DOE/CAO-95-1121

TRANSURANIC WASTE BASELINE INVENTORY REPORT

(REVISION 3)

June 1996

NOTICE TO READERS

This document, Revision 3 of the Transuranic Waste Baseline Inventory Report (TWBIR), has been prepared to document the transuranic (TRU) waste inventory data to be used in the Sandia National Laboratories/New Mexico (SNL/NM) calculations for the Waste Isolation Pilot Plant's (WIPP's) performance assessment (PA). The TWBIR Revision 3, is comprised of previously published information found in Revision 2 of the TWBIR and supplemented with information and data that were specifically requested by the U.S. Department of Energy (DOE) Carlsbad Area Office (CAO) for the SNL/NM PA calculations.

The data contained in this document will also be used as the inventory basis for the WIPP Compliance Certification Application (CCA) to be submitted to the U.S. Environmental Protection Agency. The site information requested in the January 1996 data call has not been included in Revision 3. Future editions of the TWBIR will be identified by the year of data origin.

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ACRONYMS AND ABBREVIATIONS

AE	Argonne National Laboratory-East site identifier
AL	Ames Laboratory site identifier
AM	ARCO Medical Products Company site identifier
AW	ANL-W site identifier
BC	Battelle Columbus Laboratory site identifier
BT	Bettis Atomic Power Laboratory site identifier
C&C Agreement	Agreement for Consultation and Cooperation between the Department of Energy and the State of New Mexico on the Waste Isolation Pilot Plant
CAO	Carlsbad Area Office
CCA	Compliance Certification Application
CFR	Code of Federal Regulations
CH	contact-handled
CY	calendar year
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ER	environmental restoration
ET	Energy Technology Engineering Center site identifier
FFCAct	Federal Facilities Compliance Act
IDB	Integrated Data Base
IN	Idaho National Engineering Laboratory site identifier
IT	Inhalation Toxicology Research Institute site identifier
KA	Knolls Atomic Power Laboratory-Schenectady site identifier
kg	kilograms
LA	Los Alamos National Laboratory site identifier
LANL	Los Alamos National Laboratory
LB	Lawrence Berkeley Laboratory site identifier
LL	Lawrence Livermore National Laboratory site identifier
LWA	Land Withdrawal Act
MC	U.S. Army Material Command
MD	Mound Plant site identifier
m^3	cubic meters
mrem	millirem
MU	University of Missouri Research Reactor site identifier
NT	Nevada Test Site site identifier
OR	Oak Ridge National Laboratory site identifier
ORIGEN2	Oak Ridge Isotope Generation and Depletion Code
ORNL	Oak Ridge National Laboratory
PA	performance assessment (in text only)
PA	Paducah Gaseous Diffusion Plant site identifier (in waste profiles only)
PCB	polychlorinated biphenyls
PX	Pantex site identifier
RCRA	Resource Conservation and Recovery Act
RF	Rocky Flats Environmental Technology Site site identifier
RFETS	Rocky Flats Environmental Technology Site

RH	remote-handled
RL	Hanford (Richland) site identifier
SA	Sandia National Laboratories/New Mexico site identifier
SNL/NM	Sandia National Laboratories/New Mexico
SR	Savannah River Site site identifier
SRS	Savannah River Site
TB	Teledyne Brown Engineering
TOC	total organic carbon
TRU	transuranic
TWBIR	Transuranic Waste Baseline Inventory Report
WAC	waste acceptance criteria
WIPP	Waste Isolation Pilot Plant
WMC	waste matrix code
WMP	waste material parameter
WV	West Valley Demonstration Project site identifier

EXECUTIVE SUMMARY

The *Transuranic Waste Baseline Inventory Report* (TWBIR) establishes a methodology for grouping wastes of similar physical and chemical properties from across the U.S. Department of Energy (DOE) transuranic (TRU) waste system into a series of "waste profiles" that can be used as the basis for waste form discussions with regulatory agencies.

The purpose of Revisions 0 and 1 of this report was to provide data to be included in the Sandia National Laboratories/New Mexico (SNL/NM) performance assessment (PA) processes for the Waste Isolation Pilot Plant (WIPP). Revision 2 of the document expanded the original purpose and was also intended to support the WIPP Land Withdrawal Act (LWA) requirement for providing the total DOE TRU waste inventory. The document included a chapter and an appendix that discussed the total DOE TRU waste inventory, including nondefense, commercial, polychlorinated biphenyls (PCB)-contaminated, and buried (predominately pre-1970) TRU wastes that are not planned to be disposed of at WIPP.

Revision 3 of the TWBIR is based on the TWBIR Revision 2 data which are supplemented by data in several memoranda issued during early calendar year (CY) 1996. These memoranda summarize additional data requested by the U. S. Department of Energy/Carlsbad Area Office (DOE/CAO) to support the SNL/NM PA modeling. The primary purpose of Revision 3 is to provide the summary data from TWBIR Revision 2 and the supplemental information used by SNL/NM in the development of the Compliance Certification Application (CCA) to be delivered to the Environmental Protection Agency (EPA), and to support the LWA (Public Law, 1992b). The supplemental information was generated from specific data requests to the TRU waste sites since the publication of Revision 2. The supplemental data discussed in detail in Chapter 3 and Appendices A and B are listed below:

- Radionuclide data in support of the Compliance Certification Application.
- Estimate of complexing agents in TRU solidified waste forms scheduled for disposal in WIPP.
- Estimate for SNL/NM PA calculations of nitrate, sulfate, and phosphate content in transuranic solidified wastes destined for disposal in WIPP.
- Estimate of cement content in TRU solidified waste forms scheduled for disposal in WIPP.

Revision 2 of the TWBIR included both the TRU waste that is allowed to be disposed of in WIPP and the DOE TRU waste that is not currently allowed to be disposed of in WIPP (Public Law, 1992b). Because the primary purpose of this Revision 3 TWBIR is to support the CCA and PA, it includes only the DOE TRU waste that is currently allowed to be disposed of in WIPP.

Revision 3 of the TWBIR is different from previous revisions in that it provides the TRU waste inventory information developed for Revision 2 along with supplemental data. It is necessary for the reader to be familiar with Revision 2 of the TWBIR to understand this TWBIR Revision 3 document. Much of the TWBIR Revision 2 information is referenced, rather than repeated, in this document, resulting in an abbreviated document. Revision 3 of the TWBIR consists of one volume having five chapters and four appendices. There is not a new electronic database for

TWBIR Revision 3 because the data in the Revision 2 database are unchanged; therefore new database diskettes are not being published with this document.

The WIPP anticipated (stored and projected) inventory of TRU waste is defined as the sum of retrievably stored waste plus currently projected TRU waste volumes. Current projections do not include waste generated as a result of future environmental restoration (ER) and decontamination and decommissioning (D&D) activities and have only been developed over a 25 year period, consequently the anticipated inventory for CH-TRU waste is not sufficient to fill the maximum CH-TRU disposal inventory for WIPP (calculated to be approximately 168,500 cubic meters or 5,950,000 cubic feet). Scaling has been developed as a means for SNL/NM to model the impacts of a full repository. Scaling has not been applied to the RH-TRU inventory since the sites have reported sufficient RH-TRU waste to fill the RH-TRU disposal inventory (approximately 7,080 cubic meters or 250,000 cubic feet).

The TWBIR also estimates the WIPP disposal inventory in terms of 12 waste material parameters and additional packaging materials that have been identified by SNL/NM as necessary for PA. The 12 waste material parameters and additional packaging materials are constituents of TRU waste and are input parameters for one or more PA models or are required to adequately describe the waste form.

The 12 waste material parameters and additional packaging materials are listed below:

Waste Material Parameters
- Iron-base metal/alloys
- Aluminum-base metal/alloys
- Other metal/alloys
- Other inorganic materials
- Vitrified
- Cellulosics
- Rubber
- Plastics
- Solidified inorganic material
- Solidified organic material
- Cement (solidified)
- Soils

Packaging Materials
- Steel
- Plastic
- Lead (for RH-TRU waste only)

The waste material parameters are expressed on a weight/volume (kilograms per cubic meter) basis. The occurrence of more than one waste material parameter at the maximum value within a waste stream is highly unlikely. If required by PA calculations, the sampling statistics must be controlled so that several waste material parameters do not get sampled all at their maximum value (weight/volume), thereby exceeding the average weight/volume.

Attached to this Executive Summary are several summary tables from the body of the TWBIR Revision 3 which are frequently requested by TWBIR users:

- Table ES-1. WIPP CH-TRU Waste Material Parameter Disposal Inventory
- Table ES-2. WIPP RH-TRU Waste Material Parameter Disposal Inventory
- Table ES-3. WIPP CH-TRU Waste Anticipated Inventory by Site
- Table ES-4. WIPP RH-TRU Waste Anticipated Inventory by Site
- Table ES-5. Summary Radionuclide Inventory

Table ES-1. WIPP CH-TRU Waste Material Parameter Disposal Inventory*

Waste Material Parameters (Kg/m3)	Maximum	Average	Minimum
Iron Base Metal/Alloys	2.6E+03	1.7E+02	0.0E+00
Aluminum Base Metal/Alloys	8.0E+02	1.8E+01	0.0E+00
Other Metal/Alloys	1.6E+03	6.7E+01	0.0E+00
Other Inorganic Materials	1.4E+03	3.1E+01	0.0E+00
Vitrified	2.5E+03	5.5E+01	0.0E+00
Cellulosics	9.6E+02	5.4E+01	0.0E+00
Rubber	6.3E+02	1.0E+01	0.0E+00
Plastics	8.9E+02	3.4E+01	0.0E+00
Solidified Inorganic Material	2.2E+03	5.4E+01	0.0E+00
Solidified Organic Material	1.4E+03	5.6E+00	0.0E+00
Cement (Solidified)	1.2E+03	5.0E+01	0.0E+00
Soils	1.6E+03	4.4E+01	0.0E+00
Container Materials - Kg/m3			
Steel		139	
Plastic/ Liners		26	

*This table is identical to Table ES-1 of TWBIR Revision 2, page ES-4 (DOE, 1995c).

Table ES-2. WIPP RH-TRU Waste Material Parameter Disposal Inventory*

Waste Material Parameters (Kg/m3	Maximum	Average	Minimum
Iron Base Metal/Alloys	1.7E+03	1.0E+02	0.0E+00
Aluminum Base Metal/Alloys	1.7E+02	7.1E+00	0.0E+00
Other Metal/Alloys	9.1E+02	2.5E+02	0.0E+00
Other Inorganic Materials	2.0E+03	6.4E+01	0.0E+00
Vitrified	2.5E+03	4.7E+00	0.0E+00
Cellulosics	5.7E+02	1.7E+01	0.0E+00
Rubber	4.4E+02	3.3E+00	0.0E+00
Plastics	6.2E+02	1.5E+01	0.0E+00
Solidified Inorganic Material	6.1E+02	2.2E+01	0.0E+00
Solidified Organic Material	8.1E+02	9.3E-01	0.0E+00
Cement (Solidified)	5.8E+02	1.9E+01	0.0E+00
Soils	2.4E+01	1.0E+00	0.0E+00

Container Materials - Kg/m3	
Steel	446
Plastic/Liners	3.1
Lead	465
Steel Plug	2145

*This table is identical to Table ES-2 of TWBIR Revision 2, page ES-5 (DOE, 1995c).

Table ES-3. WIPP CH-TRU Waste Anticipated Inventory By Site*

(Cubic Meters)

Storage/Generator Site	Stored Volumes	Projected Volumes	Anticipated Volumes
Ames Laboratory - Iowa State Univ.	0.0E+00	4.2E-01	4.2E-01
Argonne National Laboratory - East	1.1E+01	1.3E+02	1.4E+02
Argonne National Laboratory - West	6.5E+00	7.4E+02	7.5E+02
Bettis Atomic Power Laboratory	0.0E+00	1.2E+02	1.2E+02
Energy Technology Engineering Center	1.7E+00	0.0E+00	1.7E+00
Hanford (Richland) Site	1.2E+04	3.3E+04	4.6E+04
Idaho National Engineering Laboratory	2.9E+04	0.0E+00	2.9E+04
Lawrence Livermore National Laboratory	2.3E+02	7.1E+02	9.4E+02
Los Alamos National Laboratory	1.1E+04	7.4E+03	1.8E+04
Mound Plant	2.7E+02	0.0E+00	2.7E+02
Nevada Test Site	6.2E+02	9.0E+00	6.3E+02
Oak Ridge National Laboratory	1.3E+03	2.6E+02	1.6E+03
Paducah Gaseous Diffusion Plant	0.0E+00	1.9E+00	1.9E+00
Pantex Plant	6.2E-01	0.0E+00	6.2E-01
Rocky Flats Environmental Technology Site	7.1E+02	4.4E+03	5.1E+03
Sandia National Laboratory - Albuquerque	6.7E+00	7.5E+00	1.4E+01
Savannah River Site	2.9E+03	6.8E+03	9.6E+03
Teledyne Brown Engineering	2.1E-01	0.0E+00	2.1E-01
U.S. Army Material Command	2.5E+00	0.0E+00	2.5E+00
University of Missouri Research Reactor	2.1E-01	8.3E-01	1.0E+00
Total CH Volumes	**5.8E+04**	**5.4E+04**	**1.1E+05**

*This table is identical to Table ES-3 of TWBIR Revision 2, page ES-6 (DOE, 1995c).

Table ES-4. WIPP RH-TRU Waste Anticipated Inventory By Site*

(Cubic Meters)

Storage/Generator Site	Stored Volumes	Projected Volumes	Anticipated Volumes
Argonne National Laboratory - West	1.9E+01	1.3E+03	1.3E+03
Battelle Columbus Laboratories	5.8E+02	0.0E+00	5.8E+02
Bettis Atomic Power Laboratory	0.0E+00	6.7E+00	6.7E+00
Energy Technology Engineering Center	8.9E-01	0.0E+00	8.9E-01
Hanford (Richland) Site	2.0E+02	2.2E+04	2.2E+04
Idaho National Engineering Laboratory	2.2E+02	0.0E+00	2.2E+02
Los Alamos National Laboratory	9.4E+01	9.9E+01	1.9E+02
Oak Ridge National Laboratory	2.5E+03	4.5E+02	2.9E+03
Total RH Volumes	**3.6E+03**	**2.3E+04**	**2.7E+04**
Total TRU Waste Volumes	**6.2E+04**	**7.7E+04**	**1.4E+05**

*This table is identical to Table ES-4 of TWBIR Revision 2, page ES-7 (DOE, 1995c).

Table ES-5. Summary Radionuclide Inventory[1*]

Nuclide	CH-TRU Waste (Ci/m^3)	RH-TRU Waste (Ci/m^3)
Am241	2.62E+00	8.42E-01
Ba137m	4.53E-02	2.89E+01
Cm244	1.87E-01	4.45E-02
Co60	3.83E-04	1.47E+00
Cs137	4.78E-02	3.05E+01
Pu238	1.55E+01	2.05E-01
Pu239	4.66E+00	1.45E+00
Pu240	1.25E+00	7.15E-01
Pu241	1.37E+01	2.00E+01
Sr90	4.07E-02	2.95E+01
Y90	4.07E-02	2.95E+01

[1]Summary shows the ten radionuclides with the highest concentration in curies per cubic meter for both CH-TRU and RH-TRU waste. The list includes eleven radionuclides because the ten radionuclides with the highest concentration are different for CH-TRU and RH-TRU waste.

*This table is an update of Table ES-7, of TWBIR Revision 2, page ES-10 (DOE, 1995c).

1. INTRODUCTION

1.1 BACKGROUND

Transuranic (TRU) waste is defined as waste that is contaminated with alpha-emitting radionuclides with an atomic number greater than 92, with half-lives greater than 20 years, and concentrations of TRU isotopes greater than 100 nanocuries per gram of waste at the time of assay (DOE, 1988). TRU wastes are classified as either contact-handled (CH) waste or remote-handled (RH) waste, depending on the dose rate at the surface of the waste container. CH-TRU wastes are packaged TRU wastes with an external surface dose rate less than 200 millirems (mrem) per hour, while RH-TRU wastes are packaged TRU wastes with an external surface dose rate of 200 mrem or greater per hour (Public Law, 1992b). Unless otherwise indicated, for the purposes of this document, all references to TRU waste include TRU waste and mixed TRU waste (waste that contains both radioactive and hazardous components, as defined by the Atomic Energy Act [Public Law, 1954] and the Resource Conservation and Recovery Act [RCRA] as codified in Title 40 Code of Federal Regulations [CFR] Part 261.3 [EPA, 1980]).

The Waste Isolation Pilot Plant (WIPP) is a TRU waste management facility operated by the U.S. Department of Energy (DOE). The WIPP is currently identified as the permanent disposal site for TRU wastes (in retrievable storage or projected) generated at various DOE sites from defense-related activities of the United States government. The WIPP is scheduled to receive and dispose of TRU defense wastes from 8 major and additional minor DOE TRU waste sites (see Figure 1-1).

The DOE is committed to demonstrating compliance with all applicable regulations prior to permanent disposal of TRU defense wastes in the WIPP repository. These regulations are the environmental standards for management and disposal of TRU defense wastes as mandated in 40 CFR Part 191 (EPA, 1993) and Part 194 (EPA, 1996), and the RCRA regulations. Compliance demonstration through Sandia National Laboratories/New Mexico (SNL/NM) performance assessment (PA) calculations will be based on the inventory of existing and currently projected waste streams compiled in this document and the *Transuranic Waste Baseline Inventory Report* (TWBIR) Revision 2, as reported by the DOE TRU waste sites. Revision 3 of the TWBIR is different from previous revisions in that it provides the TRU waste inventory information developed for Revision 2 along with supplemental data. It is necessary for the reader to be familiar with Revision 2 of the TWBIR (DOE, 1995c) to understand TWBIR Revision 3.

1.2 PURPOSE

The purpose of the TWBIR is to document the total inventory of DOE TRU waste as defined by the DOE TRU waste sites. This document is based on the TWBIR Revision 2 data supplemented by several memoranda prepared during early calendar year (CY) 1996 that summarize additional data requested by the U. S. Department of Energy/Carlsbad Area Office (DOE/CAO) to support the SNL/NM PA modeling. The primary purpose of this document is to provide the summary data from TWBIR Revision 2 and the supplemental information used by SNL/NM for the development of the Compliance Certification Application (CCA) to be delivered to the Environmental Protection Agency (EPA), and to support the Land Withdrawal Act (LWA) (Public Law, 1992b). The supplemental information was generated from specific data requests

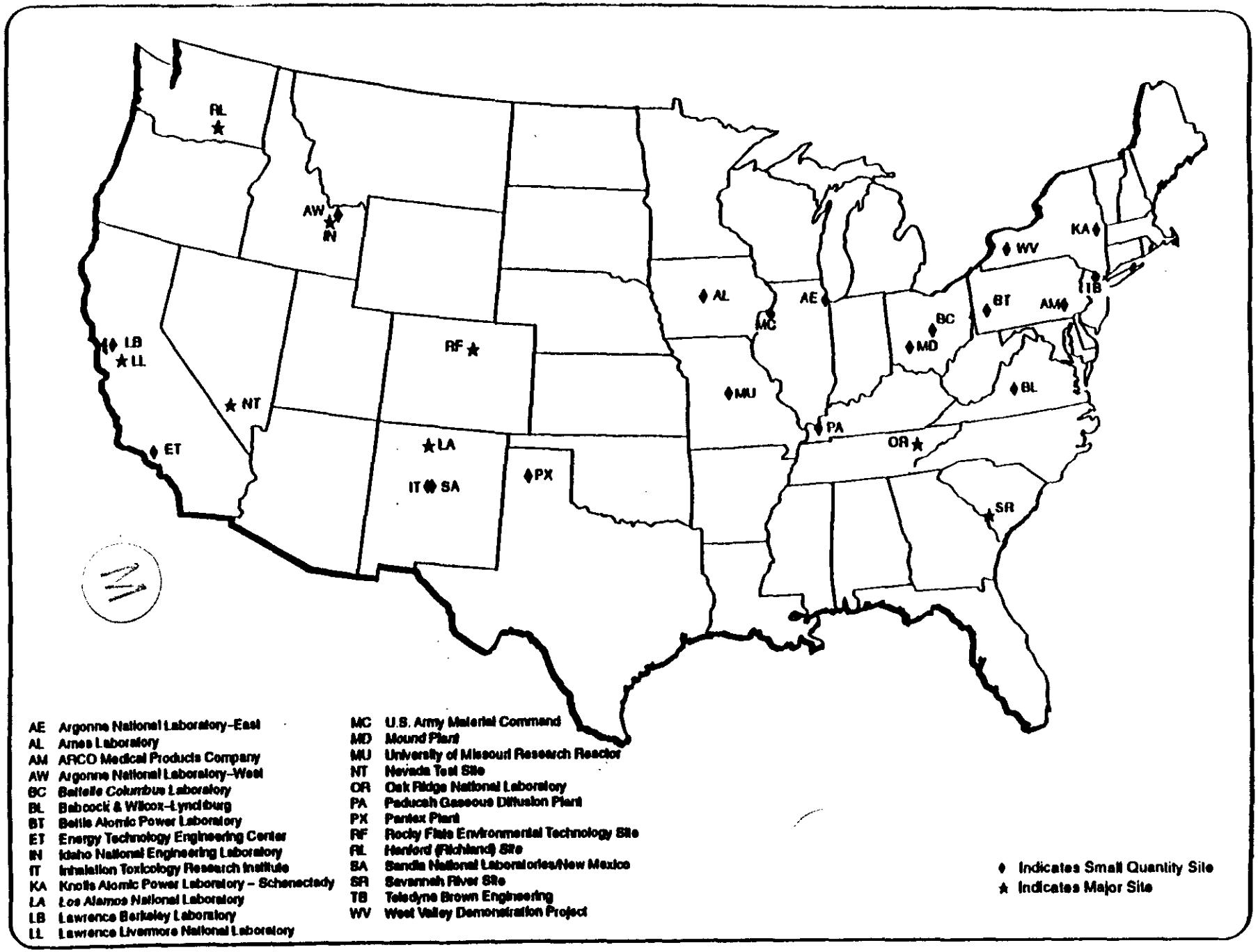

Figure 1-1. U.S. DOE Transuranic Waste Sites*

*This figure is identical to Figure 1-1 in TWBIR Revision 2, page 1-2 (DOE, 1995c).

to the TRU waste sites since the publication of Revision 2.

Revision 2 of the TWBIR included both the TRU waste that is allowed to be disposed of in WIPP and the DOE TRU waste that is not currently allowed to be disposed of in WIPP (Public Law, 1992b). Because the primary purpose of this Revision 3 TWBIR is to support the CCA and PA, it includes only the DOE TRU waste that is currently identified by the sites as being allowed to be disposed of in WIPP.

The TWBIR has been developed from the best available information and acceptable knowledge provided by the DOE TRU waste sites. In support of PA, the TWBIR describes a process for grouping individual waste streams with similar physical and chemical properties into waste profiles, based on their waste matrix code (WMC) (DOE, 1995a) assigned by the DOE TRU waste sites. The individual waste streams are also evaluated to estimate the occurrence and quantities of nonradioactive waste material parameters (WMPs) listed in Table 1-1 (e.g., cellulosics, plastics, iron-base metal/alloys, etc.) that have been identified by SNL/NM as being potentially important to the performance of the WIPP repository. Waste profiles with similar WMCs are then combined across the DOE TRU waste system to provide estimated total volumes and total WMPs.

1.3 WASTE INVENTORY TERMINOLOGY

All terminology in this document is unchanged from the TWBIR Revision 2. A summary of terminology used in this document is provided in this section and in Chapter 5 (Glossary). A list of acronyms and abbreviations used are provided in the front of the document.

Stored Inventory – The part of the TRU inventory currently in retrievable storage at the time of the TWBIR Revision 2 data call for inventory information is known as "stored inventory" in this document. Retrievably stored waste includes waste stored since approximately 1970 in buildings or in berms with earthen cover and does not include any waste that was buried (predominately prior to 1970) (DOE, 1990).

As-Generated Waste – The chemical and physical status of waste when it is generated. The "as-generated" term applies to both stored and projected waste.

Projected Inventory – The part of the TRU waste inventory that has not been generated but is currently estimated to be generated at some time in the future by the TRU waste sites is known as "projected inventory."

Anticipated Inventory – For the TWBIR, this is the sum of the stored and projected inventories, calculated as:

Stored Inventory	+	Projected Inventory	=	Anticipated Inventory

Scaling – The process for adjusting, if needed, the projected inventory to the design limit (disposal inventory) of the WIPP repository is called "scaling."

Stored Inventory + Projected Inventory (scaled as needed) = Disposal Inventory

TABLE 1-1. TECHNICAL DATA NEEDS FOR PERFORMANCE ASSESSMENT WASTE MATERIAL PARAMETERS

Waste Material Parameter	Input Variable in Current PA Models	
	Gas Generation	Mechanical Characteristics
Iron-base metal/alloys	YES	YES
Aluminum-base metal/alloys	-	YES
Other metal/alloys	-	YES
Other inorganic materials	-	YES
Vitrified[1]	-	YES
Cellulosics	YES	YES
Rubber	YES[2]	YES
Plastics	YES[2]	YES
Solidified inorganic material	-	YES
Solidified organic material	-	YES
Cement (solidified)[3,4]	YES	-
Soils[5]	-	YES

[1] Waste material parameter corresponding to treatment, identified by some sites that plan to treat waste in the future.
[2] Only one-half of materials assumed to generate gas.
[3] Percentage of material to generate gas is unknown at the present time.
[4] Information on this waste material parameter is needed for non-PA scoping calculations for assessment of its importance.
[5] May impact colloids.

Disposal Inventory – The inventory volume defined for WIPP emplacement to be used for PA calculations is the "disposal inventory." The LWA defines the total amount of TRU waste allowed for disposal in the WIPP as approximately 175,600 cubic meters (6,200,000 cubic feet) (Public Law, 1992b). The "Agreement for Consultation and Cooperation" (C&C Agreement) limits the RH-TRU inventory to approximately 7,080 cubic meters (250,000 cubic feet) (DOE and State of New Mexico, 1981). Therefore by difference, the CH-TRU inventory will be limited to approximately 168,500 cubic meters (5,950,000 cubic feet) if all of the RH-TRU allowance is filled.

Waste Matrix Code (WMC) - The WMCs were developed by DOE in response to the Federal Facilities Compliance Act (FFCAct) (Public Law, 1992a) as a methodology to aid in categorizing mixed waste streams in the DOE system into a series of five-digit alphanumeric codes (e.g., S3100; Inorganic Process Residues) that represent different physical/chemical matrices (DOE, 1995a).

Final Waste Form – Final waste form of a waste stream refers to the expected physical and chemical form of that stream once the waste has been processed, treated, or repackaged (if necessary) and is ready for disposal. This consists of a series of WMCs that are grouped together. The use of the final waste form helps to group waste streams that are expected to have similar physical and chemical properties at the time of disposal. The final waste form applies to both stored and projected waste. An example of combining three waste streams which either contain particulates or are cemented particulate waste is presented below:

WMC S3100 (inorganic process residues)
WMC S3110 (inorganic particulates)
WMC S3150 (solidified process residues)
] Solidified Inorganics

Particulate waste may be immobilized prior to shipment to WIPP. If so, all three of these waste streams would be the same basic waste form when emplaced in WIPP and have similar physical and chemical properties. The final waste form for this example is solidified inorganics. Table 1-2 presents all anticipated WMCs for TRU waste and indicates the final waste form typically assigned to each WMC for the TWBIR. There are 11 final waste forms used in this TWBIR. The last two rows in Table 1-2, Excluded and Unknown Waste Streams, group WMCs that will not be accepted at WIPP until additional characterization and/or processing occurs to meet the WIPP Waste Acceptance Criteria (WAC) (DOE, 1996).

Waste Material Parameter – This is one (or more) nonradioactive waste constituent(s) that occurs in a TRU waste stream that is an input parameter into one or more PA models or is required to adequately describe the waste form. The waste material parameters and additional packaging materials that are reported in weight/volume (kg/m^3) and included in the TWBIR are:

WASTE MATERIAL PARAMETERS
- Iron-base metal/alloys
- Aluminum-base metal/alloys
- Other metal/alloys
- Other inorganic materials
- Vitrified
- Cellulosics
- Rubber
- Plastics
- Solidified inorganic material
- Solidified organic material
- Cement (solidified)
- Soils

PACKAGING MATERIALS
- Steel
- Plastic
- Lead (for RH-TRU waste only)

WIPP Waste Profile – The WIPP waste profile represents a summary of TRU wastes at all DOE TRU waste sites that have an identical final waste form.

TABLE 1-2. WASTE MATRIX CODES AND THEIR ANTICIPATED FINAL WASTE FORM

Final Waste Form	Waste Matrix Codes
Solidified Inorganics	L1000[1], L1100[1], L1110[1], L1120[1], L1130[1], L1140[1], L1190[1],1200[1], L1210[1], L1220[1], L1230[1], L1240[1], L1290[1], S3000[2], S3100[3], S3110[3], S3111[3], S3112[3], S3113[3], S3115[3], S3118[3], S3119[3], S3120[1], S3121[1], S3122[1], S3123[1], S3124[1], S3125[1], S3129[1], S3130[1 or 3], S3131[1 or 3], S3132[1 or 3], S3139[1 or 3], S3144[3], S3150, S3160[3], S3190[1 or 3], S3900[2], X6000[4], X6200[5], X6300[6], X6400[5], X6900[4], X7300[3], X7500[8], X7510[8], X7520[8], X7530[8], X7590[8], L9000[2], Z1110, Z1190
Salt	S3000[2], S3140, S3141, S3142, S3143, S3149, S3900[2], L9000[2]
Solidified Organics	L2000[1], L2100[1], L2110[1], L2120[1], L2190[1], L2200[1], L2210[1], L2220[1], L2290[1], L2900[1], S3000[2], S3114[3], S3200[3], S3210[3], S3211[3], S3212[3], S3219[3], S3220[1], S3221[1], S3222[1], S3223[1], S3229[1], S3230[3], S3290[1 or 3], S3900[2], S5340[3], X6000[4], X6100[5], X6190[4], X6900[4], L9000[2], Z1110, Z1190
Soils	S4000, S4100, S4200, S4300, S4900,
Uncategorized Metal (Metal Waste Other Than Lead and/or Cadmium)	S3116, S5000[9], S5100[7], S5110, S5111, S5119, S5190, X6200, X7000[10], X7290, X7400[11], X7430, X7490[11], X7520[8], Z1140, Z1190, Z2100[10]
Lead/Cadmium Metal	S5000[9], S5100[7], S5110, S5112, S5113, S5119, S5190, X6220[8], X7000[10], X7200, X7210, X7211, X7212, X7219, X7220, X7290, X7400[11], X7410[11], X7420[11], X7490[11], Z2100[10]
Inorganic Non-Metal	S3117, S3118, S3160, S5000[9], S5100[7], S5120, S5121, S5122, S5123, S5124, S5125, S5126, S5129, S5190, Z1120, Z1150, Z1190
Combustible	S5000[9], S5300, S5310, S5311, S5312, S5313, S5319, S5320, S5330, S5390, Z1130, Z1190, Z1200
Graphite	S5000[9], S5126
Heterogeneous	S5000[9], S5100[9], S5400, S5420, S5440, S5450, S5460, S5490, X7520[8], Z2900
Filter	S5000[9], S5410
Excluded Waste Streams[12]	X7000, X7100, X7600, X7700
Unknown[13]	S5190, X7900, L9000, S9000, Z9000, U9999

TABLE 1-2. WASTE MATRIX CODES AND THEIR ANTICIPATED FINAL WASTE FORM (CONTINUED)

[1] Liquid waste streams are assumed to be solidified prior to being sent to WIPP.

[2] WMCs S3000, S3900, and L9000 are placed in "solidified inorganics," "salt," or "solidified organics," depending on the information provided by the TRU waste site.

[3] Particulate waste streams are assumed to be solidified prior to being sent to WIPP.

[4] WMCs X6000 and X6900 are placed in "solidified organics" or "solidified inorganics" depending on the information provided by the TRU waste site.

[5] Liquid lab pack waste is assumed to be solidified prior to being sent to WIPP.

[6] Solid lab packs are assumed to be solidified prior to being sent to WIPP.

[7] WMC S5100 is placed in "uncategorized metal," "lead-cadmium metal," or "inorganic non-metal" depending on the information provided by the site.

[8] Waste stream is assumed to be treated prior to being sent to WIPP.

[9] WMC S5000 is placed in "uncategorized metal," "lead/cadmium metal," "inorganic non-metal," "combustible," "graphite," "heterogeneous," or "filter," depending on the information provided by the site.

[10] WMC Z2100 is placed in "uncategorized metal" or "lead/cadmium metal" depending on the information provided by the site.

[11] WMCs X7400, X7410, X7420, and X7490 are assumed to be drained of liquid and contain only metal waste.

[12] These waste streams are excluded from disposal in WIPP at this time, e.g., PCB and elemental mercury.

[13] If adequate information is provided by the TRU waste site, these WMCs are changed. If there is not enough information, these waste streams remain as "unknown" and are excluded from disposal in WIPP until characterized.

1.4 METHODOLOGY FOR DEVELOPMENT OF DISPOSAL INVENTORY

Development of the WIPP TRU waste disposal inventory is accomplished by a series of steps starting with the individual waste stream profiles submitted by the TRU waste sites. These waste stream profiles are grouped together, based on similar physical and chemical properties, into common "WIPP waste profiles," which should facilitate discussions with regulatory agencies and stakeholders concerning the disposal waste inventory. The process of grouping similar waste streams is exemplified in Figure 1-2. The waste profiles also contain information on waste material parameters that could affect the performance of the WIPP repository and that may be direct inputs to the PA models.

The CH-TRU anticipated inventory consists of up to 11 overall CH-TRU WIPP final waste forms based on the physical and chemical properties of the waste streams. Because the volume of the CH-TRU anticipated inventory is not sufficient to fill the maximum calculated CH-TRU capacity of WIPP, scaling of the projected CH-TRU inventory is necessary to attain the maximum calculated WIPP CH-TRU disposal inventory of approximately 168,500 cubic meters (5.95 million cubic feet). The scaling factor for CH-TRU waste is computed as follows:

$$\frac{\text{maximum calculated CH-TRU inventory - stored CH-TRU inventory}}{\text{projected CH-TRU inventory}} = \text{CH-TRU scaling factor}$$

The WIPP disposal inventory is the inventory to be used in PA calculations. To calculate the disposal inventory by final waste form for CH-TRU waste, the **projected inventory** is multiplied by the scaling factor, added to the stored inventory for each final waste form, and summed together.

The RH-TRU anticipated inventory is greater than the WIPP C&C Agreement limit (DOE and State of New Mexico, 1981) of approximately 7,080 cubic meters. DOE will abide by the WIPP C&C Agreement for RH-TRU waste volumes and the LWA, which limits the curies of RH-TRU waste allowed in WIPP to 5.1 million curies (Public Law, 1992b). As stated earlier, one purpose of the TWBIR is to report the DOE TRU inventory in such a way that it will facilitate performance assessment by SNL/NM and support development of compliance applications to the appropriate regulatory agencies. Since this is not a WIPP load management document, the RH-TRU inventory has not been scaled back in this document to the regulatory limit. The RH-TRU inventory for WIPP will be averaged across all RH-TRU waste sites and reported as kilograms/cubic meter for the waste material parameters and curies/cubic meter for radionuclides.

1.5 DOCUMENT ORGANIZATION

The TWBIR Revision 3 is organized into chapters of text, figures, tables, and supporting appendices. The contents of remaining chapters in this document are summarized below:

- Chapter 2 provides a summary of the WIPP disposal inventory information previously presented in TWBIR Revision 2.
- Chapter 3 presents supplementary disposal inventory information.
- Chapter 4 provides the document references.

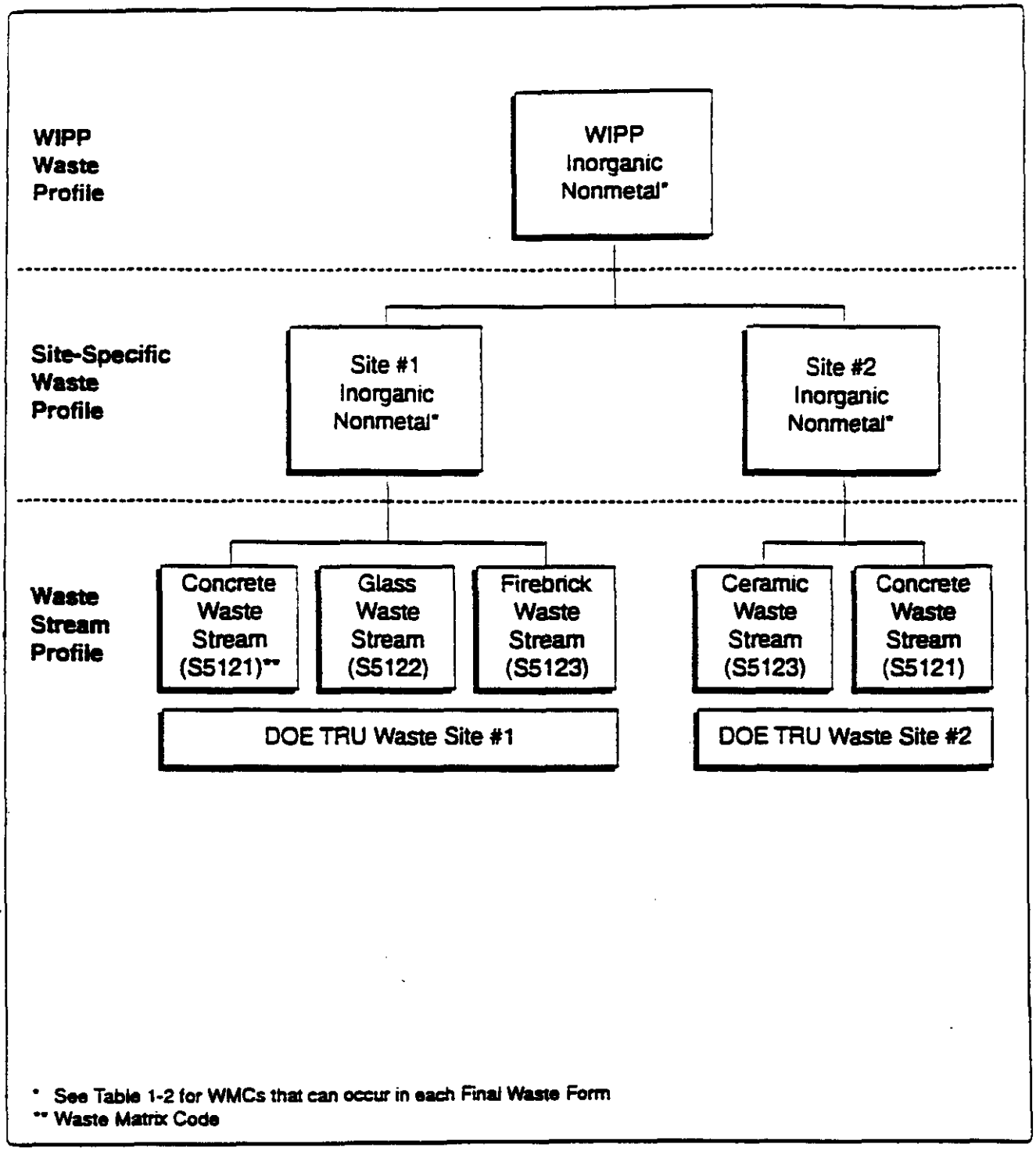

Figure 1-2. Schematic of Waste Stream Profile Methodology*

*This figure is identical to Figure 2-3 of TWBIR Revision 2, page 2-10 (DOE, 1995c).

- Chapter 5 provides a document glossary.
- Appendix A provides the SNL/NM memoranda requesting information to supplement the TWBIR Revision 2.
- Appendix B includes DOE and SNL/NM memoranda that provide information to supplement the TWBIR Revision 2.
- Appendix C provides the site-specific stored radionuclide inventories decayed to December 1995.
- Appendix D provides the correction received from SNL/NM for Cf-252 decayed inventory.

2. SUMMARY OF WIPP DISPOSAL INVENTORY INFORMATION

2.1 INTRODUCTION

The DOE TRU waste sites have assigned an overall final waste form to each waste stream based on the expected physical and chemical form of the waste after the sites process, treat, or repackage the waste (if necessary). Each site provides the stored and projected inventory for each waste stream. The TWBIR generates the WIPP TRU waste inventory by rolling-up the waste stream volumes that have the same final waste form within a site to generate site profiles (see TWBIR Revision 2 [DOE, 1995c] for waste stream and site-specific waste profiles). Then the site-level volumes with the same final waste form are rolled-up to generate the WIPP TRU waste inventory by final waste form (see TWBIR Revision 2 for detailed information on the roll-up methodology).

This chapter summarizes the WIPP-level information for the disposal inventory. The data provided in this chapter are identical to those provided in TWBIR Revision 2. These are the data used by SNL/NM in the WIPP performance assessment to demonstrate regulatory compliance. This chapter will include the following TWBIR Revision 2 information:

- WIPP disposal inventory volumes for each final waste form - taken from Table 3-1 (unchanged) in Section 3.2 of TWBIR Revision 2.
- WIPP disposal inventory waste material parameters - taken from Tables 3-2 and 3-3 (unchanged) in Section 3.3 of TWBIR Revision 2.
- Summary of WIPP anticipated inventory from each site - taken from Tables 4-1 and 4-2 (unchanged) in Chapter 4 of TWBIR Revision 2.

2.2 WIPP DISPOSAL INVENTORY VOLUMES FOR EACH FINAL WASTE FORM

The disposal inventory is defined by the LWA (Public Law, 1992b) and the WIPP C&C Agreement (DOE and the State of New Mexico, 1981) as follows: the maximum allowable WIPP capacity is approximately 175,600 cubic meters, of which RH-TRU disposal inventory is limited to approximately 7,080 cubic meters resulting in a calculated CH-TRU disposal inventory limit of approximately 168,500 cubic meters.

Using volumes for all the retrievably stored and projected defense TRU waste streams (including the mixed and nonmixed TRU waste volumes) a disposal inventory of TRU waste has been developed using the methodology described in Chapter 3 of Revision 2 of the TWBIR. This inventory is presented in Table 2-1 (by final waste forms) and depicts both the anticipated and disposal inventory volumes.

The anticipated CH-TRU inventory volumes are the sum of the stored and projected volumes. Scaling of the disposal inventory is for PA purposes to enable SNL/NM to model a capacity waste load based on currently anticipated profiles.

TABLE 2-1. TRANSURANIC WASTE DISPOSAL INVENTORY FOR WIPP*

Contact Handled Waste (Cubic Meters)

Final Waste Forms	Stored Volumes	Projected Volumes	Anticipated Volumes	WIPP Disposal Volumes
Combustible	5.8E+03	4.6E+03	1.0E+04	1.4E+04
Filter	2.2E+02	5.1E+02	7.3E+02	1.2E+03
Graphite	5.1E+02	4.8E+01	5.6E+02	6.0E+02
Heterogeneous	2.7E+04	1.3E+04	4.0E+04	5.1E+04
Inorganic Non-Metal	3.1E+03	9.4E+02	4.1E+03	4.9E+03
Lead/Cadmium Metal Waste	3.5E+01	3.3E+02	3.7E+02	6.6E+02
Salt Waste	2.1E+01	3.3E+02	3.5E+02	6.4E+02
Soils	4.1E+02	6.0E+03	6.4E+03	1.2E+04
Solidified Inorganics	9.6E+03	4.5E+03	1.4E+04	1.8E+04
Solidified Organics	9.1E+02	7.5E+01	9.8E+02	1.1E+03
Uncategorized Metal	1.1E+04	2.3E+04	3.4E+04	5.4E+04
Total CH Volumes	**5.8E+04**	**5.4E+04**	**1.1E+05**	**1.6E+05**
Remote Handled Waste				
Combustible	3.6E+01	4.9E+01	8.5E+01	
Heterogeneous	2.3E+03	5.5E+03	7.8E+03	
Inorganic Non-Metal	4.6E+01	2.1E+01	6.8E+01	
Lead/Cadmium Metal Waste	7.1E+00	6.7E+01	7.4E+01	
Solidified Inorganics	1.1E+03	2.3E+02	1.3E+03	
Solidified Organics	3.6E+00	0.0E+00	3.6E+00	
Uncategorized Metal	1.2E+02	1.7E+04	1.8E+04	
Total RH Volumes	**3.6E+03**	**2.3E+04**	**2.7E+04**	
Total TRU Waste Volumes	**6.2E+04**	**7.7E+04**	**1.4E+05**	**1.7E+05**

*This table is identical to Table 3-1 of TWBIR Revision 2, page 3-2 (DOE, 1995c).

Applying the formula given in Chapter 1:

$$\frac{1.685 \times 10^5 m^3 \text{ (CH-TRU disposal inventory)} - 5.8 \times 10^4 m^3 \text{ (stored inventory)}}{5.4 \times 10^4 m^3 \text{ (projected inventory)}} \approx 2.05 \text{ (scaling factor)}$$

- Multiply the CH-TRU waste **projected inventory volumes** by the scaling factor for all the final waste forms, and add the stored volumes (which results in the numbers in the "Disposal Inventory" column of Table 2-1).

The CH-TRU waste stream volume on a system-wide final waste form basis is increased by approximately 50 percent to account for the difference between the anticipated inventory and the maximum calculated WIPP CH-TRU disposal inventory.

The RH-TRU WIPP inventory has not been scaled. The RH-TRU anticipated inventory is greater than the amount of RH-TRU waste allowed in the WIPP by the C&C Agreement (DOE and the State of New Mexico, 1981). DOE is committed to abide by all agreements and laws regarding RH-TRU limitations. DOE and SNL/NM will evaluate this inventory to determine the disposal options for all DOE RH-TRU waste. This inventory has not been scaled back to the limit imposed by the C&C Agreement so that all available data are presented to DOE and SNL/NM to conduct modeling and other evaluations to determine the disposition of this waste.

2.3 ROLL-UP OF WIPP WASTE MATERIAL PARAMETERS BY FINAL WASTE FORM

The roll-ups of waste material parameters by final waste forms are developed from the volumes presented in the TWBIR Revision 2. The roll-ups by final waste forms require combining data from several waste streams. A weighted average value for the waste material parameters is calculated from the average densities provided by the TRU waste sites modified by the volume fractions and summed as follows:

$$\text{Average Density of waste material parameter} = \sum \text{Average Density}_i^{*} \times \frac{\text{(Volume TWBIR Stream}_i\text{)}}{\text{(Total Volume of Final Waste Form)}}$$

*where i is an index representing individual waste streams of the same final waste form

The minimum density is chosen as the smallest minimum density of a particular waste material parameter in the TWBIR Revision 2. The maximum density is chosen in a similar manner, except that the largest maximum density is chosen. Thus, the maximum and minimum values reported in Tables 2-2 and 2-3 are the absolute extreme values reported across the system, and in many cases they only apply to a very small volume of waste. If required, the user can use the data in the TWBIR Revision 2 database to calculate a "weighted average maximum" value to obtain a maximum value that may be more representative of the total inventory.

The waste material parameters that are inputs to the PA models are presented in Table 2-2 for CH-TRU waste and Table 2-3 for RH-TRU waste. These tables represent the waste material parameters for the WIPP disposal inventory.

2.4 SUMMARY OF WIPP ANTICIPATED INVENTORY FROM EACH SITE

Each WIPP waste stream from each TRU waste site is characterized in a waste stream profile in TWBIR Revision 2. Summary tables of CH-TRU and RH-TRU WIPP waste volumes by site are provided in Tables 2-4 and 2-5.

Table 2-2. WIPP CH-TRU Waste Material Parameter Disposal Inventory*

Waste Material Parameters (Kg/m3)	Maximum	Average	Minimum
Iron Base Metal/Alloys	2.8E+03	1.7E+02	0.0E+00
Aluminum Base Metal/Alloys	8.0E+02	1.8E+01	0.0E+00
Other Metal/Alloys	1.6E+03	6.7E+01	0.0E+00
Other Inorganic Materials	1.4E+03	3.1E+01	0.0E+00
Vitrified	2.5E+03	5.5E+01	0.0E+00
Cellulosics	9.6E+02	5.4E+01	0.0E+00
Rubber	6.3E+02	1.0E+01	0.0E+00
Plastics	8.9E+02	3.4E+01	0.0E+00
Solidified Inorganic Material	2.2E+03	5.4E+01	0.0E+00
Solidified Organic Material	1.4E+03	5.6E+00	0.0E+00
Cement (Solidified)	1.2E+03	5.0E+01	0.0E+00
Soils	1.6E+03	4.4E+01	0.0E+00
Container Materials - Kg/m3			
Steel		139	
Plastic/ Liners		28	

*This table is identical to Table 3-2 in TWBIR Revision 2, page 3-4 (DOE, 1995c).

Table 2-3. WIPP RH-TRU Waste Material Parameter Disposal Inventory*

Waste Material Parameters (Kg/m3	Maximum	Average	Minimum
Iron Base Metal/Alloys	1.7E+03	1.0E+02	0.0E+00
Aluminum Base Metal/Alloys	1.7E+02	7.1E+00	0.0E+00
Other Metal/Alloys	9.1E+02	2.5E+02	0.0E+00
Other Inorganic Materials	2.0E+03	6.4E+01	0.0E+00
Vitrified	2.5E+03	4.7E+00	0.0E+00
Cellulosics	5.7E+02	1.7E+01	0.0E+00
Rubber	4.4E+02	3.3E+00	0.0E+00
Plastics	6.2E+02	1.5E+01	0.0E+00
Solidified Inorganic Material	6.1E+02	2.2E+01	0.0E+00
Solidified Organic Material	8.1E+02	9.3E-01	0.0E+00
Cement (Solidified)	5.8E+02	1.9E+01	0.0E+00
Soils	2.4E+01	1.0E+00	0.0E+00

Container Materials - Kg/m3

Steel	446
Plastic/Liners	3.1
Lead	465
Steel Plug	2145

*This table is identical to Table 3-3 in TWBIR Revision 2, page 3-5 (DOE, 1995c).

Table 2-4. WIPP CH-TRU Waste Anticipated Inventory By Site*

(Cubic Meters)

Storage/Generator Site	Stored Volumes	Projected Volumes	Anticipated Volumes
Ames Laboratory - Iowa State Univ.	0.0E+00	4.2E-01	4.2E-01
Argonne National Laboratory - East	1.1E+01	1.3E+02	1.4E+02
Argonne National Laboratory - West	6.5E+00	7.4E+02	7.5E+02
Bettis Atomic Power Laboratory	0.0E+00	1.2E+02	1.2E+02
Energy Technology Engineering Center	1.7E+00	0.0E+00	1.7E+00
Hanford (Richland) Site	1.2E+04	3.3E+04	4.6E+04
Idaho National Engineering Laboratory	2.9E+04	0.0E+00	2.9E+04
Lawrence Livermore National Laboratory	2.3E+02	7.1E+02	9.4E+02
Los Alamos National Laboratory	1.1E+04	7.4E+03	1.8E+04
Mound Plant	2.7E+02	0.0E+00	2.7E+02
Nevada Test Site	6.2E+02	9.0E+00	6.3E+02
Oak Ridge National Laboratory	1.3E+03	2.6E+02	1.6E+03
Paducah Gaseous Diffusion Plant	0.0E+00	1.9E+00	1.9E+00
Pantex Plant	6.2E-01	0.0E+00	6.2E-01
Rocky Flats Environmental Technology Site	7.1E+02	4.4E+03	5.1E+03
Sandia National Laboratory - Albuquerque	6.7E+00	7.5E+00	1.4E+01
Savannah River Site	2.9E+03	6.8E+03	9.6E+03
Teledyne Brown Engineering	2.1E-01	0.0E+00	2.1E-01
U.S. Army Material Command	2.5E+00	0.0E+00	2.5E+00
University of Missouri Research Reactor	2.1E-01	8.3E-01	1.0E+00
Total CH Volumes	**5.8E+04**	**5.4E+04**	**1.1E+05**

*This table is identical to Table 4-1 in TWBIR Revision 2, page 4-2 (DOE, 1995c).

Table 2-5. WIPP RH-TRU Waste Anticipated Inventory By Site*

(Cubic Meters)

Storage/Generator Site	Stored Volumes	Projected Volumes	Anticipated Volumes
Argonne National Laboratory - West	1.9E+01	1.3E+03	1.3E+03
Battelle Columbus Laboratories	5.8E+02	0.0E+00	5.8E+02
Bettis Atomic Power Laboratory	0.0E+00	6.7E+00	6.7E+00
Energy Technology Engineering Center	8.9E-01	0.0E+00	8.9E-01
Hanford (Richland) Site	2.0E+02	2.2E+04	2.2E+04
Idaho National Engineering Laboratory	2.2E+02	0.0E+00	2.2E+02
Los Alamos National Laboratory	9.4E+01	9.9E+01	1.9E+02
Oak Ridge National Laboratory	2.5E+03	4.5E+02	2.9E+03
Total RH Volumes	**3.6E+03**	**2.3E+04**	**2.7E+04**
Total TRU Waste Volumes	**6.2E+04**	**7.7E+04**	**1.4E+05**

*This table is identical to Table 4-2 in TWBIR Revision 2, page 4-3 (DOE, 1995c).

3. SUPPLEMENTAL DISPOSAL INVENTORY INFORMATION

3.1 INTRODUCTION

This chapter summarizes supplemental information about the WIPP disposal inventory that was requested by SNL/NM in support of WIPP PA either after the publication of Revision 2 of the TWBIR or that was not available from the TRU waste sites at the time of publication of Revision 2 of the TWBIR in December 1995 (DOE, 1995c). Appendices A-1 through A-3 are the three memoranda from SNL/NM requesting supplemental information about the WIPP TRU waste inventory.

The first memorandum from SNL/NM (dated November 6, 1995), entitled "CH and RH-TRU Waste Parameters Potentially Important in WIPP PA" (Appendix A-1), was included as Appendix B in Revision 2 of the TWBIR. This memorandum requested information on certain nonradioactive materials present in the TRU waste (nitrates, sulfates, phosphates, cement, and organic ligands), and also requested information on residues present at TRU waste sites other than Rocky Flats Environmental Technology Site (RFETS). The information on residues was provided in Revision 2 of the TWBIR. However, the remainder of the requested information had to be obtained from the sites after the publication of Revision 2 and is presented in this document.

The second and the third memoranda from SNL/NM (dated January 11 and January 30, 1996), both entitled "Information Needed from TWBIR (Revision 2/Addendum)" (Appendices A-2 and A-3), requested additional information about the WIPP disposal radionuclide inventory. This information is also presented in the main body of this document.

The supplemental information provided to SNL/NM in response to the memoranda referenced above is discussed in the following sections:

- Supplemental Radionuclide Information (Section 3.2)
- Supplemental Information for Other Constituents (Section 3.3)

3.2 SUPPLEMENTAL RADIONUCLIDE INFORMATION

In response to the memoranda requesting radionuclide information (Appendices A-2 and A-3), two sets of radionuclide information were provided in support of WIPP PA (Appendices B-1 and B-2). Appendix B-1 is an update of the WIPP disposal radionuclide inventory presented in Table 3-4 of Revision 2 of the TWBIR, while Appendix B-2 presents preliminary activity calculations for seven radionuclides on a waste stream basis. The memoranda reporting these supplemental data and the details of the methodology for calculations are included in Appendices B-1 and B-2. A summary of the information provided by DOE to SNL/NM and the major assumptions used in deriving portions of the data are presented in Sections 3.2.1 and 3.2.2.

3.2.1 Revised WIPP Disposal Radionuclide Inventory

A revised estimate of the WIPP disposal radionuclide inventory (i.e., Table 3-4 in TWBIR Revision 2) was not specifically requested by SNL/NM in the memoranda included in Appendices A-1 through A-3. However, after the publication of TWBIR Revision 2, new and updated

radionuclide information became available from four sites (Hanford, Oak Ridge National Laboratory [ORNL], RFETS, and Savannah River Site [SRS]). A review of the new information indicated that it may result in considerable changes to the WIPP disposal radionuclide inventory published in Revision 2 of the TWBIR. Therefore, the disposal radionuclide inventory was recalculated on the basis of the new information and the results provided to SNL/NM in a format identical to Table 3-4 in TWBIR Revision 2 (see Table 3-1). The methodology and the assumptions used for recalculation of the radionuclide inventory are identical to those described in TWBIR Revision 2, except that the new radionuclide information from the four sites was incorporated. The new information from the four sites is summarized below:

- Hanford Site reported corrections to the values for Cf-252, Cm-244, and Cm-245 from their earlier submittals for the Integrated Data Base (IDB) (DOE, 1995b).

- Preliminary sludge sampling data were obtained for the ORNL RH-TRU sludges, which showed that the primary uranium isotope present in these sludges is U-238 (not U-235, as reported in their previous IDB submittals). The uranium curies reported for RH-TRU waste in previous ORNL IDB submittals were redistributed based on the preliminary sludge sampling data. This corrected the previously high estimates of U-235 in the ORNL RH-TRU inventory.

- The RFETS provided undecayed yearly activity data for the radionuclides present in the RFETS residues, which enabled activity decay calculations for these radionuclides. This was not provided for in TWBIR Revision 2; therefore the radionuclide activity from these residues could not be decayed.

- The SRS provided a break-up of radionuclide activity data for SRS waste between on-site and off-site waste (i.e., waste from other sites that was shipped to SRS for storage in the early 1970s). The activity from the off-site waste was included in the WIPP disposal radionuclide inventory but excluded from any extrapolations for SRS projected waste under the assumption that there would be no future accumulation of off-site Pu-238 dominant waste at SRS.

Based on the above information, Table 3-1 provides the revised WIPP disposal radionuclide inventory estimated in curies per cubic meter and total curies for each radionuclide for both CH-TRU and RH-TRU waste. The revised stored radionuclide inventory for each site in decayed curies is provided in Appendix C for both CH-TRU and RH-TRU waste. Appendix C includes the effect of all corrections, additions, or revisions to the site radionuclide inventories used to develop Table 3-1 and is an update of Appendix D in TWBIR Revision 2. All numbers in Appendix C are decayed to December 1995 using the Oak Ridge Isotope Generation and Depletion Code (ORIGEN 2) (Croff, 1980; 1983).

Based on the total curies shown in Table 3-1, it is estimated that approximately 98.9 percent of the total CH-TRU curies is contributed by Pu-238, Pu-239, Pu-240, Pu-241, and Am-241. In contrast, approximately 96.5 percent of the total RH-TRU curies is contributed by Cs-137, Sr-90, Ba-137m, Pu-241, and Y-90. Thus, the remaining radionuclides contribute a very small fraction of the total curies for the repository.

In comparison to TWBIR Revision 2, the most significant change in the revised disposal radionuclide inventory shown in Table 3-1 is the *decrease* in the estimated concentration of Pu-

Table 3-1. WIPP DISPOSAL RADIONUCLIDE INVENTORY FOR THE CCA[1]*

Nuclide	CH-TRU Waste (Ci/m^3)	RH-TRU Waste (Ci/m^3)	CH-TRU Waste (Total Curies[2])	RH-TRU Waste (Total Curies[2])
Ac225	1.71E-05	1.66E-05	2.88E+00	1.17E-01
Ac227	3.61E-06	1.07E-07	6.08E-01	7.57E-04
Ac228	4.43E-06	1.10E-05	7.47E-01	7.77E-02
Ag109m	9.32E-05	NR	1.57E+01	NR
Ag110	4.19E-14	2.46E-13	7.07E-09	1.74E-09
Ag110m	3.15E-12	1.85E-11	5.31E-07	1.31E-07
Am241	2.62E+00	8.42E-01	4.42E+05	5.96E+03
Am242	1.04E-05	NR	1.75E+00	NR
Am242m	1.04E-05	NR	1.75E+00	NR
Am243	1.93E-04	3.23E-08	3.26E+01	2.28E-04
Am245	7.89E-15	4.06E-20	1.33E-09	2.87E-16
At217	1.71E-05	1.66E-05	2.88E+00	1.17E-01
Ba137m	4.53E-02	2.89E+01	7.63E+03	2.04E+05
Bi210	1.52E-05	1.01E-09	2.55E+00	7.16E-06
Bi211	3.61E-06	1.07E-07	6.09E-01	7.58E-04
Bi212	1.61E-04	1.04E-05	2.71E+01	7.36E-02
Bi213	1.71E-05	1.66E-05	2.88E+00	1.17E-01
Bi214	6.91E-05	5.05E-09	1.16E+01	3.58E-05
Bk249	5.44E-10	2.80E-15	9.16E-05	1.98E-11
Bk250	2.59E-16	NR	4.37E-11	NR

NR = Not reported by sites.
[1]Decayed to December 1995.
[2]Total curies estimated by assuming a volume of 168,500 cubic meters for CH-TRU waste and 7,080 cubic meters for RH-TRU waste.
[3]The values for Cf252 and Cm248 are different from the values reported in Attachment A in Appendix B-1 because these incorporate the corrections received from SNL/NM for these isotopes (see Appendix D) after Appendix B-1 was finalized.

*This table is an update of Table 3-4, of TWBIR Revision 2, pages 3-30 through 3-36 (DOE, 1995c)

Table 3-1. WIPP DISPOSAL RADIONUCLIDE INVENTORY FOR THE CCA (continued)

Nuclide	CH-TRU Waste (Ci/m^3)	RH-TRU Waste (Ci/m^3)	CH-TRU Waste (Total Curies[2])	RH-TRU Waste (Total Curies[2])
C14	6.43E-05	2.90E-04	1.08E+01	2.05E+00
Cd109	9.31E-05	NR	1.57E+01	NR
Cd113m	1.08E-11	7.71E-11	1.82E-06	5.46E-07
Ce144	3.71E-07	7.24E-04	6.26E-02	5.13E+00
Cf249	3.81E-07	6.31E-07	6.42E-02	4.47E-03
Cf250	1.96E-06	NR	3.30E-01	NR
Cf251	2.24E-08	NR	3.78E-03	NR
Cf252[3]	1.44E-05	1.82E-04	2.43E+00	1.29E+00
Cm242	6.76E-06	NR	1.14E+00	NR
Cm243	1.61E-05	6.99E-03	2.72E+00	4.95E+01
Cm244	1.87E-01	4.45E-02	3.15E+04	3.15E+02
Cm245	6.81E-08	2.07E-10	1.15E-02	1.46E-06
Cm246	6.06E-07	NR	1.02E-01	NR
Cm247	1.91E-14	NR	3.21E-09	NR
Cm248[3]	2.19E-07	2.89E-08	3.69E-02	2.05E-04
Co58	1.81E-18	1.75E-15	3.05E-13	1.24E-11
Co60	3.83E-04	1.47E+00	6.46E+01	1.04E+04
Cr51	NR	4.29E-10	NR	3.04E-06
Cs134	7.97E-08	2.60E-03	1.34E-02	1.84E+01
Cs135	2.98E-09	1.66E-08	5.02E-04	1.17E-04

NR = Not reported by sites.
[1]Decayed to December 1995.
[2]Total curies estimated by assuming a volume of 168,500 cubic meters for CH-TRU waste and 7,080 cubic meters for RH-TRU waste.
[3]The values for Cf252 and Cm248 are different from the values reported in Attachment A in Appendix B-1 because these incorporate the corrections received from SNL/NM for these isotopes (see Appendix D) after Appendix B-1 was finalized.

* This table is an update of Table 3-4, of TWBIR Revision 2, pages 3-30 through 3-36 (DOE, 1995c)

Table 3-1. WIPP DISPOSAL RADIONUCLIDE INVENTORY FOR THE CCA (continued)

Nuclide	CH-TRU Waste (Ci/m^3)	RH-TRU Waste (Ci/m^3)	CH-TRU Waste (Total Curies[2])	RH-TRU Waste (Total Curies[2])
Cs137	4.78E-02	3.05E+01	8.06E+03	2.16E+05
Es254	2.51E-16	NR	4.24E-11	NR
Eu150	2.08E-10	NR	3.51E-05	NR
Eu152	7.46E-06	1.73E-01	1.26E+00	1.22E+03
Eu154	6.80E-06	8.34E-02	1.15E+00	5.91E+02
Eu155	5.62E-06	1.67E-02	9.46E-01	1.18E+02
Fe55	1.13E-10	2.38E-05	1.91E-05	1.69E-01
Fe59	1.57E-12	NR	2.64E-07	NR
Fr221	1.71E-05	1.66E-05	2.88E+00	1.17E-01
Fr223	4.98E-08	1.48E-09	8.39E-03	1.04E-05
H3	5.16E-06	9.33E-06	8.69E-01	6.60E-02
I129	4.18E-12	NR	7.05E-07	NR
Kr85	1.20E-06	2.37E-04	2.02E-01	1.68E+00
Mn54	5.05E-09	3.32E-06	8.51E-04	2.35E-02
Nb95	1.51E-14	9.45E-05	2.54E-09	6.69E-01
Nb95m	5.04E-17	3.17E-07	8.50E-12	2.24E-03
Ni59	4.47E-08	NR	7.52E-03	NR
Ni63	5.46E-06	1.40E-04	9.19E-01	9.88E-01
Np237	3.33E-04	4.02E-04	5.61E+01	2.85E+00
Np238	5.20E-08	NR	8.77E-03	NR

NR = Not reported by sites.
[1]Decayed to December 1995.
[2]Total curies estimated by assuming a volume of 168,500 cubic meters for CH-TRU waste and 7,080 cubic meters for RH-TRU waste.
[3]The values for Cf252 and Cm248 are different from the values reported in Attachment A in Appendix B-1 because these incorporate the corrections received from SNL/NM for these isotopes (see Appendix D) after Appendix B-1 was finalized.

*This table is an update of Table 3-4, of TWBIR Revision 2, pages 3-30 through 3-36 (DOE, 1995c)

Table 3-1. WIPP DISPOSAL RADIONUCLIDE INVENTORY FOR THE CCA (continued)

Nuclide	CH-TRU Waste (Ci/m^3)	RH-TRU Waste (Ci/m^3)	CH-TRU Waste (Total Curies[2])	RH-TRU Waste (Total Curies[2])
Np239	1.93E-04	3.23E-08	3.26E+01	2.28E-04
Np240m	8.91E-12	3.12E-15	1.50E-06	2.21E-11
Pa231	2.67E-06	2.70E-07	4.51E-01	1.91E-03
Pa233	3.33E-04	4.02E-04	5.61E+01	2.85E+00
Pa234	3.05E-07	1.92E-06	5.14E-02	1.36E-02
Pa234m	2.35E-04	1.48E-03	3.96E+01	1.05E+01
Pb209	1.71E-05	1.66E-05	2.88E+00	1.17E-01
Pb210	1.52E-05	1.01E-09	2.55E+00	7.16E-06
Pb211	3.61E-06	1.07E-07	6.09E-01	7.58E-04
Pb212	1.61E-04	1.04E-05	2.71E+01	7.36E-02
Pb214	6.91E-05	5.05E-09	1.16E+01	3.58E-05
Pd107	4.40E-10	2.45E-09	7.41E-05	1.73E-05
Pm147	4.67E-05	1.52E-03	7.87E+00	1.07E+01
Po210	1.52E-05	1.01E-09	2.55E+00	7.16E-06
Po211	1.01E-08	3.00E-10	1.71E-03	2.12E-06
Po212	1.03E-04	6.66E-06	1.73E+01	4.72E-02
Po213	1.67E-05	1.62E-05	2.82E+00	1.15E-01
Po214	6.91E-05	5.05E-09	1.16E+01	3.57E-05
Po215	3.61E-06	1.07E-07	6.09E-01	7.58E-04
Po216	1.61E-04	1.04E-05	2.71E+01	7.36E-02

NR = Not reported by sites.
[1]Decayed to December 1995.
[2]Total curies estimated by assuming a volume of 168,500 cubic meters for CH-TRU waste and 7,080 cubic meters for RH-TRU waste.
[3]The values for Cf252 and Cm248 are different from the values reported in Attachment A in Appendix B-1 because these incorporate the corrections received from SNL/NM for these isotopes (see Appendix D) after Appendix B-1 was finalized.

*This table is an update of Table 3-4, of TWBIR Revision 2, pages 3-30 through 3-36 (DOE, 1995c)

Table 3-1. WIPP DISPOSAL RADIONUCLIDE INVENTORY FOR THE CCA (continued)

Nuclide	CH-TRU Waste (Ci/m^3)	RH-TRU Waste (Ci/m^3)	CH-TRU Waste (Total Curies[2])	RH-TRU Waste (Total Curies[2])
Po218	6.91E-05	5.05E-09	1.16E+01	3.58E-05
Pr144	3.67E-07	7.16E-04	6.18E-02	5.07E+00
Pu236	6.16E-08	NR	1.04E-02	NR
Pu238	1.55E+01	2.05E-01	2.61E+06	1.45E+03
Pu239	4.66E+00	1.45E+00	7.85E+05	1.03E+04
Pu240	1.25E+00	7.15E-01	2.10E+05	5.07E+03
Pu241	1.37E+01	2.00E+01	2.31E+06	1.42E+05
Pu242	6.96E-03	2.11E-05	1.17E+03	1.50E-01
Pu243	1.91E-14	NR	3.21E-09	NR
Pu244	8.92E-12	3.12E-15	1.50E-06	2.21E-11
Ra223	3.61E-06	1.07E-07	6.09E-01	7.58E-04
Ra224	1.61E-04	1.04E-05	2.71E+01	7.36E-02
Ra225	1.71E-05	1.66E-05	2.88E+00	1.17E-01
Ra226	6.91E-05	5.05E-09	1.16E+01	3.58E-05
Ra228	4.43E-06	1.10E-05	7.47E-01	7.77E-02
Rh106	1.72E-07	1.54E-03	2.90E-02	1.09E+01
Rn219	3.61E-06	1.07E-07	6.09E-01	7.58E-04
Rn220	1.61E-04	1.04E-05	2.71E+01	7.36E-02
Rn222	6.91E-05	5.05E-09	1.16E+01	3.58E-05
Ru106	1.72E-07	1.54E-03	2.90E-02	1.09E+01

NR = Not reported by sites.
[1]Decayed to December 1995.
[2]Total curies estimated by assuming a volume of 168,500 cubic meters for CH-TRU waste and 7,080 cubic meters for RH-TRU waste.
[3]The values for Cf252 and Cm248 are different from the values reported in Attachment A in Appendix B-1 because these incorporate the corrections received from SNL/NM for these isotopes (see Appendix D) after Appendix B-1 was finalized.

*This table is an update of Table 3-4, of TWBIR Revision 2, pages 3-30 through 3-36 (DOE, 1995c)

Table 3-1. WIPP DISPOSAL RADIONUCLIDE INVENTORY FOR THE CCA (continued)

Nuclide	CH-TRU Waste (Ci/m^3)	RH-TRU Waste (Ci/m^3)	CH-TRU Waste (Total Curies[2])	RH-TRU Waste (Total Curies[2])
Sb125	7.17E-07	2.67E-04	1.21E-01	1.89E+00
Sb126	8.02E-10	4.46E-09	1.35E-04	3.16E-05
Sb126m	5.73E-09	3.18E-08	9.65E-04	2.25E-04
Se79	2.58E-09	1.44E-08	4.35E-04	1.02E-04
Sm151	8.72E-06	5.05E-05	1.47E+00	3.57E-01
Sn119m	2.46E-11	1.35E-10	4.14E-06	9.59E-07
Sn121m	1.58E-07	9.45E-07	2.66E-02	6.69E-03
Sn126	5.73E-09	3.18E-08	9.65E-04	2.25E-04
Sr90	4.07E-02	2.95E+01	6.85E+03	2.09E+05
Ta182	NR	5.95E-12	NR	4.21E-08
Tc99	1.49E-04	8.26E-07	2.52E+01	5.85E-03
Te125m	1.75E-07	6.57E-05	2.95E-02	4.65E-01
Te127	7.72E-13	2.41E-13	1.30E-07	1.71E-09
Te127m	7.88E-13	2.47E-13	1.33E-07	1.75E-09
Th227	3.56E-06	1.06E-07	6.01E-01	7.47E-04
Th228	1.61E-04	1.04E-05	2.71E+01	7.36E-02
Th229	1.71E-05	1.66E-05	2.88E+00	1.17E-01
Th230	4.78E-07	1.07E-06	8.06E-02	7.56E-03
Th231	7.59E-05	6.53E-04	1.28E+01	4.63E+00
Th232	5.42E-06	1.31E-05	9.13E-01	9.25E-02

NR = Not reported by sites.
[1]Decayed to December 1995.
[2]Total curies estimated by assuming a volume of 168,500 cubic meters for CH-TRU waste and 7,080 cubic meters for RH-TRU waste.
[3]The values for Cf252 and Cm248 are different from the values reported in Attachment A in Appendix B-1 because these incorporate the corrections received from SNL/NM for these isotopes (see Appendix D) after Appendix B-1 was finalized.

* This table is an update of Table 3-4, of TWBIR Revision 2, pages 3-30 through 3-36 (DOE, 1995c)

Table 3-1. WIPP DISPOSAL RADIONUCLIDE INVENTORY FOR THE CCA (continued)

Nuclide	CH-TRU Waste (Ci/m^3)	RH-TRU Waste (Ci/m^3)	CH-TRU Waste (Total Curies[2])	RH-TRU Waste (Total Curies[2])
Th234	2.35E-04	1.48E-03	3.96E+01	1.05E+01
Tl207	3.61E-06	1.07E-07	6.07E-01	7.56E-04
Tl208	5.77E-05	3.74E-06	9.73E+00	2.65E-02
Tl209	3.69E-07	3.58E-07	6.22E-02	2.53E-03
U232	1.53E-04	NR	2.58E+01	NR
U233	1.06E-02	2.23E-02	1.79E+03	1.58E+02
U234	2.76E-03	6.03E-03	4.65E+02	4.27E+01
U235	7.59E-05	6.53E-04	1.28E+01	4.63E+00
U236	1.98E-06	1.37E-05	3.33E-01	9.68E-02
U237	3.36E-04	4.91E-04	5.66E+01	3.48E+00
U238	2.35E-04	1.48E-03	3.96E+01	1.05E+01
U240	8.91E-12	3.12E-15	1.50E-06	2.21E-11
Y90	4.07E-02	2.95E+01	6.85E+03	2.09E+05
Zr93	3.34E-08	1.86E-07	5.63E-03	1.32E-03
Zr95	6.80E-15	4.27E-05	1.15E-09	3.02E-01
TOTALS	**3.81E+01**	**1.43E+02**	**6.42E+06**	**1.02E+06**

NR = Not reported by sites.
[1]Decayed to December 1995.
[2]Total curies estimated by assuming a volume of 168,500 cubic meters for CH-TRU waste and 7,080 cubic meters for RH-TRU waste.
[3]The values for Cf252 and Cm248 are different from the values reported in Attachment A in Appendix B-1 because these incorporate the corrections received from SNL/NM for these isotopes (see Appendix D) after Appendix B-1 was finalized.

*This table is an update of Table 3-4, of TWBIR Revision 2, pages 3-30 through 3-36 (DOE, 1995c)

238 for the CH-TRU waste in the repository. This is primarily due to the exclusion of the SRS off-site waste from any future extrapolations. Since this off-site waste has a high concentration of Pu-238, excluding it from the extrapolations decreases the amount of Pu-238 in the projected portion of the inventory. It should be noted that this off-site waste is included in the stored waste portion of the disposal radionuclide inventory. The decrease in the Pu-238 also causes a decrease in the total estimated curies for CH-TRU waste in the repository.

Based on the data corrections from Hanford Site to the Cm-244 and Cm-245 inventories, the estimated concentration of Cm-244 has increased, while that of Cm-245 has decreased. Similarly, based on the correction to the reported value of Cf-252 from the Hanford Site, the revised concentration of Cf-252 has decreased significantly from the values estimated in Revision 2 of the TWBIR. The effect of decaying the activity from the RFETS residues has resulted in a minor decrease in the estimated concentration of Pu-241. Since Pu-241 decays to Am-241, the decrease in the Pu-241 concentration is also accompanied by a corresponding increase in the concentration of Am-241.

The major change for the RH-TRU waste from TWBIR Revision 2 is the decrease in the estimated concentration of U-235 and an increase in the concentration of U-238. Both are a result of the preliminary sludge sampling data from ORNL mentioned earlier.

3.2.2 Activity Calculations for Waste Streams

As documented in the SNL/NM memoranda in Appendices A-2 and A-3, data on radionuclide activity on a waste stream basis was requested for 21 radionuclides. However, the request was subsequently limited to seven radionuclides by SNL/NM WIPP PA staff (Am-241, Cm-244, Pu-238, Pu-239, Pu-240, Pu-241, and U-234). Appendix B-2 presents the results provided to SNL/NM by DOE/CAO in response to this data request.

Since many sites did not have the ability to provide radionuclide data on a detailed waste stream basis for every waste stream in TWBIR Revision 2, the radionuclide activities for many individual waste streams (especially for projected waste) were not reported by the sites for TWBIR Revision 2. Therefore, the radionuclide activity data for the WIPP disposal inventory cannot be directly obtained on a waste stream basis by running queries on the TWBIR Revision 2 database. Due to the unavailability of detailed radionuclide data on a waste stream basis for many waste streams, the WIPP disposal radionuclide inventory presented in all revisions of the TWBIR has always been developed on the basis of the site-level radionuclide inventories reported by the sites in the IDB.

For the sake of consistency with the revised WIPP disposal radionuclide inventory in Attachment A of Appendix B-1 (which is also based on the site-level IDB data), assumptions were required in order to estimate the waste stream radionuclide activities presented in Appendix B-2. These assumptions can be found in Appendix B-2 and are not reproduced here. Thus, it should be noted that the data in Appendix B-2 are *derived* on the basis of assumptions and not directly obtainable from the TWBIR Revision 2 database. Because of the unavailability of the radionuclide data on a waste stream basis, some of the waste streams from small sites are not included in the activity table in Appendix B-2. Efforts are currently underway to ensure that the sites will be able to provide radionuclide data on a waste stream basis for most waste streams in future updates of the TWBIR so that radionuclide activity data for the WIPP disposal inventory can be directly obtained from the TWBIR database.

3.3 SUPPLEMENTAL INFORMATION FOR OTHER CONSTITUENTS

SNL/NM and DOE/CAO requested supplemental information on several constituents in TRU waste (see Appendix A-1) that were not able to be estimated based on the information reported by the TRU waste sites in Revision 2 of the TWBIR (DOE, 1995c). The information requested can be divided into three general categories which were requested on solidified waste forms destined for disposal in WIPP:

- Complexing Agents
- Nitrate, Sulfate, and Phosphate
- Cement

The TWBIR team worked with those major sites that generate/store most of the solidified waste forms: Los Alamos National Laboratory (LANL), RFETS/INEL, and ORNL. A summary of the results of these supplemental information requests is provided in Section 3.3.1, 3.3.2 and 3.3.3 and the memoranda reporting the data are located in Appendices B-3 through B-7. The detailed methodology for calculating the estimates of these physical/chemical constituents are provided in each memorandum in these Appendices.

3.3.1 Estimate of Complexing Agents in Transuranic Solidified Waste Forms Scheduled for Disposal in WIPP

The information on complexing agents in the waste was provided in a series of three memoranda to DOE/CAO. The initial memorandum, entitled "Preliminary Estimate of Complexing Agents in TRU Waste Forms Scheduled for Disposal in WIPP," provided in Appendix B-3, represents the earliest estimate of complexing agents in the TRU Waste. The Appendix B-3 memorandum was superseded by the second estimate, entitled "Current Estimate of Complexing Agents in Transuranic Solidified Waste Forms Scheduled for Disposal in WIPP," provided in Appendix B-4. After the Appendix B-4 memorandum was issued, preliminary information from the January 1996 data submittal from INEL was received. The data submittal indicated that over 90% of the stored waste at INEL would be vitrified, a process that should destroy complexing agents in TRU waste. Based on the preliminary data from INEL, the estimated amount of complexing agents due to RFETS waste stored at INEL could be reduced from that reported in Appendix B-4. A synopsis of the INEL information is reported in the third memorandum that estimates complexing agents in the waste, entitled "Revision of Current Estimate of Complexing Agents in Transuranic Solidified Waste Forms Scheduled for Disposal in WIPP," provided in Appendix B-5.

Table 3-2 provides a summary of the anticipated mass (in kilograms) of complexing agents in TRU waste reported by RFETS/INEL, LANL, and Hanford. The estimates in Table 3-2 include the anticipated reduction in mass of complexing agents reported from RFETS/INEL based on the preliminary data for proposed vitrification of waste at INEL (Appendix B-5). In addition to the mass of complexing agents reported in Table 3-2, ORNL has provided an estimate of total organic carbon (TOC) in their RH-TRU sludges (Table 3-3). ORNL does not have any analytical data to quantitatively estimate which organic chemicals are responsible for the TOC content of the sludges. However, ORNL has provided a list of chemicals, summarized in Table 3-3, that could contribute to the TOC value reported (see Table 1 in Appendix B-4). It is estimated that most of the TOC in the tanks is not associated with complexing agents, but that has not been verified at this time. As a conservatism, PA calculations can assume that any complexing agents listed in Table 3-3 could form the bulk of the TOC in the ORNL RH-TRU tanks.

Table 3-2. Estimates of Complexing Agents in Transuranic Waste from RFETS, INEL, LANL, and Hanford*

Compound	Low Estimate (kg)	Recommended Estimate (kg)	High Estimate (kg)
Ascorbic Acid	18	30	34
Acetic Acid	27	44	50
Sodium Acetate	141	282	333
Citric Acid	1110	1120	1130
Sodium Citrate	51	102	120
Oxalic Acid	13700	13700	13700
EDTA	3	6	7
8-Hydroxyquinoline	6	12	14
Tributyl Phosphate	102	111	115
1,10 Phenanthroline	0.03	0.06	0.07
Dihexyl-n,n-diethyl carbamoylmethyl phosphonate	9	18	22

* Refer to Appendices B-4 and B-5 for methodology of calculated estimates.

Table 3-3. Estimate of Total Organic Carbon (TOC) in ORNL Transuranic Sludge Tanks and Possible Complexing Agents that can Contribute to TOC.

Total Organic Carbon in ORNL Transuranic Sludge = 3691 kg

Possible Complexing Agents and Other Organic Compounds* in ORNL RH-TRU Sludges:

Acetic Acid
Acetone
Adogen-364-HP (–triluarylamine)
Carbon tetrachloride
Deodorized mineral spirits (Amsco)
2,5-di-tert-butylhydroquinone (DBHQ)
Diethylbenzene (DEB)
Diethylenetriaminepentaacetic acid (DPTA)
Di (2-ethylhexyl) phosphoric acid (HDEHP)
Di-isopropylbenzene (DIPB)
Ethanol
Ether
Ethylenediaminetetraacetic acid (EDTA)
2-ethyl-1-hexanol
α-hydroxyisobutyric acid
Isopropanol
Methanol
n-dodecane
n-paraffin (NPH)
Oxalic Acid
Thenoyltrifluoroacetone (TTA)
Tributylphosphate (TBP)
Trichloroethylene (TCE)
Xylene

*Adapted from Table 1 in Appendix B-4.

3.3.2 Estimate of Nitrate, Sulfate, and Phosphate Content in Transuranic Solidified Wastes for Disposal in WIPP

Estimates of nitrate and sulfate in solidified TRU final waste forms were provided in the memorandum entitled "Preliminary Estimate for SNL/NM Performance Assessment Calculations of Nitrate, Sulfate, and Phosphate in Transuranic Solidified Wastes Destined for Disposal in WIPP," provided in Appendix B-6. In that memorandum, it is estimated that densities for the overall disposal inventory are as follows: 9.2 kilograms/cubic meter for nitrate and 3.6 kilograms/cubic meter for sulfate. No estimate of phosphate was reported due to lack of sufficient information.

3.3.3 Estimate of Cement in TRU Solidified Waste Forms for Disposal in WIPP

An estimate of cement (portland-based) in solidified TRU final waste forms was calculated in the memorandum entitled "Estimate of Cement Content in TRU Solidified Waste Forms Scheduled for Disposal in WIPP," provided in Appendix B-7. The estimated density of cement over the entire disposal inventory is 48.6 kilogram/cubic meter. This estimate includes both CH-TRU and RH-TRU final waste forms. The portland cement reported is both reacted and unreacted cement in the waste. There are no data available to estimate the percentage of reacted versus unreacted cement in the waste.

4. REFERENCES

Croff, A. G., 1983, "ORIGEN2: A Versatile Computer Code for Calculating the Nuclide Compositions and Characteristics of Nuclear Materials," *Nuclear Technology*, Vol. 62, pp. 335-352, November 1983.

Croff, A. G., 1980, *A User's Manual for the ORIGEN2 Code*, ORNL/TM-7175, Oak Ridge National Laboratory, July 1980.

DOE – See U.S. Department of Energy.

EPA – See U.S. Environmental Protection Agency.

SNL/NM – See Sandia National Laboratory/NM.

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5. GLOSSARY

40 CFR Part 191, Protection of Environment. EPA: Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes – The EPA's environmental standards for the storage (Subpart A) and disposal (Subpart B) of spent nuclear fuel, and high-level and TRU radioactive wastes. This is the primary post-closure standard that applies to WIPP.

Anticipated Inventory – The sum of the stored and projected inventories, as defined in this document.

As-Generated Waste – The chemical and physical status of waste when it is generated.

Buried Waste – TRU waste buried in shallow trenches prior to the 1970 Atomic Energy Commission policy that required TRU waste to be retrievably stored.

Code of Federal Regulations (CFR) – (1) A codification of the general and permanent rules published in the **Federal Register** by the department and agencies of the federal government. The CFR is divided into 50 titles that represent broad areas subject to federal regulation. It is issued quarterly and revised annually. (2) All federal regulations in force are published annually in codified form in the CFR.

Contact-Handled (CH) TRU Waste – Packaged TRU wastes with an external surface dose rate of less than 200 mrem per hour.

Defense Waste – (1) Radioactive waste from any activity performed in whole or in part in support of DOE atomic energy defense activities; excludes waste under purview of the Nuclear Regulatory Commission or generated by the commercial nuclear power industry. (2) Nuclear waste derived mostly from the manufacture of nuclear weapons, weapons-related research programs, the operation of naval reactors, and the decontamination of nuclear weapons production facilities.

Department of Energy Site – A DOE-owned or -controlled tract used for DOE operations. Either a tract owned by DOE or a tract leased or otherwise made available to the federal government under terms that afford to DOE rights of access and control substantially equal to those that DOE would possess if it were the holder of the fee (or pertinent interest therein) as agent of and on behalf of the government. One or more DOE operations/program activities are carried out within the boundaries of the described tract.

Disposal – Emplacement of waste in a manner that assures isolation from the biosphere for the foreseeable future with no intent of retrieval and that requires deliberate action to regain access to the waste. For example, disposal of wastes in a mined geologic repository occurs when all of the shafts to the repository area are backfilled and sealed.

Disposal Inventory – The inventory volume defined for WIPP emplacement to be used for PA calculations is the "disposal inventory." The LWA defines the total amount of TRU waste allowed in the WIPP as 6,200,000 cubic feet (approximately 176,000 cubic meters) (Public Law, 1992b). The "Agreement for Consultation and Cooperation" (C&C Agreement) limits the RH-TRU inventory to 250,000 cubic feet (approximately 7,080 cubic meters) (DOE and State of New

Mexico, 1981). Therefore by difference, the CH-TRU inventory is limited to 5,950,000 cubic feet (approximately 168,500 cubic meters).

Final Waste Form – Consists of a series of WMCs that for PA purposes have similar physical and chemical properties.

Integrated Data Base (IDB) – The latest version of the IDB, the *Integrated Data Base for [1995]: U.S. Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics* (DOE, 1995b).

Land Withdrawal Act - The 1992 legislation passed by the U.S. Congress withdrawing the surface land and underlying minerals at the WIPP site from public use, transferring the property from the DOI to the DOE, and enabling the start of the WIPP Test Phase. The LWA sets prerequisites to be met before the start of the Test Phase, such as the repromulgation by EPA of 40 CFR 191 and the concurrence of EPA with the Test Phase Plan (Public Law, 1992b).

Mixed TRU Waste – TRU waste that contains both radioactive and hazardous components as defined by the Atomic Energy Act and the RCRA as codified in 40 CFR Parts 261.3 (EPA, 1980).

Newly Generated Wastes – See Projected Inventory.

Performance Assessment (PA) – (1) A systematic analysis of the potential risks posed by waste management systems to the public and environment and a comparison of those risks to established performance objectives. (2) An analysis that (a) identifies the processes and events that might affect the disposal system, (b) examines the effects of these processes and events on the performance of the disposal system, and (c) estimates the cumulative releases of radionuclides, considering the associated uncertainties, caused by all significant processes and events. These estimates shall be incorporated into an overall probability distribution of cumulative release to the extent practicable. (3) A term used to denote all activities (qualitative and quantitative) carried out to (a) determine the long-term ability of a site/facility to effectively isolate the waste and ensure the long-term health and safety of the public and (b) provide the basis for demonstrating regulatory compliance.

Projected Inventory – That part of the inventory that has not been generated but is estimated to be generated at some time in the future by the TRU waste generator/storage sites. The estimated timeframe may vary, but is usually between 20 and 30 years. "Newly generated waste" also is sometimes used as a synonym for the projected inventory.

Radioactive – Term used to refer to an unstable atomic nucleus that decays with the spontaneous emission of ionizing radiation (also see "radionuclide").

Radionuclide – (1) A species of atom having an unstable nucleus, that is subject to spontaneous decay or disintegration and usually accompanied by the emission of ionizing radiation. (2) Any nuclide that emits radiation. A nuclide is a species of atom characterized by the constitution of its nucleus and hence by the number of protons, the number of neutron, and the energy content.

Remote-Handled (RH) TRU Waste – Packaged TRU wastes with an external surface dose rate equal to or exceeding 200 mrem per hour.

Resource Conservation and Recovery Act (RCRA) – (1) Establishes a system for controlling hazardous waste from generation to disposal. (2) A Federal law passed in 1976, and amended under the HSWA of 1984, that established a structure to track and regulate hazardous wastes from the time of generation to disposal. The law requires safe and secure procedures to be used in treating, handling, transporting, storing, and disposing of hazardous substances. RCRA is designed to prevent new uncontrolled hazardous waste sites. The law also regulates the disposal of solid waste that may not be considered hazardous. (3) Specifically, Subtitle D of RCRA governs the management of solid waste. (Note: 40 CFR Parts 260-272 are the regulations for complying with RCRA with respect to hazardous waste and hazardous waste treatment, storage, and disposal facilities.)

Scaling – The process for adjusting the anticipated inventory to equal the maximum authorized disposal inventory of the WIPP repository for the purposes of WIPP performance assessment modeling.

Stored Inventory – That part of the TRU waste inventory currently in retrievable storage as of the time of the last data call for inventory information. Retrievably stored waste includes waste stored in buildings or in berms with earthen cover since 1970 and does not include any waste that was buried prior to 1970. Stored inventory can be in the "as-generated" form or "final waste form."

Transuranic – Pertaining to elements that have atomic numbers greater than 92, including neptunium, plutonium, americium, and curium; all are radioactive, are not naturally occurring, and are members of the actinide group.

Transuranic (TRU) Waste – (1) Waste containing alpha-emitting radionuclides with an atomic number greater than 92 and half-lives greater than 20 years, at concentrations of TRU isotopes greater than 100 nanocuries per gram of waste. **This core definition appears in modified form in various relevant documents as follows**: (a) For purposes of management, DOE Order 5820.2A: (i) considers TRU waste, as defined above, "without regard to source or form" *(The proposed revision to the Order [DOE Order 5820.2A Major Issues for Revision, May 6, 1992]* contemplates removing this clause); (ii) allows head of field elements to determine that wastes containing other alpha-emitting radionuclides must be managed as TRU waste; and (iii) adds "at time of assay," implying both that the classification of a waste as TRU waste is to be made based on an assay, and that such classification can be superseded only by another assay. (b) For purposes of setting standards for management and disposal, 40 CFR 191.02(i) adds "except for: (i) high-level wastes; (ii) wastes that the DOE has determined, with the concurrence of the EPA Administrator, do not need the degree of isolation required by this part; or (iii) wastes that the Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR 61." (2) Waste materials contaminated with U-233 (and its daughter products), with certain isotopes of plutonium, or with other nuclides with atomic numbers greater than 92. In order to be classified as TRU waste, the long-lived alpha activity from subject isotopes must exceed 100 nanocuries per gram of waste material independent of the level of beta-gamma activity. These wastes are produced primarily from reprocessing spent fuel and from the use of plutonium in the fabrication of nuclear weapons. (3) Wastes that are contaminated with radioactive elements heavier than uranium, thus the name trans-(or beyond) uranic.

Waste Acceptance Criteria (WAC) – The criteria used to determine if waste packages are acceptable. For the purposes of this document, WAC refers to WIPP WAC.

Waste Form – The physical form of the waste such as sludges, combustibles, metals, etc.

TRU Waste Sites – The 8 major DOE facilities and several smaller sites throughout the U.S. that generate and store TRU waste.

Waste Isolation Pilot Plant (WIPP) – (1) The project authorized under Section 213 of the DOE National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (Public Law, 1979) to demonstrate the safe and environmentally sound disposal of radioactive waste materials generated by atomic energy defense activities. (2) A research and development facility located near Carlsbad, New Mexico to be used to demonstrate a practical, long-term solution to a complex problem: the safe disposal in deep geologic repositories of TRU waste resulting from DOE activities.

Waste Material Parameter – A waste material that occurs in TRU waste that is an input parameter into one (or more) current PA model(s) or is required to adequately describe the waste form.

Waste Matrix Code (WMC) – A DOE-developed coding system for grouping waste streams that have similar matrix constituents, especially for treatment objectives. This coding system allows waste streams within the DOE TRU waste system that have similar physical and chemical waste form properties to be categorized together. WMCs also have been called "waste treatability codes" in other DOE documents. An example of a WMC for "heterogeneous waste" is 5400 (DOE, 1995a).

Waste Stream – A flow of waste materials with specific definable characteristics that remain the same throughout the life of the process generating the waste stream.

Waste Stream Profile – A description of a CH-TRU or RH-TRU waste stream destined for shipment to and disposal in WIPP, if authorized under permits and certifications by appropriate regulatory agencies for disposal in the WIPP repository. The waste stream profile is presented in tabular format and is intended to provide a summary of the important information about a particular waste stream.

WIPP Waste Profile – Represents a summary of TRU waste at all DOE TRU waste generator/storage sites that have an identical Final Waste Form.