

GTCC LLW ENVIRONMENTAL IMPACT STATEMENT: PRE-CLOSURE ASSESSMENT DATA PACKAGE

Waste Isolation Pilot Plant

ADDENDUM A GROUP 2 WASTES

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For the U.S. Department of Energy
Washington, DC
October 2008**

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ACRONYMS AND ABBREVIATIONS

AFCF	Advanced Fuel Cycle Facility
CH	contact-handled
CNS	Chem-Nuclear Systems, Inc.
CO	carbon monoxide
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FTE	Full-Time Equivalent
FY	fiscal year
g/hp-hr	gallons per horsepower-hour
GNEP	Global Nuclear Energy Project
GTCC	Greater-Than-Class-C
HC	hydrocarbon
HP or hp	horsepower
hp-hour	horsepower-hour
h-SAMC	half - Shielded Activated Metal Canister
K	thousand
kg	kilogram
kW	kilowatt
kWh	kilowatt-hour
LANL	Los Alamos National Laboratory
LLW	Low-Level Radioactive Waste
NDA	NRC-licensed disposal area
M	million
NEPA	National Environmental Policy Act
NM	New Mexico
NOI	Notice of Intent
NO _x	nitrogen oxides
NRC	U.S. Nuclear Regulatory Commission
PM	particulate matter
RH	remote-handled
RPS	Radioisotope Power Systems
SDA	State-Licensed Disposal Area
SNL	Sandia National Laboratories
SWB	Standard Waste Box
TDOP	Ten-drum Overpack
TRU	Transuranic Waste
TRUPACT	Transuranic Packaging Transporter
WIPP	Waste Isolation Pilot Plant

1. INTRODUCTION

This addendum to *GTCC LLW Environmental Impact Statement, Task 3.6, Pre-Closure Assessment Data Package, Site A–Waste Isolation Pilot Plant* (SNL 2008), addresses Group 2 wastes. DOE has grouped waste into three categories to analyze the inventory in the Greater-than-Class-C (GTCC) Environmental Impact Statement (EIS). Group 1, which was addressed in the parent document cited above, includes commercial and DOE wastes that already exist or will be generated from existing facilities or activities, such as operating commercial nuclear utilities. Group 1 is comparable to the inventory presented in the Notice of Intent (NOI) and consists of waste already in storage or expected to be generated from facilities already in operation. Group 2, which is the focus of this addendum, includes commercial and DOE wastes from other potential DOE National Environmental Policy (NEPA) actions, such as projected waste from the Global Nuclear Energy Project- Advanced Fuel Cycle Facility (GNEP-AFCF) and potential excavation of the West Valley disposal areas. Group 3 includes wastes from the proposed Global Nuclear Energy Project (GNEP) programmatic activities and from the previously proposed Advanced Fuel Cycle Facility (AFCF) and will be qualitatively addressed in the cumulative impacts section of the GTCC EIS. This addendum uses the same methodology and assumptions contained in the parent document, and the reader is referred to that document for additional detail.

The analysis contained in this addendum addresses the following GTCC low level waste (LLW) and DOE GTCC-like Group 2 waste streams:

Waste stream 5 consists of GTCC activated metal from new commercial reactors;

Waste stream 6a consists of DOE GTCC-like activated metal from the GNEP-AFCF (Note that Waste Stream 6 is now considered to be Group 3 waste);

Waste stream 6b consists of DOE GTCC-like other contact-handled (CH) Waste from the GNEP-AFCF (Note that Waste Stream 6 is now considered to be Group 3 waste);

Waste stream 6c consists of DOE GTCC-like other remote-handled (RH) Waste from the GNEP-AFCF (Note that Waste Stream 6 is now considered to be Group 3 waste);

Waste stream 4b consists of DOE GTCC-like CH waste from the Radioisotope Power Systems (RPS);

Waste stream 4d consists of DOE GTCC-like RH waste from the RPS;

Waste stream 9a consists of activated metal and other RH waste from the West Valley NRC-Licensed Disposal Area (NDA);

Waste stream 9b consists of waste from the West Valley State-Licensed Disposal Area (SDA); and

Waste stream 9c consists of activated metal and other RH waste from the West Valley SDA.

Table 1-1. Summary of GTCC LLW and DOE GTCC-like Group 2 Waste Volumes^a

Waste Stream	ID	Description	Volume (m ³)	Container Type	Number of Containers
5	Com	New Commercial Reactors -GTCC Activated Metal	367	h-SAMC	5,317
6a ^b	DOE	GNEP-AFCF DOE GTCC-like Activated Metal	328	h-SAMC	4,761
6b ^b	DOE	GNEP-AFCF DOE GTCC-like Other CH Waste	23,870	SWB	12,697
6c ^b	DOE	GNEP-AFCF DOE GTCC-like Other RH Waste	977	Lead shielded container	8,651
4b	DOE	RPS DOE GTCC-like CH	875	55-gallon drum	4,207
4d	DOE	RPS DOE GTCC-like RH	385	h-SAMC	1,955
9a	DOE	West Valley NDA - Activated Metal	210	h-SAMC	1,066
9a	DOE	West Valley NDA - Other RH	1,944	Lead shielded container	17,204
9b	DOE	West Valley SDA	1,552	SWB	826
9c	DOE	West Valley SDA - Activated Metal	525	h-SAMC	2,665
9c	DOE	West Valley SDA - Other RH	30	h-SAMC	152

^aAll data taken from Argonne (2008). Com = Commercial Waste; DOE = Department of Energy Waste; h-SAMC = half - Shielded Activated Metal Canister; SWB = Standard Waste Box.; ^bNote that Waste Stream 6 is now considered to be Group 3 waste.

The methods and assumptions used to formulate the information summarized in Table 1-1 are documented in Argonne (2008). In addition, it is assumed that the disposal of Group 2 waste in the WIPP will receive regulatory approval and comply with appropriate Congressional mandates in place at the time of disposal. For additional information regarding the approach and assumptions, the reader is referred to Section 1.3 of SNL (2008).

Table 1-2. WIPP Room Space for GTCC LLW and DOE GTCC-like Group 2 Waste Streams

Waste Stream	Description	Container	Room Space Required
5	New Commercial Reactors -GTCC Activated Metal	h-SAMC	1.89
6a ^a	GNEP-AFCF DOE GTCC-like Activated Metal	h-SAMC	1.70
6b ^a	GNEP-AFCF DOE GTCC-like Other CH Waste	SWB	7.75
6c ^a	GNEP-AFCF DOE GTCC-like Other RH Waste	Lead shielded container	1.76
4b	RPS DOE GTCC-like CH	55-gallon drum	0.37
4d	RPS DOE GTCC-like RH	h-SAMC	0.70
9a	West Valley NDA - Activated Metal	h-SAMC	0.38
9a	West Valley NDA - Other RH	Lead shielded container	3.50
9b	West Valley SDA	SWB	0.50
9c	West Valley SDA - Activated Metal	h-SAMC	0.95
9c	West Valley SDA - Other RH	h-SAMC	0.05

^aNote that Waste Stream 6 is now considered to be Group 3 waste.

2. THE WIPP UNDERGROUND

Section 2 of this addendum provides information regarding emplacement of Group 2 wastes in WIPP. For a complete discussion of the climate, geology and hydrology and land use near the WIPP site, the reader is referred to Sections 2 and 3, respectively, of SNL (2008). For information regarding the WIPP underground, including the shafts and underground structures, the reader is referred to Section 4 of SNL (2008).

It is assumed that Group 2 GTCC LLW and DOE GTCC-like waste will be disposed in underground waste disposal rooms similar (if not identical) to those currently used for the disposal of transuranic (TRU) waste. Tables 2-1 and 2-2 provide information on the number of stacks, disposal rooms, packages, and trips. The lead shielded container proposed for Waste Stream 6c, DOE GTCC-like Other RH Waste from the GNEP-AFCF, and for Waste Stream 9a, Other RH waste from the West Valley NRC-licensed disposal area (NDA), is discussed in Section 2.1.

The number of WIPP disposal rooms required for 55-gallon drum, lead shielded container, or SWB waste streams is calculated by dividing the number of stacks by 546, which is the number of stacks per average WIPP room. However, the half - Shielded Activated Metal Canister (h-SAMC) is 26.5%, larger than the largest WIPP disposal package, the Ten-drum Overpack (TDOP), and therefore, the number of stacks per room for h-SAMC waste streams is 401 (i.e., 73.5% of 546). Therefore, the number of WIPP disposal rooms required for h-SAMC waste streams is calculated by dividing the number of stacks per h-SAMC waste stream by 401.

Table 2-1. Number of Stacks Required for Disposal of Group 2 Waste in WIPP

Waste Stream	Description	Number of Stacks ^a	WIPP Disposal Rooms Required ^b
5	New Commercial Reactors -GTCC Activated Metal	760	1.89 ^d
6a ^c	GNEP-AFCF DOE GTCC-like Activated Metal	680	1.70 ^d
6b ^c	GNEP-AFCF DOE GTCC-like Other CH Waste	4,232	7.75
6c ^c	GNEP-AFCF DOE GTCC-like Other RH Waste	961	1.76
4b	RPS DOE GTCC-like CH	200	0.37
4d	RPS DOE GTCC-like RH	279	0.70 ^d
9a	West Valley NDA - Activated Metal	152	0.38 ^d
9a	West Valley NDA - Other RH	1,912	3.50
9b	West Valley SDA	275	0.50
9c	West Valley SDA - Activated Metal	381	0.95 ^d
9c	West Valley SDA - Other RH	22	0.05 ^d

^aThe number of stacks are calculated in Sections 4.4.1 through 4.4.4; ^bThere are 546 stacks per average WIPP disposal room (U. S. DOE 2002), ^cNote that Waste Stream 6 is now considered to be Group 3 waste; ^dFor the h-SAMCs, there are 401 stacks per average WIPP disposal room.

Table 2-2. Number of Waste Hoist Trips for Group 2 Waste Streams

Waste Stream	Description	Number of Disposal Packages	Number per Trip	Number of Trips
5	New Commercial Reactors -GTCC Activated Metal	760	1	760
6a ^a	GNEP-AFCF DOE GTCC-like Activated Metal	680	1	680
6b ^a	GNEP-AFCF DOE GTCC-like Other CH Waste	12,697	4	3,174
6c ^a	GNEP-AFCF DOE GTCC-like Other RH Waste	2,884	2	1,442
4b	RPS DOE GTCC-like CH	601	4	150
4d	RPS DOE GTCC-like RH	279	1	279
9a	West Valley NDA - Activated Metal	152	1	152
9a	West Valley NDA - Other RH	5,735	2	2,867
9b	West Valley SDA	826	4	207
9c	West Valley SDA - Activated Metal	381	1	381
9c	West Valley SDA - Other RH	22	1	22

^aNote that Waste Stream 6 is now considered to be Group 3 waste.

2.1 LEAD SHIELDED CONTAINER

A lead shielded container (see Figure 2-1) will be used for Waste Stream 6c, GNEP-AFCF DOE GTCC-like Other RH Waste, and for Waste Stream 9a, West Valley NDA - Other RH Waste. Each 30-gallon drum of waste will be inserted into a 55-gallon lead shielded container. This container is currently unavailable; however, it is assumed that it will be available and approved for use at WIPP in the future. The conceptual design for the lead shielded container consists of a 3” thick iron top and bottom with radial walls consisting of a 0.188” thick iron inner liner, a 1” thick lead, and a 0.125” thick iron outer liner (LANL 2007). Remote-handled waste in the shielded containers will be emplaced in 3-packs, which will likely be stacked on top of other containers in the repository for worker safety and stability because they have a smaller footprint than the other packages, according to WIPP Operations personnel (Britain 2008). However, the precise stacking arrangement has yet to be determined and approved. As described in Section 5, it is assumed that the shielded containers will be transported in 3-packs and 3 TRUPACT-IIs will be transported per truck shipment. Four 3-packs will be contained in each TRUPACT-II for a total of 36 shielded containers per truck shipment.

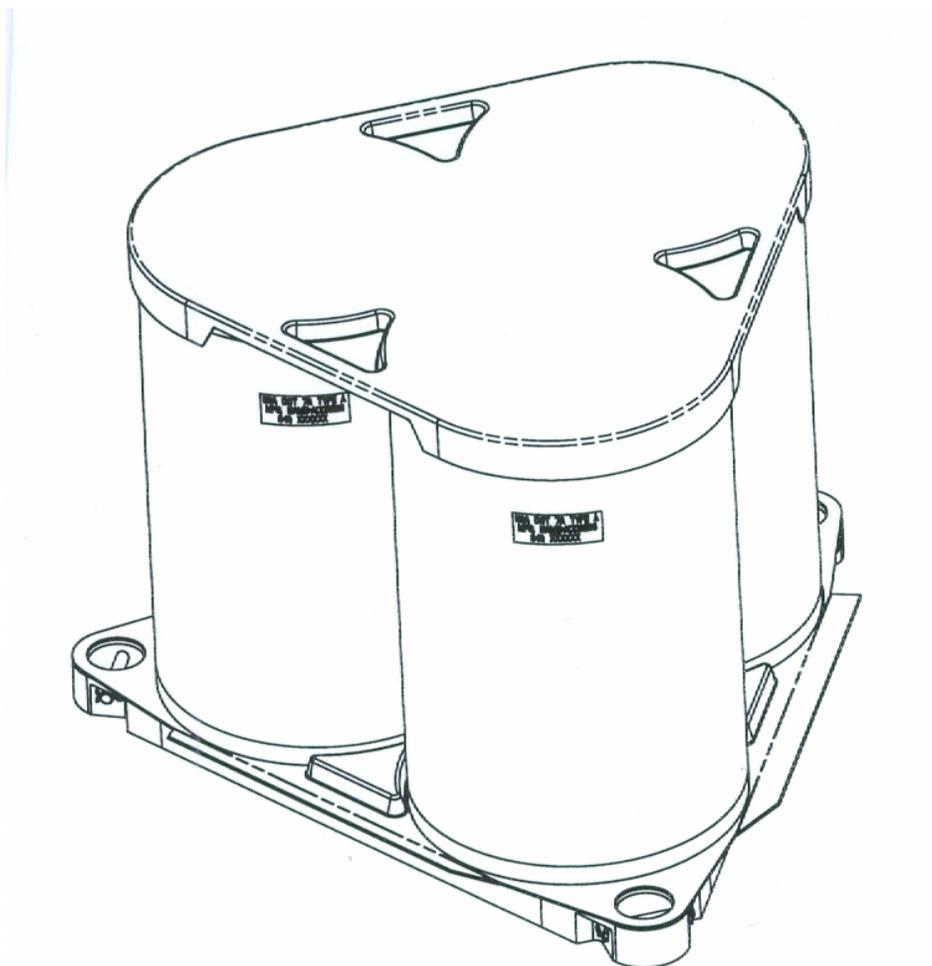


Figure 2-1. Conceptual Drawing of a Lead Shielded Container 3-pack for Disposal in WIPP

3. RESOURCE AND EQUIPMENT REQUIREMENTS

This section presents the resources and equipment needed to dispose of Group 2 waste in the WIPP. Additional surface facilities will not be required to handle Group 2 waste, as existing equipment and facilities are assumed to be available and adequate. Therefore, resource and equipment needs identified in this section are limited to those necessary for the construction of additional disposal rooms in the underground and to that necessary for waste emplacement during operations. The reader is referred to Section 5 of SNL (2008) for detailed information regarding the resource and equipment assumptions.

Table 3-1 shows the resources and equipment required for the construction of room space for Group 2 waste in WIPP. For a detailed explanation of the approach and the assumptions, the reader is referred to Section 5.1.1.1 of SNL (2008) for a description of the diesel fuel calculations; Section 5.1.1.2 for a description of the electric power calculations; Section 5.1.1.3 for a description of the water calculations; and Section 5.1.1.4 for a description of the steel calculations (SNL 2008).

Table 3-1. Resources Required for Construction of WIPP Disposal Room Space for Group 2 Waste

Waste Stream	Room Space Required	Diesel (liters)	Electricity (kWh)	Water (liters)	Steel (kg)
5	1.89	1.05E+05	9.86E+06	1.25E+05	3.79E+04
6a ^a	1.70	9.37E+04	8.83E+06	1.12E+05	3.39E+04
6b ^a	7.75	4.28E+05	4.03E+07	5.10E+05	1.55E+05
6c ^a	1.76	9.73E+04	9.16E+06	1.16E+05	3.52E+04
4b	0.37	2.03E+04	1.91E+06	2.41E+04	7.34E+03
4d	0.70	3.85E+04	3.62E+06	4.58E+04	1.39E+04
9a	0.38	2.10E+04	1.98E+06	2.50E+04	7.60E+03
9a	3.50	1.93E+05	1.82E+07	2.30E+05	7.00E+04
9b	0.50	2.79E+04	2.62E+06	3.32E+04	1.01E+04
9c	0.95	5.25E+04	4.94E+06	6.25E+04	1.90E+04
9c	0.05	2.99E+03	2.82E+05	3.56E+03	1.08E+03

^aNote that Waste Stream 6 is now considered to be Group 3 waste.

Water use for calendar year 2006 was 3.98E+06 gallons (Bostick 2007). This value is reduced by the amount of water used during underground mining operations (6500 gallons/month) [see (SNL 2008)]. This value has been assumed as a representative amount of water to be used during disposal operations for Group 2 waste.

Table 3-2. Estimate of Water Resources Required for WIPP Operation

Resource	Estimate (gallons/day)
Water	10,696

For the same calendar year (2006), the site provided that 4,659 disposal assemblies were emplaced in the WIPP. Using the following conversions:

- 365 days/year,

the water usage per waste hoist trip can be derived.

Table 3-3. Estimate of Water Resources Required Per Waste Hoist Trip

Resource	Estimate (gallons/waste hoist trip)
Water	8.38E+02

The values shown in Table 3-3 and the diesel and electricity values calculated above can be applied to the total number of waste hoist trips for the Group 2 waste to determine the resource requirements associated with processing the Group 2 waste streams at WIPP. These results are shown in Table 3-4.

Table 3-4. Operational Resources Required for Disposal of Group 2 Waste at WIPP

Waste Stream	Description	Number of Trips of the Waist Hoist	Diesel fuel (liters)	Electricity (kWh)	Water (liters)
5	New Commercial Reactors -GTCC Activated Metal	760	1.01E+04	3.96E+05	2.41E+06
6a ^a	GNEP-AFCF DOE GTCC-like Activated Metal	680	9.07E+03	3.55E+05	2.16E+06
6b ^a	GNEP-AFCF DOE GTCC-like Other CH Waste	3,174	4.23E+04	1.66E+06	1.01E+07
6c ^a	GNEP-AFCF DOE GTCC-like Other RH Waste	1,442	1.92E+04	7.53E+05	4.57E+06
4b	RPS DOE GTCC-like CH	150	2.00E+03	7.84E+04	4.77E+05
4d	RPS DOE GTCC-like RH	279	3.73E+03	1.46E+05	8.86E+05
9a	West Valley NDA - Activated Metal	152	2.03E+03	7.95E+04	4.83E+05
9a	West Valley NDA - Other RH	2,867	3.82E+04	1.50E+06	9.10E+06
9b	West Valley SDA	207	2.75E+03	1.08E+05	6.55E+05
9c	West Valley SDA - Activated Metal	381	5.08E+03	1.99E+05	1.21E+06
9c	West Valley SDA - Other RH	22	2.90E+02	1.13E+04	6.89E+04

^aNote that Waste Stream 6 is now considered to be Group 3 waste.

4. FACILITY WASTES AND EMISSIONS

This section describes the wastes and emissions created through the construction of underground disposal rooms needed for Group 2 GTCC LLW and DOE GTCC-like waste and by the activities necessary to handle, transport, and emplace these wastes underground for final disposal (see Tables 4-1 through 4-7). This section does not present any information related to pre-existing surface facilities, underground support facilities, or wastes and emissions from ancillary activities at the WIPP not directly related to the construction of waste disposal room(s) and disposal of Group 2 waste. For a detailed explanation of the calculation of wastes resulting from construction of room space, the reader is referred to Section 6 of SNL (2008).

Table 4-1. Construction Waste Production Associated with Disposal of Group 2 Waste at WIPP

Waste Stream	Description	Room Space Required	Salt Waste ^a (kg)
5	New Commercial Reactors -GTCC Activated Metal	1.89	4.07E+07
6a ^b	GNEP-AFCF DOE GTCC-like Activated Metal	1.70	3.65E+07
6b ^b	GNEP-AFCF DOE GTCC-like Other CH Waste	7.75	1.67E+08
6c ^b	GNEP-AFCF DOE GTCC-like Other RH Waste	1.76	3.79E+07
4b	RPS DOE GTCC-like CH	0.37	7.89E+06
4d	RPS DOE GTCC-like RH	0.70	1.50E+07
9a	West Valley NDA - Activated Metal	0.38	8.17E+06
9a	West Valley NDA - Other RH	3.50	7.53E+07
9b	West Valley SDA	0.50	1.08E+07
9c	West Valley SDA - Activated Metal	0.95	2.04E+07
9c	West Valley SDA - Other RH	0.05	1.16E+06

^aCalculated by multiplying the room requirements per waste stream by 2.15E+07 kg salt/allocated disposal room;

^bNote that Waste Stream 6 is now considered to be Group 3 waste.

The EPA standard emissions values (U. S. EPA 1998) shown in Table 4-2 can be applied to the Group 2 waste streams by multiplying the fraction of a disposal room occupied by the waste stream. These results are shown in Table 4-3.

Table 4-2. EPA Standard Emissions Based on Group 2 Equipment HP Ratings (EPA 1998).

HP (Tier ^a 2)	CO (g/hp-hr)	HC (g/hp-hr)	NO _x (g/hp-hr)	PM (g/hp-hr)
>0 to 11	5.60	0.60	5.00	0.75
>11 to 16	2.00	0.60	5.00	0.60
>16 to 25	2.00	0.60	5.00	0.60
>25 to 50	2.50	0.60	5.00	0.60
>50 to 100	1.00	0.40	5.20	0.72
>100 to 175	1.00	0.40	4.50	0.40
>175 to 300	1.00	0.40	4.50	0.40
>300 to 600	1.00	0.30	4.50	0.40

^a Tier in this context refers to equipment per EPA (1998).

Table 4-3 shows the construction emissions associated with disposal of Group 2 waste at WIPP.

Table 4-3. Construction Emissions Associated with Disposal of Group 2 Waste at WIPP

ID	Description	Room Space Required	CO (kg)	HC (kg)	NO _x (kg)	PM (kg)
5	New Commercial Reactors - GTCC Activated Metal	1.89	2.94E+02	1.07E+02	1.32E+03	1.18E+02
6a ^a	GNEP-AFCF DOE GTCC-like Activated Metal	1.70	2.64E+02	9.61E+01	1.19E+03	1.05E+02
6b ^a	GNEP-AFCF DOE GTCC-like Other CH Waste	7.75	1.20E+03	4.39E+02	5.42E+03	4.82E+02
6c ^a	GNEP-AFCF DOE GTCC-like Other RH Waste	1.76	2.74E+02	9.97E+01	1.23E+03	1.09E+02
4b	RPS DOE GTCC-like CH	0.37	5.70E+01	2.08E+01	2.57E+02	2.28E+01
4d	RPS DOE GTCC-like RH	0.70	1.08E+02	3.94E+01	4.87E+02	4.33E+01
9a	West Valley NDA - Activated Metal	0.38	5.90E+01	2.15E+01	2.66E+02	2.36E+01
9a	West Valley NDA - Other RH	3.50	5.44E+02	1.98E+02	2.45E+03	2.18E+02
9b	West Valley SDA	0.50	7.84E+01	2.86E+01	3.53E+02	3.13E+01
9c	West Valley SDA - Activated Metal	0.95	1.48E+02	5.38E+01	6.64E+02	5.90E+01
9c	West Valley SDA - Other RH	0.05	8.42E+00	3.07E+00	3.79E+01	3.37E+00

^aNote that Waste Stream 6 is now considered to be Group 3 waste.

Wastes produced for calendar year 2006 (Bostick 2007) were assumed to be like the wastes produced as a result of Group 2 waste disposal at WIPP [see (SNL 2008)].

Table 4-4. Estimate of Wastes Produced From WIPP Operation

Resource	Estimate
Liquid Waste, gallons/year	2.35E+06
Solid (Sanitary) Waste, tons/year	273.7
Solid (Hazardous) Waste, tons/year	26.4
Sludge Waste, tons/year	75.8

For the same calendar year (2006), 4,659 disposal assemblies were emplaced in the WIPP. Using the following conversions:

- 901.2 kg/ton,

the waste produced per waste hoist trips can be derived.

Table 4-5. Estimate of Wastes Produced Per CH-TRU Waste Hoist Trips Processed at WIPP

Resource	Estimate
Liquid waste, gallons/waste hoist trip	503.64
Solid (Sanitary) waste, kg/waste hoist trip	53.3
Solid (Hazardous) waste, kg/waste hoist trip	5.14
Sludge waste, kg/waste hoist trip	14.8

The values shown in Table 4-5 can be applied to the total number of waste hoist trips for Group 2 waste to determine the liquid and solid waste production associated with processing the Group 2 waste streams at WIPP. These results are shown in Table 4-6.

Table 4-6. Operational Waste Production Associated with Disposal of Group 2 Waste at WIPP

Waste Stream	Description	Waste Hoist Trips	Liquid Waste (liters)	Solid (Sanitary) Waste (kg)	Solid (Hazardous) Waste (kg)	Sludge Waste (kg)
5	New Commercial Reactors - GTCC Activated Metal	760	1.45E+06	4.05E+04	3.90E+03	1.12E+04
6a ^a	GNEP-AFCF DOE GTCC-like Activated Metal	680	1.30E+06	3.62E+04	3.50E+03	1.00E+04
6b ^a	GNEP-AFCF DOE GTCC-like Other CH Waste	3174	6.05E+06	1.69E+05	1.63E+04	4.69E+04
6c ^a	GNEP-AFCF DOE GTCC-like Other RH Waste	1442	2.75E+06	7.68E+04	7.41E+03	2.13E+04
4b	RPS DOE GTCC-like CH	150	2.86E+05	8.01E+03	7.72E+02	2.22E+03
4d	RPS DOE GTCC-like RH	279	5.32E+05	1.49E+04	1.44E+03	4.12E+03
9a	West Valley NDA - Activated Metal	152	2.90E+05	8.12E+03	7.83E+02	2.25E+03
9a	West Valley NDA - Other RH	2867	5.47E+06	1.53E+05	1.47E+04	4.23E+04
9b	West Valley SDA	207	3.94E+05	1.10E+04	1.06E+03	3.05E+03

^aNote that Waste Stream 6 is now considered to be Group 3 waste.

Table 4-6. Operational Waste Production Associated with Disposal of Group 2 Waste at WIPP
 (continued)

Waste Stream	Description	Waste Hoist Trips	Liquid Waste (liters)	Solid (Sanitary) Waste (kg)	Solid (Hazardous) Waste (kg)	Sludge Waste (kg)
9c	West Valley SDA - Activated Metal	381	7.26E+05	2.03E+04	1.96E+03	5.62E+03
9c	West Valley SDA - Other RH	22	4.14E+04	1.16E+03	1.12E+02	3.21E+02

^aNote that Waste Stream 6 is now considered to be Group 3 waste.

The values shown in Table 4-2 can be applied to the Group 2 waste streams by multiplying the fraction of a disposal room occupied by the waste stream. These results are shown in Table 4-7 [See (SNL 2008) for further explanation].

Table 4-7. Operational Emissions Production Associated with Processing of Group 2 Waste at WIPP

Waste Stream	Description	Waste Hoist Trips	CO (kg)	HC (kg)	NO _x (kg)	PM (kg)
5	New Commercial Reactors - GTCC Activated Metal	760	4.68E+01	1.87E+01	2.19E+02	2.25E+01
6a ^a	GNEP-AFCF DOE GTCC-like Activated Metal	680	4.19E+01	1.68E+01	1.96E+02	2.02E+01
6b ^a	GNEP-AFCF DOE GTCC-like Other CH Waste	3174	1.96E+02	7.83E+01	9.16E+02	9.42E+01
6c ^a	GNEP-AFCF DOE GTCC-like Other RH Waste	1442	8.89E+01	3.56E+01	4.16E+02	4.28E+01
4b	RPS DOE GTCC-like CH	150	9.27E+00	3.71E+00	4.33E+01	4.46E+00
4d	RPS DOE GTCC-like RH	279	1.72E+01	6.89E+00	8.06E+01	8.29E+00
9a	West Valley NDA - Activated Metal	152	9.39E+00	3.76E+00	4.39E+01	4.52E+00
9a	West Valley NDA - Other RH	2867	1.77E+02	7.07E+01	8.27E+02	8.51E+01
9b	West Valley SDA	207	1.27E+01	5.09E+00	5.96E+01	6.13E+00
9c	West Valley SDA - Activated Metal	381	2.35E+01	9.39E+00	1.10E+02	1.13E+01
9c	West Valley SDA - Other RH	22	1.34E+00	5.36E-01	6.26E+00	6.44E-01

^aNote that Waste Stream 6 is now considered to be Group 3 waste.

5. COSTS, DURATIONS, AND PERSONNEL

Costs, durations, and personnel associated with disposal of Group 2 waste in WIPP are shown in Tables 5-1 through 5-12. In developing these estimated costs, it is assumed that no additional facilities or workers will be required to process the additional waste, and additional underground excavations will be necessary to accommodate the Group 2 waste volume. Thus, operations costs are derived from current WIPP processing costs, and construction costs are derived from mining costs. For detailed information regarding the calculations and assumptions for the

operations costs, durations, and personnel involved in processing the Group 2 waste streams at WIPP, the reader is referred to Section 7 of SNL (2008).

Table 5-1. Estimate of Salt Mining Costs at WIPP^a

Activity	Cost
Salt Mining and Removal, dollars/ton	20
Roof and Floor Support Structures, dollars/m ²	25

^a(Nelson 2002).

The cost per kilogram (kg) of salt can be determined using the equation:

$$C_s = (C_s)/(U_c) + S_i / (HD_s)$$

Where C_s is the cost of salt mining in dollars/kg, C_s is the cost of salt mining in dollars per ton, U_c is a standard unit conversion for mass (907.2 kg/ton), S_i is the cost of emplacing support structures per m², D_s is the density of salt [2.18E+03 kg/m³ from SNL (2008)], and H is the height of the cavity, 4 m (U. S. DOE 1999). The result is a total cost of 2.49E-02 dollars per kilogram of salt.

The mass of salt excavated from a panel and an access drift is 1.50E+08 kg (SNL 2008). Assuming seven rooms in a panel, the mass of salt excavated for an allocated disposal room in WIPP is 2.15E+07 kg which can be applied to the total mass for a room to get \$535K per allocated disposal room. This value can be applied to the room space required for each waste stream as shown in Table 5-2.

Table 5-2. Costs from Construction of Room Space for Group 2 Waste Streams in WIPP

Waste Stream	Description	Room Space Required	Room Construction Cost ^a (K, dollars)
5	New Commercial Reactors -GTCC Activated Metal	1.89	1,010
6a ^b	GNEP-AFCF DOE GTCC-like Activated Metal	1.70	907
6b ^b	GNEP-AFCF DOE GTCC-like Other CH Waste	7.75	4,150
6c ^b	GNEP-AFCF DOE GTCC-like Other RH Waste	1.76	942
4b	RPS DOE GTCC-like CH	0.37	196
4d	RPS DOE GTCC-like RH	0.70	373
9a	West Valley NDA - Activated Metal	0.38	203
9a	West Valley NDA - Other RH	3.50	1,870
9b	West Valley SDA	0.50	270
9c	West Valley SDA - Activated Metal	0.95	508
9c	West Valley SDA - Other RH	0.05	29

^aCalculated by multiplying 535K dollars/allocated disposal room by the room requirements for each waste stream; ^bNote that Waste Stream 6 is now considered to be Group 3 waste.

Table 5-3 shows the man-hours required for the construction of room space for Group 2 waste in WIPP. For detailed information regarding the approach and assumptions underlying these calculations, the reader is referred to Section 7.1.3 of SNL (2008).

Table 5-3. Duration and Man-hours Associated with Construction of Room Space for Group 2 Waste Streams in WIPP

Waste Stream	Description	Room Space Required	Duration (hours) ^a	Room Construction ^b (Man-hours)
5	New Commercial Reactors -GTCC Activated Metal	1.89	2,370	10,300
6a ^c	GNEP-AFCF DOE GTCC-like Activated Metal	1.70	2,120	9,210
6b ^c	GNEP-AFCF DOE GTCC-like Other CH Waste	7.75	9,690	42,100
6c ^c	GNEP-AFCF DOE GTCC-like Other RH Waste	1.76	2,200	9,560
4b	RPS DOE GTCC-like CH	0.37	459	1,990
4d	RPS DOE GTCC-like RH	0.70	871	3,780
9a	West Valley NDA - Activated Metal	0.38	475	2,060
9a	West Valley NDA – Other RH	3.50	4,380	19,000
9b	West Valley SDA	0.50	631	2,740
9c	West Valley SDA - Activated Metal	0.95	1,190	5,150
9c	West Valley SDA – Other RH	0.05	68	294

^aCalculated by multiplying 52.1 days to excavate a room by 24 hours/day by the required room space for each waste stream; ^bCalculated by multiplying 5,428 man hours/allocated disposal room by the required room space for each waste stream; ^cNote that Waste Stream 6 is now considered to be Group 3 waste.

For detailed information regarding the approach and assumptions for calculating the operations costs, durations, and personnel required for processing the Group 2 waste streams at WIPP, the reader is referred to Section 7.2 of SNL (2008). Table 5-4 shows the WIPP operations costs and Table 5-5 shows the average operations cost per shipment of CH-TRU waste to WIPP (U. S. DOE 2002).

Table 5-4. WIPP Operations Costs^{a,b}

Carlsbad Operations	2002 (M)	2003 (M)	2004 (M)	2005 (M)	2006 (M)	2007 (M)	2008 (M)	Average Annual Cost (M)
Transportation	\$68	\$70	\$56	\$56	\$56	\$56	\$56	\$60
Disposal	\$54	\$55	\$60	\$47	\$51	\$49	\$53	\$53
Remaining Mission-Critical	\$107	\$111	\$102	\$101	\$103	\$106	\$109	\$106
Total	\$229	\$236	\$218	\$204	\$210	\$211	\$219	\$218

^aFrom the TRU Waste Management Plan, Revision 3 (U. S. DOE 2002); ^bAll costs in millions of 2002 dollars and are not adjusted to 2006.

Assuming WIPP receives 17 shipments per week (U. S. DOE 2002) or 850 shipments per year (17 shipments per week for 50 weeks), the average annual cost per shipment is \$187K per shipment, as shown in Table 5-5. Average cost per shipment for disposal is \$62K and remaining mission-critical activities is \$125K.

Table 5-5. Average Operations Cost per WIPP CH-TRU Shipment^a

Operations Activities	Average Processing Cost per Shipment ^b (K)
Disposal	\$62
Remaining Mission-Critical	\$125
Total	\$187

^aBased on data from the *TRU Waste Management Plan*, Revision 3 (U. S. DOE 2002); ^bAssuming 17 shipments per week (U. S. DOE 2002) for 50 weeks/year.

The processing cost for the Group 2 waste streams can be estimated by multiplying the average processing cost per shipment (\$187K) by the number of estimated shipments for each waste stream. Table 5-6 lists the number of shipments, disposal cost, remaining mission critical costs, and the total processing cost for each Group 2 waste stream.

The number of shipments shown in Tables 5-6, 5-7, and 5-12 assume the following: All shipments will be by truck. One h-SAMC will be transported in a CNS 3-55 shipping container per shipment (only one CNS 3-55 will be transported on each truck). The SWBs, lead shielded containers, and 55-gallon drums will be transported in TRUPACT-II shipping containers, and three TRUPACT-IIs will be shipped on each truck. Each TRUPACT-II will contain two SWBs and three TRUPACT-II containers will be transported in each truck for a total of 6 SWBs per shipment. Each TRUPACT-II container will contain two 7-packs of 55-gallon drums and three TRUPACT-II containers will be transported in each truck for a total of forty-two 55-gallon drums per shipment. Each TRUPACT-II container will contain four 3-packs and three TRUPACT-II containers will be transported in each truck for a total of 36 shielded containers per shipment.

Table 5-6. Operational Costs Associated with Processing Group 2 Waste Streams at WIPP

Waste Stream	Description	Total Shipments ^a	Disposal Cost ^b (M)	Remaining Mission Critical Cost ^c (M)	Total Cost ^d (M)
5	New Commercial Reactors -GTCC Activated Metal	5,317	330	665	994
6a ^e	GNEP-AFCF DOE GTCC-like Activated Metal	4,761	295	595	890
6b ^e	GNEP-AFCF DOE GTCC-like Other CH Waste	2,116	131	265	396
6c ^e	GNEP-AFCF DOE GTCC-like Other RH Waste	240	15	30	45
4b	RPS DOE GTCC-like CH	100	6	13	19
4d	RPS DOE GTCC-like RH	1,955	121	244	366
9a	West Valley NDA – Activated Metal	1,066	66	133	199
9a	West Valley NDA - Other RH	478	30	60	89
9b	West Valley SDA	138	9	17	26
9c	West Valley SDA – Activated Metal	2,665	165	333	498
9c	West Valley SDA - Other RH	152	9	19	28

^aShipment data calculated based on assumptions in Section 5; ^bCalculated by multiplying 62K dollars/shipment processed by the number of shipments for each waste stream; ^cCalculated by multiplying 125K dollars/shipment processed by the number of shipments for each waste stream; ^dCalculated by multiplying 187K dollars/shipment processed by the number of shipments for each waste stream; ^eNote that Waste Stream 6 is now considered to be Group 3 waste.

For detailed information on the calculation of the number of employees required to process Group 2 waste at WIPP, the reader is referred to Section 7.2.3 of SNL (2008). The hours required to process Group 2 waste shipments are shown in Table 5-7. As described in SNL (2008), it requires 6.59 hours to process a shipment at WIPP.

Table 5-7. Operational Durations Associated with Processing Group 2 Waste Streams at WIPP

Waste Stream	Description	Total Shipments ^a	Duration (hours) ^b
5	New Commercial Reactors -GTCC Activated Metal	5,317	35,000
6a ^c	GNEP-AFCF DOE GTCC-like Activated Metal	4,761	31,400
6b ^c	GNEP-AFCF DOE GTCC-like Other CH Waste	2,116	13,900
6c ^c	GNEP-AFCF DOE GTCC-like Other RH Waste	240	1,580
4b	RPS DOE GTCC-like CH	100	660
4d	RPS DOE GTCC-like RH	1,955	12,900
9a	West Valley NDA - Activated Metal	1,066	7,030
9a	West Valley NDA - Other RH	478	3,150
9b	West Valley SDA	138	907
9c	West Valley SDA - Activated Metal	2,665	17,600
9c	West Valley SDA - Other RH	152	1,000

^aShipment data calculated based on assumptions in Section 5; ^bCalculated by multiplying 6.59 hours/shipment processed by the number of shipments; ^cNote that Waste Stream 6 is now considered to be Group 3 waste.

Table 5-8. Full-Time Equivalent Composition Table^a

Labor Category	Total FTE		
	1996	1997	1998
General Managers, Exec	91	86	84
Gen Admin Sec and Clerical	78	75	72
Admin and other professionals	219	226	225
Engineers	294	296	300
Scientists	124	118	111
Technicians	149	153	139
Crafts	51	55	62
Laborers and Other Gen Workers	3	2	2
Operators	48	74	100
Total	1,057	1,085	1,095

^a Projections are based on FY 1996 planning baselines (U. S. DOE 1996).

A summary of the staffing requirements is given in Table 5-9. The labor category listed in Table 5-9 corresponds to the labor category given in Table 5-8. The total by labor category is given in Table 5-10.

Table 5-9. Staffing Requirements for CH Waste Handling Operations^a

Title	Labor Category	FTE
CH Waste Handling Operations		
Facilities Shift Manager General	General Managers, Exec	1
Central Monitoring Room Operator	Operators	1
Surface Roving Watch	Technicians	1
CH Waste Handling Engineer	Engineers	1
CH Bay Operations		
Radiological Control Technician	Technicians	3
Radiological Control Air Monitoring Technician Rover	Technicians	2
Waste Handling Technician (crane operator)	Technicians	3
Waste Handling Technician (direct off-loading of waste)	Technicians	3
Waste Handling Technician (fork lift driver and a spotter)	Technicians	2
Surface Operations		
Waste Handling Technician (fork lift driver and a spotter)	Technicians	2
Underground Operations		
Radiological Control Technician	Technicians	1
Waste Handling Technician (fork lift driver and a spotter)	Technicians	2
UG Facility Operations Engineer	Engineers	1
Underground Roving Watch	Technicians	1
Hoisting Operator (Operator, Top and Bottom Lander)	Operators	3

^afrom WIPP Contact Handled (CH) Technical Safety Requirements (U. S. DOE 2005).

Table 5-10. Staffing Requirements for CH Waste Handling Operations by Labor Category^a

Labor Category	FTE
General Managers, Exec	1
Engineers	2
Technicians	20
Operators	4
Total	27

^aSummarized from Table 5-9.

Assuming WIPP receives 17 shipments (U. S. DOE 2002) per week or 850 shipments per year (17 shipments per week for 50 weeks), the personnel employed at WIPP on a “per shipment processed” basis is shown in Table 5-11.

Table 5-11. Personnel Employed at WIPP on a per Shipment Processed Basis

Labor Category	Total FTE	FTE per WIPP CH-TRU Shipment Processed
General Managers, Exec	1	1.18E-03
Engineers	2	2.35E-03
Technicians	20	2.35E-02
Operators	4	4.71E-03
Total	27	3.18E-02

The values in Table 5-11 can be applied to the Group 2 waste shipments as shown in Table 5-12.

Table 5-12. Personnel Associated with Processing Group 2 Waste Streams at WIPP

Waste Stream	Description	Number of Shipments Processed ^a	General Managers, Exec (FTE) ^b	Engineers (FTE) ^c	Technician (FTE) ^d	Operators (FTE) ^e	Total (FTE) ^f
5	New Commercial Reactors -GTCC Activated Metal	5,317	6.3	12.5	125	25.0	169
6a ^g	GNEP-AFCF DOE GTCC-like Activated Metal	4,761	5.6	11.2	112	22.4	151
6b ^g	GNEP-AFCF DOE GTCC-like Other CH Waste	2,116	2.5	5.0	50	10.0	67
6c ^g	GNEP-AFCF DOE GTCC-like Other RH Waste	240	0.3	0.6	6	1.1	8
4b	RPS DOE GTCC-like CH	100	0.1	0.2	2	0.5	3
4d	RPS DOE GTCC-like RH	1,955	2.3	4.6	46	9.2	62
9a	West Valley NDA - Activated Metal	1,066	1.3	2.5	25	5.0	34
9a	West Valley NDA - Other RH	478	0.6	1.1	11	2.3	15
9b	West Valley SDA	138	0.2	0.3	3	0.6	4
9c	West Valley SDA - Activated Metal	2,665	3.1	6.3	63	12.6	85
9c	West Valley SDA - Other RH	152	0.2	0.4	4	0.7	5

^aShipment data calculated based on assumptions in Section 5; ^bCalculated by multiplying 1.18E-03 FTE/shipment processed by the number of shipments.

^cCalculated by multiplying 2.35E-03 FTE/shipment processed by the number of shipments; ^dCalculated by multiplying 2.35E-02 FTE/shipment processed by the number of shipments; ^eCalculated by multiplying 4.71E-03 FTE/shipment processed by the number of shipments; ^fCalculated by multiplying 3.18E-02 FTE/shipment processed by the number of shipments; ^gNote that Waste Stream 6 is now considered to be Group 3 waste.

6. TRANSPORTATION

This section provides data to be used in analyzing the risks of transporting Group 2 waste from its current location to WIPP. Inventories per shipment of Group 2 waste are based on information provided in Argonne (2008) and the assumptions regarding the number of shipments for each waste stream are contained in Section 5 of this report. It is assumed that all shipments will be by truck. One h-SAMC will be transported in a CNS 3-55 shipping container per shipment (only one CNS 3-55 will be transported on each truck). The SWBs, lead shielded containers, and 55-gallon drums will be transported in TRUPACT-II shipping containers, and three TRUPACT-IIs will be shipped on each truck. Each TRUPACT-II will contain two SWBs and three TRUPACT-II containers will be transported in each truck for a total of 6 SWBs per shipment. Each TRUPACT-II container will contain two 7-packs of 55-gallon drums and three TRUPACT-II containers will be transported in each truck for a total of forty-two 55-gallon drums per shipment. Each TRUPACT-II container will contain four 3-packs and three TRUPACT-II containers will be transported in each truck for a total of 36 shielded containers per shipment. The destination for all of these shipments is WIPP.

Table 6-1. Summary of GTCC LLW and DOE GTCC-like Group 2 Waste Shipments to WIPP

Waste Stream	ID	Description	Package Type	Number of Shipments ^a
5	Com	New Commercial Reactors -GTCC Activated Metal	h-SAMC	5,317
6a ^b	DOE	GNEP-AFCF DOE GTCC-like Activated Metal	h-SAMC	4,761
6b ^b	DOE	GNEP-AFCF DOE GTCC-like Other CH Waste	SWB	2,116
6c ^b	DOE	GNEP-AFCF DOE GTCC-like Other RH Waste	Lead shielded container	240
4b	DOE	RPS DOE GTCC-like CH	55-gallon drum	100
4d	DOE	RPS DOE GTCC-like RH	h-SAMC	1,955
9a	DOE	West Valley NDA - Activated Metal	h-SAMC	1,066
9a	DOE	West Valley NDA - Other RH	Lead shielded container	478
9b	DOE	West Valley SDA	SWB	138
9c	DOE	West Valley SDA - Activated Metal	h-SAMC	2,665
9c	DOE	West Valley SDA - Other RH	h-SAMC	152

^aShipment data calculated based on assumptions in Section 5; ^bNote that Waste Stream 6 is now considered to be Group 3 waste.

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