- No action, continue to store these waste forms at SRS

- Construct and operate onsite treatment and disposal facilities

2.2.1 No Action, Continue to Store these Waste Forms at SRS

One alternative to the proposed action is to take no action. DOE would continue to store these waste forms onsite. The impacts associated with the proposed action would not occur. DOE would not provide onsite treatment or disposal capabilities for these waste forms. Storage space and disposal capacity needs would increase each year as waste was generated. Environmental restoration and decontamination and decommissioning projects at SRS would have to be postponed because of lack of available storage space and treatment and disposal capacity to handle the waste generated by these activities. The continued storage of these waste forms could also result in violations of RCRA and TSCA regulatory limits. The potential outcome of this could be significant fines and penalties for SRS. Also, the average costs associated with the proper management of stored waste is approximately $45 per 1.0 cubic meter (35.3 cubic feet) per year. These costs would be in addition to the ultimate treatment and/or disposal costs for these SRS waste forms.

2.2.2 Construct and Operate Onsite Treatment and Disposal Facilities

One alternative to the proposed action would be to construct and operate onsite treatment and disposal facilities for these waste forms. This would include the construction and operation of the following new facilities: a non-alpha vitrification facility, a containment

building, 3 low-activity waste disposal vaults, and 26 RCRA disposal vaults. The environmental impacts and administrative decisions associated with these facilities were addressed in DOE (1995a, 1995b, and 1997b). However, expenditure of capital funds for new treatment and disposal facilities while offsite capacity exists for these waste forms is not a cost-effective solution. The RCRA disposal vaults could not be built onsite to meet current SCDHEC requirements for such facilities. Therefore, given the current funding limitations and alternatives available for these waste forms, DOE does not plan to build the previously proposed treatment and disposal facilities.

3.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION AND ALTERNATIVES

SRS occupies an area of approximately 803 square kilometers (310 square miles) in southwestern South Carolina (Figure 1-1). The site borders the Savannah River for about 27 kilometers (17 miles) near Augusta, Georgia, and Aiken and Barnwell, South Carolina. SRS contains five non-operational nuclear production reactor areas, two chemical separations facilities, waste treatment, storage and disposal facilities, and various supporting facilities. The final EIS for the management of spent nuclear fuel at SRS (DOE 2000b) and the most recent socio-economic survey of the six-county SRS area of influence (HNUS 1997) contain additional information on SRS facilities and the areas surrounding the site.

3.1 Onsite Loading Operation

Site personnel would load the waste into the appropriate shipping containers at the onsite staging area. The vendor would take custody of the packaged waste prior to shipping. The container loading/packaging activities would be conducted in conjunction with ongoing site activities associated with the generation and storage of these waste forms. The site workforce involved with these efforts would be approximately 5 to 20 employees per loading operation. Appropriate protective clothing would be worn by the workers conducting these activities.

Site personnel working in waste management operations at SRS received an average annual dose of 0.037 rem (DOE 1995a). The current DOE worker exposure limit is 5 rem per year, and the SRS sitewide administrative exposure guideline is 0.5 rem per year. The average annual worker dose would not be expected to change under the proposed action. Arnett and Mamatey (1998a, 1998b) contain more information about SRS worker exposure.

The Occupational Safety and Health Act (OSHA) requires that employers comply with the safety and health standards set by the act (29 CFR 1910) to provide each employee with a worksite that is free from recognized hazards that are likely to cause death or serious injury. Aside from unforeseen accidents, DOE expects no impacts to human health and worker safety associated with the loading operations portion of the proposed

action. Any spills which might occur during the loading operations would be cleaned-up immediately. No additional impacts would be expected as a result of the proposed action.

3.2 Transportation Impacts

3.2.1 Analyzed Scenarios

The proposed action would include the offsite transportation of LLW and MLLW generated at SRS. Waste shipments would originate at SRS and be transported offsite by either rail or truck conveyance for final treatment and/or disposal. As discussed in the scope of the proposed action, the destinations addressed in this EA include: 1) Idaho Falls, Idaho; 2) Eunice, New Mexico; 3) Beatty, Nevada; 4) Oak Ridge, Tennessee; 5) Clive, Utah; and 6) Richland, Washington.

The LLW and MLLW proposed for shipment offsite may be in one of five forms (Table 1-1). The first case involves M-Area blended uranium immobilized in glass. The second and third cases consider miscellaneous debris at a contamination level of 99 nCi Pu^{239} per gram for volumes corresponding to 4.41E+06 ft^3 and 45,000 drums (3.31E+05 ft^3), respectively. The fourth case considers 5000 drums of liquid with a concentration of 99 nCi Pu^{239} per gram. This material is shipped in a Type A shipping container, a Low Specific Activity (LSA) drum or the equivalent of one of these. The fifth case also involves liquids with a concentration of 99 nCi Pu^{239} per gram. However, this waste would be shipped in 10 tanker trailers, each with a volume of 12,869 liters (3,400 gallons).

3.2.2 Assumptions

Isotopic contents of the first source term case were developed from laboratory analysis and accountability reports (Thoman 2000). It should be noted that the second through fifth source terms are hypothetical worst case scenarios. This is only an assumption for use in the RADTRAN model; furthermore, there are presently no known LLW or MLLW forms onsite with this concentration of plutonium radioactivity. These source terms were chosen to provide worst case bounding scenarios within the context of this EA.

Transport of the material would be containers in exclusive use vehicles. Table 3-1 presents the isotopic composition of each of the five source terms. Table 3-2 presents the number of containers per shipment and the total number of shipments for each source term.

Both incident-free and accident radiological impacts for the shipment of LLW and MLLW from SRS were analyzed. Routing conditions (including population densities, distance and time traveled, and fraction of highway and rail travel in urban, suburban and rural population zones) were obtained from the HIGHWAY 3.4 (Johnson et al. 1993, Maheras and Pippen 1995) and INTERLINE (Maheras and Pippen 1995) computer codes for truck and rail transport, respectively. Routing parameters are listed in Tables 3-3 and

Table 3-1. Isotopic composition for the five source terms (Hang 2000, Hang and Thoman 2000, Thoman 2000).

Source Term Number	Isotope	Total Activity (in Ci)	Average Activity per Drum (in Ci)	Average Activity per Railcar (in Ci)	Average Activity per Truck (in Ci)
1	U^{235}	1.86E-01	6.53E-05	1.63E-02	3.93E-03
	U^{238}	9.59E+00	3.36E-03	8.41E-01	2.02E-01
2	Pu^{239}	1.90E+04	3.16E-02	8.6E+00	1.90E+00[a]
3	Pu^{239}	1.42E+03	3.16E-02	N/A[b]	1.90E+00
4	Pu^{239}	1.65E+02	3.31E-02	N/A[b]	1.97E+00
5	Pu^{239}	1.97E+01	N/A[c]	N/A[b]	1.97E+00

[a] - Rail ends at Pocatello, ID and Las Vegas, NV. Therefore, truck was analyzed only for these two cases: from Pocatello to Idaho Falls, ID and from Las Vegas to Beatty, NV
[b] - The volume of material in this source term is transported solely via trucks
[c] - The volume of material in source term 5 is transported solely via tanker trailer.

3-4 for truck and rail shipments, respectively, and include the distance traveled and the percent of route in rural, suburban, and urban areas. Routing conditions, dose rates, and neutron-gamma fractions were used as inputs to the RADTRAN 4 computer code (Neuhauser and Kanipe 1992, 1995, Maheras and Pippen 1995) to calculate radiological impacts. The exact route chosen to ship the material depends on many factors and will be similar but probably not identical to the route projected here.

Input to RADTRAN 4 is described in Table 3-5 below for truck and rail shipments. Pathways analyzed for human exposure include direct exposure from contained material, and inhalation and airborne immersion from accidentally released material.

This analysis did not attempt to quantify risks from agricultural products contaminated as a result of dispersal of the material being transported and involved in a serious accident. Emergency Action Guidelines applicable to the area surrounding an accident would require interdiction of crops, cattle, and milk at specific thresholds, and these foodstuffs would thus be taken out of the market. As a result, the options dealing with this analysis

Table 3-2. Transport information for each source term.

Source Term Number	Drums or Volume per Railcar	Drums or Volume per Trainload [a]	Total Number of Trainloads	Drums per Truck	Total Number of Truckloads
1	250	2,850	1	60	50
2	57 m^3 (2,000 ft^3)	1,132.80 m^3 (~ 40,000 ft^3)	111	60	10,000
3	N/A	N/A	N/A	60	750
4	N/A	N/A	N/A	60	84
5	N/A	N/A	N/A	N/A	10 [b]

[a] Assuming a maximum of 20 railcars per trainload (Hang 2000, Hang and Thoman 2000)
[b] Source term 5 is transported via tanker trailer

were set to the "off" condition, and no calculations were made by the software to assign risk values to food pathways. All other accidental exposure pathways were considered.

3.2.3 Radiological Consequences

Incident-Free Conditions – The level of the incident-free consequence depends on the dose rate at the external surface of the transport vehicle. The current analysis is based on identifying an external radiation field from the transported waste that is equivalent to the maximum allowable by Part 173 of the Code of Federal Regulations under Title 49, Transportation (CFR 1999), or 0.1 mSv/h (10 mrem/hour) at 2 meters distance from the package.

A limited radiation transport study was performed to evaluate the ratio of dose rate as a function of distance, given the package dimension and resulting field from the various waste forms (White 2000). The study indicated the ratio of 1-meter dose rate to the 2-meter dose rate in the same direction from the waste container varies from about 2 to a little above 3, and is maximum for the field at package "end" (Table 3-6). As a conservatism, the effective dose equivalent (EDE) field input to RADTRAN was scaled

Table 3-3. Routing parameters for offsite SRS solid waste truck shipments.

Destination	Total Distance in Kilometers (in Miles)	Percent Rural	Percent Suburban	Percent Urban
SRS to Idaho Falls, Idaho	3,471.3 (2,157.0)	82.9	15.3	1.8
SRS to Eunice, New Mexico	2,349.6 (1,460.0)	77.7	21.0	1.3
SRS to Beatty, Nevada	3,654.7 (2,271.0)	84.2	14.2	1.6
SRS to Oak Ridge, Tennessee	539.1 (335.0)	66.7	32.5	0.8
SRS to Clive, Utah	3,479.3 (2,162.0)	83.2	15.2	1.6
SRS to Richland, Washington	4,240.5 (2,635.0)	84.2	14.2	1.6
Pocatello, Idaho to Idaho Falls, Idaho	90.1 (56.0)	71.7	24.5	3.8
Las Vegas, Nevada to Beatty, Nevada	209.2 (130.0)	83.4	10.0	6.6

by a factor of 4 from the 49 CFR 173 limit of 0.1 mSv/h (10 mrem/hour) at 2 meters, to 0.4 mSv/h (40 mrem/hour) at 1 meter.

The EDE field is used in RADTRAN to predict worker and general public exposure during transit as part of the incident-free risk. In the RADTRAN analysis, the dose field parameter is not specific to radiation decay energies associated with the waste package radionuclide composition; rather as stated above, it is tied to a bounding limit allowed by 49 CFR 173. As recommended by the RADTRAN code user's manual, the external radiation field is attributed entirely to gamma radiation.

Table 3-4. Routing parameters for offsite SRS solid waste rail shipments.

Destination	Total Distance in Kilometers (in Miles)	Percent Rural	Percent Suburban	Percent Urban
SRS to Pocatello, Idaho	3,885.8 (2,414.6)	85.4	13.2	1.4
SRS to Eunice, New Mexico	2,745.8 (1,706.2)	77.7	20.1	2.2
SRS to Las Vegas, Nevada	4,545.5 (2,824.6)	86.3	12.2	1.5
SRS to Oak Ridge, Tennessee	636.6 (395.6)	64.2	33.9	1.9
SRS to Clive, Utah	3,804.5 (2,364.1)	84.8	13.4	1.8
SRS to Richland, Washington	5,017.3 (3,117.8)	82.0	15.7	2.3

Additional key parameters include the exposure time and distance of the receptors, and the number of receptors involved in the transport process. Additionally, on-link receptors not involved in the transport process are exposed, as are off-link receptors near the transport path. On-link receptors are members of the general public assumed to be on the transportation corridor (both railway and roadway) in other vehicles. Off-link receptors are members of the general public assumed to live or work near the transportation corridor. Table 3-7 provides the incident-free consequence results for transport of the five source terms to the six treatment and/or disposal locations (Hang and O'Kula 2000). Additionally, Table 3-7 lists the natural background dose for the same population. By default, RADTRAN locates the maximum individual at a distance of 30 meters from the transport link (highway or rail line). Crew and handler dose calculations are based on the number of packages per shipment, the dose rate from the packages, and the average time of exposure.

Table 3-5. RADTRAN input data for truck and rail shipments.

Input Variable	Value or Source of Data	
	Truck	Rail
Material Dispersion Category	2 (Case 1), 5 (Cases 2 and 3), 8 (Cases 4 and 5)	2 (Case 1), 5 (Case 2)
Packages per Shipment	See Table 3-2	See Table 3-2
Number of Shipments	See Table 3-2	See Table 3-2
External Radiation Field	40 mrem/h at 1 m	40 mrem/h at 1 m
Fraction of Gamma Radiation	1	1
Length of Package	0.86 meters[a]	20 meters
Isotopes in Package	See Table 3-1	See Table 3-1
Activity in Package	See Table 3-1	See Table 3-1
Distance Traveled	(Hang, 2000)	(Hang, 2000)
Fraction of Travel in Population Zone	(Hang, 2000)	(Hang, 2000)
Accident Severity Categories	8	8
Accident Rates (Accident Per Mile)	1.4E-6 rural 1.4E-6 suburban 1.4E-6 urban	2.4E-6 rural 2.4E-6 suburban 2.4E-6 urban

[a] Except for Case 5 tanker truck

Table 3-6. Radiation dose field ratios for truck and rail waste forms.

Case	Description	Ratio of Dose rate at 1 m/Dose rate at 2 m		
		Side	Top	End
1/Truck	Vitrified uranium in drums, transported by truck	1.94	1.75	2.72
1/Rail	Vitrified uranium in drums, transported by rail	1.44	1.70	1.99
2/Rail	Plutonium in soil and debris in drums, transported by rail	1.53	1.69	2.10
2/Truck	Plutonium in soil and debris in drums, transported by truck	1.97	1.72	2.76
3/Truck	Plutonium in soil and debris in drums, transported by truck	1.97	1.72	2.76
4/Truck	Plutonium in solution in drums, transported by truck	1.97	1.72	2.77
5/Truck	Plutonium in solution, transported by tanker truck	1.71	1.71	3.11

Accident Consequences – Radiological risks from accidentally released material due to transport vehicle collision would result primarily from the release of respirable radioactive particulates and subsequent inhalation by individuals downwind of the accident, either directly or after resuspension. Other exposure pathways of significance include direct radiation from the cloud of airborne material and from contamination on the ground. Consequences involving contaminated agricultural products as a result of dispersion of the accidentally released material are not considered. Emergency Action Guidelines applicable to the area surrounding an accident would require diversion of crops, cattle, and milk at specific thresholds, and these foodstuffs would thus be taken out of the market.

Table 3-7. Incident-free radiological consequences (Hang and O'Kula 2000).

Route Case - Mode	Incident-free workers exposure (person – rem)	Incident-free general public exposure (person – rem)	Maximum individual general public dose (rem)	Exposed population – incident-free (persons)	Natural background dose to incident-free general public (person – rem)[a]
SRS to Clive, UT					
Case 1 - Rail	1.45E+00	1.23E-01	8.40E-05	5.41E+05	1.62E+05
Case 2 - Rail	2.26E+02	1.37E+01	1.55E-02	5.41E+05	1.62E+05
Case 1 - Truck	1.80E+01	9.33E+00	9.38E-04	5.21E+05	1.56E+05
Case 3 - Truck	2.71E+02	1.40E+02	1.41E-02	5.21E+05	1.56E+05
Case 4 - Truck	3.03E+01	1.57E+01	1.58E-03	5.21E+05	1.56E+05
Case 5 - Truck	2.70E+01	2.82E+01	7.00E-05	5.21E+05	1.56E+05
SRS to Eunice, NM					
Case 1 - Rail	1.42E+00	1.18E-01	8.40E-05	5.49E+05	1.65E+05
Case 2 - Rail	2.23E+02	1.31E+01	1.55E-02	5.49E+05	1.65E+05
Case 1 - Truck	1.25E+01	6.39E+00	9.38E-04	3.91E+05	1.17E+05
Case 3 - Truck	1.87E+02	9.59E+01	1.41E-02	3.91E+05	1.17E+05
Case 4 - Truck	2.10E+01	1.07E+01	1.58E-03	3.91E+05	1.17E+05
Case 5 - Truck	1.84E+01	1.93E+01	7.00E-05	3.91E+05	1.17E+05
SRS to Oak Ridge, TN					
Case 1 - Rail	1.34E+00	5.12E-02	8.40E-05	1.61E+05	4.83E+04
Case 2 - Rail	2.14E+02	5.69E+00	1.55E-02	1.61E+05	4.83E+04
Case 1 - Truck	3.02E+00	1.51E+00	9.38E-04	1.03E+05	3.09E+04
Case 3 - Truck	4.53E+01	2.26E+01	1.41E-02	1.03E+05	3.09E+04
Case 4 - Truck	5.07E+00	2.52E+00	1.58E-03	1.03E+05	3.09E+04
Case 5 - Truck	4.24E+00	4.55E+00	7.00E-05	1.03E+05	3.09E+04
SRS to Hanford, WA					
Case 1 - Rail	1.50E+00	1.76E-01	8.40E-05	8.98E+05	2.69E+05
Case 2 - Rail	2.32E+02	1.95E+01	1.55E-02	8.98E+05	2.69E+05
Case 1 - Truck	2.18E+01	1.13E+01	9.38E-04	6.14E+05	1.84E+05
Case 3 - Truck	3.28E+02	1.70E+02	1.41E-02	6.14E+05	1.84E+05
Case 4 - Truck	3.67E+01	1.90E+01	1.58E-03	6.14E+05	1.84E+05
Case 5 - Truck	3.29E+01	3.43E+01	7.00E-05	6.14E+05	1.84E+05

Table 3-7. (Continued).

Route Case - Mode	Incident-free workers exposure (person – rem)	Incident-free general public exposure (person – rem)	Maximum individual general public dose (rem)	Exposed population – incident-free (persons)	Natural background dose to incident-free general public (person – rem)[a]
SRS to Beatty, NV					
Case 1 – Rail	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]
Case 2 – Rail	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]
Case 1 – Truck	1.88E+01	9.78E+00	9.38E-04	5.41E+05	1.62E+05
Case 3 – Truck	2.82E+02	1.47E+02	1.41E-02	5.41E+05	1.62E+05
Case 4 – Truck	3.17E+01	1.65E+01	1.58E-03	5.41E+05	1.62E+05
Case 5 – Truck	2.84E+01	2.96E+01	7.00E-05	5.41E+05	1.62E+05
SRS to Idaho Falls, ID					
Case 1 – Rail	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]
Case 2 – Rail	NA[c]	NA[c]	NA[c]	NA[c]	NA[c]
Case 1 – Truck	1.80E+01	9.33E+00	9.38E-04	5.53E+05	1.66E+05
Case 3 – Truck	2.70E+02	1.40E+02	1.41E-02	5.53E+05	1.66E+05
Case 4 – Truck	3.03E+01	1.57E+01	1.58E-03	5.53E+05	1.66E+05
Case 5 – Truck	2.71E+01	2.83E+01	7.00E-05	5.53E+05	1.66E+05
SRS to Las Vegas, NV					
Case 1 – Rail	1.48E+00	1.44E-01	8.40E-05	5.84E+05	1.75E+05
Case 2 – Rail	2.30E+02	1.60E+01	1.55E-02	5.84E+05	1.75E+05
Las Vegas, NV to Beatty, NV					
Case 1 – Truck	1.12E+00	5.83E-01	9.38E-04	7.29E+04	2.19E+04
Case 2 – Truck	2.23E+02	1.17E+02	1.88E-01	7.29E+04	2.19E+04
SRS to Pocatello, ID					
Case 1 – Rail	1.45E+00	1.23E-01	8.40E-05	4.94E+05	1.48E+05
Case 2 – Rail	2.27E+02	1.36E+01	1.55E-02	4.94E+05	1.48E+05

Table 3-7. (Continued).

Route Case - Mode	Incident-free workers exposure (person – rem)	Incident-free general public exposure (person – rem)	Maximum individual general public dose (rem)	Exposed population – incident-free (persons)	Natural background dose to incident-free general public (person – rem)[a]
Pocatello, ID to Idaho Falls, ID					
Case 1 – Truck	5.01E-01	2.55E-01	9.38E-04	2.78E+04	8.34E+03
Case 2 – Truck	1.00E+02	5.10E+01	1.88E-01	2.78E+04	8.34E+03

[a] Based on an average individual background dose of 300 mrem/yr (Kathren, 1984).
[b] Rail ends at Las Vegas, NV. Results are presented in table for two separate legs consisting of: (1) rail from SRS to Las Vegas, and (2) truck from Las Vegas to Beatty, NV.
[c] Rail ends at Pocatello, ID. Results are presented in table for two separate legs consisting of: (1) rail from SRS to Pocatello, ID, and (2) truck from Pocatello to Idaho Falls, ID.

Consequences of an accident depend upon the severity and population density at the location of the accident. Table 3-8 provides the sum of the accident risks for transport of the five source terms to the six treatment and/or disposal facilities (Hang and O'Kula 2000). Table 3-8 also lists the natural background dose for the same population.

Health Effects – Tables 3-7 and 3-8 present doses for transportation under both incident-free and accident conditions. Health effects, measured as the number of potential latent cancer fatalities (LCFs), were calculated by multiplying the population consequence (in units of person-rem) by the cancer risk factor of 5E-4 potential LCFs per person-rem (DOE 1993). For maximum individual exposures, this same value is used to calculate cancer mortality probability. Table 3-9 presents the maximum calculated total incidence of potential LCFs for incident-free transport and due to an accident from shipments of LLW and MLLW from SRS.

Consequences of an accident depend upon the severity and population density at the location of the accident. Table 3-8 provides the sum of the accident risks for transport of the five source terms to the six treatment and/or disposal facilities. Additionally, Table 3-8 lists the natural background dose for the same population.

Table 3-8. Sum of accident radiological consequences (Hang and O'Kula 2000).

Route Case - Mode	Accident risk general public (person – rem)	Exposed general public – accident (persons)	Natural background dose to accident exposed general public (person – rem) [a]
SRS to Clive, UT			
Case 1 - Rail	6.69E-07	3.34E+06	1.00E+06
Case 2 - Rail	3.28E+02	3.34E+06	1.00E+06
Case 1 - Truck	3.58E-07	3.39E+06	1.02E+06
Case 3 - Truck	1.31E+01	3.39E+06	1.02E+06
Case 4 - Truck	3.07E+02	3.39E+06	1.02E+06
Case 5 - Truck	3.63E+01	3.39E+06	1.02E+06
SRS to Eunice, NM			
Case 1 - Rail	7.36E-07	3.35E+06	1.01E+06
Case 2 - Rail	3.61E+02	3.35E+06	1.01E+06
Case 1 - Truck	3.13E-07	3.13E+06	9.38E+05
Case 3 - Truck	1.14E+01	3.13E+06	9.38E+05
Case 4 - Truck	2.69E+02	3.13E+06	9.38E+05
Case 5 - Truck	3.17E+01	3.13E+06	9.38E+05
SRS to Oak Ridge, TN			
Case 1 - Rail	2.56E-07	3.10E+06	9.31E+05
Case 2 - Rail	1.26E+02	3.10E+06	9.31E+05
Case 1 - Truck	9.42E-08	2.94E+06	8.81E+05
Case 3 - Truck	3.45E+00	2.94E+06	8.81E+05
Case 4 - Truck	8.09E+01	2.94E+06	8.81E+05
Case 5 - Truck	9.56E+00	2.94E+06	8.81E+05
SRS to Hanford, WA			
Case 1 - Rail	1.09E-06	3.41E+06	1.02E+06
Case 2 - Rail	5.37E+02	3.41E+06	1.02E+06
Case 1 - Truck	4.14E-07	3.39E+06	1.02E+06
Case 3 - Truck	1.52E+01	3.39E+06	1.02E+06
Case 4 - Truck	3.56E+02	3.39E+06	1.02E+06
Case 5 - Truck	4.20E+01	3.39E+06	1.02E+06
SRS to Beatty, NV			
Case 1 – Rail	NA[b]	NA[b]	NA[b]
Case 2 – Rail	NA[b]	NA[b]	NA[b]
Case 1 – Truck	3.64E-07	3.47E+06	1.04E+06
Case 3 – Truck	1.33E+01	3.47E+06	1.04E+06
Case 4 – Truck	3.13E+02	3.47E+06	1.04E+06
Case 5 – Truck	3.70E+01	3.47E+06	1.04E+06

Table 3-8. (Continued).

Route Case - Mode	Accident risk General public (person – rem)	Exposed general public – accident (persons)	Natural background dose to accident exposed general public (person – rem) [a]
SRS to Idaho Falls, ID			
Case 1 – Rail	NA[c]	NA[c]	NA[c]
Case 2 – Rail	NA[c]	NA[c]	NA[c]
Case 1 – Truck	3.67E-07	3.41E+06	1.02E+06
Case 3 – Truck	1.35E+01	3.41E+06	1.02E+06
Case 4 – Truck	3.16E+02	3.41E+06	1.02E+06
Case 5 – Truck	3.73E+01	3.41E+06	1.02E+06
SRS to Las Vegas, NV			
Case 1 – Rail	7.52E-07	3.39E+06	1.02E+06
Case 2 – Rail	3.69E+02	3.39E+06	1.02E+06
Las Vegas, NV to Beatty, NV			
Case 1 – Truck	2.34E-08	4.08E+06	1.22E+06
Case 2 – Truck	1.14E+01	4.08E+06	1.22E+06
SRS to Pocatello, ID			
Case 1 – Rail	6.57E-07	3.36E+06	1.01E+06
Case 2 – Rail	3.23E+02	3.36E+06	1.01E+06
Pocatello, ID to Idaho Falls, ID			
Case 1 – Truck	1.92E-08	3.14E+06	9.41E+05
Case 2 – Truck	9.37E+00	3.14E+06	9.41E+05

[a] Based on an average individual background dose of 300 mrem/yr (Kathren, 1984)

[b] Rail ends at Las Vegas, NV. Results are presented in table for two separate legs consisting of: (1) rail from SRS to Las Vegas; and (2) truck from Las Vegas to Beatty, NV.

[c] Rail ends at Pocatello, ID. Results are presented in table for two separate legs consisting of: (1) rail from SRS to Pocatello, ID, and (2) truck from Pocatello to Idaho Falls, ID.

3.2.4 Non-radiological Transportation Accidents

The nonfatal and fatal accident probabilities per shipment for material transported along the postulated truck routes are listed in Table 3-10. The average nonfatal accident rate for vehicles is 1.4E-06 accidents per kilometer (DOT 1999b). The traffic fatality rate used in the analysis is from DOT 1998 data for large trucks (DOT 1999b). DOE assumes that the percent of accidents resulting in a fatality would be the same as that for interstate travel

Table 3-9. Number of potential latent cancer fatalities for incident-free and accident transportation (Hang and O'Kula 2000).

Route Case - Mode	Potential LCFs for workers for incident-free transportation	Potential LCFs for general public for incident-free transportation	Potential LCFs for accident exposed population
SRS to Clive, UT			
Case 1 - Rail	7.25E-04	6.16E-05	3.35E-10
Case 2 - Rail	1.13E-01	6.83E-03	1.64E-01
Case 1 - Truck	9.01E-03	4.67E-03	1.79E-10
Case 3 - Truck	1.36E-01	7.02E-02	6.55E-03
Case 4 - Truck	1.52E-02	7.86E-03	1.54E-01
Case 5 - Truck	1.35E-02	1.41E-02	1.82E-02
SRS to Eunice, NM			
Case 1 - Rail	7.08E-04	5.91E-05	3.68E-10
Case 2 - Rail	1.11E-01	6.56E-03	1.81E-01
Case 1 - Truck	6.25E-03	3.19E-03	1.57E-10
Case 3 - Truck	9.36E-02	4.79E-02	5.70E-03
Case 4 - Truck	1.05E-02	5.37E-03	1.35E-01
Case 5 - Truck	9.19E-03	9.67E-03	1.59E-02
SRS to Oak Ridge, TN			
Case 1 - Rail	6.69E-04	2.56E-05	1.28E-10
Case 2 - Rail	1.07E-01	2.84E-03	6.30E-02
Case 1 - Truck	1.51E-03	7.53E-04	4.71E-11
Case 3 - Truck	2.27E-02	1.13E-02	1.73E-03
Case 4 - Truck	2.54E-03	1.26E-03	4.05E-02
Case 5 - Truck	2.12E-03	2.27E-03	4.78E-03
SRS to Hanford, WA			
Case 1 - Rail	7.50E-04	8.80E-05	5.45E-10
Case 2 - Rail	1.16E-01	9.76E-03	2.69E-01
Case 1 - Truck	1.09E-02	5.66E-03	2.07E-10
Case 3 - Truck	1.64E-01	8.51E-02	7.60E-03
Case 4 - Truck	1.84E-02	9.52E-03	1.78E-01
Case 5 - Truck	1.65E-02	1.71E-02	2.10E-02
SRS to Beatty, NV			
Case 1 – Rail	NA[a]	NA[a]	NA[a]
Case 2 – Rail	NA[a]	NA[a]	NA[a]
Case 1 – Truck	9.42E-03	4.89E-03	1.82E-10
Case 3 – Truck	1.41E-01	7.34E-02	6.65E-03
Case 4 – Truck	1.59E-02	8.23E-03	1.57E-01
Case 5 – Truck	1.42E-02	1.48E-02	1.85E-02

Table 3-9. (Continued).

Route Case - Mode	Potential LCFs for workers for incident-free transportation	Potential LCFs for general public for incident-free transportation	Potential LCFs for accident exposed population
SRS to Idaho Falls, ID			
Case 1 – Rail	NA[b]	NA[b]	NA[b]
Case 2 – Rail	NA[b]	NA[b]	NA[b]
Case 1 – Truck	9.02E-03	4.67E-03	1.84E-10
Case 3 – Truck	1.35E-01	6.98E-02	6.75E-03
Case 4 – Truck	1.52E-02	7.83E-03	1.58E-01
Case 5 – Truck	1.35E-02	1.41E-02	1.87E-02
SRS to Las Vegas, NV			
Case 1 – Rail	7.41E-04	7.19E-05	3.76E-10
Case 2 – Rail	1.15E-01	7.98E-03	1.85E-01
Las Vegas, NV to Beatty, NV			
Case 1 – Truck	5.59E-04	2.92E-04	1.17E-11
Case 2 – Truck	1.12E-01	5.83E-02	5.70E-03
SRS to Pocatello, ID			
Case 1 – Rail	7.26E-04	6.14E-05	3.29E-10
Case 2 – Rail	1.13E-01	6.81E-03	1.62E-01
Pocatello, ID to Idaho Falls, ID			
Case 1 – Truck	2.51E-04	1.27E-04	9.60E-12
Case 2 – Truck	5.02E-02	2.55E-02	4.69E-03

[a] Rail ends at Las Vegas, NV. Results are presented in table for two separate legs consisting of (1) rail from SRS to Las Vegas and (2) truck from Las Vegas to Beatty, NV.

[b] Rail ends at Pocatello, ID. Results are presented in table for two separate legs consisting of (1) rail from SRS to Pocatello, ID and (2) truck from Pocatello to Idaho Falls, ID.

by truck, 7.5 percent (DOT 1989). This is conservative with respect to the 1998 DOT data which shows that only 1.2 percent of large truck accidents resulted in fatalities (DOT 1999b).

Based on the data from the third column, this proposed action is not expected to result in a fatal accident. As indicated in the second column, some nonfatal accidents may be expected from the proposed action.

Table 3-10. Expected accident levels for the designated truck travel routes (O'Kula 2000).

Route Case	Expected Number of Nonfatal Accidents	Expected Number of Fatal Accidents
SRS to Clive, UT		
Case 1	2.44E-01	1.83E-02
Case 3	3.65E+00	2.74E-01
Case 4	4.09E-01	3.07E-02
Case 5	4.87E-02	3.65E-03
SRS to Eunice, NM		
Case 1	1.64E-01	1.23E-02
Case 3	2.47E+00	1.85E-01
Case 4	2.76E-01	2.07E-02
Case 5	3.29E-02	2.47E-03
SRS to Oak Ridge, TN		
Case 1	3.77E-02	2.83E-03
Case 3	5.66E-01	4.25E-02
Case 4	6.34E-02	4.75E-03
Case 5	7.55E-03	5.66E-04
SRS to Hanford, WA		
Case 1	2.97E-01	2.23E-02
Case 3	4.45E+00	3.34E-01
Case 4	4.99E-01	3.74E-02
Case 5	5.94E-02	4.45E-03
SRS to Beatty, NV		
Case 1	2.56E-01	1.92E-02
Case 3	3.84E+00	2.88E-01
Case 4	4.30E-01	3.22E-02
Case 5	5.12E-02	3.84E-03

Table 3-10. (Continued)

Route Case	Expected Number of Nonfatal Accidents	Expected Number of Fatal Accidents
SRS to Idaho Falls, ID		
Case 1	2.43E-01	1.82E-02
Case 3	3.64E+00	2.73E-01
Case 4	4.08E-01	3.06E-02
Case 5	4.86E-02	3.64E-03
Las Vegas, NV to Beatty, NV		
Case 1	1.46E-02	1.10E-03
Case 2	2.93E+00	2.20E-01
Pocatello, ID to Idaho Falls, ID		
Case 1	6.31E-03	4.73E-04
Case 2	1.26E-00	9.46E-03

The nonfatal and fatal accident probabilities per shipment for material transported along the postulated rail routes are listed in Table 3-11. For train events, the 1998 accident rate was 3.77 accidents per million train miles, corresponding to an accident probability rate of 2.4E-06 accidents per kilometer (DOT 1999a). Fatal accident probabilities were not provided by DOT, although 8.1 percent of all reported casualties were fatal. Based on the data from the third column of Table 3-11, this proposed action is not expected to result in a fatal accident. As indicated in the second column, some nonfatal accidents may be expected from the proposed action.

3.2.5 Environmental Justice

In general, the consequences associated with incident free and accident conditions of the offsite transportation were small for the exposed population. This is due to the low expected frequency of such accident scenarios and the ability to mitigate the impacts of such events with the existing training and technology for controlling spills or releases from vehicles. These rare events would also be expected to occur randomly in time with

Table 3-11. Expected accident levels for the designated rail travel routes (O'Kula 2000).

Route Case	Expected Number of Nonfatal Accidents	Expected Number of Fatal Accidents
SRS to Clive, UT		
Case 1	9.13E-03	7.40E-04
Case 2	1.01E+00	8.21E-02
SRS to Eunice, NM		
Case 1	6.59E-03	5.34E-04
Case 2	7.31E-01	5.92E-02
SRS to Oak Ridge, TN		
Case 1	1.53E-03	1.24E-04
Case 2	1.70E-01	1.37E-02
SRS to Hanford, WA		
Case 1	1.20E-02	9.75E-04
Case 2	1.34E+00	1.08E-01
SRS to Las Vegas, NV		
Case 1	1.09E-02	8.84E-04
Case 2	1.21E+00	9.81E-02
SRS to Pocatello, ID		
Case 1	9.33E-03	7.55E-04
Case 2	1.04E+00	8.38E-02

equal distribution throughout various types of communities. Based on the percentage breakdown of the routes analyzed, the highest risk would be along rural interstate highways (Table 3-3). Minorities are found to be disproportionately lower in representation in the populations residing near interstate highways (DOT 1992). Therefore, there would be little to no potential for a disproportionately high adverse impact on either poor or minority communities from the proposed shipments from SRS to the offsite commercial and government facilities.

Based on the radioactive and hazardous materials transportation analyses conducted in support of the DOE programmatic waste management EIS (DOE 1997a), minority or low-income populations in either the Hanford Site, Idaho National Engineering Laboratory, Nevada Test Site, SRS or Oak Ridge areas would not be expected to experience disproportionately high adverse health impacts associated with LLW or MLLW shipments from the DOE sites at those locations. The Envirocare of Utah, Inc., and Waste Control Specialists vendor facilities are located in such remote, unpopulated areas that no environmental justice impacts would be expected.

3.2.6 Conclusion

Doses have been calculated from each of the transportation options using the RADTRAN 4 computer code for the following conservative assumptions:

- 99 nCi/g Pu^{239} (maximum amount of worst case isotope for low-level waste)
- 10 mrem/hour @ 2 meters (interpretation of maximum radiation field allowed by 49 CFR 173)

The health effects, measured as the number of potential LCFs, due to exposure from the radioactive waste during incident free and accident conditions of transportation are specified in Table 3-9. To conservatively determine the cumulative effects from transporting all five waste forms, the highest number for each case should be added together. This results in a potential LCF to workers of 0.437, to the public of 0.184, and during an accident of 0.475 (assuming an accident occurs for each waste type). No LCFs are expected from the proposed action since the numbers are all less than 1. The expected number of nonfatal and fatal accidents from truck and rail transportation is specified in Tables 3-10 and 3-11, respectively. To conservatively determine the cumulative effects of transportation the highest number for each case should be added together to determine the overall expected number of accidents, both non-fatal and fatal. DOE expects transportation to result in about nine non-fatal accidents and no fatal accidents.

3.3 Waste Processing Centers Operations

Operations at the commercial facilities are ongoing activities and environmental impacts of their operations are not evaluated in this EA. The operation of such facilities would be classified as low hazard facility under DOE Order 5481.1B. A low hazard classification is used to define facilities which, in the event of an unmitigated release of the total radiological inventory contained in that facility, would present only minor onsite and negligible offsite impacts to either people or the environment. Under the terms of the proposed contracts, the vendors would be responsible for identifying and complying with all applicable laws and regulations governing the operation of the offsite facility and transportation of LLW and MLLW from SRS. The waste treatment and/or disposal operations at the government facilities (i.e., Hanford Site, Idaho National Environmental

and Engineering Laboratory, and Nevada Test Site) were addressed in DOE (1995c, 1996, 1997a, 1999a).

3.4 Environmental Consequences of the Alternatives

The no-action alternative would create none of the transportation impacts associated with the proposed action. However, implementation of the no-action alternative would ultimately result in a shortage of interim storage and disposal space for the five waste forms. This situation would create problems associated with the management of large and increasing volumes of waste in these storage areas. There would be an increase in onsite land use to accommodate these larger waste volumes. However, all of this would likely be in already developed or industrialized areas onsite. In addition, the worker exposure would be higher because of increased time period in storage. More over, continued storage would not be consistent with the agreements between DOE and the State of South Carolina concerning MLLW management under the SRS Site Treatment Plan that was developed pursuant to the Federal Facility Compliance Act of 1992. Violating these agreements could result in fines and penalties for DOE as well as suspension of the site's RCRA permit.

The alternative to construct and operate treatment and disposal capabilities at SRS would result in a variety of impacts associated with these facilities. The impacts resulting from this alternative were addressed in DOE (1995a). These consequences would include land use, socioeconomic, and human health impacts. The new facilities would require a minimum of approximately 40 hectares (99 acres) of currently undeveloped land onsite. Depending upon the specific location for these facilities, other impacts (e.g., hydrological, ecological, and archaeological) could also be realized. In addition, since the project planning for such facilities has not even been initiated at this time, the storage of existing waste inventories and those volumes generated in the near-term would also present problems similar to those stated for the no-action alternative. The cost of this alternative would also be significantly greater than the proposed action.

3.5 Cumulative Impacts

The principle cumulative impacts from the proposed action would be those associated with the offsite transportation of the five waste forms. There would be no change in the site workforce. No excess LCFs would be expected to result from radiation doses resulting from non-incident and accident scenarios during transportation of the waste forms in this proposed action. The human population exposures resulting from this proposed action are several orders of magnitude less than naturally occurring background radiation exposure to the same population; thus, no impacts are expected on human health. Although nine accidents may be expected from transportation of the proposed action, no fatalities associated with these accidents are expected. In addition, no disproportionately high adverse environmental justice impacts would be expected from the proposed action.

4.0 REGULATORY AND PERMITTING PROVISIONS CONSIDERED

DOE policy is to carry out its operations in compliance with all applicable Federal, State and local laws and regulations, as well as all DOE Orders. This section provides a discussion of the major regulatory permit programs that might be applicable to the proposed action.

4.1 National Environmental Policy Act of 1969, as amended (42 USC 4321 et seq.)

This EA has been prepared in accordance with NEPA of 1969, as amended, and with the requirements of the Council of Environmental Quality Regulations for Implementing NEPA (40 CFR 1500-1508), DOE Regulations (10 CFR 1021), and DOE Order 451.1A. NEPA, as amended, requires "all agencies of the Federal Government" to prepare a detailed statement on the environmental effects of proposed "major Federal actions significantly affecting the quality of the human environment." This EA has been written to comply with NEPA and assess the environmental effects of the proposed offsite transportation of certain LLW and MLLW from SRS.

4.2 Waste Shipment Regulations

The vendor must comply with DOT regulation 49 CFR 173 for shipments of radioactive and hazardous materials and any applicable State regulations for transportation of radioactive and hazardous materials. The shipping vendor/motor carrier must pass a pre-trip inspection checklist in conformance with the requirements of the Federal Motor Carrier Safety Regulations (49 CFR 390-399).

4.3 Occupational Safety and Health Act of 1970, as amended (29 USC 651 et seq.)

The Occupational Safety and Health Act and the regulations thereunder do not directly apply to Federal agencies or government–owned corporations. However, Section 19 of the Act (29 USC 668) requires all Federal agencies to have occupational safety programs "consistent" with the Occupational Safety and Health Act standards. This requirement has been applied to government-owned corporations, as well as agencies, through 5 USC 7902 and Executive Order 12196.

5.0 AGENCIES AND PERSONS CONSULTED

Westinghouse Safety Management Services, Inc. were consulted during the preparation of this EA.

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