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(3A) Disciplines - Technical Data

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- G EIS Public Comment/Resolution
- H Reference Material
- I Other

ENVIRONMENTAL
 0024

ENGINEERING DESIGN FILE

Project/Task: INCIDENT-FREE TRANSPORTATION

Subtask: ONSITE INEL INCIDENT-FREE TRANSPORTATION

Title: DOSES AND HEALTH EFFECTS FROM INEL ONSITE INCIDENT-FREE TRANSPORTATION FOR ALTERNATIVES A, B, C, AND D

Summary:

This analysis presents the doses and health effects from onsite INEL incident-free transportation for Alternatives A, B, C, and D. This analysis does not include offsite waste shipments. The dose assessments were performed using the RADTRAN 4 computer code.

Distribution (complete package): S. P. Jones, M. W. Howard, T. D. Enyeart, S. J. Maheras,
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Distribution (summary page only): Transportation Engineering Design File Log

Author: <i>S. P. Jones</i> S. P. Jones	Date: <i>1-5-94</i>	Reviewed: <i>St J Hall</i> 01/05/94	Date: <i>01/05/94</i>	Approved: <i>M.A. Mellenz</i> 11/5/94	Date: <i>11/5/94</i>
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Radiological impacts were determined for two groups of people during normal, incident-free transportation: (1) crewmen, and (2) members of the public. The crewmen were the drivers of the shipment vehicle. In transportation dose assessments, the members of the public are usually considered to be persons within 800 meters (2,625 feet) of the transport link (off-link), persons sharing the transport link (on-link), and persons at stops. Since members of the public do not reside on the INEL and the major INEL facilities are located far from major roads, no off-link doses or doses at stops were calculated for onsite shipments. However, on-link doses were evaluated for onsite shipments because members of the public do have access to the majority of the roads on the INEL.

The doses were calculated using the RADTRAN 4 computer code (Neuhauser and Kanipe 1992). In the context of onsite shipments, the magnitude of the incident-free dose depends mainly on the Transport Index (TI) of the shipment. The TI is defined as the dose rate at 1 m from the surface of a radioactive package and has units of mrem/hr. For the purposes of this analysis, each category of material to be shipped was assigned a TI based on its radiological characteristics (see Table 1).

The dose assessments are based on the calculation of unit risk factors (URFs). URFs provide an estimate of the dose to an exposure group from transporting one shipment of radioactive material over a unit distance of travel in a given population density zone and have units of person-rem/km. For onsite transportation, occupational and on-link URFs were calculated using the RADTRAN 4 computer code, based on travel within a rural population density zone (see Table 2). Table 2 also includes the RADTRAN 4 incident-free data specific to the onsite analyses. The RADTRAN 4 results are contained in Maheras (1993). Tables 3 and 4 contain the shipment data used in the analyses.

Occupational doses to the crew were calculated using the equation:

$$\text{Dose} = \text{Total distance} \times \text{Occupational URF}$$

For members of the public, on-link doses were calculated in the same manner:

$$\text{Dose} = \text{Total distance} \times \text{On-Link URF}$$

The total distance is the distance based on shipments for 1995-2005.

The shipment data in Tables 3 and 4 that were used in this analysis were based on the waste shipment data presented in Lehto (1993). Table 3 lists the Environmental Restoration (ER) and Decommissioning and Decommissioning (D&D) projected waste shipments, total mileage, doses, and health effects for transport of waste from 1995-1998 for Alternative A. Table 4 lists the same information for 1995-2005 for Alternative B. ER and D&D activities under Alternative C are the same as Alternative A. Alternative D activities are the same as Alternative B. The analysis does not incorporate offsite waste shipments.

Radiological doses were converted to cancer fatalities using risk conversion factors of $5.0E-4$ fatal cancers/person-rem for members of the public and $4.0E-4$ cancer fatalities/person-rem for workers. Radiological doses were converted to total detriment (health effects) using risk conversion factors of $7.3E-4$ health effects/person-rem for members of the public and $5.6E-4$ health effects/person-rem for workers. These risk conversion factors are from Publication 60 of the International Commission on Radiological Protection (ICRP 1991). Based on the data in Rao et al. (1982), incident-free transportation-related nonradiological health effects are postulated for urban areas but not for suburban or rural areas. Therefore, no incident-free transportation-related nonradiological health effects were calculated for onsite shipments because the INEL was considered a rural area.

References:

- DOE (U.S. Department of Energy), 1990, Supplemental Environmental Impact Statement, Waste Isolation Pilot Plant, DOE/EIS-0026-FS.
- ICRP (International Commission on Radiological Protection), 1991, 1990 Recommendations of the International Commission on Radiological Protection, ICRP Publication 60, Annals of the ICRP, Volume 21, No. 1-3, Pergamon Press, NY.
- Lehto, W. K., 1993, Traffic and Transportation, Engineering Design File ERDM-EDF-0020-93, Revision 1.
- Maheras, S. J., 1993, Health Effects From Onsite INEL Baseline Incident-Free Transportation, Engineering Design File EIS-TRANS-07.
- Neuhauser, K. S., F. L. Kanipe, 1992, RADTRAN 4 User Guide, SAN089-2370.
- Rao, R. K., E. L. Wilmot, R. E. Luna, 1982, Non-Radiological Impacts of Transporting Radioactive Material, SAN081-1703.

Table 1. Transport Index Values

Material	TI ^a Value	Reference
LLW ^b	1.0	This study
TRU ^c	1.0	DOE (1990)
Mixed Waste	1.0	This study

- a. TI - Transport Index
- b. LLW - Contact-Handled Low-Level Waste
- c. TRU - Contact-Handled Transuranic Waste

Table 2. Incident-free Transportation Parameters and Unit Risk Factors for Onsite Shipments

Parameter	Value
Fraction of travel in rural population zone	1
Population density in rural population zone	0 persons/km ²
Speed in rural population zone	56.3 km/hr (35 mi/hr)
Number of crewmen	2
Distance from source to crew	3 m
Package size	3 m
Number of handlings	0
Stop time per km	0.0 hr/km
Minimum stop time per trip	0.0 hr
Zero stop time per trip	0.0 hr
Storage time per shipment	0.0 hr
Number of people per vehicle on link	2
Fraction of rural travel on freeways ^a	0.0
Traffic count ^b passing a specific point in rural zone	25

Material	Unit Risk Factors	
	Crew (person-rem/km)	Members of the Public (person-rem/km)
LLW (TI=1)	2.49E-5	1.31E-7
TRU (TI=1)	2.49E-5	1.31E-7
Mixed Waste (TI=1)	2.49E-5	1.31E-7

- a. Onsite roads were modeled as two lane roads.
- b. One way vehicles/hr

Table 3. Projected Doses and Health Effects From ER and D&D Waste Shipments for Alternative A.

<u>ER WASTE SHIPMENTS</u>														
	1995	1996	1997	1998	NUMBER OF SHIPMENTS	MILES PER SHIPMENT	TOTAL MILES	TOTAL DISTANCE (KM)	OCCUPATIONAL DOSE (PERSON-REM)	PUBLIC DOSE (PERSON-REM)	<u>OCCUPATIONAL HEALTH EFFECTS</u>		<u>PUBLIC HEALTH EFFECTS</u>	
											CANCER FATALITIES	TOTAL DETRIMENT	CANCER FATALITIES	TOTAL DETRIMENT
TAN -> CFA	2	2	2	2	8	28.8	230.4	370.7	9.23E-03	4.86E-05	3.69E-06	5.17E-06	2.43E-08	3.55E-08
TAN -> RWMC	6	6	6	6	24	34.4	825.6	1328.4	3.31E-02	1.74E-04	1.32E-05	1.85E-05	8.70E-08	1.27E-07
TOTAL	8	8	8	8	32		1056.0	1699.1	4.23E-02	2.23E-04	1.69E-05	2.37E-05	1.11E-07	1.62E-07

<u>D&D WASTE SHIPMENTS</u>														
	1995	1996	1997	1998	NUMBER OF SHIPMENTS	MILES PER SHIPMENT	TOTAL MILES	TOTAL DISTANCE (KM)	OCCUPATIONAL DOSE (PERSON-REM)	PUBLIC DOSE (PERSON-REM)	<u>OCCUPATIONAL HEALTH EFFECTS</u>		<u>PUBLIC HEALTH EFFECTS</u>	
											CANCER FATALITIES	TOTAL DETRIMENT	CANCER FATALITIES	TOTAL DETRIMENT
TAN -> CFA				1	1	28.8	28.8	46.3	1.15E-03	6.07E-06	4.62E-07	6.46E-07	3.04E-09	4.43E-09
TAN -> RWMC				4	4	34.4	137.6	221.4	5.51E-03	2.90E-05	2.21E-06	3.08E-06	1.45E-08	2.12E-08
TAN -> PBF				3	3	34.9	104.7	160.5	4.19E-03	2.21E-05	1.68E-06	2.35E-06	1.10E-08	1.61E-08
ARA -> RWMC	12	8			20	13.6	272.0	437.6	1.09E-02	5.73E-05	4.36E-06	6.10E-06	2.87E-08	4.19E-08
ARA -> PBF	1	1			2	4.9	9.8	15.8	3.93E-04	2.07E-06	1.57E-07	2.20E-07	1.03E-09	1.51E-09
EBR -> CFA	4				4	5.1	20.4	32.8	8.17E-04	4.30E-06	3.27E-07	4.58E-07	2.15E-09	3.14E-09
EBR -> RWMC	15	3			18	1.5	27.0	43.4	1.08E-03	5.69E-06	4.33E-07	6.06E-07	2.85E-09	4.15E-09
EBR -> PBF	3	3			6	11.2	67.2	108.1	2.69E-03	1.42E-05	1.08E-06	1.51E-06	7.08E-09	1.03E-08
CPP -> CFA	1	1			2	3.4	6.8	10.9	2.72E-04	1.43E-06	1.09E-07	1.53E-07	7.17E-10	1.05E-09
CPP -> RWMC			4		4	9.4	37.6	60.5	1.51E-03	7.93E-06	6.03E-07	8.44E-07	3.96E-09	5.79E-09
CPP -> RWMC			4		4	9.4	37.6	60.5	1.51E-03	7.93E-06	6.03E-07	8.44E-07	3.96E-09	5.79E-09
TOTAL	36	24	0	8	68		749.5	1205.9	3.00E-02	1.58E-04	1.20E-05	1.68E-05	7.90E-08	1.15E-07

Table 4. Projected Doses and Health Effects From ER and D&D Waste Shipments for Alternative B.

ER WASTE SHIPMENTS

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	NUMBER OF SHIPMENTS	MILES PER SHIPMENT	TOTAL MILES	TOTAL DISTANCE (KM)
TAN -> CFA						2							2	28.8	57.6	92.7
TAN -> RWMC		2	9			220	224						455	34.4	15652.0	25184.1
TAN -> MWSF			9			1							10	35.1	351.0	564.8
CFA -> CFA	17												17	2.4	40.8	65.6
PBF -> RWMC			4	3									7	12.4	86.8	139.7
CPP -> MWSF		6											6	9.7	58.2	93.6
CPP -> CFA			1										1	3.4	3.4	5.5
CPP -> RWMC			55										55	9.4	517.0	831.9
TOTAL	17	8	78	3	0	223	224						553		16766.8	26977.8

D&D WASTE SHIPMENTS

TRIPS	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	NUMBER OF SHIPMENTS	MILES PER SHIPMENT	TOTAL MILES	TOTAL DISTANCE (KM)
TAN -> RWMC							1	3					4	34.4	137.6	221.4
TAN -> PBF							1						1	34.9	34.9	56.2
ARA -> CF		25	25	25									75	7.8	585.0	941.3
ARA -> RWMC		6	6	15									27	13.6	367.2	590.8
TRA -> RWMC				1	18	71	71	71	71	71	71	71	516	10.9	5624.4	9049.7
TRA -> PBF				1	1	63	20	20	20	20	20	20	185	11.0	2035.0	3274.3
TRA -> MWSF						3	1						4	11.2	44.8	72.1
TOTAL	0	31	31	42	19	137	94	94	91	91	91	91	812		8828.9	14205.7

Table 4. Projected Doses and Health Effects from ER and D&D Waste Shipments for Alternative B (Continued).

ER WASTE SHIPMENTS

	OCCUPATIONAL DOSE (PERSON-REM)	PUBLIC DOSE (PERSON-REM)	OCCUPATIONAL HEALTH EFFECTS		PUBLIC HEALTH EFFECTS	
			CANCER FATALITIES	TOTAL DETRIMENT	CANCER FATALITIES	TOTAL DETRIMENT
TAN -> CFA	1.31E-03	1.21E-05	9.23E-07	1.29E-06	6.07E-09	8.86E-09
TAN -> RWMC	6.27E-01	3.30E-03	2.51E-04	3.51E-04	1.65E-06	2.41E-06
TAN -> MWSF	1.41E-02	7.40E-05	5.62E-06	7.87E-06	3.70E-08	5.40E-08
CFA -> CFA	1.63E-03	8.60E-06	6.54E-07	9.15E-07	4.30E-09	6.28E-09
PBF -> RWMC	3.48E-03	1.83E-05	1.39E-06	1.95E-06	9.15E-09	1.34E-08
CPP -> MWSF	2.33E-03	1.23E-05	9.33E-07	1.31E-06	6.13E-09	8.96E-09
CPP -> CFA	1.36E-04	7.17E-07	5.45E-08	7.63E-08	3.58E-10	5.23E-10
CPP -> RWMC	2.07E-02	1.09E-04	8.29E-06	1.16E-05	5.45E-08	7.96E-08
TOTAL	6.72E-01	3.53E-03	2.69E-04	3.76E-04	1.77E-06	2.58E-06

D&D WASTE SHIPMENTS

	OCCUPATIONAL DOSE (PERSON-REM)	PUBLIC DOSE (PERSON-REM)	OCCUPATIONAL HEALTH EFFECTS		PUBLIC HEALTH EFFECTS	
			CANCER FATALITIES	TOTAL DETRIMENT	CANCER FATALITIES	TOTAL DETRIMENT
TAN -> RWMC	5.51E-03	2.90E-05	2.21E-06	3.09E-06	1.45E-08	2.12E-08
TAN -> PBF	1.40E-03	7.36E-06	5.59E-07	7.83E-07	3.68E-09	5.37E-09
ARA -> CFA	2.34E-02	1.23E-04	9.37E-06	1.31E-05	6.17E-08	9.00E-08
ARA -> RWMC	1.47E-02	7.74E-05	5.88E-06	8.24E-06	3.87E-08	5.65E-08
TRA -> RWMC	2.25E-01	1.19E-03	9.01E-05	1.26E-04	5.93E-07	8.65E-07
TRA -> PBF	8.15E-02	4.29E-04	3.26E-05	4.57E-05	2.14E-07	3.13E-07
TNA -> MWSF	1.79E-03	9.44E-06	7.18E-07	1.01E-06	4.72E-09	6.89E-09
TOTAL	3.54E-01	1.86E-03	1.41E-04	1.98E-04	9.30E-07	1.36E-06

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