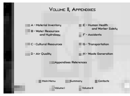

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G

Transportation

APPENDIX G – TRANSPORTATION

G.1 INTRODUCTION

This appendix contains material supporting the transportation impacts analysis. It details Sandia National Laboratories/New Mexico (SNL/NM)-related transportation activities pertaining to waste and other material. The information is taken from various documents, databases, and reports. Referenced documents used in the analysis include facility source documents (SNL/NM 1998a); the *SNL/NM Environmental Information Document* (SNL/NM 1997h); the *Environmental Assessment for SNL/NM Offsite Transportation of Low-level Radioactive Waste*, DOE/EA-1180 (DOE 1996h); and the *Medical Isotopes Production Project* [MIPP]: *Molybdenum-99 and Related Isotopes Environmental Impact Statement* [EIS], DOE/EIS-0249F (DOE 1996b). For additional information on air transportation issues, see the MIPP EIS, the *Hazardous Materials Shipments Report* (DOT 1998a), and the *Transportation Evaluation Report* [TER] *for Ross Aviation, Inc.* (Ross Aviation 1994). For additional information on waste generation, see Appendix H and Sections 5.3.10, 5.4.10, 5.5.10.

G.2 SCOPE OF THE ANALYSIS

The transportation-related impacts evaluation included the calculation of

- incident-free radiological doses and corresponding potential latent cancer fatalities (LCFs) to the crew and the public from radiation exposure,
- dose risks due to transportation accidents,
- nonradiological impacts due to traffic fatalities, and
- LCFs due to potential vehicle emissions of air pollutants.

These calculations were for combined lifetime fatalities from the transportation shipments of each material type. Overall impacts from all potential transportation activities for each of the alternatives considered in the SNL/NM Site-Wide Environmental Impact Statement (SWEIS) were also evaluated. The analysis focused on regular (or routine) shipments and identified shipment origins and destinations that posed the largest risks. Due to the nature of SNL/NM operations, irregular (nonroutine) or one-time shipments of hazardous materials from around the world are possible. However, the nonroutine shipments pertaining to transuranic (TRU) waste and special projects, such as legacy waste and Environmental Restoration (ER) Project wastes, were analyzed. The routine transportation operations analysis was conservative and bounding.

Air transportation-related impacts are bounded by truck transportation impacts. Three areas of air transportation were considered:

- air transportation of medical isotopes, as discussed in the MIPP EIS, including an accident analysis;
- air transportation of other materials, as discussed in the Office of Hazardous Materials Safety Research and Special Programs Administration's *Hazardous Materials Shipments Report* (DOT 1998a) (see Section G.8 for details)
- air transportation of the U.S. Department of Energy (DOE) and SNL/NM materials by Ross Aviation, as discussed in the *Transportation Evaluation Report for Ross Aviation, Inc. (Ross Aviation 1994)*

The MIPP EIS discusses the shipment of medical isotopes from the Albuquerque International Sunport to Boston, Chicago, and St. Louis. The number of shipments would be limited due to the number of direct flights (passenger or cargo) and the locations of the medical isotope distributors. Shipments would be transported to distribution airfreight hubs connecting with each of these three cities. Air traffic data were not available for the distribution airfreight hubs.

The MIPP EIS discussed radiological impacts to the public and onsite individuals due to routine transportation. The public included airplane passengers and people in the airport terminals. The *RADTRAN 4* computer model was used to perform these calculations.

Air transportation of other materials is discussed briefly in the *Hazardous Materials Shipment Report* (DOE 1998a). The Sunport freight center moved 130 M lb of cargo in 1998. It is estimated the Sunport would handle approximately 20 tons of hazardous materials per day. Nine major commercial carriers and five airfreight carriers serve the airport. Additional information is provided in Section G.8.

Air transportation by Ross Aviation is discussed in detail in the TER (Ross Aviation 1994). Appendix 2A of the TER describes the number of total air shipments and maximum quantities per shipment, including flammable liquids, compressed gases, explosives, and radioactives. Other information in the TER document includes environment, safety, and health (ES&H) management programs, types of aircraft, and operational safety requirements.

G.3 MATERIAL SHIPMENTS AND RECEIPTS

The various material types that have the potential for transportation impacts resulting from SNL/NM operations include radioactive, chemical, explosive, and waste materials. Radioactive waste includes low-level waste (LLW); low-level mixed waste (LLMW); TRU waste; municipal and construction solid waste; hazardous waste and other waste, including asbestos, biohazardous waste (medical), and polychlorinated biphenyls (PCBs).

The information required to determine the transportation impacts includes the number of shipments of each material type, potential origins of shipments, and potential destinations of shipments. This information was generated from available baseline data, projected material inventories, projected material usage, and projected waste generation presented in the facility source documents (SNL/NM 1998a) and associated inventory databases (such as the *Chemical Information System* [CIS]).

If implemented, the Microsystems and Engineering Sciences Applications (MESA) Complex configuration would not change the number of material (or waste) shipments. The current and projected material (or waste) shipments would accommodate any increases resulting from the MESA Complex operations. This condition has been extensively used in the following text and tables and is not cited repeatedly.

G.3.1 Radioactive Material

Shipping and receiving records from 1995, 1996, and 1997 were used to calculate related transportation impacts for radioactive material. This information included the number of shipments and receipts, origins, and destinations. SNL/NM ships and receives radioactive material from various locations in the U.S.

For each alternative, the number of potential radioactive material shipments was calculated using the normalized activity multipliers presented in Appendix A. The results are shown in Table G.3–1.

The longest and most representative route was selected for a bounding analysis. This was accomplished by reviewing baseline shipments and receipts information. The route from SNL/NM to Mountain Top, Pennsylvania, was selected to model from the many routes used in 1997 for radioactive material shipments and receipts (Table G.3–2). The modeled route was screened and represented the route with the largest number of shipments, longest distance, and highest population distribution (Section G.6).

In 1997, according to data reflected in Table G.3–1, 36 tests/shots resulted in 305 shipments or receipts. The projected tests/shots in the table are used to estimate projected shipments. Projected tests/shots presented in the SNL/NM facility source documents would require shipments or receipts ranging from 140 under the Reduced Operations Alternative to 1,782 under the Expanded Operations Alternative.

G.3.2 Chemicals

A review of the CIS database and inventories and usage information on chemicals determined that approximately 80 percent of the chemicals supplied to SNL/NM were

Table G.3–1. Estimated Total Annual Shipments and Receipts of Radioactive Material by Alternative

ACTIVITY	BASE YEAR 1997	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Tests/Shots	36	66.3	70.4	210.3	16.5
Shipments/Receipts	305	562	597	1,782	140

Source: SNL/NM 1998a

Table G.3–2. Truck Traffic Bounding Case Distances

MATERIAL TYPES[a]	ORIGIN-DESTINATION	DISTANCE (km)
***Radioactive*[b]**	SNL/NM—Bounding distance to Mountain Top, PA	3,022
Chemical	Albuquerque to SNL/NM	40
Explosive	SNL/NM to Silverdale, WA	2,406
LLW	SNL/NM to Clive, UT	1,722
LLMW*[c] *(Receipt)	SNL/CA to SNL/NM	1,780
LLMW (Shipment)	SNL/NM to Savannah River Site, SC	2,548
Hazardous Waste (Shipment)	SNL/NM to Clive, UT	1,722
Hazardous Waste (Receipt)	Local	13
Hazardous Waste (California) (Recyclable)	SNL/NM to Anaheim, CA	1,306
Hazardous Waste (Local) (Recyclable)	SNL/NM to Albuquerque, NM	32
Hazardous Solid Waste (D&D)	Local	32
Nonhazardous Solid Waste (Recyclable)	Local	32
Nonhazardous Landscaping (Recyclable)	SNL/NM to Rio Rancho, NM	50
Solid Waste (Municipal and C&D)	SNL/NM to Rio Rancho Sanitary Landfill, NM	50
TRU/MTRU*[d] *Waste	SNL/NM to Los Alamos National Laboratory, NM	167
Hazardous Waste TSCA-PCBs (D&D)	SNL/NM to Clive, UT	1,722
Hazardous Waste TSCA-Asbestos (D&D)	SNL/NM to Mountainair, NM	190
LLW (D&D)	SNL/NM to Clive, UT	1,722
Biohazardous Waste (Medical)	SNL/NM to Aragonite, UT	1,114
Legacy LLW (Storage)	SNL/NM to Clive, UT	1,722
Legacy LLMW (Storage)	SNL/NM to Savannah River Site, SC	2,548
Legacy TRU/MTRU (Storage)	SNL/NM to Los Alamos National Laboratory, NM	167
LLW (ER Project)	SNL/NM to Clive, UT	1,722
LLMW (ER Project)	SNL/NM to Savannah River Site, SC	2,548
RCRA Hazardous Waste (ER Project)	SNL/NM to Clive, UT	1,722
Nonhazardous Solid Waste (ER Project)	SNL/NM to Rio Rancho, NM	50

Sources: DOE 1996h, SNL 1992a, SNL/NM 1998a
C&D: construction and demolition
Ci: curies
D&D: decontamination and decommissioning
ER: Environmental Restoration
kg: kilograms
km: kilometer
LLW: low-level waste
LLMW: low-level mixed waste
MTRU: mixed transuranic
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
SNL/NM: Sandia National Laboratories/New Mexico
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] Material types are used in or generated from normal operations unless otherwise noted.
[b] Shipment consists of 100 kg of depleted uranium. The composition is given in Table G.4–2.
[c] 1996 shipment of 7.2×10^{-6} Ci of sodium -24; Transport Index = 0.1.
[d] 1997 shipment of americium -241, europium-152, cesium-137; Transport Index = 1.0.

from 11 vendors making approximately 1 delivery per day, excluding bulk chemicals such as liquid nitrogen.

11 vendors/day x 1 shipment/vendor x 5 days/week x 50 weeks/year = 2,750 shipments/year

(Eq. G.3–1)

These chemicals included a variety of hazardous and nonhazardous materials, including solvents, corrosives, and flammables.

For the SWEIS analysis, the bounding calculation assumed the supplies would be located within 40 km of SNL/NM and delivered from a centralized facility. Using the following equation, the calculated number of annual shipments would be 2,750.

The number of shipments would not vary by alternative, but the amount of material shipped could vary to accommodate the material requirements under each alternative. Table G.3–3 shows 2,750 shipments per year for each alternative.

G.3.3 Explosives

Most of the transportation involving explosives is expected to be by onsite transfer. These transfers are typically small in quantity, of short duration, and do not contribute a notable portion to the transportation impacts. Offsite transportation impacts are considered risk-dominant and bound onsite transfers of explosive materials.

For the SWEIS analysis, the longest route for explosives was selected for a bounding analysis. The longest route is from Albuquerque, New Mexico, to Silverdale, Washington, a distance of approximately 2,406 km. The projected consumption rates of explosive materials were similarly based on the facility source document projections for the baseline and activity multipliers presented in Appendix A. In 1997, 303 offsite explosive material shipments and receipts were recorded (Table G.3–3).

For each alternative, the numbers of potential explosive material shipments were calculated using the projected number of shipments compared to the baseline ratio of explosive shipments to the number of activities (see Appendix A). Table G.3–3 presents the potential total number of explosives shipments/receipts by alternative.

G.3.4 Wastes

Various types of waste are generated at SNL/NM, including LLW, LLMW, and hazardous waste. For a detailed discussion of these waste types and other waste generation impacts by alternative, see Sections 5.3.10, 5.4.10, and 5.5.10 and Appendix H.

Shipments of LLW, LLMW, hazardous waste, TRU waste, and solid waste were considered in the transportation impacts analysis. For completeness, recyclable hazardous waste, decontamination and decommissioning (D&D) waste, other solid waste, legacy waste, and ER Project waste were also included in the analysis. These waste categories (see Table G.3–3) are discussed in the following sections, and the number of shipments for each waste type for the base year and for each of the alternatives was evaluated for transportation impacts.

G.3.4.1 Low-Level Waste

The *Environmental Assessment for SNL/NM Offsite Transportation of Low-Level Radioactive Waste, DOE/EA-1180* (DOE 1996h), considered four potential LLW disposal sites: Hanford, Washington; Nevada Test Site (NTS), Nevada; Savannah River Site (SRS), South Carolina; and Clive, Utah. The DOE anticipates that the disposal of LLW would continue at facilities such as the Envirocare facility located outside of Clive, Utah. There were four shipments in 1996, the base year for analysis. Following are the projected numbers of LLW shipments: No Action Alternative–13, Expanded Operations Alternative–21, and Reduced Operations Alternative–8 (Table G.3–3). Other routine shipments would be possible between SNL/NM and Hanford or SNL/NM and NTS. However, Table G.3–4 shows that the impacts in person-rem per shipment would be comparable among all four disposal sites (DOE 1996h).

G.3.4.2 Low-Level Mixed Waste

In the future, LLMW would be shipped to facilities such as the Idaho National Engineering and Environmental Laboratory, Envirocare, Diversified Scientific Services, Inc., Waste Control Specialists, Inc., Oak Ridge, and SRS for treatment or disposal. For bounding purposes, SRS shipments (approximately 2,548 km) were considered representative. For the base year (1996), one offsite LLMW shipment and one onsite receipt from SNL/California (CA) were considered. The projected numbers of LLMW shipments would remain constant under all alternatives (see Table G.3–3).

Table G.3–3. Summary of Annual Shipments or Receipts for Transportation Impacts

MATERIAL TYPE[a]	BASE YEAR (TYPICALLY 1996)	NO ACTION ALTERNATIVE 2003	NO ACTION ALTERNATIVE 2008	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
Radioactive	305	562	597	1,782	140
Radioactive MIPP (Receipt)	0	16	16	55	2
Radioactive MIPP (Shipment)	0	1,140	1,140	1,140	1,140
Chemical	2,750	2,750	2,750	2,750	2,750
Explosive	303	557	593	1,771	138
LLW	4	13	13	21	8
LLMW (Receipt)	0	1	1	1	1
LLMW (Shipment)	1	3	3	3	3
RCRA Hazardous Waste (Shipment)	64	80	84	112	58
RCRA Hazardous Waste (Receipt)	12	25	25	25	25
Hazardous Waste (California) (Recyclable)	2	3	3	4	2
Hazardous Waste (Local) (Recyclable)	6	8	8	11	6
Hazardous Waste (D&D)	22	22	22	22	22
Nonhazardous Solid Waste (Recyclable)	78	78	78	78	78
Nonhazardous Landscaping (Recyclable)[b]	NA	142	142	142	142
Solid Waste	51	51	51	51	51
Construction And Demolition[b] *Solid Waste (KAFB)*	NA	599	599	599	599
TRU/MTRU Waste	0	1	3	4	2
Hazardous Waste TSCA-PCBs (D&D)	1	1	1	1	1
Hazardous Waste TSCA-Asbestos (D&D)	14	14	14	14	14
LLW (D&D)	4	4	4	4	4
Biohazardous Waste (Medical)	1	1	1	1	1

Sources: DOE 1996h, SNL 1992a, SNL/NM 1998a
D&D: decontamination and decommissioning
ER: Environmental Restoration
KAFB: Kirtland Air Force Base
LLMW: low-level mixed waste
LLW: low-level waste
MESA: Microsystems and Engineering Sciences Applications
MIPP: Medical Isotopes Production Project
MTRU: mixed transuranic
NA: not applicable
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
TSCA: *Toxic Substances Control Act*
[a] Material type is used or generated during normal operations unless otherwise noted
[b] Recycled and solid waste currently handled by the KAFB landfill could be shipped offsite in the future.
Note: If implemented, the MESA Complex configuration under the Expanded Operations Alternative would not change the number of material (or waste) shipments.

Table G.3–4. Low-Level Waste Disposal Sites

DISPOSAL ROUTE/SITE FROM SNL/NM	CLASSIFICATION DISTANCE (km)			TOTAL DISTANCE (km)	INCIDENT-FREE IMPACT, PERSON-REM PER UNIT SHIPMENT			
	RURAL	SUBURBAN	URBAN		DOSE TO CREW	PUBLIC OFF-LINK DOSE	PUBLIC ON-LINK DOSE	STOP
Hanford, WA	2,324	224	36	2,584	$7.8x10^{-2}$	$2.0x10^{-3}$	$1.4x10^{-2}$	0.22
NTS, NV	945	68	25	1,038	$3.2x10^{-2}$	$2.0x10^{-3}$	$1.2x10^{-2}$	$8.6x10^{-2}$
SRS, SC	2,051	455	41	2,548	$8.0x10^{-2}$	$3.0x10^{-3}$	$1.5x10^{-2}$	0.22
Clive, UT	1,533	156	33	1,722	$5.2x10^{-2}$	$1.4x10^{-3}$	$1.0x10^{-2}$	0.14

Source: DOE 1996h
km: kilometer
NTS: Nevada Test Site
rem: Roentgen equivalent, man
SNL/NM: Sandia National Laboratories/New Mexico
SRS: Savannah River Site
Notes: 1) On-link means occupants of vehicles that share the transportation corridor with the radioactive shipment.
2) Off-link means people by the side of the transportation corridor.
3) Stop means people in the vicinity of the shipment when it stopped.

G.3.4.3 Hazardous Waste

In 1996, the total number of hazardous waste shipments was 91; the ER Project was responsible for 27 of those shipments. Only normal operations-related shipments (64) were considered routine. Table G.3–3 presents the expected number of shipments by alternative. SNL/NM uses multiple hazardous waste disposal facilities located throughout the U.S. The longest route for hazardous waste was selected for the SWEIS bounding analysis: Albuquerque, New Mexico, to Clive, Utah, a distance of approximately 1,722 km (Table G.3–2). The projected numbers of hazardous waste shipments would be: No Action Alternative–84, Expanded Operations Alternative–112, and Reduced Operations Alternative–58.

G.3.4.4 Solid Waste

Solid waste is generally picked up once a week. In 1997, 51 shipments were made from SNL/NM to the Rio Rancho Sanitary Landfill. The bounding calculation assumed that the disposal of solid waste would be located within 50 km for the SWEIS analysis. These shipments would not be expected to vary over the time frame of the SWEIS. Table G.3–3 shows the number of shipments would be constant at 51 for each of the alternatives. In addition, should the Kirtland Air Force Base (KAFB) landfill close, construction and demolition debris shipments (599 per year) would likely go to the Rio Rancho Sanitary Landfill or the Cerro Colorado Landfill. Landscaping waste, also handled at the KAFB landfill, would be required to be shipped offsite (142 per year).

G.3.4.5 Recycled Hazardous Material

In 1997, two recycled hazardous material shipments were made to Anaheim, California. Six shipments were made to a local facility in Albuquerque, New Mexico (see Tables G.3–2 and G.3–3).

G.3.4.6 Transuranic and Mixed Transuranic Wastes

During normal operations, minimal quantities of TRU and mixed transuranic (MTRU) wastes are generated at SNL/NM. As TRU and MTRU wastes are generated, they are collected and stored until sufficient quantities are accumulated for shipment. The existing TRU/MTRU wastes stored onsite, as well as all future TRU/MTRU wastes, would be transferred to Los Alamos National Laboratory (LANL) for certification, as indicated in the *Waste Management Programmatic Impact Statement* [PEIS] *for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997i) Record of Decision (ROD) (DOE 1998n), prior to disposal at the Waste Isolation Pilot Plant (WIPP).

G.3.4.7 Special Projects Waste

The wastes in storage (legacy wastes) and the wastes generated during special projects, such as ER Project wastes, were included in the analysis as total shipments over a 5-year period. These waste shipments are presented in Table G.3–5.

For the transportation impact evaluation, the representative distances traveled for the receipt and shipment of SNL/NM special projects material and waste are summarized in Table G.3–2.

Table G.3–5. Summary of Total Shipments for Transportation Impacts Under Special Projects Over 5 Years

MATERIAL TYPE	TOTAL NUMBER OF SHIPMENTS (OVER 5 YEARS)
Legacy LLW[a]	56
Legacy LLMW[a]	8
Legacy TRU/MTRU[a]	2
LLW[a] *(ER)*	136
LLMW[a] *(ER)*	5
TSCA Hazardous Waste[b] *(ER)*	113
Nonhazardous Solid Waste[b] *(ER)*	9

Source: SNL/NM 1998a
ER: Environmental Restoration
LLW: low-level waste
LLMW: low-level mixed waste
MTRU: mixed transuranic
TSCA: *Toxic Substances Control Act*
TRU: transuranic
[a] Storage operation
[b] ER Project operation

G.4 ANALYSIS OF RADIOLOGICAL IMPACTS OF TRANSPORTATION: *RADTRAN 4* METHODOLOGY

Radiological transportation risk was modeled using *RADTRAN 4,* a computer modeling program developed at SNL/NM (SNL 1992a). Although the most current version of *RADTRAN is RADTRAN 5*, *RADTRAN 4*, which is fully documented, was used in the analysis.

G.4.1 Incident-Free Transportation

RADTRAN 4 models incident-free transportation as a separate module from transportation accidents. When radioactive materials are transported, there is some external radiation dose from the transported cargo. The external dose rate (mrem/hour) measured at 1 m from the external surface of the transported package is called the transport index (TI) and is limited by regulation (10 CFR Part 71). *RADTRAN 4* models the TI as the point source for radiological risks of incident-free transportation. The measured and recorded TI is used in RADTRAN 4 when it is available. When the actual TI is not known, the regulatory limit for each type of shipment is modeled, although experience indicates that the external dose rate is well below the regulatory limit in many shipments. In this analysis, as in most, only external gamma radiation is considered, because external neutrons are absorbed by air before reaching a receptor. Figure G.4–1 illustrates the *RADTRAN 4* incident-free model.

At the distances of interest, the dose rate at the receptor is inversely proportional to the square of the receptor distance from the radiation source. The total (integrated) radiation dose to the receptor is inversely proportional to the distance of the receptor from the radiation source. Dose is also inversely proportional to vehicle velocity and directly proportional to distance traveled and to the number of shipments. Population radiation dose is the dose to the total number of receptors exposed. Incident-free dose is independent of the isotopic content or radioactivity of the material being shipped and depends only on the external dose rates.

Radiation doses are calculated separately for the truck crew (crew dose), people residing along the transportation corridor (off-link dose), occupants of vehicles that share the transportation corridor with the radioactive shipment (on-link dose), and people in the vicinity of the shipment when it stopped (stop dose). For the *RADTRAN 4* analyses in this study, each route was divided into rural, suburban, and urban links. Highway routes are modeled using the *HIGHWAY* routing code (Johnson et al 1993), which provides distances and population densities for rural, suburban, and urban segments, or links, of the route. Actual 1990 census population data (for populations within a half-mile of the route) and actual distances were used in *RADTRAN 4* for each route. The rural-suburban-urban classification provided national average vehicle densities, vehicle speeds, accident rates, and similar parameter values.

Doses from incident-free transportation include the crew dose and the combined off-link, on-link, and stop doses to the public. The crew and population dose from more than one shipment can be calculated by multiplying the crew and population dose for one shipment (Table G.4–1) by the number of shipments of a given material.

G.4.2 Accident Radiation Dose Risks

The radioactive materials being shipped, and their activities, become important in the transportation accident module. *RADTRAN 4* models accident risk as the risk from emission of fractions of the radioactive cargo into the air. This risk combines the probability that an accident will occur, the probability of a particular size breach of containment, and the fraction of each isotope

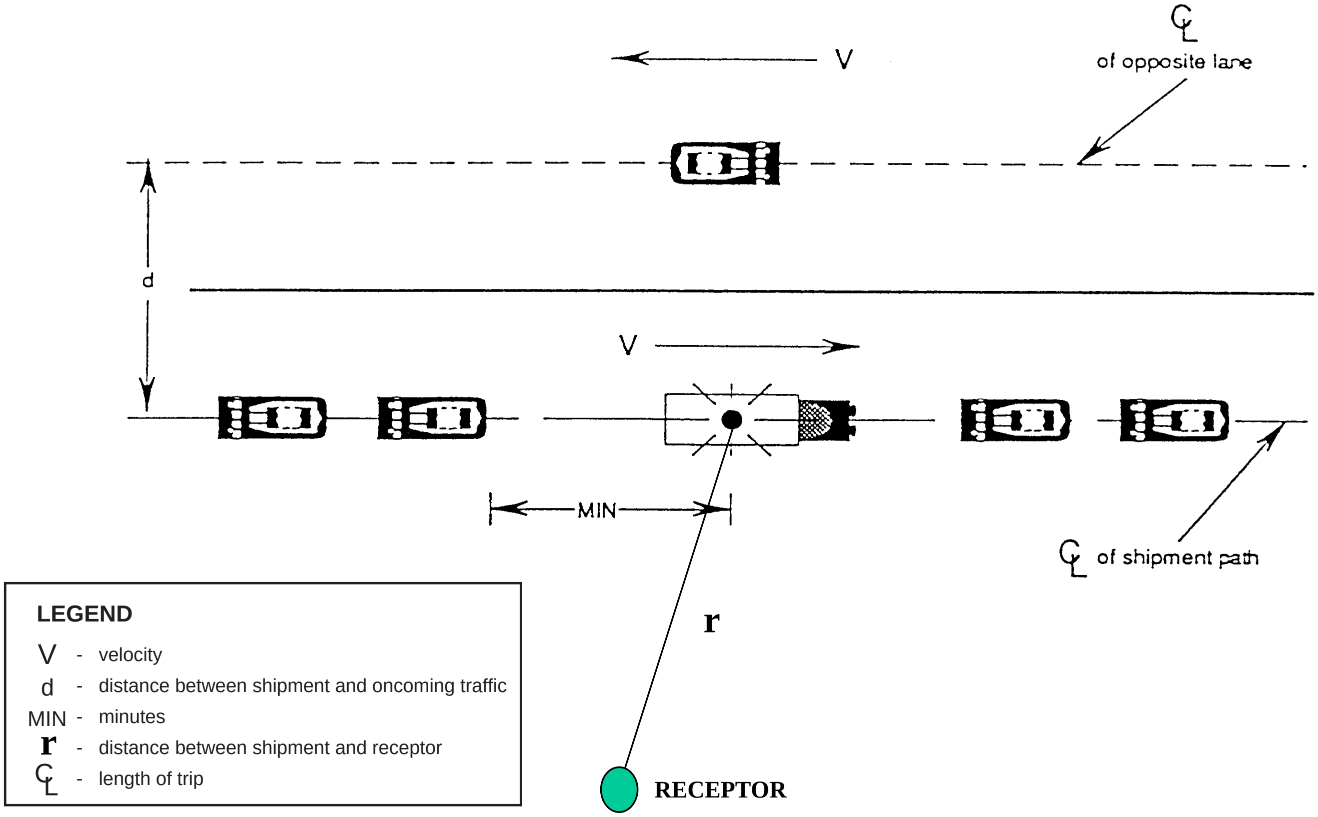

Figure G.4–1. The *RADTRAN 4* Incident-Free Model

Examples of SNL/NM radioactive material shipments were used during SWEIS analysis of potential impacts.

that would be leaked, aerosolized, and inhaled under a particular accident scenario. Groundshine (whole-body radiation dose from aerosols deposited on the ground) and cloudshine (whole-body radiation dose from reflected radiation) is also part of this risk. Dose to the receptor is calculated from the dose conversion factors in (SNL 1993b, Johnson et al. 1993, DOE 1988b).

In the model, the set of all possible accidents is divided into subsets called "accident severity categories." There are eight severity categories in the present study, each with a particular probability of occurrence and varying degrees of cargo damage that result in aerosolized and respirable release fractions. The accident severity categories always include a category for no release and no loss of shielding (by far the most probable case) and a category for loss of shielding only (no actual release of material). A detailed description of the accident severity category approach is contained in NUREG-0170 (NRC 1977b). The severity categories capture the universe of accidents.

The probability of occurrence of an accident depends on truck accident frequency (accidents per vehicle-mile) and indirectly on population density (for example, a larger fraction of accidents in urban areas are minor). The overall (conditional) probability of an accident of a particular severity is estimated by multiplying the probability of the severity category by the frequency of truck accidents along the route. For example, if Severity Category VIII had an occurrence probability of 1.3×10^{-4}, and the probability of any accident happening in an urban area is 1.6×10^{-5}, the likelihood of an accident in Severity Category VIII occurring on a 5-km

Table G.4–1. Radiological Doses to Crew and Public and Accident Risks to Public (Person-Rem) Per Unit Shipment

MATERIAL TYPE	ROUTE DESTINATION	CREW	INCIDENT-FREE PUBLIC			ACCIDENT IMPACTS PUBLIC	TOTAL	
			OFF-LINK	ON-LINK	STOPS		CREW	PUBLIC
Radioactive Material[a]	Mountain Top, PA	$3.2x10^{-2}$	$2.4x10^{-3}$	$2.5x10^{-2}$	$2.4x10^{-1}$	$7.6x10^{-3}$	$3.2x10^{-2}$	$2.7x10^{-1}$
LLW	Clive, UT	$5.2x10^{-2}$	$1.4x10^{-3}$	$1.0x10^{-2}$	$1.4x10^{-1}$	$5.8x10^{-4}$	$5.2x10^{-2}$	$1.5x10^{-1}$
LLMW[b]	SRS	$1.6x10^{-4}$	$1.3x10^{-5}$	$1.2x10^{-4}$	$1.5x10^{-3}$	$4.6x10^{-11}$	$1.6x10^{-4}$	$1.6x10^{-3}$
LLMW[b]	SNL/NM[a]	$1.1x10^{-4}$	$8.9x10^{-6}$	$8.4x10^{-5}$	$1.5x10^{-3}$	$3.2x10^{-11}$	$1.1x10^{-4}$	$1.6x10^{-3}$
TRU/MTRU[c]	LANL	$1.6x10^{-3}$	$1.5x10^{-4}$	$1.4x10^{-3}$	$7.3x10^{-3}$	$2.4x10^{-8}$	$1.6x10^{-3}$	$8.8x10^{-3}$

Sources: DOE 1996h, SNL 1992a
kg: kilograms
LANL: Los Alamos National Laboratory
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
SNL/NM: Sandia National Laboratories/New Mexico
SNL/CA: Sandia National Laboratories/California
SRS: Savannah River Site
TRU: transuranic
[a] Shipment consists of 100 kg of depleted uranium. The composition is given in Table G.4–2.
[b] 1996 shipment of 7.2 x 10^{-6} curies of sodium -24; Transport Index = 0.1.
[c] 1997 shipment of americium -241, europium -152, cesium -137, Transport Index = 1.0.

urban part of a route would be:

$$(1.3x10^{-4})x(1.6 \text{ accidents}/10^{5} \text{ km})x(5\text{urban km}) = 1.04x10^{-7}$$

Eq. G.4.1

G.4.3 Calculation of Radiological Health Risks

Health risks from incident-free population doses are calculated by multiplying any occupational dose by 0.0004 LCF per person-rem and any dose to the public by 0.0005 LCF per person-rem (ICRP 1991). Inhalation and immersion population dose risks are calculated in *RADTRAN 4* using established dose conversion factors (DOE 1988b). Population dose risks can then be expressed as LCFs, using the public dose conversion factor of 0.0005 LCF per person-rem. Radiation doses are reported as committed effective dose equivalent (CEDE), a quantity that considers the type of radiation (gamma, in this case) and its distribution throughout the body as well as the absorbed dose itself, and integrates the combination of these over 50 years (ICRP 1991).

G.4.4 The Modeled "Bounding Case" Shipment

The analysis considered a representative shipment of radiological material of 100 kg of depleted uranium (DU), as shown in Table G.4–2. Five 1-m packages were identified that could contain the shipment. Although the TI associated with such packages is approximate, the maximum regulatory TI would be 16, so TI=16 was modeled. Neither this shipment nor any shipment with attributes close to its parameters appears in unclassified shipment databases for 1995, 1996, or 1997. The TI and release fractions postulated for this shipment result in very conservatively estimated radiological risks.

The radiation doses from modeled accidents are reported as dose risks rather than doses because incident-free transportation has essentially a probability of 1 (or 100 percent) of occurring, because most transportation is incident-free. The probabilities of a transportation accident and of a resulting release of radioactive material are orders of magnitude less than one, and are incorporated into the reported accident population dose. Radiological health risk is the product of probability and consequence; radiation dose risks are the products of the

Table G.4–2. Radionuclide Content of Depleted Uranium per Shipment

ISOTOPE	CURIES PER SHIPMENT	GRAMS PER SHIPMENT
Uranium-232	$8.8x10^{-2}$	$4.11x10^{-3}$
Uranium-234	$2.2x10^{-2}$	3.56
Uranium-235	$4.2x10^{-4}$	196
Uranium-238	$3.3x10^{-2}$	96,100

Source: DOE 1996i

probability of an accident happening, times the probability of release of radioactive material if that accident happens, times the respirable fraction of released material, times the radiation dose per inhaled unit of radioactive material. Therefore, rather than reporting population radiation *doses,* as for incident-free transportation, this analysis reported radiation *dose risks* for potential accident scenarios. The unit of dose risk is person-rem, as is the unit of population radiation dose.

Releases and aerosol fractions depend on the physical and chemical nature of the isotope (for example, volatility and particle size), as well as the severity of the accident. Such fractions have been incorporated into the *RADTRAN 4* model (SNL 1992). For this study, all material released was assumed to be aerosolized and respirable. The dispersion of airborne gases and particulate matter is modeled using a Gaussian dispersion model, as discussed in Chapter 5 and Appendix D. The two factors that independently affect the modeled dose to the population under the plume footprint are the downwind distance to which the dispersion is modeled, and the concentration of dispersed material within the isopleth pattern. The concentration of airborne breathable material decreases very sharply as one moves away from the source.

G.4.5 Accident Fatalities Risk

As with the incident-free risk analysis, the dose to the public due to accidental release was calculated for a single shipment of each material type to determine a bounding transportation impact. The unit shipment doses are presented in Table G.4–1. Table G.4–3 presents the annual doses to population from a radiological release due to a potential transportation accident supporting normal operations under each alternative. Table G.4–4 presents the doses to population from a radiological release due to a hypothetical transportation accident during special project shipments.

G.4.6 Traffic Fatalities Risk

Traffic fatalities were estimated using unit-risk factors (risk per kilometer traveled) developed from national statistics for highway accident-related deaths (SNL 1986). These nonradiological unit-risk factors are presented in Table G.4–5. The traffic fatalities per unit shipment are presented in Tables G.4–6 and G.4–7 for normal operations shipments and total special project shipments, respectively. The calculated lifetime traffic fatalities resulting from normal operations shipments for each alternative are presented in Table G.4–8. The calculated total traffic fatalities associated with special project shipments are presented in Table G.4–9.

G.4.7 Vehicle Emissions Fatalities Risk

Nonradiological LCFs due to truck emissions (air pollutants) were evaluated based on unit-risk factors developed by SNL/NM (SNL/NM 1982). These nonradiological unit-risk factors are presented in Table G.4–5. Table G.4–10 presents the annual incident-free exposures due to truck emissions that could result in LCFs due to normal operations shipments. Table G.4–11 presents the estimated incident-free exposures due to truck emissions that could result in LCFs due to special project shipments.

G.4.8 Bounding Accident Scenario

The bounding transportation accident involves an explosion of a tractor-trailer containing 40,000 ft^3 of hydrogen. Appendix F provides detailed information regarding this bounding transportation accident. Additionally, Sections 5.3.8, 5.4.8, and 5.5.8 discuss radiological and chemical facility accidents.

Table G.4.3. Dose Risk to Population for Radiological Release Due to Transportation Accident During Normal Operations Shipments

MATERIAL TYPE	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
ANNUAL DOSE RISK TO POPULATION (person-rem)					
Radioactive [b]	2.3	4.3	4.5	13.5	1.1
LLW	2.3×10^{-3}	7.5×10^{-3}	7.5×10^{-3}	1.2×10^{-2}	4.6×10^{-3}
LLW (D&D)	2.3×10^{-3}	2.3×10^{-3}	2.3×10^{-3}	2.3×10^{-3}	2.3×10^{-3}
LLMW [c]	4.6×10^{-11}	1.7×10^{-10}	1.7×10^{-10}	1.7×10^{-10}	1.7×10^{-10}
Medical Isotopes Production	NA	1.5×10^{-2}	1.5×10^{-2}	5.2×10^{-2}	1.9×10^{-3}
ANNUAL LCFs					
Radioactive [b]	1.2×10^{-3}	2.2×10^{-3}	2.3×10^{-3}	6.0×10^{-3}	5.5×10^{-4}
LLW	1.2×10^{-6}	3.8×10^{-6}	3.8×10^{-6}	6.0×10^{-6}	2.3×10^{-6}
LLW (D&D)	1.2×10^{-6}	1.2×10^{-6}	1.2×10^{-6}	1.2×10^{-6}	1.2×10^{-6}
LLMW [c]	2.3×10^{-14}	8.5×10^{-14}	8.5×10^{-14}	8.5×10^{-14}	8.5×10^{-14}
Medical Isotopes Production	NA	7.5×10^{-6}	7.5×10^{-6}	3.0×10^{-5}	9.6×10^{-7}
TOTAL RISK[d]	**1.2×10^{-3}**	**2.2×10^{-3}**	**2.3×10^{-3}**	**6.8×10^{-3}**	**5.5×10^{-4}**

Sources: DOE 1996h, SNL 1992a; SNL/NM 1997b, 1998a
D&D: decontamination and decommissioning
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
NA: not applicable
rem: Roentgen equivalent, man

[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Shipment consists of 100kg of depleted uranium.
[c] 1996 shipment of 7.2 x 10-6 curies of sodium -24: Transport Index = 0.1.
[d] Lifetime estimated LCFs due to potential radiological accident
Note: Calculations using *RADTRAN 4* (SNL 1992a)

Table G.4–4. Doses Risk to Population from Radiological Release Due to Transportation Accident During Normal Operations Shipments

MATERIAL TYPE	BASE YEAR (1996)	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
ANNUAL DOSE RISK, GENERAL POPULATION (person-rem)					
TRU/MTRU [a]	0	2.4×10^{-8}	7.2×10^{-8}	9.6×10^{-8}	4.8×10^{-8}
TRU/MTRU (Legacy) [a]	0	0	4.8×10^{-8}	4.8×10^{-8}	4.8×10^{-8}
LLW (Legacy + ER)	0	0	0.11	0.11	0.11
LLMW (Legacy + ER) [b]	0	0	4.4×10^{-4}	4.4×10^{-4}	4.4×10^{-4}
ANNUAL LCFs					
TRU/MTRU [a]	0	1.2×10^{-11}	3.6×10^{-11}	4.8×10^{-11}	2.4×10^{-11}
TRU/MTRU (Legacy) [a]	0	0	2.4×10^{-11}	2.4×10^{-11}	2.4×10^{-11}
LLW (Legacy + ER)	0	0	5.5×10^{-5}	5.5×10^{-5}	5.5×10^{-5}
LLMW (Legacy + ER) [b]	0	0	3.0×10^{-13}	3.0×10^{-13}	3.0×10^{-13}
TOTAL [c]		**1.2×10^{-11}**	**5.5×10^{-5}**	**5.5×10^{-5}**	**5.5×10^{-5}**

Sources: DOE 1996h, SNL 1992a, SNL/NM 1998a
ER: Environmental Restoration
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
rem: Roentgen equivalent, man
TRU: Transuranic
[a] 1997 shipment of americium -241, europium -152, cesium -137; Transport Index= 1.0.
[b] 1996 shipment of 7.2×10^{-6} curies of sodium -24; Transport Index= 0.1.
[c] Lifetime estimated LCFs from total special project shipments
Note: Calculations using *RADTRAN 4* (SNL 1992)

Table G.4–5. Nonradiological Unit-Risk Factors for Truck Transport

NORMAL	RURAL	SUBURBAN	URBAN
Nonoccupational Latent Cancers/km	-	-	1.0×10^{-7}
Nonoccupational Fatalities/km	5.3×10^{-8}	1.3×10^{-8}	7.5×10^{-9}
Occupational Fatalities/km	1.5×10^{-8}	3.7×10^{-9}	2.1×10^{-9}

Sources: SNL 1986, SNL/NM 1982
km: kilometer

Table G.4–6. Transportation Traffic Fatalities Per Unit Shipment from Normal Operations Shipment by Alternative

MATERIAL TYPE	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
TRAFFIC FATALITIES, CREW AND GENERAL PUBLIC, PER SHIPMENT (ROUND TRIP)					
Radioactive	3.5×10^{-4}	3.5×10^{-4}	3.5×10^{-4}	3.5×10^{-4}	3.5×10^{-4}
Chemical	2.1×10^{-6}	2.1×10^{-6}	2.1×10^{-6}	2.1×10^{-6}	2.1×10^{-6}
Explosive	2.9×10^{-4}	2.9×10^{-4}	2.9×10^{-4}	2.9×10^{-4}	2.9×10^{-4}
LLW	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
LLMW (Receipt)	2.1×10^{-4}	2.1×10^{-4}	2.1×10^{-4}	2.1×10^{-4}	2.1×10^{-4}
LLMW (Shipment)	3.0×10^{-4}	3.0×10^{-4}	3.0×10^{-4}	3.0×10^{-4}	3.0×10^{-4}
Hazardous Waste	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
Recyclable Hazardous Waste (California)	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}	1.5×10^{-4}
Recyclable Hazardous Waste (Local)	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}
Solid Waste	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}
D&D Hazardous Waste TSCA-PCBs	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}
D&D Hazardous Waste TSCA-Asbestos	2.2×10^{-5}	2.2×10^{-5}	2.2×10^{-5}	2.2×10^{-5}	2.2×10^{-5}
Biohazardous Waste	1.4×10^{-4}	1.4×10^{-4}	1.4×10^{-4}	1.4×10^{-4}	1.4×10^{-4}
Recyclable D&D Hazardous Waste	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}
Recyclable Nonhazardous Solid Waste	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-6}	1.6×10^{-4}
Nonhazardous Landscaping Waste	NA	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}
Construction and Demolition Solid Waste	NA	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}	2.6×10^{-6}
RCRA Hazardous Waste (Receipt)	6.7×10^{-7}	6.7×10^{-7}	6.7×10^{-7}	6.7×10^{-7}	6.7×10^{-7}
LLW (D&D)	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}	2.2×10^{-4}

Sources: SNL 1986, 1992a; SNL/NM 1982
D&D: decontamination and decommissioning
LLMW: low-level mixed waste
LLW: low-level waste
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
TSCA: *Toxic Substances Control Act*
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.

Table G.4–7. Transportation Traffic Fatalities Per Unit Shipment from Total Special Project Shipments

MATERIAL TYPE	BASE YEAR (1996)	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
TRU/MTRU	0	$1.9x10^{-5}$	$1.9x10^{-5}$	$1.9x10^{-5}$	$1.9x10^{-5}$
TRU/MTRU (Legacy)	0	0	$1.9x10^{-5}$	$1.9x10^{-5}$	$1.9x10^{-5}$
LLW (Legacy)	0	0	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$
LLMW (Legacy)	0	0	$3.0x10^{-4}$	$3.0x10^{-4}$	$3.0x10^{-4}$
LLW (ER)	0	0	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$
LLMW (ER)	0	0	$3.0x10^{-4}$	$3.0x10^{-4}$	$3.0x10^{-4}$
Hazardous Waste (ER)	0	0	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$
Nonhazardous Solid Waste (ER)	0	0	$2.6x10^{-6}$	$2.6x10^{-6}$	$2.6x10^{-6}$

Sources: SNL 1986, 1992a; SNL/NM 1982
ER: Environmental Restoration
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
TRU: transuranic

Table G.4–8. Transportation Traffic Lifetime Fatalities for Normal Operations from Annual Shipments by Alternative

MATERIAL TYPE	BASE YEAR[a]	NO ACTION ALTERNATIVE 2003	NO ACTION ALTERNATIVE 2008	EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
TRAFFIC FATALITIES, CREW AND GENERAL PUBLIC, PER SHIPMENT (ROUND TRIP)					
Radioactive	0.11	0.20	0.21	0.62	$4.9x10^{-2}$
Explosive	$8.8x10^{-2}$	0.16	0.17	0.51	$4.0x10^{-2}$
Chemical	$5.8x10^{-3}$	$5.8x10^{-3}$	$5.8x10^{-3}$	$5.8x10^{-3}$	$5.8x10^{-3}$
Medical Isotopes Production	NA	$6.0x10^{-3}$	$6.0x10^{-3}$	$2.1x10^{-2}$	$7.7x10^{-4}$
LLW	$8.8x10^{-4}$	$2.9x10^{-3}$	$2.9x10^{-3}$	$4.6x10^{-3}$	$1.8x10^{-3}$
LLMW (Receipt)	0	$2.1x10^{-4}$	$2.1x10^{-4}$	$2.1x10^{-4}$	$2.1x10^{-4}$
LLMW (Shipment)	$3.0x10^{-4}$	$9.0x10^{-4}$	$9.0x10^{-4}$	$9.0x10^{-4}$	$9.0x10^{-4}$
Hazardous Waste	$1.4x10^{-2}$	$1.8x10^{-2}$	$1.9x10^{-2}$	$2.5x10^{-2}$	$1.3x10^{-2}$
Recyclable Hazardous Waste (California)	$3.0x10^{-4}$	$4.5x10^{-4}$	$4.5x10^{-4}$	$6.0x10^{-4}$	$3.0x10^{-4}$
Recyclable Hazardous Waste (Local)	$9.6x10^{-6}$	$1.3x10^{-5}$	$1.3x10^{-5}$	$1.8x10^{-5}$	$9.6x10^{-6}$
Solid Waste	$1.3x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$	$1.3x10^{-4}$
D&D Hazardous Waste TSCA-PCBs	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$	$2.2x10^{-4}$
D&D Hazardous Waste TSCA-Asbestos	$3.1x10^{-4}$	$3.1x10^{-4}$	$3.1x10^{-4}$	$3.1x10^{-4}$	$3.1x10^{-4}$
Biohazardous Waste	$1.4x10^{-4}$	$1.4x10^{-4}$	$1.4x10^{-4}$	$1.4x10^{-4}$	$1.4x10^{-4}$
Recyclable D&D Hazardous Waste	$3.5x10^{-5}$	$3.5x10^{-5}$	$3.5x10^{-5}$	$3.5x10^{-5}$	$3.5x10^{-5}$
Recyclable Nonhazardous Solid Waste	$1.2x10^{-4}$	$1.2x10^{-4}$	$1.2x10^{-4}$	$1.2x10^{-4}$	$1.2x10^{-4}$
Nonhazardous Landscaping Waste	NA	$3.7x10^{-4}$	$3.7x10^{-4}$	$3.7x10^{-4}$	$3.7x10^{-4}$
Construction and Demolition Solid Waste	NA	$1.6x10^{-3}$	$1.6x10^{-3}$	$1.6x10^{-3}$	$1.6x10^{-3}$
RCRA Hazardous Waste (Receipt)	$8.0x10^{-6}$	$1.7x10^{-5}$	$1.7x10^{-5}$	$1.7x10^{-5}$	$1.7x10^{-5}$
LLW (D&D)	$8.8x10^{-4}$	$8.8x10^{-4}$	$8.8x10^{-4}$	$8.8x10^{-4}$	$8.8x10^{-4}$
TOTAL[b]	**0.22**	**0.40**	**0.42**	**1.2**	**0.11**

Sources: DOE 1997i, SNL 1986, 1992a; SNL/NM 1997b, 1997d, 1982, 1998a
D&D: decontamination and decommissioning
LLMW: low-level mixed waste
LLW: low-level waste
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
rem: Roentgen equivalent, man
TSCA: *Toxic Substances Control Act*
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Lifetime estimated fatalities from annual shipments
Note: Calculations were completed using *RADTRAN 4* (SNL 1992b)

Table G.4–9. Transportation Traffic Fatalities from Total Special Project Shipments

MATERIAL TYPE	BASE YEAR (1996)	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
TRU/MTRU	0	$1.9x10^{-5}$	$5.7x10^{-5}$	$7.6x10^{-5}$	$3.8x10^{-5}$
TRU/MTRU (Legacy)	0	0	$3.8x10^{-5}$	$3.8x10^{-5}$	$3.8x10^{-5}$
LLW (Legacy)	0	0	$1.2x10^{-2}$	$1.2x10^{-2}$	$1.2x10^{-2}$
LLMW (Legacy)	0	0	$2.4x10^{-3}$	$2.4x10^{-3}$	$2.4x10^{-3}$
LLW (ER)	0	0	$3.0x10^{-2}$	$3.0x10^{-2}$	$3.0x10^{-2}$
LLMW (ER)	0	0	$1.5x10^{-3}$	$1.5x10^{-3}$	$1.5x10^{-3}$
Hazardous Waste (ER)	0	0	$2.5x10^{-2}$	$2.5x10^{-2}$	$2.5x10^{-2}$
Solid Waste (ER)	0	0	$2.3x10^{-5}$	$2.3x10^{-5}$	$2.3x10^{-5}$
TOTAL[a]			**$7.1x10^{-2}$**	**$7.1x10^{-2}$**	**$7.1x10^{-2}$**

Sources: SNL 1986, 1992a; SNL/NM 1982, 1998a
ER: Environmental Restoration
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
TRU: transuranic
[a] Lifetime estimated fatalities from annual shipments
Note: Calculations were completed using *RADTRAN 4* (SNL 1992b)

Table G.4–10. Annual Incident-Free Exposures Due to Truck Emissions from Normal Operations Shipments

MATERIAL TYPE	UNIT RISK [a] FACTOR PER URBAN KILOMETER	TRUCK DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER SHIPMENT FOR ROUND TRIP	TOTAL LCFs FOR BASE YEAR SHIPMENTS (TYPICALLY 1996)	TOTAL LCFs FOR NO ACTION ALTERNATIVE		TOTAL LCFs FOR EXPANDED OPERATIONS ALTERNATIVE	TOTAL LCFs FOR REDUCED OPERATIONS ALTERNATIVE
					2003	2008		
Radioactive	$1.0x10^{-7}$	73	$1.5x10^{-5}$	$4.6x10^{-3}$	$8.4x10^{-3}$	$9.0x10^{-3}$	$2.8x10^{-2}$	$2.1x10^{-3}$
Chemical	$1.0x10^{-7}$	8.0	$1.6x10^{-6}$	$4.4x10^{-3}$	$4.4x10^{-3}$	$4.4x10^{-3}$	$4.4x10^{-3}$	$4.4x10^{-3}$
Explosive	$1.0x10^{-7}$	48.0	$9.6x10^{-6}$	$2.9x10^{-3}$	$5.3x10^{-3}$	$5.7x10^{-3}$	$1.7x10^{-2}$	$1.3x10^{-3}$
LLW	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	$2.6x10^{-5}$	$8.6x10^{-5}$	$8.6x10^{-5}$	$1.4x10^{-4}$	$5.3x10^{-5}$
LLMW (Receipt)	$1.0x10^{-7}$	35.6	$7.1x10^{-6}$	0	$7.1x10^{-6}$	$7.1x10^{-6}$	$7.1x10^{-6}$	$7.1x10^{-6}$
LLMW (Shipment)	$1.0x10^{-7}$	40.6	$8.1x10^{-6}$	$8.1x10^{-6}$	$2.4x10^{-5}$	$2.4x10^{-5}$	$2.4x10^{-5}$	$2.4x10^{-5}$
Medical Isotopes Production	-	-	-	NA	$2.0x10^{-3}$	$2.0x10^{-3}$	$1.0x10^{-2}$	$3.5x10^{-4}$
Hazardous Waste	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	$4.2x10^{-4}$	$5.3x10^{-4}$	$5.5x10^{-4}$	$7.4x10^{-4}$	$3.8x10^{-4}$
Recyclable Hazardous Waste (California)	$1.0x10^{-7}$	23.0	$4.6x10^{-6}$	$9.2x10^{-6}$	$1.4x10^{-5}$	$1.4x10^{-5}$	$1.8x10^{-5}$	$9.2x10^{-6}$
Recyclable Hazardous Waste (Local)	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	$7.8x10^{-6}$	$1.0x10^{-5}$	$1.0x10^{-5}$	$4.4x10^{-5}$	$7.8x10^{-6}$
Solid Waste	$1.0x10^{-7}$	10.0	$2.0x10^{-6}$	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$
D&D hazardous waste TSCA-PCBs	$1.0x10^{-7}$	33.0	$6.6x10^{-6}$	$6.6x10^{-6}$	$6.6x10^{-6}$	$6.6x10^{-6}$	$6.6x10^{-6}$	$6.6x10^{-6}$
D&D Hazardous Waste TSCA-Asbestos	$1.0x10^{-7}$	10.0	$2.0x10^{-6}$	$2.8x10^{-5}$	$2.8x10^{-5}$	$2.8x10^{-5}$	$2.8x10^{-5}$	$2.8x10^{-5}$
Biohazardous Waste	$1.0x10^{-7}$	24.0	$4.8x10^{-6}$	$4.8x10^{-6}$	$4.8x10^{-6}$	$4.8x10^{-6}$	$4.8x10^{-6}$	$4.8x10^{-6}$
Recyclable D&D Hazardous Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	$2.9x10^{-5}$	$2.9x10^{-5}$	$2.9x10^{-5}$	$2.9x10^{-5}$	$2.9x10^{-5}$

Table G.4–10. Annual Incident-Free Exposures Due to Truck Emissions from Normal Operations Shipments (concluded)

MATERIAL TYPE	UNIT RISK [a] FACTOR PER URBAN KILOMETER	TRUCK DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER SHIPMENT FOR ROUND TRIP	TOTAL LCFs FOR BASE YEAR SHIPMENTS (TYPICALLY 1996)	TOTAL LCFs FOR NO ACTION ALTERNATIVE		TOTAL LCFs FOR EXPANDED OPERATIONS ALTERNATIVE	TOTAL LCFs FOR REDUCED OPERATIONS ALTERNATIVE
					2003	2008		
Recyclable Nonhazardous Solid Waste	$1.0x10^{-7}$	6.4	$1.3x10^{-6}$	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$	$1.0x10^{-4}$
Nonhazardous Landscaping Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	$2.8x10^{-4}$	$2.8x10^{-4}$	$2.8x10^{-4}$	$2.8x10^{-4}$
Construction and Demolition Solid Waste	$1.0x10^{-7}$	10	$2.0x10^{-6}$	NA	$1.2x10^{-3}$	$1.2x10^{-3}$	$1.2x10^{-3}$	$1.2x10^{-3}$
RCRA Hazardous Waste (Receipt)	$1.0x10^{-7}$	3	$6.0x10^{-7}$	$7.2x10^{-6}$	$1.5x10^{-5}$	$1.5x10^{-5}$	$1.5x10^{-5}$	$1.5x10^{-5}$
LLW (D&D)	$1.0x10^{-7}$	33	$6.6x10^{-6}$	$2.6x10^{-5}$	$2.6x10^{-5}$	$2.6x10^{-5}$	$2.6x10^{-5}$	$2.6x10^{-5}$
TOTAL [b]				**$1.33x10^{-2}$**	**$2.3x10^{-2}$**	**$2.4x10^{-2}$**	**$6.2x10^{-2}$**	**$1.1x10^{-2}$**

Sources: SNL 1992a; SNL/NM 1982, 1998a
D&D: decontamination and decommissioning
km: kilometer
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
PCB: polychlorinated biphenyl
RCRA: *Resource Conservation and Recovery Act*
TSCA: *Toxic Substance Control Act*
[a] LCFs per km of urban travel
[b] Lifetime estimated total LCFs from annual shipments

Table G.4–11. Total Incident-Free Exposures Due to Truck Emissions from Special Project Shipments

MATERIAL TYPE	UNIT RISK [a] FACTOR PER URBAN KILOMETER	TRUCK DISTANCE TRAVELED PER SHIPMENT (km)	LCFs PER SHIPMENT FOR ROUND TRIP	TOTAL LCFs FOR BASE YEAR SHIPMENTS (TYPICALLY 1996)	TOTAL LCFs FOR NO ACTION ALTERNATIVE		TOTAL LCFs FOR EXPANDED OPERATIONS ALTERNATIVE	TOTAL LCFs FOR REDUCED OPERATIONS ALTERNATIVE
					2003	2008		
TRU/MTRU	1.0×10^{-7}	8.4	1.7×10^{-6}	0	1.7×10^{-6}	5.1×10^{-6}	6.8×10^{-6}	3.4×10^{-6}
TRU/MTRU (Legacy)	1.0×10^{-7}	8.4	1.7×10^{-6}	0	0	3.4×10^{-6}	3.4×10^{-6}	3.4×10^{-6}
LLW (Legacy)	1.0×10^{-7}	33	6.6×10^{-6}	0	0	3.7×10^{-4}	3.7×10^{-4}	3.7×10^{-4}
LLMW (Legacy)	1.0×10^{-7}	40.6	8.1×10^{-6}	0	0	6.5×10^{-5}	6.5×10^{-5}	6.5×10^{-5}
LLW (ER)	1.0×10^{-7}	33	6.6×10^{-6}	0	0	9.0×10^{-4}	9.0×10^{-4}	9.0×10^{-4}
LLMW (ER)	1.0×10^{-7}	40.6	8.1×10^{-6}	0	0	4.1×10^{-5}	4.1×10^{-5}	4.1×10^{-5}
Hazardous Waste (ER)	1.0×10^{-7}	33	6.6×10^{-6}	0	0	7.5×10^{-4}	7.5×10^{-4}	7.5×10^{-4}
Nonhazardous Solid Waste (ER)	1.0×10^{-7}	10	2.0×10^{-6}	0	0	1.8×10^{-5}	1.8×10^{-5}	1.8×10^{-5}
TOTAL[b]					**1.7×10^{-6}**	**2.1×10^{-3}**	**2.1×10^{-3}**	**2.1×10^{-3}**

Sources: SNL 1992a; SNL/NM 1982, 1998a
ER: Environmental Restoration
km: kilometer
LCFs: latent cancer fatalities
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
TRU: transuranic
[a] LCFs per km of urban travel
[b] Lifetime estimated LCFs from total special project shipments.

G.5 SUMMARY OF TRANSPORTATION RISK CALCULATIONS

Table G.5–1 presents a summary of overall transportation impacts evaluated in terms of fatalities due to annual shipments for the SNL/NM operations for the base year and under each alternative. The major contributor to the overall impact would be highway traffic fatalities. Table G.5–2 presents the total transportation impacts evaluated in terms of fatalities due to total special project shipments. These impacts, when combined with annual normal operations shipments, would have minimal effect on overall transportation impacts. The impacts of annual shipments supporting normal operations would be much higher than those of special project shipments.

G.6 TRANSPORTATION ROUTE SCREENING AND INCIDENT-FREE IMPACTS ANALYSIS

G.6.1 Transportation Route Screening

SNL/NM operations rely on the transportation of material and wastes throughout much of the U.S. The estimated quantities of material and wastes were projected based on the levels of activities presented in the SNL/NM facility source documents (SNL/NM 1998a). Appendix A contains the information regarding SNL/NM material inventories. Waste generation projections and wastes currently in storage are presented in Appendix H.

Table G.5–1. Summary of Overall Lifetime Estimated Transportation Impacts Due to Normal Operations (Fatalities per Annual Shipments)

TYPE OF IMPACT	BASE YEAR (1996)	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Radiological Incident-Free	$4.6x10^{-2}$	$9.9x10^{-2}$	0.1	0.31	$2.4x10^{-2}$
Radiological Accident	$1.2x10^{-3}$	$2.2x10^{-3}$	$2.3x10^{-3}$	$6.8x10^{-3}$	$5.5x10^{-4}$
Traffic Fatalities	0.22	0.40	0.42	1.2	0.11
LCFs Due to Truck Emissions	$1.3x10^{-2}$	$2.3x10^{-2}$	$2.4x10^{-2}$	$6.2x10^{-2}$	$1.1x10^{-2}$

Sources: SNL 1986, 1992a; SNL/NM 1982, 1998a
LCFs: latent cancer fatalities
Note: Calculations using *RADTRAN 4* (SNL 1992a)

Table G.5–2. Overall Lifetime Estimated Transportation Impacts Due to Special Project Operations (Fatalities per Annual Shipments)

TYPE OF IMPACT	BASE YEAR (1996)	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
		2003	2008		
Radiological Incident-Free	0	$5.0x10^{-6}$	$1.8x10^{-2}$	$1.8x10^{-2}$	$1.8x10^{-2}$
Radiological Accident	0	$1.2x10^{-11}$	$5.5x10^{-5}$	$5.5x10^{-5}$	$5.5x10^{-5}$
Traffic Fatalities	0	0	$7.1x10^{-2}$	$7.1x10^{-2}$	$7.1x10^{-2}$
LCFs Due to Truck Emissions	0	$1.7x10^{-6}$	$2.1x10^{-3}$	$2.1x10^{-3}$	$2.1x10^{-3}$

Sources: SNL 1986, 1992a; SNL/NM 1982, 1998a
LCFs: latent cancer fatalities
Note: Calculations using *RADTRAN 4* (SNL 1992a)

The transportation impacts associated with material and wastes have been calculated. Due to uncertainties in the number of projected shipments, receipts, and possible transportation routes, a bounding analysis was completed using representative routes for each material and waste. To select a representative route, a screening was performed that included reviewing SNL/NM transportation records for each material type and waste category. Table G.6–1 presents the sites and corresponding parameters considered in selecting representative routes. The selection was made based on the location with the largest number of shipments/ receipts, the longest transportation route, and the highest population distribution along the route.

G.6.2 Incident-Free Impacts Analysis

The incident-free impacts associated with radioactive material and wastes have been calculated. Due to uncertainties in the quantities and radioactivity of projected shipments and receipts, a bounding analysis was completed using the maximum TI value allowed by regulation. The *RADTRAN 4* model limits TI-related calculations based on package size. A package 1-m in size carries a TI value of 16, while a 5-m-size package carries a TI value of 13. The SNL/NM SWEIS evaluated a 1-m-size package, 1 package per shipment, a TI value of 16 per shipment, and a stop time of 0.011 hr/km. Further, the data presented in Table G.6–1 for radioactive materials and radioactive wastes were used in the *RADTRAN 4* modeling.

Calculations using TI values of 5, 8, and 13 were completed to illustrate the bounding affect of the 16-TI value. Table G.6–2 compares the incident-free impact calculation for a radioactive material shipment to Mountaintop, Pennsylvania, with variations in TI. The table shows that the doses to the crew and the public (off-link, on-link, and stop) are linearly proportional to the TI value and decrease as the TI value decreases.

The 16-TI value is conservative. The incident-free impacts for the transport of radioactive materials would be much lower than the highway traffic fatalities (see Section G.4).

Table G.6–1. SNL/NM Shipping Locations, Material Type, Route Characteristics, and Total Distance

SHIPMENT FROM SNL/NM TO LOCATION (MATERIAL TYPE)	ROUTE CHARACTERISTICS			TOTAL DISTANCE (km)
	RURAL	SUBURBAN	URBAN	
MOUNTAINTOP, PA (RADIOACTIVE MATERIALS)				
Population Density, people/square km	11.3	297.2	2,408.1	
Distance, km	2,408.8	539.5	73	3,022.3
Percent in Each Classification	79.7	17.9	2.4	
OAKRIDGE, TN (RADIOACTIVE MATERIALS)				
Population Density, people/square km	7.9	317.3	2,132	
Distance, km	1,915.3	272.4	31.3	2,219.2
Percent in Each Classification	86.3	12.3	1.4	
BUFFALO, NY (RADIOACTIVE MATERIALS)				
Population Density, people/square km	10.5	291.1	2,343.1	
Distance, km	2,245.2	545	60.6	2,851.7
Percent in Each Classification	78.7	19.1	2.1	
ST. LOUIS, MO (RADIOACTIVE MATERIALS)				
Population Density, people/square km	7.3	321	2,467.9	
Distance, km	1,430.1	197.3	35.9	1,664
Percent in Each Classification	85.9	11.9	2.2	
LARGO, FL (RADIOACTIVE MATERIALS)				
Population Density, people/square km	9	353.5	2,036.7	
Distance, km	2,277.4	465.3	49	2,792.1
Percent in Each Classification	81.6	16.7	1.8	
CHARLESTON, SC (RADIOACTIVE MATERIALS)				
Population Density, people/square km	9.7	337.2	2,139.9	
Distance, km	2,244.7	467.5	37.1	2,750.3
Percent in Each Classification	81.6	17	1.4	
SAVANNAH RIVER SITE, SC (RADIOACTIVE MATERIALS)				
Population Density, people/square km	9.3	345.4	2,109	
Distance, km	2,051.1	455.3	40.6	2,548
Percent in Each Classification	80.5	17.9	1.6	
ALBUQUERQUE (CHEMICALS)				
Population Density, people/square km	NA	NA	NA	
Distance, km	8	24	8	40
Percent in Each Classification	20	60	20	

Table G.6–1. SNL/NM Shipping Locations, Material Type, Route Characteristics, and Total Distance (continued)

SHIPMENT FROM SNL/NM TO LOCATION (MATERIAL TYPE)	ROUTE CHARACTERISTICS			TOTAL DISTANCE (km)
	RURAL	SUBURBAN	URBAN	
SILVERDALE, WA (EXPLOSIVES)				
Population Density, people/square km	NA	NA	NA	
Distance, km	2,069.1	288.8	48.1	2,406
Percent in Each Classification	86	12	2	
ALBUQUERQUE AREA (RECYCLABLE WASTES)				
Population Density, people/square km	NA	NA	NA	
Distance, km	10	30	10	50
Percent in Each Classification	20	60	20	
ALBUQUERQUE CITY (RECYCLABLE WASTES)				
Population Density, people/square km	NA	NA	NA	
Distance, km	6.4	19.2	6.4	32
Percent in Each Classification	20	60	20	
RICHLAND, WA (LLW)				
Population Density, people/square km	3.7	377.4	2,140.3	
Distance, km	2,324	224	36	2,584
Percent in Each Classification	89.9	8.7	1.4	
NEVADA TEST SITE, NV (LLW)				
Population Density, people/square km	3.3	486.4	2,357.5	
Distance, km	945	68	25	1,038
Percent in Each Classification	91	7	2	
SAVANNAH RIVER SITE, SC (LLMW)				
Population Density, people/square km	9.3	345.4	2,109	
Distance, km	2,051.1	455.3	40.6	2,548
Percent in Each Classification	80.5	17.9	1.6	
CLIVE, UT (LLW, HAZARDOUS)				
Population Density, people/square km	NR	NR	NR	
Distance, km	1,533	156	33	1,722
Percent in Each Classification	89	9	2	
LOS ALAMOS, NM (TRU/MTRU)				
Population Density, people/square km	8.6	431.0	2,125.0	
Distance, km	132.1	27	8.3	167.4

Table G.6–1. SNL/NM Shipping Locations, Material Type, Route Characteristics, and Total Distance (concluded)

SHIPMENT FROM SNL/NM TO LOCATION (MATERIAL TYPE)	ROUTE CHARACTERISTICS			TOTAL DISTANCE (km)
	RURAL	SUBURBAN	URBAN	
Percent in Each Classification	78.9	16.1	5	
ARAGONITE, UT (BIOHAZARDOUS WASTE)				
Population Density, people/square km	NA	NA	NA	
Distance, km	984.8	105.8	24.4	1,114
Percent in Each Classification	88.4	9.5	2.2	

Sources: DOE 1996h, SNL 1992a
km: kilometer
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: Not applicable
NR: not reported
TRU: transuranic
Note: Only radioactive material and waste require population density information for the *RADTRAN 4* model.

Table G.6–2. Comparison of Incident-Free Impacts with Variations in Transport Index Values[a]

TRANSPORT INDEX	CREW DOSE (person-rem)	DOSE TO PUBLIC (person-rem)		
		OFF-LINK	ON-LINK	STOP
13	$1.12x10^{-1}$	$1.7x10^{-2}$	$7.1x10^{-2}$	$6.02x10^{-1}$
8	$5.6x10^{-2}$	$1.1x10^{-2}$	$4.4x10^{-2}$	$3.71x10^{-1}$
5	$3.5x10^{-2}$	$6.7x10^{-3}$	$2.7x10^{-2}$	$2.32x10^{-1}$

Sources: Original, SNL 1992a
hr: hour
km: kilometer
m: meter
rem: Roentgen equivalent, man
[a] Shipment to Mountaintop, Pennsylvania; 5.2-m package; stop time of 0.011 hr/km

G.7 ONSITE TRANSPORTATION IMPACTS

Onsite transportation impacts due to the movement of various materials and waste within SNL/NM and the KAFB site boundary would be small compared to the offsite transportation impacts. This is due to the shorter travel distance, smaller quantities, and lower population density. This assumption was supported by quantifying the impacts for the Expanded Operations Alternative onsite shipments/transfers. Table G.7–1 presents the projected number of onsite transfers of various materials and wastes, along with expected travel distances. These distances were assumed to be suburban type. Transportation impacts would include incident-free radiological doses and nonradiological traffic fatalities. The impacts calculated for each of these are presented in Table G.7–2 for the Expanded Operations Alternative. The onsite impacts would be much smaller than the offsite transportation impacts summarized in Table G.5–1. Therefore, onsite impacts were not evaluated in detail for all alternatives.

Table G.7–1. Summary of Annual Onsite Transfers

MATERIAL TYPE	MAXIMUM ROUND TRIP DISTANCE (km)	BASE YEAR[a]	NO ACTION ALTERNATIVE		EXPANDED OPERATIONS ALTERNATIVE	REDUCED OPERATIONS ALTERNATIVE
			2003	2008		
Radioactive	19	10	1,158[b]	1,160[b]	1,198[b]	1,145[b]
Explosives	32	1,453	2,675	2,844	8,490	665
LLW	16	761	772	772	775	770
LLMW	16	35	24	24	20	28
TRU/MTRU	16	4	4	4	5	2
Hazardous (RCRA)	16	800	800	800	800	800
Municipal Solid Waste	80	896[c]	155	155	155	155
ER RCRA	16	NA	1,407	NA	1,407	1,407

Sources: SNL 1996a, SNL/NM 1998a, SNL/NM 1997b
ER: Environmental Restoration
KAFB: Kirtland Air Force Base
km: kilometer
LLMW: low-level mixed waste
LLW: low-level waste
MTRU: mixed transuranic
NA: Not applicable
NR: Not reported
RCRA: *Resource Conservation and Recovery Act*
TRU: transuranic
[a] The base year varies depending on information provided in the *Facilities and Safety Information Document* (FSID) (SNL/NM 1997b). Typically, the base year is 1996 or 1997, as appropriate.
[b] Increase in transfers due to medical isotope production
[c] Includes waste managed at the KAFB landfill

Table G.7–2. Onsite Transportation Impacts

TYPE OF IMPACT	EXPANDED OPERATIONS ALTERNATIVE (NUMBER OF FATALITIES)
Radiological Incident-Free	1.7×10^{-4}
Traffic Fatalities	5.7×10^{-3}

Source: DOE 1996h, SNL 1986

G.8 HAZARDOUS MATERIALS AND AIR CARGO, NATIONALLY AND AT THE ALBUQUERQUE INTERNATIONAL SUNPORT

The U.S. Department of Transportation (DOT), Office of Hazardous Material Safety, estimates approximately 800,000 U.S. hazardous material cargos are shipped each day by water, air, rail, truck, and pipeline (DOT 1998a). Of these, about 500,000 shipments involve chemical and associated products, about 300,000 involve petroleum products, and at least 10,000 other shipments involve other hazardous materials including medical wastes and hazardous wastes.

Truck transport accounts for only about 43 percent of hazardous materials tonnage, but about 94 percent of the individual shipments. The air mode, while almost negligible in terms of tonnage (about 1 percent), has a share of individual shipments that greatly exceeds its percent tonnage (about 5 percent). In contrast, enormous amounts of hazardous materials tonnage are carried by rail, pipeline, and water modes, but the number of shipments is less than 1 percent (see Table G.8–1).

Hazardous materials air tonnage amounts to only 0.1 percent of hazardous materials truck tonnage. The SWEIS transportation analysis focuses on the dominant mode of transportation (trucks) and does not directly analyze air transportation. The DOE feels that it is reasonable to believe that very little tonnage of SNL/NM hazardous materials shipments and receipts are managed through the Albuquerque International Sunport.

Complete facts on Albuquerque International Sunport air cargo, including hazardous materials, were not available. The following information has been compiled to provide some context, based on reasonable assumptions. Further, the following information and its underlying analysis are an attempt to quantify the levels of hazardous materials air cargo shipments at the Sunport and quantities possibly related to SNL/NM. Virtually all figures in both the text and tables are estimates that can be rounded to the nearest tens, hundreds, thousands, millions, etc. Where precise figures are used, the intent is not to convey a false sense of precision, but rather to facilitate tracking the data and methodology used.

In 1997, approximately 62 M tons of all types of cargo were shipped by air domestically. In 1998, approximately 65,000 tons of cargo moved through the Albuquerque International Sunport freight center. According to the Federal Aviation Administration (FAA) and the DOT, 312,000 tons were landed at the Sunport (includes KAFB). The FAA and the DOT rank the Sunport the 45th largest of the 102 qualifying air cargo airports in the U.S.

Assuming the Sunport handles 0.5 percent of national shipments (312,000/62 M), it would handle approximately 20 tons of hazardous materials per day (0.5 times 4,049). This is small compared to the 312,000 tons of all cargo the Sunport handles. To estimate SNL/NM's portion of this 20 of tons hazardous materials at the Sunport, the analysis can use the SNL/NM's portion of placarded truck traffic in the region of influence (ROI). Within the ROI, SNL/NM material and waste transportation represents only 0.96 percent (14.5/ 1,514) of the total 24-hour placarded material and waste truck traffic (see Table 5.3.9–3) along Interstate (I)-25 and I-40. A reasonable assumption is that, on a daily basis, only 400 lb (or 1 percent of 20 tons/day), which would be 10 or 20 packages, of the hazardous material that lands at the Sunport, are related to SNL/NM. This is small in comparison to the approximately 25,000 nonbulk chemical packages (approximately 540 tons) shipped by truck each year to and from SNL/NM. In the base year, another 370 tons (340,317 kg) of total chemical waste were shipped by truck for disposal (see Table 3.6–2). The percentage of SNL/NM material shipped by air is further reduced when hazardous materials truck shipments include bulk chemicals (130 tons), bulk gases (argon, carbon dioxide, and oxygen), explosives, radioactive materials, and radioactive wastes (another 50 tons; see Table 5.3.10–1 [49,414 kg] in the base year). SNL/NM also receives 475 M ft^3, or 45,000 tons, of natural gas (at 60 pounds per square inch) through a pipeline each year.

In conclusion, while air cargo tonnage is increasing both nationally and internationally, the transportation of hazardous materials is dominated by transportation modes other than air. SNL/NM shipments and receipts are dominated by truck transport, and the DOE has focused the analysis accordingly.

Table G.8–1. Hazardous Material Shipments and Tons by Mode

MODE	SHIPMENTS	%	TONS SHIPPED	%
Truck	768,907	93.98	3,709,180	42.94
Rail	4,315	0.53	378,916	4.39
Pipeline	873	0.11	3,273,750	37.90
Water	335	0.04	1,272,925	14.73
Air	43,750	5.35	4,049	0.05
Daily Totals	818,180	100	8,638,820	100
Annual Totals	298,635,700		3,153,169,300	

Source: DOT 1998a

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