APPENDIX J: TABLE OF CONTENTS

LIST OF TABLES

APPENDIX J: RADIOLOGICAL TRANSPORTATION ANALYSIS METHODOLOGY

J.1 SHIPMENT SCENARIOS

J.1.1 Proposed Action and Alternatives for Transportation

The No Action Alternative, Proposed Action, and Reduced Operation Alternative, as described in Chapter 3 of the *Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (LLNL SW/SPEIS), include transportation of radioactive materials. Low-level radioactive waste would be shipped from the Lawrence Livermore National Laboratory (LLNL) to the Nevada Test Site. Transuranic (TRU) waste would be shipped to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. Other radioactive materials for research or weapons stockpile stewardship would be sent to LLNL from other U.S. Department of Energy (DOE) and National Nuclear Security Administration (NNSA) facilities and from LLNL to these same facilities. There are occasional shipments of radioactive materials that do not fit into these categories.

J.1.2 Materials Shipped

The materials shipped are described as follows.

Low-Level Waste

For purposes of analysis, all low-level waste shipments are assumed to go to either the Nevada Test Site or the PermaFix Facility in Kingston, Tennessee. Other destinations are possible, including privately operated facilities in Barnwell, South Carolina, and Clive, Utah, and several mixed-waste treatment facilities. One such example, the low-level wastes contaminated with chemicals identified in the *Toxic Substance Control Act* (TSCA), would be shipped to DOE's TSCA incinerator at Oak Ridge, Tennessee, with the ash returned to LLNL. Low-level waste shipments throughout DOE complex were analyzed in the *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE 1997f), but are calculated and reported in this LLNL SW/SPEIS to give a complete picture of radiological transportation impacts for LLNL.

Transuranic Waste

For many years, LLNL had been accumulating TRU waste because there was no disposal site or because facilities used to characterize and package the waste were not available at LLNL. LLNL plans to ship nearly 1,000 TRU waste drums to the WIPP, DOE's designated repository for TRU waste since 1999. This one-time shipment of TRU waste backlog is analyzed separately in Section J.6.3 of this appendix. Another one-time shipment analyzed in this LLNL SW/SPEIS is the shipment of 14 drums of TRU and mixed TRU waste from the Lawrence Berkeley National Laboratory (LBNL) to LLNL for characterization and ultimate shipment to the WIPP. Finally, this LLNL SW/SPEIS also analyzes the continuing shipment of TRU waste generated as a result of LLNL operations. TRU waste shipments from LLNL to the WIPP were analyzed in the *Waste*

Isolation Pilot Plant Final Supplemental Environmental Impact Statement (WIPP SEIS) (DOE 1997e), but are calculated and reported in this LLNL SW/SPEIS to give a complete picture of radiological transportation impacts for LLNL.

Special Nuclear Materials

Special nuclear materials used at LLNL are primarily plutonium and some enriched uranium in the metal or oxide forms. Many of these shipments were analyzed in the *Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE 1996a) and the *Surplus Plutonium Disposition Environmental Impact Statement* (DOE 1999c). The shipments are to or from other NNSA weapons facilities.

Tritium

Illumination devices containing tritium are shipped to LLNL for tritium recycling. Tritium targets are sent from Los Alamos National Laboratory (LANL), New Mexico, to LLNL for National Ignition Facility (NIF) experiments, and tritium gas is sent from the Savannah River Site to LLNL for various other experiments. Tritium does not emit radiation from its packaging; therefore, it does not have any incident-free radiological impacts. Section J.4 addresses the consequences of a transportation accident involving tritium gas.

Miscellaneous Radioactive Materials

A search of DOE's Enterprise Transportation Analysis System identified a number of shipments not included in any of the categories above. These shipments are made to DOE and private laboratories across the nation. Most shipments are small, commercial-carrier shipments with no measurable dose rate. The radiological impacts of these shipments are not quantified.

J.1.3 Packaging

For purposes of this analysis, NNSA used two general package types: Type A and Type B packaging. Type A packaging is designed to protect and retain its contents under normal transport conditions and maintain sufficient shielding to limit radiation exposure to handling personnel. These packages are used to transport low-level waste. Type B packages are used to transport material with the highest radioactivity levels and to protect and retain their contents under transportation accident conditions. TRU waste and special nuclear materials are shipped in Type B packages.

DOE adopts Nuclear Regulatory Commission (NRC) standards for Type B packages, which include certification of packages against stringent testing standards (10 CFR Part 71). The testing or other analysis must certify that the contents of the package will not be released under the following tests:

- Free Drop—The package/cask drops 30 feet onto a flat, horizontal, unyielding surface so that it strikes at its weakest point.

- Puncture—The package/cask drops 40 inches onto a 6-inch-diameter steel bar at least 8 inches long. The bar strikes the cask at its most vulnerable spot.

- Fire—After the impact tests, the cask is totally engulfed in a 1,475-degree Fahrenheit (°F) thermal environment for 30 minutes. The cask is then completely submerged under at least 40 inches of water for 8 hours. Undamaged packages must withstand more severe immersion tests.

There are numerous designs of Type B packages that NNSA uses for transporting radioactive materials. NNSA selects packages that are appropriate for the purpose and contents for which they will be used. NNSA typically uses the TRU package transporter (TRUPACT)-II for contact-handled TRU waste shipments. The TRUPACT-II is a large cask that can contain multiple smaller packages. It includes armor, impact limiters, and thermal insulation. Other similarly robust transporters, such as the HalfPACT, may also be used.

Type B packages for special nuclear materials are shipped in specially designed safe secure trailers/safeguards transports (SST/SGT). The SST/SGT contains enhanced structural and security features that are classified. They operate under operational security procedures and emergency plans that include armed escort, satellite tracking, and advanced communications.

J.2 ROUTING AND DEMOGRAPHICS

NNSA used the computer code, Transportation Routing Analysis Geographic Information System (TRAGIS) (ORNL 2000), to determine representative routes for the transportation indicated in Table J.2–1. Designed by the Oak Ridge National Laboratory, TRAGIS gives routes from an origin to a destination based on user-selected criteria. NNSA-selected criteria are consistent with transport of radioactive material by preferred routes such as those described in 49 CFR Part 397, Subpart D; i.e., highway route-controlled quantities.

TABLE J.2–1.—*Unique TRAGIS Runs*

Origin-Destination Pair (between LLNL and -)	Material Shipped
Los Alamos National Laboratory	Special nuclear material, tritium, depleted uranium
Pantex	Special nuclear material
Nevada Test Site	Low-level waste, special nuclear material
Savannah River Site	Special nuclear material, tritium
Argonne National Laboratory – West	Special nuclear material
Rocky Flats Environmental Technology Site	Special nuclear material
Atomic Weapons Establishment (United Kingdom)[a]	Special nuclear material
Hanford Site	Special nuclear material
Oak Ridge National Laboratory	Special nuclear material, TSCA waste
PermaFix	Mixed low-level waste
Waste Isolation Pilot Plant	TRU waste
Lawrence Berkeley National Laboratory	TRU waste and mixed TRU waste

Source: Original.
[a] Shipments to the United Kingdom were modeled by truck to the shipping terminal in Charleston, South Carolina.
LLNL = Lawrence Livermore National Laboratory; TRU = transuranic; TSCA = *Toxic Substance Control Act.*

TRAGIS provides route information such as nodes, segments, miles per segment, miles per state, miles per highway type, miles per population density category, population within 800 meters of the route, and other parameters of interest. Some of the output is specifically designed for direct input into the RADTRAN 5 computer code (Section J.3).

TRAGIS runs were performed for the unique origin-destination pairs required under the Proposed Action. Pairs already represented by a reverse-direction pair were eliminated. Unique TRAGIS runs were reduced to those in Table J.2–1.

J.3 INCIDENT-FREE ANALYSIS

NNSA used RADTRAN 5 (SNL 2000) to calculate collective dose from incident-free transportation of radioactive materials by truck. RADTRAN 5 was developed and is maintained by Sandia National Laboratories. It is capable of analyzing both incident-free and accident impacts for highway, rail, ship and barge, and air transport. For incident-free analysis, the code calculates collective doses to persons along the route, such as residents; persons sharing the route; persons at stops; and drivers. Important inputs to RADTRAN 5 are the demographic and route data described in Section J.2, the dose rate 1 meter from the truck, and other parameters.

Microshield® (Grove Engineering 1996) calculations of arrays of special nuclear material packages placed into SST/SGTs yielded very low dose rates. For conservatism, NNSA selected a larger dose rate to model, 1 millirem per hour. Years of experience shipping weapons-related fissile materials have demonstrated that the 1-millirem-per-hour dose rate is not likely to be exceeded. Dose rates for TRU waste were not calculated but taken from the WIPP SEIS (DOE 1997e) as 4 millirems per hour. Low-level waste was assumed to have a dose rate of 1 millirem per hour, based on information in the Waste Management Programmatic EIS (DOE 1997f).

Individual RADTRAN 5 runs for one shipment were conducted for the analysis, and their results are indicated in Table J.3–1, identified with case numbers. These results can be aggregated into values for the No Action Alternative, Proposed Action, and Reduced Operation Alternative, depending on numbers of shipments. NNSA also performed a cumulative impacts analysis of radiological shipments converging on LLNL area from shipments to and from Sandia National Laboratories/California (SNL/CA). The route was assumed to be 3.5 miles in LLNL vicinity with a speed of 25 miles per hour, commensurate with heavy traffic.

TABLE J.3–1.—*Unique RADTRAN 5 Runs for Incident-Free Transport*

Case Number[a]	Origin-Destination Pair	Material Shipped	Collective Dose to Drivers	Collective Dose to Members of the Public (person-rem)			
				Along Route	Sharing Route	At Stops	Total Public
1	LLNL-LANL	SNM	9.3×10^{-3}	5.7×10^{-4}	7.3×10^{-3}	4.0×10^{-3}	1.2×10^{-2}
2	LLNL-PANTEX	SNM	8.3×10^{-3}	6.1×10^{-4}	8.1×10^{-3}	4.0×10^{-3}	1.3×10^{-2}
3	LLNL-NTS	SNM	4.3×10^{-3}	4.1×10^{-4}	5.8×10^{-3}	2.4×10^{-3}	8.6×10^{-3}
4	LLNL-SRS	SNM	1.8×10^{-2}	2.0×10^{-3}	1.8×10^{-2}	8.0×10^{-3}	2.8×10^{-2}
5	LLNL-ANL-W	SNM	6.1×10^{-3}	6.1×10^{-4}	7.0×10^{-3}	2.4×10^{-3}	1.0×10^{-2}
6	LLNL RFETS	SNM	7.7×10^{-3}	6.3×10^{-4}	7.9×10^{-3}	3.2×10^{-3}	1.2×10^{-2}
7	LLNL-AWE	SNM	1.9×10^{-2}	2.3×10^{-3}	1.9×10^{-2}	8.8×10^{-3}	3.0×10^{-2}
8	LLNL-NTS	LLW	6.6×10^{-2}	8.1×10^{-4}	1.2×10^{-2}	4.8×10^{-3}	1.7×10^{-2}
9	LLNL-PERMA FIX	MLLW	2.5×10^{-1}	3.1×10^{-3}	2.8×10^{-2}	1.5×10^{-2}	4.6×10^{-2}
10	LLNL-OAK RIDGE	TSCA	2.5×10^{-1}	3.1×10^{-3}	2.8×10^{-2}	1.5×10^{-2}	4.6×10^{-2}
11	LLNL- OAK RIDGE	TSCA	3.0×10^{-2}	2.8×10^{-4}	2.6×10^{-3}	1.3×10^{-3}	4.2×10^{-3}
13	LLNL-WIPP	TRU	8.6×10^{-3}	1.0×10^{-3}	1.3×10^{-2}	5.8×10^{-3}	1.9×10^{-2}
14	SRS-LLNL	SNM	2.4×10^{-2}	3.4×10^{-3}	3.0×10^{-2}	1.4×10^{-2}	4.7×10^{-2}
15	LLNL-LANL	SNM	1.1×10^{-2}	8.2×10^{-5}	1.0×10^{-3}	5.7×10^{-4}	1.7×10^{-3}
16	LLNL-SRS	SNM	2.4×10^{-2}	3.4×10^{-3}	3.0×10^{-2}	1.4×10^{-2}	4.7×10^{-2}
17	LLNL-LBNL	TRU and Mixed TRU	1.3×10^{-3}	2.3×10^{-5}	4.1×10^{-4}	(b)	4.4×10^{-4}

TABLE J.3–1.—*Unique RADTRAN 5 Runs for Incident-Free Transport (continued)*

Case Number[a]	Origin-Destination Pair	Material Shipped	Collective Dose to Drivers	Collective Dose to Members of the Public (person-rem)			
				Along Route	Sharing Route	At Stops	Total Public
28	HANFORD-LLNL	TRU	8.1×10^{-3}	1.5×10^{-3}	1.4×10^{-2}	6.7×10^{-3}	2.2×10^{-2}
29	LLNL-LANL	SNM	8.1×10^{-3}	1.5×10^{-3}	1.4×10^{-2}	5.4×10^{-3}	2.1×10^{-2}
33	LLNL-PANTEX	SNM	9.3×10^{-3}	3.3×10^{-4}	4.2×10^{-3}	2.3×10^{-3}	6.9×10^{-3}
34	LLNL-NTS	SNM	8.7×10^{-3}	1.0×10^{-3}	1.3×10^{-2}	4.8×10^{-3}	1.8×10^{-2}
35	LLNL-SRS	SNM	8.7×10^{-3}	1.0×10^{-3}	1.3×10^{-2}	4.8×10^{-3}	1.8×10^{-2}
36	LLNL-LLNL	SNM	1.1×10^{-2}	8.2×10^{-5}	1.0×10^{-3}	5.7×10^{-4}	1.7×10^{-3}
37	LLNL-LLNL	SNM	9.3×10^{-3}	9.7×10^{-4}	1.2×10^{-2}	2.3×10^{-3}	2.0×10^{-2}
38	LLNL-WIPP	SNM	8.7×10^{-3}	1.0×10^{-3}	1.3×10^{-2}	4.8×10^{-3}	1.8×10^{-2}
39	LLNL-WIPP	TRU	8.7×10^{-3}	1.0×10^{-3}	1.3×10^{-2}	4.8×10^{-3}	1.8×10^{-2}
40	LLNL-LLNL	SNM	6.1×10^{-5}	8.9×10^{-6}	1.5×10^{-4}	8.8×10^{-5}	2.5×10^{-4}
41	LLNL-LLNL	SNM	6.1×10^{-5}	8.9×10^{-6}	1.5×10^{-4}	8.8×10^{-5}	2.5×10^{-4}
42	LLNL-LLNL	Tritium	0	0	0	0	0
43	LANL-LLNL	Depleted Uranium	6.1×10^{-5}	8.9×10^{-6}	1.5×10^{-4}	8.8×10^{-5}	2.5×10^{-4}

Source: Original.
[a] Cases 12, 18-27, and 30-32 are no longer used in this analysis.
[b] There were no stops on this short route.
ANL/W = Argonne National Laboratory – West; AWE = Atomic Weapons Establishment; LBNL = Lawrence Berkeley National Laboratory; LLW = low-level waste; LANL = Los Alamos National Laboratory; MLLW = mixed low-level waste; NTS = Nevada Test Site; ORR = Oak Ridge Reservation ; RFETS = Rocky Flats Environmental Technology Site; SNM = special nuclear material, various load sizes and compositions; SRS = Savannah River Site; TSCA = *Toxic Substance and Control Act*; WIPP = Waste Isolation Pilot Plant.

J.4 ACCIDENT ANALYSIS

NNSA examined the shipment campaigns under the No Action Alternative, Proposed Action, and Reduced Operation Alternative to identify bounding transportation accidents for each of four radiological shipment types: special nuclear material, TRU waste, low-level waste, and tritium. As with the incident-free analysis, NNSA used RADTRAN 5 to calculate collective dose to the public from potential transportation accidents. The routing and packaging were the same as those for the same shipments under the incident-free analysis. The general methodology is described in NUREG 0170 (NRC 1977a), using eight accident severity categories. Parameters for release fractions, aerosolized fractions, and respirable fractions were taken from the RADTRAN User Guide (SNL 2000). Table J.4-1 describes the four shipments that were analyzed.

TABLE J.4–1.—*Candidate Bounding Radiological Transportation Accidents*

Material	Origin-Destination	Description
Special nuclear material	LANL - LLNL	This is a fine oxide powder consisting mostly of plutonium isotopes and is a byproduct of the ITP process (see Appendix N). The accident would involve 25 Type B containers being transported in an SST/SGT. There would be three shipments per year of this material.
TRU waste	LLNL - WIPP	The TRU waste would originate in the ITP process and consist primarily of plutonium isotopes. The waste would be packaged into forty-two 55-gallon drums that would be placed into three TRUPACT-IIs. There would be one shipment per year of this particular type of TRU waste.
Low-level waste	LLNL - NTS	The low-level waste would consist mostly of plutonium isotopes at concentrations that are less than those needed to classify the waste as TRU. It would be packaged into eighty 55-gallon drums and transported by a standard tractor-trailer truck. There would be 80 shipments per year of this low-level waste.
Tritium	SRS - LLNL	Up to 10 grams of gaseous tritium would be transported in Type B containers. Under accident conditions, the gaseous tritium is assumed to totally oxidize. Tritium in this quantity would be shipped four times per year.

Source: Original.
ITP = Integrated Technology Project; LANL = Los Alamos National Laboratory; NTS = Nevada Test Site; SRS = Savannah River Site; SST/SGT = Safe secure trailers/safeguards transportation; TRU = transuranic; TRUPACT = transuranic package transporter; WIPP = Waste Isolation Pilot Plant.

The impacts of the accidents reported in Table J.4–2 are based on the assumption that the accidents would occur in the most populous regions along the route. Accidents in less populated regions or of lower collision impact could occur, resulting in smaller impacts. The accident probabilities were multiplied by the numbers of shipments. The lower consequence accidents would likely have larger probabilities of occurrence.

TABLE J.4–2.—*Impacts from Candidate Bounding Radiological Transportation Accidents*

Material	Collective Dose (person-rem)	Latent Cancer Fatalities	Probability (per year)
Special nuclear material	2.7×10^{4}	16	5.3×10^{-11}
TRU waste	4.6×10^{4}	28	2.1×10^{-11}
Low-level waste	44	0.026	3.5×10^{-6}
Tritium	340	0.20	9.9×10^{-10}

Source: Original.

The bounding offsite radiological transportation accident under the Proposed Action would be the TRU waste accident associated with the ITP. The probability of this accident is so low that it is not considered reasonably foreseeable. Under the No Action Alternative and Reduced Operation Alternative, the bounding accident would be the tritium accident.

J.5 FORMATION OF ALTERNATIVES

The RADTRAN 5 results presented in Section J.3 must be combined, as follows.

J.5.1 Current Operations

Radiological transportation under current operations includes shipments of special nuclear material, tritium, low-level and mixed low-level waste, TSCA-contaminated low-level waste, TRU waste backlog, and miscellaneous radioactive materials. No cases for tritium or miscellaneous radioactive materials have been quantified because the incident-free impacts are insignificant compared to the quantified shipments.

Therefore, the following RADTRAN 5 runs comprise the current operations analysis (see Table J.3–1):

- 11 shipments under RADTRAN 5 case 1
- 41 shipments under RADTRAN 5 case 8
- 4 shipments under RADTRAN 5 case 9
- 11 shipments under RADTRAN 5 case 10
- 2 shipments under RADTRAN 5 case 11

J.5.2 No Action Alternative

Radiological transportation under the No Action Alternative would include shipments of special nuclear material, tritium, low-level and mixed low-level waste, TRU waste, and miscellaneous radioactive materials. No cases for tritium or miscellaneous radioactive materials have been quantified because the incident-free impacts are insignificant compared to the quantified shipments.

Therefore, the following RADTRAN 5 runs comprise the No Action Alternative analysis (see Table J.3–1):

- 118 shipments under RADTRAN 5 case 1
- 14 shipments under RADTRAN 5 case 2
- 68 shipments under RADTRAN 5 case 3
- 39 shipments under RADTRAN 5 case 4

- 6 shipments under RADTRAN 5 case 5
- 10 shipments under RADTRAN 5 case 7
- 52 shipments under RADTRAN 5 case 8
- 9 shipments under RADTRAN 5 case 9
- 13 shipments under RADTRAN 5 case 13
- 15 shipments under RADTRAN 5 case 42
- 50 shipments under RADTRAN 5 case 43

J.5.3 Proposed Action

Radiological transportation under the Proposed Action would include shipments of special nuclear material, tritium, low-level and mixed low-level waste, TRU waste (including the Berkeley drums), and miscellaneous radioactive materials. No cases for tritium or miscellaneous radioactive materials have been quantified because the incident-free impacts are insignificant compared to the quantified shipments.

Therefore, the following RADTRAN 5 runs comprise the Proposed Action analysis (see Table J.3–1:

- 127 shipments under RADTRAN 5 case 1
- 14 shipments under RADTRAN 5 case 2
- 78 shipments under RADTRAN 5 case 3
- 8 shipments under RADTRAN 5 case 4
- 50 shipments under RADTRAN 5 case 6
- 5 shipments under RADTRAN 5 case 7
- 66 shipments under RADTRAN 5 case 8
- 16 shipments under RADTRAN 5 case 9
- 9 shipments under RADTRAN 5 case 13
- 4 shipments under RADTRAN 5 case 14
- 1 shipment under RADTRAN 5 case 15
- 3 shipments under RADTRAN 5 case 16

- 1 shipment under RADTRAN 5 case 33
- 1 shipment under RADTRAN 5 case 34
- 10 shipments under RADTRAN 5 case 40
- 10 shipments under RADTRAN 5 case 41
- 15 shipments under RADTRAN 5 case 42
- 10 shipments under RADTRAN 5 case 43

J.5.4 Reduced Operation Alternative

Radiological transportation under the Reduced Operation Alternative would include shipments of special nuclear material, tritium, low-level and mixed low-level waste, TRU waste, and miscellaneous radioactive materials. No cases for tritium or miscellaneous radioactive materials have been quantified because the incident-free impacts are insignificant compared to the quantified shipments.

Therefore, the following RADTRAN 5 runs comprise the Reduced Operation Alternative analysis (see Table J.3–1):

- 265 shipments under RADTRAN 5 case 1
- 46 shipments under RADTRAN 5 case 8
- 9 shipments under RADTRAN 5 case 9
- 7 shipments under RADTRAN 5 case 13
- 10 shipments under RADTRAN 5 case 42
- 30 shipments under RADTRAN 5 case 44

J.6 SPECIFIC CAMPAIGNS

Although the following shipment campaigns are part of the analysis of alternatives, NNSA has selected these for separate treatment and disclosure of incident-free impacts.

J.6.1 Berkeley Transuranic Waste Drums

Under the Proposed Action, there would be a one-time shipment of fourteen 55-gallon drums of solidified TRU and mixed TRU waste from LBNL to LLNL. The drums would be characterized and placed into the shipment campaign to the WIPP. RADTRAN 5 case 17 constitutes this campaign. The incident-free result would be 4.4×10^{-4} person-rem to the general public, which is equivalent to 3×10^{-7} latent cancer fatalities (LCFs).

J.6.2 *Toxic Substance Control Act*-Listed Low-Level Waste

This shipment campaign under the No Action Alternative would comprise two shipments of liquids and five shipments of solids for treatment at DOE's TSCA incinerator at Oak Ridge National Laboratory. The ash may have to be returned to LLNL. Therefore, NNSA assumed that the liquids would reduce in volume to one 55-gallon drum of ash, but that the solids (diatomaceous earth and gypsum) would not reduce in volume at all. This would mean that six shipments of solids would be returned. Therefore, the following RADTRAN 5 runs comprise this shipment campaign (see Table J.3–1):

- 11 shipments under RADTRAN 5 case 10
- 2 shipments under RADTRAN 5 case 11

The result would be 0.51 person-rem to the general public, which is equivalent to 3×10^{-4} LCFs.

J.6.3 Transuranic Waste Backlog

TRU waste has accumulated at LLNL waiting for the disposal method to become available. NNSA has estimated that under the No Action Alternative, 24 full shipments to the WIPP (case 13) would be needed (see Table J.3–1). This would result in 1.9 person-rem to the general public, which is equivalent to 1×10^{-3} LCFs.

J.6.4 Integrated Technology Project

Details of this Proposed Action shipment campaign are reported in Appendix N. The result would be 0.55 person-rem per year to the general public, which is equivalent to 3×10^{-4} LCFs per year.

J.6.5 National Ignition Facility Target Materials (see Appendix M)

Under the Proposed Action, plutonium and enriched uranium would be shipped from LANL to LLNL. Therefore, the following RADTRAN 5 runs comprise this campaign (see Table J.3–1):

- 10 shipments under RADTRAN 5 case 40
- 10 shipments under RADTRAN 5 case 41
- 15 shipments under RADTRAN 5 case 42
- 10 shipments under RADTRAN 5 case 43

The result would be 0.019 person-rem to the general public, which is equivalent to 1.1×10^{-5} LCFs per year.

J.7 CUMULATIVE IMPACTS ANALYSIS

LLNL and SNL/CA are the largest shippers of radioactive materials in the immediate area. The close proximity of these two government laboratories means that shipments to these laboratories to or from any location in the county converge on nearby roads, producing a cumulative impact. The most probable route in the immediate area in which these shipments converge is I-580 from the east to Greenville Road to East Avenue. The Greenville Road segment of this route has very low population density. Therefore, for purposes of analysis, NNSA has analyzed a route along I-580 from Greenville Road exit to the Vasco Road exit and then along South Vasco Road to East Avenue.

Using RADTRAN 5, NNSA analyzed all the shipments under the Proposed Action along this 3.5-mile route segment. Except for the route and demographics, all of the analytical parameters for this cumulative impacts analysis were the same as those for the Proposed Action. Shipments to and from SNL/CA were also analyzed for this route segment; NNSA assumed five shipments of low-level waste and other incidental radioactive materials. There were no TRU waste shipments included in the SNL/CA analysis. The collective dose to the general population along this route segment would be 6.1×10^{-2} person-rem per year from LLNL Proposed Action shipments and 1.2×10^{-3} person-rem per year from the SNL/CA shipments, for a cumulative impact of 6.2×10^{-2} person-rem per year. This is equivalent to 3.7×10^{-5} LCFs per year in the exposed population.

J.8 CALCULATION OF LATENT CANCER FATALITIES

In Chapter 5 of this LLNL SW/SPEIS, DOE reports human health effects from transportation of radioactive materials in terms of LCFs. Consistent with recommendations of the Interagency Steering Committee on Radiation Standards (Lawrence 2002), DOE uses a factor to convert collective dose in person-rem to numbers of LCFs. The value would be 6×10^{-4} LCFs per person-rem.

J.9 REFERENCES:

10 CFR Part 71 — Nuclear Regulatory Commission (NRC), "Energy, Packaging and Transportation of Radioactive Material." *Code of Federal Regulations*, Office of the Federal Register National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, Revised January 1, 2003.

49 CFR Part 397 — U.S. Department of Transportation, "Transportation, Transportation of Hazardous Materials; Driving and Parking Rules," *Code of Federal Regulations*, Office of the Federal Register, National Archives and Records Administration, U.S. Government Printing Office, Washington, DC, Revised October 1, 2003.

DOE 1996a — U.S. Department of Energy (DOE), *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management, Summary*, Vols. 1-4, DOE/EIS-0236, Washington, DC, September 1996.

DOE 1997e — DOE, *Waste Isolation Pilot Plant Final Supplemental Environmental Impact Statement,* DOE/EIS-026-S-2, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, NM, September 1997.

DOE 1997f — DOE, *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive Waste and Hazardous Waste*, DOE/EIS-0200-F, U.S. Department of Energy, May 1997.

DOE 1999c — DOE, *Surplus Plutonium Disposition Final Environmental Impact Statement*, DOE/EIS-0283, U.S. Department of Energy, Office of Fissile Materials Disposition, Washington, DC, November 1999.

Grove Engineering 1996 — Grove Engineering, *MicroShield-Version 5 User's Manual*, Rockville, MD, October 1996.

Lawrence 2002 — Lawrence, Andy, Memorandum from Andy Lawrence, U.S. Department of Energy, Office of Environmental Policy and Guidance, dated August 9, 2002, regarding the *Radiation Risk Estimation from Total Effective Dose Equivalents (TEDE's)*, Washington, DC, 2002.

NRC 1977a NRC, *Final Environmental Statement on the Transportation of Radioactive Materials by Air and Other Modes*, Vol. 1, NUREG-0170, Nuclear Regulatory Commission, Rockville, MD, December 1977.

ORNL 2000 Oak Ridge National Laboratory (ORNL), T*ransportation Routing Analysis, Geographic Information System (WebTRAGIS) User's Manual,* ORNL/TM-2000/86, Oakridge National Laboratory, Oak Ridge, TN, April 2000.

SNL 2000 Sandia National Laboratory (SNL), *RADTRAN5 User Guide*, SNAD2000-1257, Sandia National Laboratories, Albuquerque, NM, May 2000.