**DEFENSE TRANSURANIC
WASTE PROGRAM**

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**CHARACTERISTICS OF
TRANSURANIC WASTE AT
DEPARTMENT OF ENERGY SITES**

May 1983

Rockwell International

**Energy Systems Group
Rocky Flats Plant**

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AT DEPARTMENT OF ENERGY SITES**

R. T. Jensen
F. J. Wilkinson III

Rockwell International
Energy Systems Group
Rocky Flats Plant
Golden, Colorado 80401

May 1983

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FOREWORD

Transuranic (TRU) waste as defined by the DOE is material that, without regard to source or form at the end of institutional control periods, is contaminated with alpha-emitting radionuclides of atomic number greater than 92 and has a half-life greater than 20 years and a concentration greater than 100 nanocuries per gram. However, the information in this report has been collected under the old definition that states that the waste need only be of long half-life and concentration greater than 10 nanocuries per gram alpha activity. The older definition also includes all TRU nuclides except ^{238}Pu and ^{241}Pu , and in addition, includes the ^{233}U isotope and its daughter products.

Before 1970, all TRU waste was buried in pits and trenches. In March of 1970, the U. S. Atomic Energy Commission (AEC), a predecessor of the DOE, instituted a policy requiring that waste known or suspected of containing significant quantities of TRU radionuclides be segregated from other types of radioactive waste. Such waste was to be packaged and stored so as to be retrievable, in containers free of external contamination, for a period of at least 20 years, pending the development of a suitable federal repository.² In 1973, 10 nanocuries per gram (nCi/g) of alpha activity was established as a threshold at which waste would be defined as TRU waste. In this report, waste that was packaged and set aside is referred to as "stored" waste. Waste that was buried prior to this period of segregation is called "buried" waste. Finally, waste that is currently being produced at DOE sites is called "newly generated" waste. This report is organized using those three categories.

To implement a long-term strategy for handling TRU waste, the DOE established a lead office for the Defense Transuranic Waste Program. It consists of the Albuquerque Operations Office (ALO) of the DOE which

manages the program, and Rockwell International - Rocky Flats Plant (RI-RFP), as the lead support contractor. The TRU waste inventories and projections in this study were compiled to provide data for planning and analysis activities of the lead office. Most of the data were obtained from waste management offices or data management centers at DOE sites.

CONTENTS

	<u>Page</u>
ACKNOWLEDGMENT.....	i
FOREWORD.....	ii
CONTENTS.....	iv
TABLES.....	vi
FIGURES.....	xi
QUICK LOCATOR GUIDE.....	xii
1. INTRODUCTION.....	1
2. CHARACTERISTICS OF NEWLY GENERATED TRU WASTE.....	7
2.1 Contact-Handled - Summary.....	7
2.1.1 Locations, Quantities, and Waste Forms.....	7
2.1.2 Activities that Generate TRU Waste.....	11
2.1.3 TRU Content.....	11
2.2 Review of the Major Sites that Generate Contact-Handled Waste.....	16
2.3 Remote-Handled - Summary.....	28
2.3.1 Locations, Quantities, and Waste Forms.....	28
2.4 Review of the Major Sites that Generate Remote-Handled Waste.....	32
3. CHARACTERISTICS OF STORED TRU WASTE.....	38
3.1 Contact-Handled - Summary.....	38
3.1.1 Locations, Quantities, and Waste Forms.....	38
3.1.2 Transuranic Content and Surface Dose Rate.....	42
3.2 Review of CH Waste Packages at Storage Sites.....	48
3.3 Remote-Handled - Summary.....	91
3.4 Review of the RH Waste Categories at Storage Sites.....	91

	<u>Page</u>
4. CHARACTERISTICS OF BURIED TRU WASTE.....	104
5. ADDITIONAL SOURCES OF TRU WASTE INFORMATION.....	110
5.1 Further Reports on Subjects Not Covered In This Document.....	110
5.2 Information Available at Individual Sites.....	111
REFERENCES.....	114
APPENDIX A.- Glossary of Abbreviations and Acronyms.....	118
APPENDIX B.- Examples of Tables Compiled from Computer.....	119
Data at INEL, Los Alamos, Hanford, and Savannah River	
APPENDIX C.- Storage Site Environmental Impact Reviews.....	144

TABLES

	<u>Page</u>
1.2 Major Classifications of TRU Waste.....	3
2.1 Projection of Contact Handled TRU Waste - Volumes and Waste Forms.....	10
2.4 Activities That Generate TRU Waste..... (Cubic Meters Per Year 1981-1985)	12
2.5 Forecast of Major TRU Isotopes Contained in Newly Generated Waste (Average Per Year).....	14
2.6 Typical Isotopic Composition of Weapon Plutonium/ Typical Isotopic Composition of Heat Source Plutonium.....	15
2.7 Forecast of Transuranic Waste Generation at Argonne National Laboratory - East (Contact-Handled).....	17
2.8 Forecast of Transuranic Waste Generation at Battelle-PNL (Contact handled).....	18
2.9 Forecast of Transuranic Waste Generation at Los Alamos National Laboratory (Contact-Handled).....	19
2.10 Forecast of Transuranic Waste Generation at Lawrence Livermore National Laboratory (Contact-Handled).....	20
2.11 Forecast of Transuranic Waste Generation at Mound Facility (Contact-Handled).....	21
2.12 Forecast of Transuranic Waste Generation at Oak Ridge National Laboratory (Contact-Handled).....	22
2.13 Forecast of Transuranic Waste Generation at Rocky Flats Plant (Contact-Handled).....	23
2.14 Forecast of Transuranic Waste Generation at Rockwell Hanford Operations (Contact-Handled).....	24
2.15 Forecast of Transuranic Waste Generation at Savannah River Plant and Laboratory (Contact-Handled).....	25
2.16 Forecast of Transuranic Waste Generation at Westinghouse Hanford Company (Contact-Handled).....	26

	<u>Page</u>
2.17 Forecast of Transuranic Waste Generation at Sites Generating Less Than 25 m ³ /yr (Contact-Handled).....	27
2.18 Projection of Remote Handled TRU Waste Volumes and Waste Forms.....	29
2.19 Forecast of Transuranic Waste Generation at Argonne National Laboratory - East (Remote-Handled).....	33
2.20 Forecast of Transuranic Waste Generation at Idaho National Engineering Laboratory (Remote-Handled).....	34
2.21 Forecast of Transuranic Waste Generation at Los Alamos National Laboratory (Remote-Handled).....	35
2.22 Forecast of Transuranic Waste Generation at Oak Ridge National Laboratory (Remote-Handled).....	36
2.23 Forecast of Transuranic Waste Generation at Westinghouse Hanford Company (Remote-Handled).....	37
3.1 Contact Handled Waste Forms at TRU Storage Sites (Vol.%)....	39
3.4 Effect of Container Volume on Waste Form Volume.....	43
3.5 Major TRU Radionuclide Content in Stored Wastes (To December 31, 1980).....	44
3.6 Estimated TRU Isotopes in Buried and Stored Waste.....	46
3.10 Contact-Handled Categories at TRU Waste Storage Sites (To December 31, 1980).....	51
3.11 Detailed Data on Contact-Handled TRU Waste Storage Categories -- Hanford/55-Gallon Drums.....	54
3.12 Detailed Data on Contact-Handled TRU Waste Storage Categories - Hanford/Non-Standard Drums.....	55
3.13 Detailed Data on Contact-Handled TRU Waste Storage Categories - Hanford/Plywood Boxes.....	56
3.14 Detailed Data on Contact-Handled TRU Waste Storage Categories - Hanford/Steel Boxes.....	57
3.15 Detailed Data on Contact-Handled TRU Waste Storage Categories - INEL/55-Gallon Drums.....	58
3.16 Content Data for 55-Gallon Drums at INEL.....	59

	<u>Page</u>
3.18 Detailed Data on Contact-Handled TRU Waste Storage Categories - INEL/30-Gallon Drums.....	61
3.18 Detailed Data on Contact-Handled TRU Waste Storage Categories - INEL/83-Gallon Drums.....	62
3.19 Detailed Data on Contact-Handled TRU Waste Storage Categories - INEL/Drums in Cargo Containers and Bins.....	63
3.20 Detailed Data on Contact-Handled TRU Waste Storage Categories - INEL/Non-Standard Drums.....	64
3.21 Detailed Data on Contact-Handled TRU Waste Storage Categories - INEL/Plywood Boxes (Standard).....	65
3.22 Content Data for INEL Standard Plywood Boxes.....	66
3.23 Detailed Data on Contact-Handled TRU Waste Storage Categories - INEL/Non-Standard Plywood Boxes.....	67
3.24 Detailed Data on Contact-Handled TRU Waste Storage Categories - INEL/Metal Bin.....	68
3.25 Content of INEL Metal Bins.....	69
3.26 Detailed Data on Contact-Handled TRU Waste Storage Categories - LANL/30-Gallon Drums.....	70
3.27 Content of LANL 30-Gallon Drums.....	71
3.28 Detailed Data on Contact-Handled TRU Waste Storage Categories - LANL/55-Gallon Drums.....	72
3.29 Content of LANL 55-Gallon Drums.....	73
3.30 Detailed Data on Contact-Handled TRU Waste Storage Categories - LANL/Corrugated Metal Pipe.....	74
3.31 Detailed Data on Contact-Handled TRU Waste Storage Categories - LANL/83-Gallon Drums.....	75
3.32 Detailed Data on Contact-Handled TRU Waste Storage Categories - LANL/Non-Standard Drums.....	76
3.33 Detailed Data on Contact-Handled TRU Waste Storage Categories - LANL/Plywood Boxes.....	77
3.34 Content of LANL FRP Boxes.....	78

	<u>Page</u>
3.35 Detailed Data on Contact-Handled TRU Waste Storage Categories - LANL/Concrete Cask.....	79
3.36 Content of LANL Concrete Casks.....	80
3.37 Detailed Data on Contact-Handled TRU Waste Storage Categories - NTS/55-Gallon Drums.....	81
3.38 Detailed Data on Contact-Handled TRU Waste Storage Categories - NTS/Steel Boxes.....	82
3.39 Detailed Data on Contact-Handled TRU Waste Storage Categories - ORNL/30-Gallon Drums.....	83
3.40 Detailed Data on Contact-Handled TRU Waste Storage Categories - ORNL/55-Gallon Drums.....	84
3.41 Detailed Data on Contact-Handled TRU Waste Storage Categories - ORNL/Non-Standard Drums.....	85
3.42 Detailed Data on Contact-Handled TRU Waste Storage Categories - SRP/55-Gallon Drums.....	86
3.43 Detailed Data on Contact-Handled TRU Waste Storage Categories - SRP/Steel Boxes.....	87
3.44 Detailed Data on Contact-Handled TRU Waste Storage Categories - SRP/Cement Boxes.....	88
3.45 Detailed Data on Contact-Handled TRU Waste Storage Categories - SRP/Non-Standard Concrete Boxes.....	89
3.46 Detailed Data on Contact-Handled TRU Waste Storage Categories - SRP/Concrete Culverts.....	90
3.47 Reported Inventories of Remote-Handled Transuranic Waste to Dec. 31, 1980.....	92
3.48 Major TRU Radionuclide Content in Remote-Handled Waste (To December 31, 1980).....	93
3.49 Remote-Handled Waste Categories at TRU Waste Storage Sites (To December 31, 1980).....	94
3.50 Detailed Data on Remote TRU Waste Storage Categories - Hanford/Paint Cans.....	96

	<u>Page</u>
3.51 Detailed Data on Remote TRU Waste Storage Categories - Hanford/Railroad Flat Cars.....	97
3.52 Detailed Data on Remote TRU Waste Storage Categories - Hanford/Non-Standard Casks.....	98
3.53 Detailed Data on Remote TRU Waste Storage Categories - INEL/30-Gallon Drums (Remote-Handled).....	99
3.54 Detailed Data on Remote TRU Waste Storage Categories - INEL/Steel Inserts.....	100
3.55 Detailed Data on Remote TRU Waste Storage Categories - LANL/Concrete Cylinders.....	101
3.56 Detailed Data on Remote TRU Waste Storage Categories - ORNL/Concrete Casks.....	102
3.57 Detailed Data on Remote TRU Waste Storage Categories - ORNL/Stainless Steel Capsules.....	103
4.1 Estimated Amounts of Buried TRU Waste.....	106
4.2 Buried Waste Categories at DOE Storage Sites.....	107
4.3 Summary of Containers of Solid Wastes Shipped From Rocky Flats Plant to the INEL Storage Site, 1954 to 1970)...	108
4.4 Significant Dates and Events Affecting Buried Wastes.....	109
5.1 Description of Site Automated Data Systems.....	112

FIGURES

	<u>Page</u>
1.1 Locations of DOE Facilities That Generate and/or Store Defense TRU Wastes.....	2
1.3 Buried and Stored TRU Waste at Department of Energy Sites (To December 31, 1980).....	4
2.2 Forecast of TRU Generation Rate at Department of Energy Sites From 1982-1990 (Contact Handled).....	9
2.3 Forecast of Contact Handled Waste Forms and Containers.....	10
2.19 Remote-Handled Transuranic Waste Projections (1981-1990).....	30
2.20 Forecast of Remote-Handled Waste Forms and Waste Containers (1981-1985).....,.....	31
3.2 Contact Handled Waste Forms and Waste Containers in Storage to December 31, 1980.....	40
3.3 Current and Projected Inventories of Stored TRU Waste at DOE Sites.....	41
3.7 Histogram of Pu Content in Drums Stored at Idaho from 9-1-71 to 12-31-77.....	49
3.8 Histogram of Pu Content in Boxes Stored at Idaho from 9-1-71 to 12-31-77.....	49
3.9 Histogram of Weapon and Heat Source Plutonium Content in 55-Gallon Drums Produced by Savannah River from 7-1-74 to 6-31-77.....	50

For ease in reading this report, the numbering scheme for tables and figures has been combined.

QUICK LOCATER GUIDE

	ALL SITES TOTAL PAGE NO.	ANL E	HANFORD	INEL	LANL	LLNL	MOUND	NTS	ORNL	RFP	SRP	OTHER SITES
<u>Newly Generated</u>												
CH Projections												
Volume TRU Waste, Average	3	9	9		9		9			9	9	9
Percent Volume, by Site	8	8,17	8,18,24,26	8	8,19	8,20	8,21		8,22	8,23	8,25	8,27
Volume, by Year	10	8,17	8,18,24,26	8	8,19	8,20	8,21		8,22	8,23	8,25	8,27
Waste Forms, by Percent Volume	12	12	12		12		12		12	12	12	
Volume, by Generating Activity		17	18,24,26	19	20	21		22	23	25	25	27
Volume, Average, by Location/Building/Operation	10											
Fraction of Total Volume, by Container Type	9	17	18,24,26		19	20	21		22	23	25	27
Total Weight, by Year	14	14			14	14	14		14	14	14	14
Mass of Plutonium, by Year		17	18,24,26		19	20	21		22	23	25	27
Activity of Major TRU Elements, by Isotope (Average per Year)	16	16	16		16	16	16		16	16	16	16
Activity of Plutonium, by Year		17	18,24,26		19	20	21		22	23	25	27
RH Projections												
Volume TRU Waste, Average	3	29	29	29	29				29			29
Fraction of Total Volume, by Site		30	30	30	30				30			30
Volume, by Year	30	33	34	35	35				36			
Fraction of Total Volume, by Type	31	33	34	35	35				36			
Volume, Average, by Location/Building/Operation		33	34	35	35				36			
Fraction of Total Volume, by Container Type	31											
Weight, by Year	30	33	34	35	35				36			
Mass of Plutonium, by Year		33	34	35	35				36			
Activity of Plutonium, by Year		33	34	35	35				36			
Mass of TRU Elements, by Year									36			
Activity of TRU Elements, by Year									36			
<u>Stored</u>												
CH												
Volume of TRU Waste in Storage	3,53		4,41,51	4 41,51	4,41,52			4,41,52	4,41,52		4,41,53	
Volume, by Content Code				59-60,66	71,73,78							
				69,120-126	80,128-134							
Percent Volume, by Waste Form	43		39	39	39			39	39		39	
Total Volume, by Container Type	58		51,54-57	51,58,	52,70,72			52,81-82	52,83-85		53,86-90	
				61-65,	74-77,79							
				67-68								
Fraction of Volume, by Container Type	40			59-60,66,	71,73,78							
Weight, by Content Code				69,120-126	80,128-134							
Mass of TRU Elements, by Isotope	44		44	44	44			44	44		44	
Isotopic Composition, by Percent Weight			46	46	47			46	47		47	
Mass of Plutonium, by Content Code				59-60,66,	71,73,78							
				69,120-126	80,128-134							
Mass of Americium, by Content Code				59-60,66,	71,73,78							
				69,120-126	80,128-134							
Mass of Plutonium per Drum/Box				49							50	
Activity of TRU Elements, by Isotope	44		44	44	44			44	44		44	
Containers, Number of, by Container Type	53		51,54-57	51,58,	52,70,72			52,81-82	52,83-85		53,86-90	
				61-65,	74-77,79							
				67-68								
Number of Containers, by Content Code				120-126	128-134							

[illegible]

Figure 1.1. Locations of DOE Facilities That Generate and/or Store Defense TRU Wastes

Table 1.2. Major Classifications of TRU Waste

Category	Amount (m ³)	Comment
<u>Newly-Generated TRU Waste</u>	<u>Average Generation per year (1981-90)</u>	Newly generated refers to TRU waste that is in process, or that is currently being generated. Contact handled generally refers to waste that is less than 200 mR/hr at the surface. Remote handled refers to TRU waste that must be handled remotely due to the levels of penetrating radiation given off.
Contact-Handled	4858	
Remote-Handled	<u>87</u>	
TOTAL	4945	
	<u>Total in Storage to Dec. 31, 1980</u>	
<u>Stored TRU Waste</u>		Stored waste refers to TRU waste that has been segregated from other radioactive waste when it was suspected or known to contain significant quantities of TRU radionuclides.
Contact-Handled	60,064	
Remote-Handled	<u>1,819</u>	
TOTAL	61,883	
	<u>Total Buried to Dec. 31, 1980</u>	
<u>Buried TRU Waste</u>		Buried waste is TRU waste that has been buried in pits and trenches. It can also refer to underground material that has become contaminated with TRU radionuclides. May not be segregated from wastes which are less than 10 nCi/g.
Buried Waste	298,933	
Contaminated Soil	<u>131,500 to 2,595,000</u>	
TOTAL	430,433 to 2,893,933	

Figure 1.3
 BURIED AND STORED TRU WASTE
 AT DEPARTMENT OF ENERGY SITES
 (To December 31, 1980)

the waste. These tables include the three most common TRU isotopes and present typical compositions of the two common types of plutonium.

After the summary tables, a series of charts detail similar information for ten individual sites. The contact-handled waste is covered first, followed by a summary and details on remote-handled waste. Five sites are included on remote-handled waste. These tables show where TRU waste is generated at each site, and the activity that generates it.

Section 3 contains data on Stored Waste. As in Section 2, summary tables are given first. The tables show the locations, quantities, and waste forms for six storage sites. Figures are included which indicate total percentages of waste forms and waste containers. A discussion of the contribution of the actual contents versus the volume of the containers is included. Total isotopes at the six sites, as well as the estimated isotopes in particular types of waste, are given.

A detailed review of each site follows the summary tables. The review is separated by contact- and remote-handled waste. Each part of this review begins with a summary table showing the number and kinds of containers used to store the waste. Following the summary table, each type of container is detailed for all six sites. A description of the container is followed by data on the placement, inside configuration, and all available data on the contents of each container. The TRU activity present and the radiation level are given for some. Data on the radionuclides and radiation level are often available in more detail from the site.

Section 4 presents all of the available data on Buried Wastes. Very few records have been kept on Buried Waste. The data consist primarily of estimates of the total waste and the resulting contaminated soil. A limited amount of data were obtained on the types of containers and contents.

ORNL and SRP both have a record of the number of concrete monoliths that were buried. These are presented along with the total number of cubic meters of boxes, drums, and other miscellaneous containers at the other sites. A table showing the amount and types of containers that Rocky Flats shipped to Idaho from 1954 to 1970 is also presented. This gives an indication of the types of burial that were practiced throughout all AEC sites. Finally, a chronological table of events affecting Buried Waste is included.

The final section, Section 5, was included to provide readers with a sample of other kinds of data that are available. Information is given on data at the various sites, as well as other studies which have been conducted.

Throughout this report two kinds of notation were used when data could not be found for a particular table. Each notation implies a separate reason for the lack of data. The symbol N/A means "not available," and implies that a record was not kept and further research would probably not result in more data. The symbol N/R is used to mean "not reported." This implies that the data are possibly available, but due to lack of time to research the data, they were not included.

2. CHARACTERISTICS OF NEWLY GENERATED TRU WASTE

2.1 Contact-Handled - Summary

2.1.1 Locations, Quantities, and Waste Forms

The DOE sites where contact-handled TRU waste will be generated for the next 10 years are listed in Table 2.1 and shown in Figure 2.2. These data were compiled from the tables found in Section 1.2 of this report. As in any forecast, the volumes listed cannot be completely accurate. Generally, the forecasts are based upon recent trends with allowances for new projects or the phasing out of old ones. In the next 5 years, the RFP, and the LANL, expect to reduce some kinds of waste generation. Increases in other waste streams, however, will result in a slight increase in the overall amount of TRU waste. Increases are also expected at the Hanford site. These increases will result from the Fast Flux Test Facility (FFTF) activities, additional D&D projects, and the startup of the reprocessing facility on the Hanford site. The Mound Facility generation rate will increase and then decrease as D&D projects are completed. Figure 2.2 shows the relative contributions of the major sites, and the total volume and weight of the expected generation. The differences are within the expected deviations, and overall, the rate will be about 4,900 m³ per year. A slight decrease is seen for the years 1986-1990. However, this is probably due to uncertainty in forecasting, rather than a real decrease.

Table 2.1 also shows the expected waste forms. These percentages are based upon the most recent year-of-operation data available. As seen, the data are somewhat incomplete because records are not readily available at some sites. Many records distinguish only between combustible and noncombustible. By going to the production facilities, or old burial records, some data were obtained. These percentages are not expected to remain constant. Many activities are currently underway which will reduce the amount of combustibles. Also, the amount of

Table 2.1 Projection of Contact Handled TRU Waste - Volumes and Waste Forms

Sites	Volume, m ³						Volume %							Ref
	1981	1982	1983	1984	1985	Avg/yr 1986-90	Combustibles	Glass and Metal	Filter and Filter Media	Absorbed Liquids, Dried Salts (Sludge)	Dirt Ground or Asphalt	Concrete and Cemented Waste	Other	
Argonne-East	270	180	60	60	60	60	42%	34%	a	3%	<1%	0%	21%	4,5
Argonne-West	.6	.6	.8	.8	.8	.8	50%	*	*	*	0%	0%	50%	5
Battelle-Columbus	50	204	0	0	0	0	20%	*	*	*	*	*	80%	5
Battelle-Pacific NW Lab	955	37	28	34	31	34	38%	35%	*	<1%	0%	0%	27%	6,8
Bettis	25.6	27	11	15.1	15.1	10	38%	*	*	*	*	*	62%	5
Hanford-(Offsite)	232	580	297	245	269	269	*	*	*	*	*	*	*	7
ICPP	44	2	2	2	2	2	50%	50%	0%	0%	0%	0%	0%	5
INEL Test Reactor Area	.4	.4	.4	.4	.4	.4	*	*	*	*	*	*	*	5
LANL	850	730	540	560	580	598	33%	25%	2%	7%	3%	10%	20%	9,10
LLNL	24.8	25	25	25	25	25	27%	65%	*	*	0%	8%	0%	1
Lovelace	2	2	2	2	2	2	*	*	*	*	*	*	*	1
Mound Facility	530	885	780	780	780	420	7%	65%	<1%	8%	0%	20%	<1%	11
ORNL	29.4	30	30	30	30	30	60%	15%	b	b	0%	0%	25%	12
RHO	808	220	376	410	651	560	59%	27%	*	<1%	*	*	14%	6,8
RI-RFP	1650	1650	1790	2050	1890	1820	39%	25%	11%	9%	3%	7%	6%	3
Sandia	1	1	1	1	1	1	*	*	*	*	*	*	*	1
SRP	370	445	468	515	552	580	82%	17%	a	0%	0%	0%	1%	13,14
United Nuclear Company	0	6	6	6	6	6	0%	0%	100%	0%	0%	0%	0%	6,8
Westinghouse Hanford Co.	38	506	331	76	142	141	43%	23%	a	18%	0%	0%	13%	6,8
Total	5881	5531	4748	4812	5037	4559								

* Not available

a Included in combustibles.

b Included in "other" category.

Figure 2.2

FORECAST OF TRU GENERATION RATE AT DEPARTMENT OF ENERGY SITES FROM 1982-1990 (Contact Handled)

Figure 2.3
FORECAST OF CONTACT HANDLED WASTE FORMS
AND CONTAINERS (1981-1985)

* PLYWOOD UNTIL 1983 - METAL THEREAFTER

concrete or cemented waste is expected to increase. This will result from process changes being used to stabilize process wastes for storage in the WIPP. More D&D projects will add to the percentage of metal. Figure 2.3 shows the estimated percentage of each waste form for the total DOE complex. It also shows the present percentages of containers used to store the waste. The type of containers had changed somewhat during the past 10 years, but have become standard in recent years. Some additional changes will now be made for shipping to the Waste Isolation Pilot Plant (WIPP).

2.1.2 Activities That Generate TRU Waste

Table 2.4 shows the activities that generate TRU waste. TRU waste comes from three major processes. The largest source is production lines at RFP, the LANL, and RHO. Nearly one-half of all TRU waste comes from weapons components manufacture at Rocky Flats and subsequent plutonium recovery at the three sites. This does not include D&D waste that results from those activities.³ The second largest source of TRU waste comes from D&D projects. They account for one-fourth of all TRU waste. As the Mound Facility phases out their recovery and encapsulating work, they will generate 40 percent of all D&D wastes. At most sites the amount of D&D wastes will continue to increase. As the percentage of D&D waste increases, and reductions are made in the amount of production waste, the D&D waste will become the largest source of TRU waste. Finally, about 20 percent of TRU wastes will come from laboratory activities.³ These wastes are the most difficult to characterize. Nearly all of the exotic TRU isotopes arise from these activities. The category also includes all wastes that must be shielded due to penetrating radiation [greater than 200 millirem per hour (mr/hr) at the surface of the container].

2.1.3 TRU Content

TRU content is determined by the process which generates the waste. Generally, waste from a given process will not be mixed with

Table 2.4 Activities That Generate TRU Waste³
(Cubic Meters Per Year 1981-1985)

<u>Major Sites</u>	<u>Production</u>				<u>Laboratory</u>		<u>D&D</u>	<u>Total</u>
	<u>Foundry & Fabrication</u>	<u>²³⁹Pu Recovery</u>	<u>Pu Reprocessing</u>	<u>Heat Source Work</u>	<u>Analytical Labs</u>	<u>R&D Labs</u>		
Argonne - East	0	0	0	0	<1	70	20	90
Hanford	0	310*	30*	0	N/A	150*	540	1030
LANL	160	320	0	40	N/A	80*	60	660
Mound	0	0	0	0	170	70	520	760
Rocky Flats	580	870	0	0	130	120	140	1840
ORNL	0	0	0	0	N/A	60*	0	60
Savannah River	0	0	130	80	50	40	60	360
TOTAL	740	1500	160	120	350	590	1340	4800

*Includes Analytical Lab Waste.

N/A - Not Available.

waste from another process. At the present time, two major processes account for most of the TRU content in the wastes.

First, the fabrication of nuclear weapons generates waste which has large amounts of ^{239}Pu . Second, the generation of heat source plutonium results in waste containing ^{238}Pu . Other processes generate TRU isotopes such as ^{244}Cm , ^{252}Cf , and ^{233}U , but they are small when compared to the quantities of ^{239}Pu and ^{238}Pu . A significant amount of ^{241}Am also results from the recovery and purification of ^{238}Pu in the weapons program at RFP. It should be noted that these statements pertain to the weight percent of the nuclides. If the activity (in curies) is measured, ^{241}Pu becomes the largest fraction in the waste stream. This is shown when the isotopic compositions are presented.

Table 2.5 shows a forecast of the three major TRU isotopes found in the wastes. Table 2.6 shows the typical composition of the weapons grade and heat source plutonium.¹⁵ Small differences may exist at individual sites. The forecast in Table 2.5 was tabulated from the data on individual sites in Section 2.2. It does not include isotopes from remote-handled waste. Slight variations can occur in comparing similar data, depending on the specific activity and isotopic compositions and in calculating the total activity present.

Further data are presented on the isotopic composition at individual storage sites in a later section. Storage data also include specific quantities of many of the TRU nuclides found in the waste. Because many of these isotopes are generated sporadically, however, it was not feasible to make projections on each isotope.

Table 2.5 Forecast of Major TRU Isotopes Contained in Newly Generated Waste
(Average Per Year)

Major Sites	Heat Source Plutonium (Pu-238*)		Weapons Plutonium (Pu-239*)		Am-241		Total	
	g	curies	g	curies	g	curies	g	curies
Argonne - East	None		1040	440**	145	470	1185	910
Battelle - PNL	None		105	50**	N/R		105	50
Bettis - APL	N/R		N/R	N/R	N/R		N/R	N/R
Hanford (offsite)	N/R		N/R	N/R	N/R		N/R	N/R
Los Alamos	500	7350	3420	1450	300	1020	4220	9820
Lawrence Livermore	<1	<1	350	20	9	30	359	50
Mound	304	5200	None		None		304	5200
Oak Ridge	None		7	<10**	5	20	12	20
Rockwell Hanford	None		14150	6000**	1	<10	14151	6000
Rockwell RFP	None		18749	8040	428	1390	19177	9430
Savannah River	2264	36230	627	270	None		2891	36500
Westinghouse Hanford	None		1919	810**	N/R		1919	810
TOTAL	3068	48780	40367	17080	888	2930	44323	68790

All activities reported here are rounded.

* Includes other plutonium isotopes (see Table 2.6).

** Calculated, assuming weapons grade Pu-239, specific activity = 0.424 Ci/g.² Gram amounts are as reported by the site.

N/A Not Available

N/R Not Reported

ERRATA

Page 14 In Table 2.5 Los Alamos Weapons Plutonium (Pu-239*) should read 34,200 grams and 14,500 curies. Consequently, the site total should be changed to 35,000 grams and 22,870 curies. All sites total should read 75,103 grams and 81,840 curies.

TABLE 2.6

Typical Isotopic Composition of Weapon Plutonium

<u>Isotope</u>	<u>Weight Fraction</u>	<u>Ci/g Pu</u>
^{238}Pu	0.0003	0.005
^{239}Pu	0.939	0.058
^{240}Pu	0.057	0.014
^{241}Pu	0.003	0.347
^{242}Pu	0.0003	0
^{241}Am	0.0002	0.0006
Total		0.424

Typical Isotopic Composition of Heat Source Plutonium

<u>Isotope</u>	<u>Weight Fraction</u>	<u>Ci/g Pu</u>
^{238}Pu	0.802	13.95
^{239}Pu	0.159	0.01
^{240}Pu	0.0302	0.007
^{241}Pu	0.0064	0.72
^{242}Pu	0.0013	0
Total		14.7

2.2 Review of the Major Sites that Generate Contact-Handled Waste

Tables 2.7 through 2.16 present the exact locations and sources of TRU waste generation. Sites that currently generate 25 m³ or more per year are included. A summary table (Table 2.17) shows sites that generate less than 25 m³. Each table shows the forecast volume, weight, and plutonium content of the waste. Also included are the facilities that generate the waste, and what percentage each operation contributes to the site total. Finally, a pie chart in the right-hand corner shows the expected volume percent of the various waste forms. These data are expected to remain consistent for at least the next 5 years.

Table 2.7 Forecast of Transuranic Waste Generation at Argonne National Laboratory - East^{4,5}
(Contact-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	270	180	60	60	60	60
Weight*, kg x 10 ³	81	54	18	18	18	18
Pu content						
g	1,040	500	500	500	500	500
curies**	441	212	212	212	212	212

* Based on estimated density of 300 kg/m³, from data on shipments to INEL.

** Assumes Weapons plutonium (.424 Ci/gm).

17

Sources				Composition
Location	Function	m ³ /yr	Vol. %	Volume %
202	Biological & Medical Research	.65	.5%	COMBUSTIBLES 42.0
205	Chemical Research Engineering	18.2	14%	
200	Chemical Research	23.4	18%	
212	Materials Science	36.4	28%	
208	Reactor Analysis Safety	.39	.3%	ABSORBED LIQ. 3.0
350	New Brunswick Laboratory	28.6	22%	
	Misc. D&D Projects	16.9	13%	METAL/GLASS 34.0
	OTHER	5.46	4.2%	
Total -		130.00

Table 2.8 Forecast of Transuranic Waste Generation at Battelle - PNL^{6,8}
(Contact-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	955 (25.4)	37	28	34	31	34
Weight,** kg x 10 ³	286.5 (7.62)	111.0	8.4	10.2	9.3	10.2
Pu content						
g	1249	105	105	105	105	105
curies***	529	45	45	45	45	45

* This actual volume figure includes waste held in temporary storage; i.e., some of the volume included here had been generated in previous years.

** Estimated density at 300 kg/m³.

*** Calculated using .424 Ci/g.

Sources				Composition	
Facility	Operation	(1981) m ³ /yr*	%Total	Volume %	
1706-K	R&D	.83	3
209-E	R&D	3.07	12		
231-Z	R&D	8.72	34		
325	R&D	4.81	19		
340	R&D	2.27	9		
324	R&D	5.7	23		
TOTAL		25.4

Table 2.9 Forecast of Transuranic Waste Generation at Los Alamos National Laboratory^{9,10}
(Contact-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	850	730	540	560	580	598
Weight, kg* x 10 ³	382.5	328.5	243	252	261	269
Pu content						
g	34,700	34,700	34,700	34,700	34,700	34,700
curies	21,850	21,850	21,850	21,850	21,850	21,850

* Based on average density calculation for waste generated in 1980 (450 kg/m³).

19

Table 2.10 Forecast of Transuranic Waste Generation at Lawrence Livermore National Laboratory¹
(Contact-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	24.8	25	25	25	25	25
Weight*, kg x 10 ³	7.4	7.5	7.5	7.5	7.5	7.5
Pu content						
g	380	380	380	380	380	380
curies**	161	161	161	161	161	161

* Assumes average density at 300 kg/m³.

** Assumes weapons plutonium (0.424 Ci/g).

20

Sources				Composition
Location	Operation	(1981-1980) m ³ /yr*	%Total	Volume %
Building 332	Plutonium Weapons Research	25	100%	

* Approximately 1989-1990 LLNL will begin D&D project in Building 251. This will double their rate of TRU generation for about 5 years.

Table 2.11 Forecast of Transuranic Waste Generation at Mound Facility¹¹
(Contact-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	530	885	780	780	780	420
Weight*, kg x 10 ³	419	699	616	616	616	332
Pu content**						
g	1,100	600	500	500	400	200
curies	16,000	9,000	8,000	8,000	6,000	3,000

* Based on average density for waste shipped to INEL in 1980 (790 kg/m³).

** Assumes all Mound TRU activity is due to Pu-238.

21

Sources				Composition
Location	Operation	(1981) m ³ /yr	%Total	Volume %
Bldg. 38 Bldg. R Inactive Waste Transfer System	Decontamination and Decommissioning at all three sites*	365	69
	Analytical Laboratory	117	22	
	R&D Laboratory	48	9	
TOTAL		530		

* Includes some production operations which are phasing out.

Table 2.12 Forecast of Transuranic Waste Generation at Oak Ridge National Laboratory¹²
(Contact-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	30	30	30	30	30	30
Weight*, kg x 10 ³	9	9	9	9	9	9
Pu content						
g	72	72	72	72	72	72
curies	30	30	30	30	30	30

* Based on 3rd Quarter FY 1981 density (300 kg/m³).

Sources				Composition
Location	Operation	m ³ /yr*	%Total	Volume %
3019	²³³ U Processing	2.26	9	<p>COMBUSTIBLES 60.0</p> <p>METAL/GLASS 15.0</p> <p>OTHER 25.0</p>
3028	Production Laboratory A	.46	<1	
3038	Radioisotope Laboratory Central Radioactive Gas	.23	<1	
3508	Chem. Technology Alpha Lab.	3.19	13	
7920	Transuranic Processing	16.30	65	
2026	Analytical Laboratory	.17	<1	
3500	Instrument Control	.23	<1	
4501	High Level Rad. Laboratory	.73	<1	
9204-3	Isotope Separation - Calutron Laboratory	1.56	6	
TOTAL		25.13		

* Based on data from FY 1980

Table 2.13 Forecast of Transuranic Waste Generation at Rocky Flats Plant³
(Contact-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	1650	1650	1790	2050	1890	1810
Weight, kg x 10 ³	660	660	716	870	756	724
Pu content						
g	25,000	25,900	27,800	32,100	29,500	24,500
curies	10,600	11,000	11,800	13,600	12,500	10,400

Sources		(1981) m ³ /yr	%Total	Composition	
Location	Operation			Volume %	
771 or 371	Pu Recovery and Research & Development	890	52
707 (and nearby facilities)	Pu Parts Manufacture	390	23		
776	Fabrication, Size Reduction, and D&D	220	13		
559	Analytical Lab	100	6		
779	Research & Development	70	4		
Other		30	2		

Source: Production Files, January 1981 to April 1981.

Table 2.14 Forecast of Transuranic Waste Generation at Rockwell Hanford Operations^{6,8}
(Contact-Handled)

	1981 ⁽¹⁾	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	808	220	376	410	651	560
Weight,* kg x 10 ³	242	66	113	123	195	168
Pu content**						
g	18,068	5,500	9,400	10,250	16,275	14,000
curies***	7,660	2,332	3,986	4,346	6,901	5,936

* Assumes Avg density = 300 kg/m³.

** Based on average Pu buried from 1970 to 1980 per cubic meter of waste (25 g/m³).

*** Assumes weapons grade Pu (.424 ci/g).

(1) = 1981 is actual data.

24

Sources				Composition
Location	Current Operation	m ³ /yr*	%Total	Volume %
234-52	Pu Recovery, R&D	330	96%
200 West Area	D&D projects	5.6	2%	
Tank Forms	Waste Storage and Surveillance	7.8	2%	
TOTAL		343.4		

From 1982-85 additional D&D activities and the start-up of the Purex Recovery Plant will change the locations and volumes a great deal.

* Based on data from 1980.

Table 2.15 Forecast of Transuranic Waste Generation at Savannah River Plant and Laboratory^{13,14}
(Contact-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	370	445	468	515	552	580
Weight*, kg x 10 ³	111	111	111	108	108	108
Pu content						
g	2,759	2,756	2,766	2,769	2,773	2,770
curies	35,764	36,128	36,492	36,856	37,220	37,000

* Estimated density at 300 kg/m³.

Sources		Composition	
		(1981)	
Location	Operation	m ³ /yr	%Total
25 JB Line ¹	²³⁹ Pu Reprocessing	105	28
HB Line ¹	²³⁸ Pu Recovery Heat Source Fab.	57	15
235-F ¹	Heat Source Production	62	17
772-F ²	Analytical Laboratory	76	20
773-A ²	R&D	62	17
MPPF ¹	Multipurpose Processing Facility	6	2
Other ²		3	<1
TOTAL		371

¹ Based on verbal estimate from generating facility

² Based on annual percent changes since 1975.

Table 2.16 Forecast of Transuranic Waste Generation at Westinghouse Hanford Company^{6,8}
(Contact-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	37	506	331	76	142	142
Weight,* kg x 10 ³	14	152	99	23	43	43
Pu content						
g	691	1919	1919	1919	N/R	N/R
curies	124	814	814	814	N/R	N/R

* Assumes Avg density = 300 kg/m³.
N/R = Not reported.

26

Sources			Composition	
Location*	Operation	m ³ /yr	%Total	Volume %
340		11.2	19	
325		46.7	79	
325-13		.9	2	
TOTAL		58.8

* Major locations of waste will include the FMEF area after 1984.

Table 2.17 Forecast of Transuranic Waste Generation at Sites Generating Less Than 25 m³/yr
(Contact-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	129.6	57	20.2	22.3	22.3	19.3
Weight,* kg x 10 ³	38.9	17.1	6.1	6.7	6.7	5.8
Pu content**						
g***	39.3	17.3	8.9	8.9	8.9	9.0
curies	92.8	40.8	20.9	21.1	21.1	21.4

* Assumes average density of 300 kg/m³.

** Based on Pu concentration at Bettis APL, Argonne-West, and ICPP.

*** Calculated assuming Pu specific activity of 0.424 g/curie.

27

Sources				Composition	
Location	Function	(10-yr ave) m ³ /yr	Vol %	Ref	Volume %
Argonne-West	R&D; Sodium Research	.8	3	5	Approximately 40% - combustible 60% - non-combustible
Battelle Columbus*	R&D; Waste is from D&D	34*	--	5	
Bettis APL	R&D; Reactor Research	14.4	54	5	
ICPP	Chemical Processing Plant	2**	7.5	5	
INEL Test	Materials & Fuel	.4	1.5	5	
Reactor	Testing in Nuclear Reactor				
Lovelace	Medical R&D	2	7.5	1	
Sandia	R&D	1	3.7	1	
United Nuclear Company	Operate Nuclear Reactor	6	22.6	8	
TOTAL			26.6		

* Not included in total. Will phase out in 1982.

** Does not include 1981.

2.3 Remote-Handled - Summary

2.3.1 Locations, Quantities, and Waste Forms

DOE sites that generate remote-handled TRU waste are listed in Table 2.18. Uncertainties in Research & Development (R&D) projects make forecasts of remote-handled waste especially difficult.

A breakdown of the current types of remote-handled waste is also shown in Table 2.18. As with the contact handled waste, this refers to the contents of the containers. The volume, however, includes the container itself. The data contain more detail than contact-handled waste because the percentages come from smaller waste streams. Most of the data are based on estimates from facilities rather than actual storage or burial records. Figure 2.19 presents the totals for all sites. Except for FFTF startup in 1984, very little change is anticipated. Figure 2.20 shows the current percentages of waste forms and containers. Again, these percentages will probably not change until FFTF activities begin. Remote-handled waste forms and their containers are not presently defined for the FFTF project. Because of extensive shielding required, they could be different than present remote-handled waste containers.

Table 2.18 Projection of Remote Handled TRU Waste Volumes and Waste Forms

	Volume, m ³						Volume % ^c							Ref.
	1981	1982	1983	1984	1985	Avg/yr 1986-90	Paper	Cloth	Plastic	Rubber	Glass	Metal	Other	
Argonne - East	21	7	7	7	7	7	17%	*	16%	16%	13%	25%	13%	4
Argonne - West	.8	.75	1.0	1.0	1.0	1.0	50%	-	combustibles		0%	50%	0%	5
ICPP	.3	7	14	14	14	14	0%	0%	0%	0%	0%	0%	a	5
INEL Naval Reactor Facility	1	1.36	1.4	2.0	2.0	1.4	100%		combustibles		0%	0%	b	16
Los Alamos Nat. Laboratory	10.6	5	5	5	5	5	9%	*	39%	3%	8%	23%	18%	9,17
Oak Ridge Nat. Laboratory	26.8	34.3	34.3	34.3	34.3	57	38%	3%	25%	25%	*	10%	0%	12,18
Westinghouse Hanford Company	1	2	2.7	23	45	45	17%	25%	41%	0%	3%	14%	0%	6,8

* Not available

a Nearly 100% of ICPP waste comes from filters.

b Nearly 100% of waste is combustible, approximately 5 g in every 7 cubic feet consists of actual fuel.

c NOTE: Because the actual waste is placed in heavily shielded casks which become part of the waste, for every container of waste only a small fraction (5-10%) is actually generated waste. The percent composition refers only to this latter value.

Figure 2.19
REMOTE-HANDLED TRANSURANIC WASTE
PROJECTIONS (1981-1990)

Figure 2.20
FORECAST OF REMOTE-HANDLED WASTE FORMS
AND WASTE CONTAINERS (1981-1985)

2.4 Review of Major Sites that Generate Remote-Handled Waste

Tables 2.21 through 2.25 present the locations and sources for all remote-handled TRU waste generation. The information shown in these tables is presented in the same format as for contact-handled waste.

Table 2.21 Forecast of Transuranic Waste Generation at Argonne National Laboratory - East^{4,5}
(Remote-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	15	10	10	10	10	10
Weight*, kg x 10 ³	5.8	3.9	3.9	3.9	3.9	3.9
Pu content						
g	46.4	31	31	31	31	31
curies	3.6	2.4	2.4	2.4	2.4	2.4

* Based on density of alpha hot cell waste sent to INEL (388 kg/m³).

Sources			Composition
Location	Operation	m ³ /yr	Volume %
Bldg. 212* (Materials Science Division)	Research on Special Nuclear Materials	10	

* Responsible for over 99% of Argonne Remote-Handled Waste

Table 2.22 Forecast of Transuranic Waste Generation at Idaho National Engineering Laboratory^{5,16}
(Remote-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	2.1	9.1	16.4	17	17	16.4
Weight*, kg x 10 ³	.8	3.5	6.2	6.5	6.5	6.2
Pu content**						
g	77.7	336.7	606.8	629	629	606.8
curies	N/A	N/A	N/A	N/A	N/A	N/A

* Based on estimated density of INEL waste codes 151, 152, 153, 154, 155 (380 kg/m³).

** Based on estimated Pu density of same codes (37 g/m³).

N/A Not available.

34

Sources				Composition
Location	Operation	m ³ /yr (avg)	Vol %	Volume %
Argonne-West	Fuels Testing	1	7%
ICPP	Chemical Processing	12	83%	
INEL Naval Reactor Facility	Fuels Testing	<u>1.5</u>	10%	
TOTAL		14.5		

Table 2.23 Forecast of Transuranic Waste Generation at Los Alamos National Laboratory^{9,10}
(Remote-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	10.6	5	5	5	5	5
Weight, kg x 10 ³	17	8	8	8	8	8
Pu content						
g	400	400	400	400	400	400
curies*	740	750	750	750	750	750

* Including Mixed Fission Product content.

Sources			Composition
Location	Operation	m ³ /yr	Volume %
TA-3-29	Chemical and Metallurgical Research	5

Table 2.24 Forecast of Transuranic Waste Generation at Oak Ridge National Laboratory^{12,18}
(Remote-Handled)

	1981	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	34.3	34.3	34.3	34.3	34.3	34.3
Weight*, kg x 10 ³	61.7	61.7	61.7	61.7	61.7	61.7
TRU content						
g	15.2	15.2	15.2	15.2	15.2	15.2
curies	95.9	95.9	95.9	95.9	95.9	95.9

* Based on density of beta-gamma TRU waste in 3rd Quarter 1981 ORNL Waste Disposal Log (1800 kg/m³).

Sources				Composition
Location	Operation	m ³ /yr	Vol %	Volume %
7920	TRU Processing	22.65	66%	
3038	Radioisotope Laboratory	2.83	8%	
3121	Filter Building to 3019	5.66	17%	
3508	Chemistry Technology Alpha Lab.	3.17	9%	
		34.31

Table 2.25 Forecast of Transuranic Waste Generation at Westinghouse Hanford Company^{6,8}
(Remote-Handled)

	1981***	1982	1983	1984	1985	1986-90 (Average)
Volume, m ³	1	2	2.7	23	45	45
Weight*, kg x 10 ³	.77	1.74	2.3	**	**	**
Pu content						
g	5	N/R	N/R	N/R	N/R	N/R
curies	1.9	N/R	N/R	N/R	N/R	N/R

* Estimated density of 300 kg/m³.

** Unknown for FMEF waste.

*** 1981 is actual data.

Sources		Composition	
Location	Operation	(1981-83) m ³ /yr	Vol %
327-C Building	Research on Nuclear Reactor Fuels	5	100*
FMEF	Fuels & Material Examination	38*	

* FMEF begins operation 1984, and is not included in total above

3. CHARACTERISTICS OF STORED TRU WASTES

3.1 Contact-Handled - Summary

3.1.1 Locations, Quantities, and Waste Forms

TRU wastes are currently stored at six DOE sites. These sites are shown geographically in Figure 1.1. Figure 3.2 indicates how much waste was in storage as of December 31, 1980, and it projects how much will be added during the next 10 years. This projection is based on the forecasts from the Newly Generated Waste section of this report. Stored waste is found in many different types of storage and containers. These will be covered in detail in Section 3.2.

Table 3.1 shows the total amount of stored waste at each site as of December 31, 1980, and the amount of each waste form. Data were tabulated from Tables 3.4 through 3.11. The data are limited in scope because records are not readily available at some sites. At Hanford, ORNL, and SRP, the records usually distinguish only between combustible and noncombustible, and these data are known to be questionable. By going to the production facilities, an approximation of the physical characteristics was obtained for the current waste streams. These typical percentages were applied to the total volumes, which resulted in an estimated composition of the total waste in storage. When actual data were available (INEL and LANL) they were used. Other sites provided estimates based on the best records available, which were often incomplete. In cases where the most recent year's percentage was used, different processes or events may have changed waste forms, but for the period 1970 to 1980 it is thought to be reasonably accurate. Combining the data from all sites is a difficult task because different categories have a wide assortment of waste forms. For example, waste at the Idaho National Engineering Laboratory storage site includes well over 100 categories of waste. However, some categories--such as combustibles--may include plastic wrap, cloth gloves, wood, paper, and

Table 3.1 Contact Handled Waste Forms at TRU Storage Sites (Vol. %)

Site	Combustibles	Metal	Sludge(1)	Concrete/(2) Sludge	Filters & Filter Media	Dirt, Gravel, Asphalt	Glass	Other
Hanford ⁽³⁾	67	26	2.5	.5	Not Reported	.5	a	3.5
INEL ⁽⁴⁾	19	32	8	9	7	2	2	21
LANL ⁽⁴⁾	12	51	5	15	3	2	a	12
NTS ⁽⁴⁾	89	4	4	0	b	2	a	0
ORNL ⁽⁵⁾	55	15	N/A	N/A	N/A	N/A	N/A	30
SRP ⁽³⁾	82	9	0	0	a,b	0	8.5	.5

(1) Includes organic and inorganic process solids, liquid waste solidified with various sorbents, and dried salts.

(2) Includes concrete, (some asphalt), and process waste which has been immobilized with concrete.

(3) Based on limited sampling of waste during 1981 only. (Ref. 6, 13).

(4) Based on records received from generator or site records since 1971. (Ref. 19, 9, 20).

(5) Data not available except for very general categories. (Ref. 12).

a Included with metal.

b Included with combustibles.

Figure 3.2
CONTACT HANDLED WASTE FORMS AND WASTE
CONTAINERS IN STORAGE TO DECEMBER 31, 1980

INVENTORY TO DECEMBER 31, 1980
VOLUME %

INVENTORY TO DECEMBER 31, 1980
VOLUME %

(TOTAL VOLUME = 60,064 m³)

rubber. Hanford, on the other hand, does not categorize various kinds of equipment, metals, sludges, and filters, but they did segregate all combustible waste forms such as paper, cloth, and plastic. The categories in Table 3.1 were defined as clearly as possible, but some overlapping does exist. Even on those sites that kept extensive records, examination of some of the drums indicates that the records do not always match the contents.²³ Figure 3.3 shows the total percentages of the various waste forms from Table 3.1. It also shows how these waste forms are currently packaged. These data are based on the detailed information found in Section 3.2.

One other aspect of physical waste forms is often overlooked. All records of waste forms are based upon the composition of the waste "inside" the container. However, except for the Hanford site, the volume of waste reported is always based on the entire container volume.⁸ Therefore, a volume of waste may be labeled as combustible, but that volume would also include the steel waste drum which is not combustible. Table 3.4 shows the percentages of waste forms based on the waste inside the container. It also shows the percentages of the waste forms when the volume of the individual containers are added to the categories in which they fall. For example, a 55-gallon drum is usually considered to equate to 0.217 m³ of waste. The drum itself occupies 0.0083 m³. If the drum contains combustible material, it would be reported as 0.217 m³ of combustibles. In reality, there are 0.209 m³ or less of combustibles, and 0.0083 m³ of steel. In most cases there is less than 0.209 m³ because rarely are drums packed to capacity. Calculations in Table 3.4 are based on the total number of containers found in Section 2.2.

3.1.2 Transuranic Content and Surface Dose Rate

Table 3.5 lists the common isotopes reported by the various storage sites. Other TRU isotopes are found in small quantity in the waste, but they were not researched. They include ²⁴²Pu, ²⁴⁴Pu, ²⁴²Am, ²⁴³Am, six isotopes of curium, four isotopes of californium, and ²⁴⁷Bk. As

Table 3.4

Effect of Container Volume on Waste Form Volume

<u>Waste Forms</u>	<u>Container Volume Included With Contents</u>		<u>Container Volume Separated Into Own Category*</u>	
	<u>Volume (m³)</u>	<u>Volume (%)</u>	<u>Volume (m³)</u>	<u>Volume (%)</u>
Combustibles	18,385	30.5	19,917	33
Metal	19,124	31.5	18,120	30
Filters - Filter Media	3,024	5	2,754	4.5
Dirt, Gravel, Asphalt	829	1.5	782	1.5
Concrete or Cemented Waste	4,646	7.5	4,872	8
Absorbed Liquids or Processed Sludges	3,939	6.5	8,808	6
Glass	914	1.5	905	1.5
Other	<u>9,574</u>	16	<u>9,277</u>	15.5
	60,435		60,435	

* The volume of each container has been subtracted from the contents and added to its appropriate category. For instance, the volume of a 55-gallon drum is added to metal category.

Table 3.5 Major TRU Radionuclide Content in Stored Wastes (To December 31, 1980)

Isotope	Hanford (a)		INEL (b)		LANL (c)		NTS (d)		ORNL (e)		SRP (f)	
	g	curies	g	curies	g	curies	g	curies	g	curies	g	curies
U-233	7553	71	90960	861	4305	40.8	45.5	.45	10130	96	None	
Np-237	91.6	<.1	20105	14	3	<.1	2.0	<.1	None		See Cm-244	
Pu-238	7772	135226	2459	42790	6337	93150	5.5	95	36.8	626	19,455	286000
Pu-239	230408	14147 ^g	263380	16190	67762	28731 ^h	3034	706	1019	63	6132	2600
		g										
Pu-240	13986	3343	16539	3953	See Pu-239		2.1	.11	123.6	27	See Pu-239	
Pu-241	736	82446 ^g	1142	127900	See Pu-239		<.1	5.5	<.1	6	See Pu-239	
Am-241	937	303	18058	58510	3529	11434	8.1	88	11.4	39	See Cm-244	
Cm-244	2	163	13.8	1113	<.1	<.1	31	475	5.7	439	307 ⁱ	25000
TOTAL	261485	235699	412657	251331	81936	133356	3128.2	1370	11327	1296	25894	313600

a Ref. 21, to December 31, 1981

b Ref. 19, 22

c Ref. 9, 10

d Ref. 20

e Ref. 12

f Ref. 14

g Calculated based on estimated stored waste isotopic composition found in Table 3.6.

h Calculated based on typical composition found in Table 2.6.

i Includes Np-237, Am-241

mentioned earlier, the isotopic fraction found in any volume of waste is dependent upon the process that generated the waste. It is sometimes convenient for estimating purposes to know the overall percentages of the major TRU isotopes present at each site. Table 3.6 shows such an estimate. These data are not to be taken as the isotopic composition for each package of waste. It is a composite estimate which can be used when nothing else is available to describe the isotopes. Individual containers of waste may vary widely from the table. For instance, the ORNL remote-handled waste shows 0.01 percent ^{252}Cf . In one facility no ^{252}Cf is present, therefore, waste from that facility does not contain 0.01 percent ^{252}Cf . At another facility, however, ^{252}Cf is produced, and waste from that facility will contain ^{252}Cf at a much greater amount than 0.01 percent. In most cases detailed compositions were not readily available. Many sites do have this type of data on file but there was not enough time to analyze it.

Table 3.6
Estimated TRU Isotopes in Buried and Stored Waste

Site	CH Stored Waste		RH Stored Waste		Buried		Ref.
	(Isotope)	(wt %)	(Isotope)	(wt %)	(Isotope)	(wt %)	
Hanford	²³⁸ Pu	0.03	²³⁸ Pu	0.03	Not Available		8
	²³⁹ Pu	93.9	²³⁹ Pu	87.6			
	²⁴⁰ Pu	5.7	²⁴⁰ Pu	12.0			
	²⁴¹ Pu	0.3	²⁴¹ Pu	0.3			
	²⁴² Pu	0.03	²⁴² Pu	0.03			
	²⁴¹ Am	0.02	²⁴¹ Am	0.02			
INEL	²³³ U	23.2	²³³ U	0.42			22
	²³⁸ Pu	0.63	²³⁸ Pu	0.32			
	²³⁹ Pu	67.1	²³⁹ Pu	90.88	²³⁹ Pu	90.0	
	²⁴⁰ Pu	4.21	²⁴⁰ Pu	7.20	²⁴⁰ Pu	5.63	
	²⁴¹ Pu	0.29	²⁴¹ Pu	0.85	²⁴¹ Pu	0.42	
	²⁴¹ Am	4.6	²⁴¹ Am	-	²⁴¹ Am	3.89	
NTS	²³³ U	1.22	None		None		21
	²³⁸ Pu	0.15					
	²³⁹ Pu	96.1					
	²⁴⁰ Pu	0.98					
	²⁴¹ Pu	0.09					
	²⁴¹ Am	0.22					
	²⁴⁴ Cm	0.84					
	²³⁷ Np	0.05					

Table 3.6 (Cont.)

Site	CH Stored Waste		RH Stored Waste		Buried		Ref.
	(Isotope)	(wt %)	(Isotope)	(wt %)	(Isotope)	(wt %)	
LANL	^{233}U	3.6			^{233}U	20.0	
	^{238}Pu	595			^{238}Pu	0.01	10
	$^{239,240}\text{Pu}$	87.8	$^{239,240}\text{Pu}$	100.0	$^{239,240}\text{Pu}$	67.0	
	^{241}Am	3.1			^{241}Am	13.0	
	Other	0.01			Other	0.01	
ORNL	^{233}U	85.66	^{233}U	87.67			
	^{238}Pu	0.32					
	^{239}Pu	11.89	^{239}Pu	1.63	^{239}Pu	86.96	
	^{240}Pu	1.33	^{240}Pu	0.18			12
	^{241}Pu	0.07	^{241}Pu	0.009			
	^{242}Pu	0.33	^{242}Pu	2.02			
	^{241}Am	0.14	^{241}Am	0.81	^{241}Am	8.70	
	^{243}Am	0.09	^{243}Am	0.61			
	^{244}Cm	0.17	^{244}Cm	7.07	^{244}Cm	4.35	
	^{252}Cf	0.0001	^{252}Cf	0.01			
SRP*	<u>^{239}Pu Operations</u>		<u>(Contact Handled) ^{238}Pu Operations</u>				
	^{239}Pu	93-94	^{238}Pu	80-83	Not Reported		
	^{240}Pu	6	^{239}Pu	10-20			
	$^{238}, ^{241}, ^{242}\text{Pu}$	1	$^{236}, ^{240}, ^{241}, ^{242}\text{Pu}$	0-3			
	^{241}Am	1					

*Based on estimates from current waste streams. Stored wastes are similar, but not necessarily identical. At the present time 50% of waste is from ^{238}Pu operations and 50% is from ^{239}Pu operations.

In his work in 1978, Shefelbine provides the best data available on how plutonium is distributed from package to package.¹⁵ Figures 3.7 and 3.8 are histograms that he obtained from the INEL. Figure 3.9 shows the probable content of drums at SRP. These data were also taken from the Shefelbine work.¹⁵

The maximum surface dose rate for contact-handled wastes is generally accepted to be 200 mR/hr. Although unofficial, this is probably true for most contact-handled waste. Some wastes such as heat source curium waste at SRP are in containers incorporating heavy shielding to obtain those limits. Some containers at all of the sites could exceed 200 mR/hr if the shielding were not adequate. Concrete casks at ORNL and LANL are examples.

3.2 Review of CH Waste Packages at Storage Sites

Table 3.10 summarizes contact-handled waste categories at the storage sites. These data were tabulated from the detailed tables. Following the summary, Tables 3.11 through 3.46 present the details of each waste package at all sites. The information includes: (1) the total volume for each container type, (2) a description of the category, (3) how it is currently stored, (4) what the inside configuration is, and (5) as much detail as possible on the contents of each particular category. When not available, a best estimate of the contents is given.

Figure 3.7 Histogram of Pu Content in Drums Stored at Idaho from 9-1-71 to 12-31-77

Figure 3.8 Histogram of Pu Content in Boxes Stored at Idaho From 9-1-71 to 12-31-77

Figure 3.9 Histogram of Weapon and Heat Source Plutonium Content in 55-gallon Drums Produced by Savannah River from 7-1-74 to 6-31-77

Table 3.10 Contact-Handled Packages at TRU Waste Storage Sites
(To December 31, 1980)

Sites	Contact-Handled Stored Waste											
	30-gal Drum	55-gal Drum	83-gal Drum	Non- Standard Drum	4x4x7 Ply- wood Boxes	Non- Standard Boxes	Welded Steel Box	Metal Bin	Corrugated Metal Pipe	Concrete Box	Non- Standard Concrete Box	Concrete Cylinder
<u>HANFORD</u>												
Volume of one container (m ³)		.212	--	varies	--	varies	varies	--	--	--	--	--
Number of containers		24431	none	34	See Non- Std Boxes	379	140	none	none	none	none	none
Total volume (m ³)		5189	--	12	--	3776		--	--	--	--	--
SITE TOTAL VOLUME: 8977 m ³												
Curies of TRU activity												
Average		All drums: 3.9 Ci/drum				All boxes: 3.3E-02 Ci/ft ³						
Range		0-86 Ci/drum				0-450 Ci/box						
<u>INEL</u>												
Volume of one container (m ³)	.113	.217	.314	varies	3.17	varies	--	varies	--	--	--	--
Number of containers	96	95975	4004	58	6039	197	none	407	none	none	none	none
Total volume (m ³) ^b	11.0	20827	1257	25	19144	47	--	1180	--	--	--	--
SITE TOTAL VOLUME: 42,491 m ³												
Curies of TRU activity												
Average		All drums: ^a 1.64 Ci/drum		N/R	Standard boxes: 3.51 Ci/box ^a		N/R	1.74 Ci/bin				
Range		0-85 Ci/drum			0-148 Ci/box ^a			0-25 Ci/bin				

^a Based on Rocky Flats drums and boxes only.

^b The total contact handled volume reported here, 42,490.9 m³, varies from the Integrated Data Base total contact handled volume reported 42,352 m³, due to the fact that waste generators have used different container volumes. As an example, 4'x4'x7' plywood boxes have been reported as 3.0 m³ and 112 ft³ (3.17 m³).

N/R Not Reported.

Table 3.10 Contact-Handled Packages at TRU Waste Storage Sites (Continued)
(To December 31, 1980)

Sites	Contact-Handled Stored Waste											
	30-gal Drum	55-gal Drum	83-gal Drum	Non- Standard Drum	4x4x7 Ply- wood Boxes	Non- Standard Boxes	Welded Steel Box	Metal Bin	Corrugated Metal Pipe	Concrete Box	Non- Standard Concrete Box	Concrete Cylinder
<u>LANL</u>												
Volume of one container (m ³)	.113	.217	.314	varies	--	varies	--	--	2.8	--	--	.965
Number of containers	514	5216	10	6	incl. in non-std	308	none	none	211	none	none	306
Total volume (m ³)	56	1060	3	10		2334	--	--	591	--	--	295
SITE TOTAL VOLUME: 4349 m ³												
Curies of TRU activity												
Average	6.2 Ci/drum	4.6 Ci/drum	N/R	N/R	22.3 Ci/box				N/R			N/R
Range	0-43 Ci/drum				0-150 Ci/box							
<u>NTS</u>												
Volume of one container (m ³)	--	.212	--	--	--	--	varies	--	--	--	--	--
Number of containers	none	633	none	none	none	none	29	none	none	none	none	none
Total volume (m ³)	--	134	--	--	--	--	171	--	--	--	--	--
SITE TOTAL VOLUME: 305 m ³												
Curies of TRU activity												
Average		2.5 Ci/drum					1.05 Ci/box					
Range		N/R					N/R					
<u>ORNL</u>												
Volume of one container (m ³)	.17	.227	--	.43	--	--	--	--	--	--	--	--
Number of containers	101	1587	none	2	none	none	none	none	none	none	none	none
Total volume (m ³)	17	360	--	1	--	--	--	--	--	--	--	--
SITE TOTAL VOLUME: 378 m ³												
Curies of TRU activity												
Average	All drums:											
Range	.7 Ci/drum											
	N/R			N/R								

^a Based on Rocky Flats drums and boxes only.
N/R Not Reported

Table 3.10 Contact-Handled Packages at TRU Waste Storage Sites (Continued)
(To December 31, 1980)

Sites	Contact-Handled Stored Waste											
	30-gal Drum	55-gal Drum	83-gal Drum	Non- Standard Drum	4x4x7 Ply- wood Boxes	Non- Standard Boxes	Welded Steel Box	Metal Bin	Corrugated Metal Pipe	Concrete Box	Non- Standard Concrete Box	Concrete Cylinder
<u>SRP</u>												
Volume of one container (m ³)	--	215	--	--	--	--	11.3	--	--	.99	18	7.6
Number of containers	none	7065 ^c	none	none	none	--	39	none	none	110	6	243
Total volume (m ³) ^d	--	1059	--	--	--	--	441	--	--	109	108	1847
SITE TOTAL VOLUME: 3564 m ³												
Curies of TRU activity												
Average Range		N/R 0-.5	CI/drum				N/R N/R			N/R N/R	N/R N/R	N/R 7-2000 CI/cyln. ^b
TOTAL NUMBER OF CONTAINERS	711	134,907	4014	100	6039	884	482	407	211	110	6	549
TOTAL VOLUME (m ³)	83.6	28,629	1260	47.2	19144		6769.5	1180	590.8	109	108	2141.9
TOTAL VOLUME ALL SITES: 60,064 m ³												

^a Based on Rocky Flats drums and boxes only.

^b The average radiation level is 205 mrem/hr, thus these are considered contact handled. Some may exceed the 205 mrem/hr.

^c The total number of drums here is the actual total number of 55 gal drums. Out of the 7065 drums shown in this column, approximately 2141 are placed in concrete culverts. The volume on these drums is included in the concrete cylinder category.

^d The total volume of CH waste that can be obtained from these numbers does not agree with the Integrated Data Base number because volumes reported here are container volumes while the number supplied to the IDB is a waste volume.

N/R Not reported.

Table 3.11

Category	Number of Items	Total Volume	Ref.
HANFORD 55-gallon drums	24431	5189 m ³	7,8

Description of Category:

Cylindrical carbon steel, painted, or galvanized

Dimensions: 22.5 in. ID x 33.25 in. L, 24 in. x 35 in. L, (.478 in. wall)

Volume - 7.42 ft³

of carbon steel = 25150

of galvanized = 1411

Placement:

Below grade on asphalt pad. Drums are stacked 12 ft high in modules. Plywood 5/8 in. thick separates layers. Covered with plywood and plastic and 4 ft. of dirt. Some drums are at 45° angle in cement "V" trench.

in V trench = 1378

on asphalt pad = 25183

Inside Configuration:

Loose plastic double wrapped packages and cans. One hundred ninety of total have been mixed with cement. Majority of drums were lined with a plastic bag. Since 1980 a rigid polyethylene liner conforming to the shape of the drum has been used. Less than one drum in four compacted.

Content Data:

Specific contents unknown. Some segregation of combustible/noncombustible has occurred. Estimates are ~70% combustible, and ~30% noncombustible. TRU activity can only be estimated. Estimated Pu content = 1.226 g/ft³-average, 27 g/ft³-maximum. Estimated Radiation Level = 95% are less than 5 mR/hr; 200 mR/hr-maximum.

Table 3.13

Category	Number of Items	Total Volume	Ref.
HANFORD plywood boxes	379		7,8

Description of Category:

Fiberglass reinforced plywood boxes (FRP Boxes).

Dimensions vary: 4 ft x 4 ft x 7 ft std. box, 12 ft x 10 ft 6 in. x 10 ft 8 in., 16 ft x 9 ft x 10 ft 8 in., 20 ft x 9 ft x 12 ft 8 in., 4 x 4 x 4, 3 x 3 x 3, 2 x 2 x 2.

Volume: 8 ft³ to 2300 ft³

As seen above, dimensions can vary greatly. These are the most common sizes, but slight differences could exist from box to box.

Placement:

Placed below grade in earthen trenches, covered with plastic and 4 ft of soil. Little or no stacking. Larssen steel sheet pilings and railroad ties are used to shore up boxes.

Inside Configuration:

Loose waste in plastic wrap, large equipment is loose. Some have plastic liners, some taped. Not compacted.

Content Data:

Specific contents unknown. Mostly hoods, gloveboxes, or large items of equipment. Trash included in some, but well over 50% noncombustible. TRU activity estimated -

Pu content = 7.72×10^{-2} g/ft³-average, 1000 g/box-maximum.

Radiation level = 95% are less than 5 mR/hr; 200 mR/hr-maximum.

Table 3.12

Category	Number of Items	Total Volume	Ref.
HANFORD non-standard drums	34	11.6 m ³	

Description of Category:

Cylindrical metal drums.

9-30 gal drums; volume .116 m³/drum

25-110 gal drums; volume .425 m³/drum

110 gal drums are 2-55 gal 16 gauge drums welded together

110 gal drums also referred to as L-tin containers

Placement:

110 gal drums are stacked two high in the center of a module and then surrounded by other drums. The floor of the module is asphalt. When the module is full, it is then covered with a 4 ft deep dirt backfill.

Inside Configuration:

110 gal drum containers were constructed by filling with concrete and then boring a 5 in. diameter hole down the center. The cavity was then filled with a plastic pipe which could be capped with a plastic lid and sealed by a rubber gasket. The outer lid is held in place by a spring loaded clamp that is held in place with a bolt. The outer lid has a rubber gasket for sealing purposes.

Content Data:

110 gal drums were used to transport contaminated liquids. Even though the drums do not contain liquids, they have been buried. These drums have radiation levels averaging at 50 mR/hr and a maximum of 100 mR/hr.

Table 3.14

Category	Number of Items	Total Volume	Ref.
HANFORD steel boxes	140		7,8

Description of Category:

Carbon steel boxes, welded.

No special lugs or hooks.

Dimensions: vary 10 ft 6 in. x 7 ft 1-1/2 in. x 5 ft 2-7/16 in., 16 ft 6 in. x 7 ft 1.5 in. x 5 ft 2-1/2 in., 13 ft x 5 ft x 10 ft, 3 x 3 x 3.

Volume: 25 ft³ to 650 ft³

Placement:

Below grade in earthen trenches, covered with 4 ft of soil. Limited stacking.

Inside Configuration:

Loose equipment. No liner. Lids are bolted in place. No compaction.

Content Data:

Specific contents unknown. Mostly hoods or equipment. TRU activity estimated-

Pu content = 7.72×10^{-2} g/ft³-average, 1000 g/box-maximum.

Radiation level = All less than 5 mrem/hr.

Table 3.15

Category	Number of Items	Total Volume	Ref.
INEL 55-gallon drums	95975	20827 m ³	20,22

Description of Category:

DOT Specification 17C - Cylindrical steel drum, painted

Dimensions: 22.5 in. ID x 33.25 in. L, 24 in. OD x 35 in. L (0.478 in. wall)

Volume - 7.42 ft³

Quantity received from Bettis APL have galvanized interior.

Placement:

Above grade on asphalt pads. Drums are stacked five drums high on 25 m x 46 m cells or modules. They are in rectangular array, the sides being lined with fiberglass coated wooden boxes. Plywood 1/2-in. thick separates the layers. The cell is covered with 5/8-in. fire retardant plywood, 20 mil nylon polyvinyl sheeting, and 3 ft. of soil.

Inside Configuration:

Waste can be loose, in plastic bags, buckets, or smaller drums. After 1972 a polyvinyl liner was used. Approximately 42,280 drums contain liners, while 40,740 do not. Liner is 90-mil rigid polyvinyl, since 1978. Some waste is compacted, most is not. Sealed with rubber gasket and bolted closure ring. In addition, there are 17,113 drums which have been retrieved from the subsurface disposal area, placed in cargo containers or bins, and stored on the pads.

Content Data: See Table 3.16 which follows.

Table 3.16 Content Data for 55-gal Drums at INEL*

Content Codes	Content Description	# of Drums	Volume m ³	Gross Weight, Kg	Pu (g)	Am (g)
<u>INEL Designation</u>						
1,3,5,95,102,241,290,811,976,995	Sludge - Organic and inorganic process solids, liquid waste solidified with various sorbents, and dried salts	12,360	2,643	2,776,075	35,108	13,607
2,4,292,376,836,960	Concrete/Sludge - concrete filters or sludges that have been immobilized with concrete	13,909	2,949	3,321,902	28,173	206
10,153,202,330,336,337,460,463,801,802,804,847,900,970	Combustibles - rags, paper, plastic cloth, wood, gloves	16,670	3,502	1,435,869	8,570	378
20,480,481,803,825,950,980	Metal - equipment, pipes, non-compressible - noncombustible	3,859	818	450,757	18,206	14
335,338,490,805,813	Filters and Filter Media	455	96	34,160	1,629	7
374,990	Dirt, Gravel, Asphalt	1,439	300	295,455	375	0
105,440	Glass	1,013	219	108,213	5,178	26
0	Unknown - Waste buried prior to 1970, exhumed and overpacked	18,972	4,135	1,844,572	24,958***	108***
300,301,310,311	Graphite graphite cores, scarfings, heels	1,079	226	125,514	10,494	0
441,442	Raschig Rings - borosilicate glass	2,268	473	247,054	13,571	9

Table 3.16 (Con't) Content Data for 55-gal Drums at INEL

Content Codes	Content Description	# of Drums	Volume m ³	Weight, Kg	Pu (g)	Am (g)
834	Acid	859	179	167,496	91	0
835	Caustic	1,213	253	221,172	65	0
	Other	<u>5,094</u>	<u>845</u>	<u>**</u>	<u>**</u>	<u>**</u>
Total		79,190	16,638	11,028,239	146,415	14,355

* Data were taken from Transuranic Storage Area 9-71 through 12-80. These data are found in the Appendix and provide a much more detailed breakdown. No individual container data are available for the first year of retrievable storage.

** Could not be calculated, see data in Appendix.

*** Estimated.

Table 3.17

	Category	Number of Items	Total Volume	Ref.
INEL	30-gallon drums	96	10.9 m ³	20,22

Description of Category:

Cylindrical steel drum, painted, 18 gauge.

Dimensions: 19 in. ID x 29 In. L

Volume: 4 ft³

No longer accepted by INEL storage site.

Placement:

Stored above grade, on asphalt pads, similar to 55-gallon drums

Inside Configuration:

Waste is usually bagged in plastic, not compacted. Can be in cans or other containers, most have liners. Liner is 90-mil rigid polyvinyl, since 1978. Sealed with rubber gasket and bolted closure ring.

Content Data:

Specific contents are unknown. Most likely similar to 55-gallon drums with one exception. One-third of all 55-gallon drums contains sludge. No sludge is known to have been packed in 30-gallon drums.

Table 3.18

	Category	Number of Items	Total Volume	Ref.
INEL	83-gallon drums	4004	1257 m ³	20,22

Description of Category:

Cylindrical steel drum, painted.

Dimensions: 26 in. ID x 43 in. L

Volume: 11.1 ft³

No longer accepted by INEL storage site. Used at INEL for overpacking damaged containers, primarily those from SDA.

These are not DOT-approved containers.

Placement:

Stored on asphalt pads, similar to 55-gallon drums

Inside Configuration:

Waste can be in cans, boxes, or bagged in plastic. Since 1972, drums have liners of polyvinyl plastic, but specifications unknown. Not compacted. Sealed with rubber gasket and bolted closure ring.

Content Data:

Specific contents are unknown. Most likely similar to contents in 55 gallon drums. The 83-gallon drum is also used to overpack damaged or retrieved 55-gallon drums.

Table 3.19

	Category	Number of Items	Total Volume	Ref.
INEL	Drums in Cargo Containers and Bins	489	3596 m ³ (drums only)	20,22

Description of Category:

17,113 fifty-five gallon drums have been overpacked in 209 cargo carriers and 280 bins.
 See description of bins in Table 3.24
 Dimensions: (Cargo Carrier) Rectangular, approximately 8 ft x 8 ft x 20 ft.
 Volume: Drum - 7.42 ft³, cargo carrier -1280 ft³

Placement:

Cargo container placed above grade on asphalt pads. Drums are placed inside cargo container. Container holds approximately 72 drums. Bins are sometimes used to surround modules of 55 gallon drums.

Inside Configuration:

These 55-gallon drums are from the retrieval operation which exhumed drums buried in 1970. Drums were sealed with a rubber gasket and bolted metal closure ring. Drums were placed in plastic bags prior to overpacking in cargo containers, bins, or 83-gallon drums.

Content Data:

Typical buried waste of which there are no specific records. Mix of waste is probably similar to 55-gallon stored drums, except some soil is present from the retrieval operation.

Table 3.20

Category	Number of Items	Total Volume	Ref.
INEL Non-Standard Drums	58	25 m ³	20,22

Description of Category:

Various size cylindrical metal drums.

Volume: 1 - 1 ft³, 1 - 5 gallon, 1 - 50 ft³

1 - 3 ft³, 1 - 200 gallon, 53 - 110 gallon (double 55 gallon)

Double 55 gallon containers are two 55-gallon drums welded together.

Placement:

Smaller containers may be inside 55-gallon drum. Placed on asphalt pad similar to 55 gallon drums.

Inside Configuration:

Waste is in boxes, smaller cans, or bagged in plastic, not compacted. Most do not have liners. Sealed with rubber gasket and bolted closure ring.

Content Data:

Specific contents unknown. Most likely similar to 55-gallon drums except for sludges which are in 55-gallon drums.

Table 3.21

	Category	Number of Items	Total Volume	Ref.
INEL	Plywood Boxes (Standard)	6039	19144 m ³	20,22

Description of Category:

Plywood box 3/4-in. thick. Dimensions: 4 ft x 4 ft x 7 ft.* Volume: 112 ft³
 Since 1972 boxes covered with layer of fiberglass. Thickness of fiberglass and box may vary.
 Usually 3/4 in. wood, 1/8 in. nominal thickness fiberglass

of plain boxes - 1262 $\approx$ 4000 m³

of fiberglass boxes - 4974 $\approx$ 15780 m³

* Actual dimensions may vary up to 5 in. greater in each dimension.

Placement:

65

Above grade on asphalt pads. Used to surround the cells of 55-gallon drums. Contained in cells 25 m x 46 m. Three layers are separated by 1/2 in. plywood, covered with 5/8 in. plywood, 20 mil nylon polyvinyl sheeting, and 3 ft of soil.

Inside Configuration:

Equipment or loose waste is enclosed in plastic or plastic bags. May contain drums or other packages of loose waste. Boxes contain a fiberboard liner and poly box.

Content Data:

See Table 3.22 which follows.

Table 3.22 Content Data for INEL Plywood Boxes***

Waste Codes	Description	Volume m ³	Weight, Kg	Pu (q)	Am (q)
5, 976, 978, 995	Sludge - Organic and inorganic process solids, liquid, waste solidified with various sorbents, and dried salts.	127	80,360	85	2
330, 336, 337, 900, 970	Combustibles - rags, paper, plastic, cloth, wood	3,386	919,178	9,694	757
338, 490	Filters or Filter Media	2,325	631,060	13,863	17
374, 842	Dirt, gravel, asphalt	253	139,890	273	0
480, 481, 824, 950	Metals	10,902	4,419,440	32,757	68
376, 960	Concrete cemented sludge, cemented filters	314	330,4165	2,178	11
302	Benelex and plexiglass	50	26,700	63	0
	Other*	<u>2,373</u>	<u>**</u>	<u>**</u>	<u>**</u>
TOTAL		19,780	6,547,044	58,913	855

* Includes waste not categorized

** Could not be calculated, see data in Appendix.

*** Data taken from Transuranic Storage Area 9-71 through 12-80. See in Appendix.

Table 3.23

	Category	Number of Items	Total Volume	Ref.
INEL	Non-Standard Plywood Boxes	197	47 m ³	20,22

Description of Category:

Plywood boxes of various sizes.

Volumes:

1 - 25 ft³, 5 - 72 ft³, 1 - 121 ft³, 2 - 155 ft³, 4 - 378 ft³,
 1 - 46 ft³, 9 - 84 ft³, 4 - 130 ft³, 6 - 169 ft³, 2 - 424 ft³,
 142 - 56 ft³, 8 - 93 ft³, 7 - 144 ft³, 3 - 188 ft³.

Placement:

Above ground on asphalt pads. Same as standard size boxes.

Inside Configuration:

Same as standard size boxes. Waste is usually bagged in plastic or contained in other drums or boxes.

Content Data:

Specifics on each box are unknown. Most larger than standard size contain large metal equipment or gloveboxes. Smaller sizes most likely equipment, but could be similar to mix in standard size boxes.

Table 3.24

Category	Number of Items	Total Volume	Ref.
INEL Metal Bin	407*	1180 m ³	20,22

Description of Category:

Sheet metal steel bins. Painted with white paint. 12 gauge steel.

Dimensions: 72 3/8 in. high, 50 3/8 in. long, 58 3/8 in. deep.

Volume: 120 ft³

Stiffner: 3 in. angle iron across bottom

Braces: 2 in. angle iron in corners at top, diagonally.

* Category does not include 280 bins used to overpack 55-gallon drums containing retrieval of buried waste. (See Table 3.19).

Placement:

Above ground on asphalt pads. Same as standard size plywood boxes.

Inside Configuration:

Sealed with rubber gasket. Weather stripping 7/16 in. x 1 in. wide. Cover held on with 5/16 in. hex head screw.

72 bins contain waste that was retrieved from earlier buried TRU waste. This is the same type of waste as the 280 bins above, but is not to be confused as part of it.

Content Data:

See Table 3.25 on following page.

Table 3.25 Content of INEL Metal Bins*

Waste Codes	Description	No. of Bins	Volume m ³	Weight, Kg	Pu (q)
0	Not Recorded - Unknown	72	206	67,252	948
100	Laboratory Waste 50% to 70% combustible, small equipment, filters, cans	261	746	252,742	415
101	Cut-up Glove Boxes	44	126	48,444	250
201	Noncombustible Solids	27	77	32,314	69
202	Combustibles - paper, cloth, plastic, etc.	5	14	3,488	10
203	Miscellaneous - paper, cloth, metal, glass	<u>4</u>	<u>11</u>	<u>2,858</u>	<u>0</u>
69 TOTAL		413	1,180	403,610	1,692

* Data taken from Transuranic Storage Area 9-71 through 12-80. Found in Appendix.

Table 3.26

	Category	Number of Items	Total Volume	Ref.
LANL	30-gallon drums	514	55.5 m ³	9,10

Description of Category:

Cylindrical 17H mild steel (black iron) drum.

Dimensions: 0.48 m ID x 0.74 m L

Volume: 3.81 ft³

Drums used only through ~ 1975.

Placement:

Stacked on below ground storage pad.

Inside Configuration:

Loose waste administratively segregated within TRU work areas. Glovebox waste packaged in small cans, boxes, or bagged in plastic. Sealed with rubber gasket.

Content Data:

See Table 3.27 which follows. Also see LANL data in Appendix.

Major Radionuclides: Pu-239.

0-0.100 R/hr gamma at contact.

Table 3.27 Content of LANL 30-Gallon Drums*

Content Codes	Content Description	Volume m ³	Weight, Kg	No. Drums	Pu-239 (g)	Pu-238 (g)
A15, A18, A60	Combustibles - mixed celluloseics, mixed paper, plastic, rubber, other	13.7	4215.3	135	1,236	1
A16	Combustibles - plastic material	1.0	244.8	9	21.6	0
A19	Mixed combustibles - noncom- bustible	4.3	1,068	38	82.8	0
A25, A70	Sludges - leaded process residue, chemical waste	26.2	11169.3	235	6781.9	.3
A30, A31, A50	Metal - equipment, metal crucibles, scrap, dies, precious metals, other scrap metal	5.7	2732.8	57	274.6	6.8
A21, A46, A55, A61, A95, A99	Other	<u>4.5</u>	<u>1617.3</u>	<u>40</u>	<u>44.9</u>	<u>0</u>
TOTAL		55.4	21047.5	514	7229.4	8.1

* Data taken from LANL Stored TRU Waste Data, found in Appendix.

Table 3.28

	Category	Number of Items	Total Volume	Ref.
LANL	55-gallon drums	5216	1060.2 m ³	9,10

Description of Category:

Cylindrical 17C mild steel (black iron) drum.*

Dimensions: 0.89 m ID x 0.61 m ID

Volume: 7.18 ft³

Since 1975 obtained from Rocky Flats to RFP specifications.

* Note: The outside of all LANL drums has been covered with a corrosion resistant grease. Should the drums require shipment, the grease could be removed.

Placement:

Stacked in pad-type storage (above and below ground).

Inside Configuration:

Loose waste administratively separated in TRU work areas. Glovebox waste packaged in small cans, boxes, or bagged in plastic. Prior to 1975 sealed with rubber gasket. Since 1975 Rocky Flats specifications used. Liners are used as deemed necessary. All sludge drums, soil, machine oils, and certain special cases have utilized a liner.

Content Data:

See Table 3.29 which follows. Also see LANL data in Appendix.

Major Radionuclides: Pu-239, Pu-238, AM-241, and Mixed Fission Products.

0-0.300 R/hr gamma at contact.

Table 3.29 Content of LANL 55-Gallon Drums*

Content Codes	Content Description	Volume m ³	Weight, Kg	No. Drums	Pu-239 (g)	Pu-238 (g)	Am-241 (g)	U-233 (g)
A15, A18, A60	Combustibles - mixed cellulosics, mixed paper, plastic, rubber, other combustibles	335.9	93668.1	1,672	13920.2	42.3	2.1	0
A16	Plastic material	3.8	1,017	19	81.2	0	0	0
A19	Mixed combustibles - noncombustible	15.6	4,068	75	134.8	<0.1	0	0
A25, A70, A75	Sludges - leached process, residue, chemical waste chemical treatment sludge	306	264620.1	1,480	22773.8	6.4	296.6	0
A76	Cemented sludge - cement paste	74.1	88,150	357	69.1	.2	6.5	2.1
A30, A31, A50, A52	Metal - equipment, metal crucibles, scrap, dies, other scrap metals	71	27146.6	355	1976.2	44.1	0	0
A55, A56	Filters and Filter Media	2.3	1589.9	11	5.9	<0.1	0	0
A90	Soil	9.6	8,610	46	0.6	0	0	0
A10, A20, A21, A61, A95, A99	Other	<u>241.9</u>	<u>85482.6</u>	<u>1,201</u>	<u>9649.4</u>	<u>69.9</u>	<u>13.4</u>	<u>1</u>
TOTAL		1060.2	574,352.2	5,216	48611.2	162.9	318.6	3.1

* Data taken from LANL Stored TRU Waste Data, found in Appendix.

Table 3.30

Category	Number of Items	Total Volume	Ref.
LANL Corrugated Metal Pipe	211	590.8 m ³	

Description of Category:

Corrugated metal pipe
Dimensions: 20 ft x 2.5 ft

Placement:

Pipes stacked vertically in shallow pit, pit then backfilled with dirt.

Inside Configuration:

Construction consisted of taking the corrugated pipe and welding a metal plate to one end and then filling with 1 ft of clean concrete. The waste which was not dewatered was then added. Concrete was added to the slurry to form a cement paste. After this hardened, another 1 ft of concrete was then added to the top of the pipe. No metal plate or lid was placed in the top of the pipe. Each pipe is identified with an I.D. tag.

Content Data:

Contents are PU-239/Am-241 in a cement paste.
Radiation levels are less than 200 mR/hr.

Table 3.31

	Category	Number of Items	Total Volume	Ref.
LANL	83-gallon drums	10	3.14 m ³	9,10

Description of Category:

Cylindrical mild steel (black iron) drum, 16 gauge body and heads.

Dimensions: 0.70 m ID x 0.95 m L.

Volume: 0.314 m³

Used only to overpack damaged 55 gallon drums.

Placement:

Stacked in pad-type storage (above and below ground).

Inside Configuration:

Overpack for damaged 55-gallon drums, sealed with two rolled or swedged-type hoops, 12 gage bolted ring with drop forged lugs and 5/8 in. bolt.

Content Data:

To date, contains only sludge and cement paste.

Major Radionuclides: Pu-239, Am-241

0-0.003 R/hr gamma at contact.

Table 3.32

Category	Number of Items	Total Volume	Ref.
LANL Non-Standard Drums	6	9.9 m ³	9,10

Description of Category:

Oversized mild steel drums with removable heads.

Dimensions: 4 drums measuring 0.92 m diameter ID x 1.82 m L

2 drums measuring 1.21 m diameter x 1.82 m L

Volume: 4 drums - 1.21 m³, 2 drums - 2.1 m³

Drums thought to be military surplus.

Placement:

Placed on below ground storage pad.

Inside Configuration:

Sealed with rubber gasket. Wastes are from laboratory decontamination following accidental release. Plastic bags and wrapped items fill drums.

Content Data:

Equipment and other debris.

Major Radionuclides: Pu-239

0.0 R/hr at contact.

Table 3.33

	Category	Number of Items	Total Volume	Ref.
LANL	Plywood Boxes	308	2334.1 m ³	9,10

Description of Category:

Fiberglass reinforced plywood box.

Dimensions: 1.2 x 1.2 x 2.1 m or made to order for special sizes up to 2.4 x 3 x 10.6 m

Volume: Standard - 3.17 m³ Rocky Flats Plant specification. (see INEL boxes).

Standard size - 100

Larger than standard - 159

Smaller than standard - 49

Placement:

Stacked on pad-type storage, above or below ground.

Inside Configuration:

Waste items may be wrapped in plastic, painted, or have openings sealed to contain contamination.

Content Data:

See Table 3.34 which follows. Also see Appendix, LANL section.

Major Radionuclides: Pu-239, Pu-238, Mixed Fission Products

0-0.070 R/hr gamma at contact with one exception, reading 1.5 R/hr max.

Table 3.34 Content of LANL FRP Boxes*

Content Codes	Content Description	Volume m ³	Weight, Kg	No. Boxes	Pu-239 (g)	Pu-238 (g)	Am-241 (g)
A19	Mixed combustibles - noncombustible	13.6	881.9	4	2001.3	0	0
A30, A31, A52	Metal - equipment, scrap metal	2096.9	201,17.2	234	8085.7	160	.3
A35	Combustible - Combustible building debris	7.3	51.7	2	8.8-	0	0
A55	Filters - Filter Media	117.4	7857.0	35	1.1	<.1	0
A90	Soil	69.4	42910.5	27	98.3	0	0
A36, A85, A99,	Other	<u>29.5</u>	<u>2912.9</u>	<u>6</u>	<u>450.4</u>	<u>0</u>	<u>0</u>
TOTAL		2334.1	255,791.2	308	10645.6	160	.3

* Data taken from LANL Stored TRU Waste Data, found in Appendix.

Table 3.35

	Category	Number of Items	Total Volume	Ref.
LANL	Concrete Cask	306	294.9 m ³	9,10

Description of Category:

Concrete Casks containing two 30 gallon drums.

Dimensions: 0.90 m OD (max) x 1.82 m L

Volume: 0.965 m³

Casks constructed in accordance with ASTM C76 specifications for reinforced concrete pipe.

24 in. ID, Class II, "B" wall. Concrete strength 4000 psi min. 3 in. reinforced wall thickness.

Exterior surface coated with coal tar epoxy; some also with asphalt roof compound.

Placement:

Casks are set in a shallow trench. After sealing, tops are covered with galvanized sheeting, then covered with 2 m of backfill.

Inside Configuration:

Vertical placement in shallow trench. U-233 waste placed in either 3-gallon or 15-gallon inner container sealed in concrete centered in 30-gallon drums.

Content Data:

See Table 3.36 which follows.

Major Radionuclides: Pu-238, U-233, Pu-239

0-0.250 R/hr gamma at contact with contained drums; lower but not measured values at cask surface.

Table 3.36 Content of LANL Concrete Casks*

Content Codes	Content Description	Volume m ³	Weight, Kg	No. Casks	Pu-239 (g)	Pu-238 (g)	U-233 (g)
A15, A16, A18 A60	Combustibles - mixed cellulosics, plastic material, mixed paper, plastic, rubber, other combustibles	84	107,562	84.5	43	1254.9	0
A17	Rubber material	17.1	19,990	15.5	0	122.1	0
A19	Mixed combustibles - noncombustible	40.8	47,880	38	0	1314.3	0
A30, A31, A50, A52	Metal - equipment, metal crucibles, scrap dies, other scrap metal	53	64,524	49.5	3	781.3	0
A55	Filters - Filter Media	4.5	11,170	8	0	113.5	0
A61	Other noncombustibles	92.8	135,600	107	250	2389.6	4,302
A25	Leached process residues	1.6	2,521	2	3	21.2	0
A95	Glass	<u>1.1</u>	<u>1,342</u>	<u>1</u>	<u>0</u>	<u>6.9</u>	<u>0</u>
TOTAL		294.9	390,589	305.5	299	6003.8	4,302

* Data taken from LANL stored TRU Waste Data, found in Appendix.

Table 3.37

Category	Number of Items	Total Volume	Ref.
NTS 55-gallon drums	633	134 m ³	21

Description of Category:

Cylindrical carbon steel drum.

Dimensions: 22.5 in. ID x 33.25 in. L, 24 in. OD x 35 in. L (.478 in. wall)

Volume: 7.42 ft³

Placement:

Above grade on asphalt pad. Drums are contained in cargo containers. Drums are stacked two high, 36 drums per tier. Container holds 72 drums. The cargo container is rectangular with 7 ft 6 in. minimum wide by 6 ft 11-7/16 in. minimum high door. Outside dimensions: 8 ft x 8 ft 6 in. high by 19 ft 10-1/2 in. long.

Inside Configuration:

Loose waste, not compacted. Drum sealed with pressed cork gasket until 1980. In 1980, terpolymer sealant "sealant 7600" used. Both sealed with bolted closure ring.

Content Data:*

<u>Waste Description</u>	<u>No. Containers</u>	<u>Volume (m³)</u>	<u>Weight (kg)</u>	<u>Pu (g/m³)</u>
Combustibles - paper, plastic, rags**	541	114.7	38,160	24
Process Solids	64	13.6	7,053	38.8
Metal Scrap	28	6	2,538	10.1

* Approximation based on Lawrence Livermore percentages for one year applied to total volume.

** A container is defined as "combustible" if greater than 10% by weight of the waste is combustible.

Table 3.38

	Category	Number of Items	Total Volume	Ref.
NTS	Steel Boxes	29	171 m ³	21

Description of Category:

Welded carbon steel boxes, painted white.

Dimensions: Three are 0.63 m x 0.63 m x 4.6 m; Largest 2.43 m x 2.43 m x 3 m.

Volume: Avg. 4.2 m³

Placement:

Stored inside cargo containers, placed on asphalt storage pad.

Cargo container is 3.7 m x 2.4 m x 2.6 m. Further description found on preceeding page Table 3.30

Inside Configuration:

Waste is loose, may be wrapped in plastic. Welded shut, or sealed with terpolymer sealant and bolted.

Content Data:

Gloveboxes, equipment, lathes, machinery. Gloveboxes are sprayed with polyurethane foam and nonflammable paint.

combustible - 25

noncombustible - 4

Table 3.39

	Category	Number of Items	Total Volume	Ref.
ORNL	30-gallon drums	101	17.2 m ³	12

Description of Category:

Cylindrical stainless steel or black iron drums.

Dimensions: 19 in. ID x 29 in. L

Volume: 6 ft³*

Stainless steel = 86

Black iron = 15

* ORNL designated volume.

Placement:

Stored in concrete building, 85% below grade. Drums are stacked in vertical layers.

Inside Configuration:

Waste is loose, not compacted, usually bagged in plastic. Drums are sealed with neoprene gasket and bolted closure ring.

Content Data:

Contents are only somewhat segregated by combustible/noncombustible. Waste is ~ 55% combustible, 45% noncombustible. All waste comes from laboratories. Consists mainly of paper, plastic, cloth, cans, process equipment, filters, tools, gloves, bottles, rags, silica gel. All read less than 200 mrem/hr. TRU activity only known for total. See Table 3.10.

Table 3.40

Category	Number of Items	Total Volume	Ref.
ORNL 55-gallon drums	1587	360.2 m ³	12

Description of Category:

Cylindrical stainless steel or black iron drums.

Dimensions: 22.5 in. ID x 33.25 in. L, 24 in. OD x 36 in. L (0.478-in. wall)

Volume: 8 ft³*

Stainless steel = 1325

Black iron = 262

* ORNL designated volume.

Placement:

Stored in concrete building, 85% below grade. Drums are stacked in vertical layers.

Inside Configuration:

Waste is loose, not compacted, usually bagged in plastic. Drums are sealed with neoprene gasket and bolted closure ring.

Content Data:

Contents are only somewhat segregated by combustible/noncombustible. Waste is ~ 55% combustible, 45% noncombustible. All waste comes from laboratories. Consists mainly of paper, plastic, cloth, cans, process equipment, filters, tools, gloves, bottles, rags, silica gel. All read less than 200 mrem/hr. TRU activity only known for total. See Table 3.10.

Table 3.41

	Category	Number of Items	Total Volume	Ref.
ORNL	Non-Standard Drums	2	.67	

Description of Category:

- 1 - 110 gal drum, consisting of two stainless steel 55-gal drums welded end-to-end
 Volume: .43 m³
 1 - overpack - mild steel drum
 Volume: .24 m³

Placement:

Stored in underground building

Inside Configuration:

110 gal drum has plastic liner. Lid is clamped in place with bolted ring.

Content Data:

110 gal drum - 17 grams of U-233

Overpack - 28 grams of Pu-239

107 grams of U-235

50 percent combustible

Both drums less than 200 mR/hr at contact

Table 3.42

	Category	Number of Items	Total Volume	Ref.
SRP	55-gallon drums	7065	1059 m ³	14

Description of Category:

Specification 17H: Cylindrical steel drum

Dimensions: 22.5 in. ID x 33.25 in. L, 24 in. OD x 35 in. L (0.478-in wall)

Volume: 7.62 ft³*

Since 1974 drums have been galvanized. Prior to that drums were painted.

Number drums galvanized = 3,532

Number drums painted = 31

* SRP designated

Placement:

Above ground on steel-base reinforced concrete pad. Newest pads are 150 ft x 60 ft. Older pads can vary. A module consists of one pad which is completely filled with drums, boxes, and cement culverts. After a module is completed, the drums are covered with polyethelene plastic and 4 ft layer of soil. Some stacking, two layers high, modules are covered with fish-net before plastic to resist tornadoes. Top soil is seeded.

Inside Configuration:

Since 1974 drums have contained polyethelene liner. Sealed with gasket and bolted closure ring. Waste can be loose, in plastic bags, buckets, or cans. Not compacted.

Content Data:

Specific contents are unknown. Since 1974 combustibles have been segregated from noncombustibles. Approximately 75% combustibles, 25% noncombustible.

Table 3.43

Category	Number of Items	Total Volume	Ref.
SRP steel boxes	39	441	14

Description of Category:

Welded carbon steel boxes.

Dimensions: Vary. Maximum allowable 6 ft x 8 ft x 12 ft

Volume: $\approx 440 \text{ ft}^3$ (varies)

Lifting bails on top and side.

Placement:

Above ground on steel-base reinforced concrete pad. See description of pads and storage under SRP culverts (Table 3.42). Steel boxes are stored the same way.

Inside Configuration:

Sealed with gasket and bolted. Waste may be covered with plastic.

Content Data:

Specific contents unknown. Primarily large equipment, glove boxes. Less than 10% combustible.

Table 3.44

	Category	Number of Items	Total Volume	Ref.
SRP	cement boxes	110	109 m ³	14

Description of Category:

Rectangular concrete boxes

Dimensions: 2 ft x 2 ft x 3 ft 1/4 in. to 2.625 ft x 2.208 ft x 3.688 ft. Walls 4-in to 5-in thick.

Volume: 35 ft³

Placement:

Above ground on steel-base reinforced concrete pad. See description of pad under SRP culverts (Table 3.42). These boxes are stored the same way.

Inside Configuration:

Wall of cask is lined by 1/4 in. carbon steel liner or case. Waste usually bagged in plastic.

Content Data:

Waste in these casks is from the Savannah River Laboratory. Includes a mixture of equipment, paper, plastic, gloves, and the usual laboratory-type of waste. Exact contents of each is unknown. Activity - varies widely; some contain Cm-244 and Cf-252. Most contain Pu-238. Radiation Level - average <200 mrem/hr. Range - 0 to ~ 500 mrem/hr at one foot.

Table 3.45

	Category	Number of Items	Total Volume	Ref.
SRP	Nonstandard concrete boxes	6	108 m ³	14

Description of Category:

Concrete boxes from Mound Facility and Los Alamos National Laboratory.
Dimensions: Vary. Largest - 11 ft 6 in. high, 8 ft 6 in. x 6 ft 6 in.
Weight - 15 tons
Concrete is 6-in. thick

Placement:

∞ Above ground on steel-base reinforced concrete pad. See description of pad under SRP culverts (Table 3.42).

Inside Configuration:

Unknown.

Content Data:

Mostly large equipment. Exact contents unknown. Estimated 10% combustible. Total curies - 235,000. Radiation level and activity for each box is unknown. All waste is contaminated with Pu-238.

Table 3.46

	Category	Number of Items	Total Volume	Ref.
SRP	concrete culverts	243	1847 m ³	14

Description of Category:

Cylindrical concrete casks.

Dimensions: Diameter - 1.8 m, height 2 m, thickness - 0.0142 m weight - (cask only) 10-1/2 ton

Volume: 8.21 m³

Grappling Hook on top, for lid only. Hooks on side

Placement:

Above ground on steel-base reinforced concrete pad. Newest pads are 150 ft x 60 ft. Older pads can vary. A module consists of one pad which is completely filled with drums, boxes, and cement culverts. After a module is completed, the culverts are covered with polyethelene plastic and 4 ft layer of soil. No stacking of culverts. Top soil is seeded.

Inside Configuration:

Culverts contain either 14 55-gallon drums or 8 polyethene boxes. Cement lids are sealed in place with resin. Inside drums or boxes, waste is loose, but usually bagged in plastic. Approximately 75% of culverts contain drums, 25% contain boxes.

Content Data:

Specific contents are unknown. Much of the waste is known to be combustible. Combustibles have been segregated within drums since 1974. Estimated 58% combustible, 42% noncombustible since 1974. Four cylinders are known to contain waste with Cf-252 present. Individually one cylinder could exceed 200 mR/hr; collectively they average 205 mR/hr and one classed as contact handled. Drums that are placed in the concrete culverts are those that are greater than .5 Ci/drum.

3.3 Remote-Handled - Summary

Remote-handled wastes are stored at Los Alamos, Hanford, Oak Ridge, and Idaho National Engineering Laboratory. Table 3.47 shows the volume and TRU content of each site. Because remote-handled waste records are even more scarce than are contact-handled waste records, data on waste forms are usually estimated or not available. To get an idea of the types of waste forms, the reader is referred to Section 2.3 on currently generated remote waste forms. The data in that section were collected for approximately one year of output. The percentages of waste forms will be reasonably close to the percentages of remote-handled, stored-waste forms. In some cases the waste consists of spent fuel from testing and examination programs. The details on fuel type were not readily available.

Table 3.47 shows the total TRU elements contained in the remote waste. Table 3.48 shows a further breakdown of the TRU isotopes. For LANL and Hanford these totals are based upon typical isotopic composition of weapons grade plutonium. For Oak Ridge and INEL the totals of each isotope were provided by the site.

3.4 Review of the RH Waste Categories at Storage Sites

Table 3.49 summarizes the wastes categories at each site. These data come from the detailed tables that follow. A detailed breakdown of each category is found in Table 3.50 through 3.57. These data are presented in much the same manner as the previous contact-handled data.

Table 3.47

Reported Inventories of Remote-Handled Transuranic
Waste to Dec. 31, 1980¹

<u>Storage Site</u>	<u>Volume in Storage (m³)</u>	<u>Mass of TRU Elements (kg)</u>	<u>Major Remote Generator Shipping to this Site</u>
Hanford	1261.1	5.2	Westinghouse Hanford Company (HEDL)
INEL	17.8	0.064	Argonne National Laboratory-East*
LANL	7.9	0.70	All Waste Generated On Site
ORNL	532.2	4.1	
TOTAL	1819.5	9.36	

* Has been largest contributor. Projections show the Idaho Chemical Processing Plant will become largest in 1980's.

Table 3.48

Major TRU Radionuclide Content in Remote-Handled Waste
(To December 31, 1980)

<u>Isotope</u>	<u>Hanford^{8,19}</u>		<u>INEL^{20,22}</u>		<u>LANL^{9,10}</u>		<u>ORNL¹²</u>	
	<u>Grams</u>	<u>Curies</u>	<u>Grams</u>	<u>Curies</u>	<u>Grams</u>	<u>Curies</u>	<u>Grams</u>	<u>Curies</u>
Am-241	0	0	0	0	0	0	11.4	38.88
Am-243	0	0	0	0	0	0	<0.1	1.48
Cf-252	0	0	0	0	0	0	<0.1	5.35
Cm-244	0	0	0	0	0	0	14.92	1213
Pu-238	1.34	22.4*	0.1	2.353	0.1	1.75*	0	0
Pu-239	4205.4	259.8*	58.7	3.603	328.65	20.3*	8.1	0.495
Pu-240	255.28	62.7*	5.1	1.111	19.95	4.9*	1.0	0.215
Pu-241	13.44	1554.1*	0.6	61.49	1.05	121.45*	<0.1	0.05
Pu-242	1.34	<0.1*	0.3	0.1	0.1	<0.1*	0	0
U-233	21.4	0.2	0.27	<0.1	0	0	600	5.682

* Calculated from total Pu reported using typical weapons grade percentages (Table 2.6).

Table 3.49 Remote Handled Waste Categories At TRU Waste Storage Sites
(To December 31, 1980)

Sites	Flatbed Rail Car	Steel Capsules, Casks, or Inserts	Paint Cans (In caissons)	30-gal Drums	Concrete Cylinders
<u>HANFORD</u>					
Vol. of one container (m ³)	varies	varies	0.0043	--	--
# of containers	17 cars	45	4580	none	none
Total Volume (m ³)	1104	137	20.1	--	--
SITE TOTAL VOLUME: 1261.1 m ³					
Curies of TRU Activity ^a					
Average	Not Avail	Not Avail	0.43 Ci/can	--	--
Range	0-212 Ci/can	0-.7 Ci/Vol	0-6 Ci/can	--	--
<u>INEL</u>					
Vol. of one container (m ³)	--	0.14	--	0.113	--
# of containers	none	8	none ^b	147	none
Total Volume (m ³)	--	1.2	--	16.6	--
SITE TOTAL VOLUME: 17.8 m ³					
Curies of TRU Activity ^a					
Average					
Range					
<u>LANL</u>					
Vol. of one container (m ³)	--	--	--	--	1.32
# of containers	none	none	none	none	6
Total Volume (m ³)	--	--	--	--	7.9
SITE TOTAL VOLUME: 7.9 m ³					
Curies of TRU Activity ^a					
Average					
Range					

^a Many curies of non-TRU activity are usually present in remote-handled waste. Curies of non-TRU are not included.

^b Some are found inside 30-gallon drums.

^c SRP has some which contain Cf-252. The average radiation level is 205 mrem/hr and they are found in the contact-handled section of this report. Some individual cylinders may be remote-handled.

Table 3.49 (Continued)

Sites	Flatbed Rail Car	Steel Capsules, Casks, or Inserts	Paint Cans	30-gal Drums	Concrete Cylinders
<u>ORNL</u>					
Vol. of one container (m ³)	--	varies	--	--	varies ^b
# of containers	none	32 ^d	none	--	196 ^d
Total Volume (m ³)	--	3.4	--	--	528.8
SITE TOTAL VOLUME: 532.2 m ³					
Curies of TRU Activity ^a					
Average		Not Avail			Not Avail
Range					
<u>SRP</u>					
Vol. of one container (m ³)	--	--	--	--	
# of containers	none	none	none	none	none ^c
Total Volume (m ³)	--	--	--	--	
SITE TOTAL VOLUME: --					
Curies of TRU Activity ^a					
Average					
Range					
Total # containers	17	85	4580	147	202
TOTAL VOLUME	1104	141.6	20.1	16.6	536.7
TOTAL VOLUME ALL SITES: 1819 m ³					

a Many curies of non-TRU activity are usually present in remote-handled waste. Curies of non-TRU are not included.

b Some are found inside 30-gallon drums.

c SRP has some which contain Cf-252. The average radiation level is 205 mrem/hr so they are found in contact-handled section. Some individual cylinders may be remote-handled.

d Some of these could be contact-handled due to decay of short-lived nuclides (fission by-products).

Table 3.50

Category	Number of Items	Total Volume	Ref.
HANFORD paint cans	4580	20.1 m ³	7,8

Description of Category:

Cylindrical tin paint can (1 gallon)

Dimensions: 6-5/8 in. diameter x 7-1/2 in. high

Volume: 0.15 ft³ (not including can)

Used in hot cell facility. Requires special truck for transportation, remote handling, and heavy shielding.

Placement:

Below ground in cylindrical concrete encasement known as a caisson. Caisson is 4 meters below surface, dimensions: 8 ft. diameter x 10 ft. high. Cans are dumped into caisson down an angled steel chute, 0.9 meters in diameter. Five such caissons are in use, with no more anticipated.

Inside Configuration:

Waste is loose in paint cans. No liner, and no cement present. Surface may be contaminated. Lids are sealed with clip locks, but some are known to have broken open, spilling contents inside caisson. No compaction.

Content Data:

Contents include plastic, cloth, metal, paper, glass. Some irradiated fuel elements. See Table 2.20, which is a description of one years contents from Westinghouse Hanford, the major contributor to Hanford remote-handled waste. Activity - beta-gamma (Avg.) = 250.7 Ci/ft³
 Pu = 6.38 g/ft³ (Avg.) U = 79.86 g/ft³ Rad level = 7200 mR/hr Est. = 1000 mR/hr (unshielded)

Table 3.51

Category	Number of Items	Total Volume	Ref.
HANFORD railroad flat cars	17	1104 m ³	7,8

Description of Category:

Large pieces of used equipment stored on flatbed railroad cars. Located in tunnel adjacent to Purex facility.

Dimensions: Car - 8 ft x 40 ft, Equipment - varies

Placement:

Tunnels are approximately 8 ft below surface. Two tunnels. Equipment is stacked on cars usually with no additional containment.

Inside Configuration:

No liners, no concrete encasement.

Content Data:

Large pieces of equipment from Purex reprocessing facility. Example - dissolvers, condensers, piping, other metal equipment. Activity - beta and gamma = 2.751 Ci/ft³ (Avg.) Pu = <500 g per load. Non-TRU isotopes include Cs¹³⁷, Sr⁹⁰, Co⁶⁰. No estimate available of radiation level.

Table 3.52

Category	Number of Items	Total Volume	Ref.
HANFORD nonstandard casks	45	137 m ³	7,8

Description of Category:

Three types of nonstandard casks: (1) EBR-2 steel casks - carbon steel - lead. Dimensions: 30 ft x 5 ft (2) Zirconium Hulls - Dimensions 30 ft x 5 ft 10 in. (3) Concrete casks - Dimensions: 5 ft 3 in x 5 ft 5 in. x 5 ft 6 in. All have special handling hooks. Thickness of steel and concrete unknown.

Placement:

Below ground in trenches, with 4 ft of soil cover. No stacking, no additional containment.

Inside Configuration:

Waste can be loose or inside doubled 5-gallon cans. Liner present in steel casks, usually lead for additional radiation protection.

Content Data:

Hulls are leached fuel rods, from zirconium reactor fuel assemblies. Concrete casks contain liners from General Electric.

Steel cask - Activity beta and gamma = 40,000 Ci/container (Avg.) less than 1.6 g Pu per container.
Radition = not available

Concrete Cask - Activity - beta and gamma = 23,000 Ci/containers (Avg.)
1100 gm Pu/container (Avg).

Table 3.53

	Category	Number of Items	Total Volume	Ref.
INEL	30-gallon drums (remote-handled)	147	16.6 m ³	20,22

Description of Category:

30 gallon carbon steel drums.
Cylindrical, painted, 18 gauge.
Dimensions: 19 in. ID x 29 in. L
Volume: 4 ft³

Placement:

Placed in Intermediate Level TRU Storage Facility (ILTSF). ILTSF is carbon steel storage vault. Vault consists of 7.9 m vertical pipes, 61 cm and 40.1 cm in diameter. Pipes are enclosed in 1.5 m high earth shield, with a removable cement shield plug. Gasketed cover is used on the vault.

Inside Configuration:

Waste in 30-gallon drum with 100 mil rigid plastic liner. Waste usually contained in 3- or 5-gallon paint cans (steel) but may be loose. When loose is bagged in plastic. Drum is sealed with rubber gasket and bolted closure ring.

Content Data:

Majority of contents come from Argonne National Laboratory East. See Table 2.20 for one-year breakdown. Activity - 0.32 g Pu-239/drum (ave.) - 0.03 g Pu-240/drum (avg.)
Data on non-TRU activity not available.
Radiation level: Limits are greater than 200 mrem/hr, less than 30 R/hr.
Actual dose rates are: 0.4 - 50 R/hr at contact.
Average dose rate is 7.0 R/hr at contact, median dose rate is 4.0 R/hr at contact.

Table 3.54

	Category	Number of Items	Total Volume	Ref.
INEL	Steel Inserts	8	1.2 m ³	20,22

Description of Category:

Dimensions: Cylindrical stainless steel containers 12-3/4 in. x 72-in. long.
Average volume - 5 ft³
Lifting fixture is attached to cask.

Placement:

Placed in Intermediate Level TRU Storage Facility (ILTST). ILTSF is carbon steel storage vault. Vault consists of 7.9 m vertical pipes, 61 cm and 40.1 cm in diameter. Pipes are enclosed in 1.5 m high earth shield, with a removable cement shield plug. Gasketed cover is used on the vault.

Inside Configuration:

Waste inside carbon steel welded insert; usually inside plastic bags.

Content Data:

Waste is primarily associated with fuels examination and testing. Specific contents not available. Waste includes fuel assemblies, paper, gloves, plastic, labware, and small tools and equipment. Radioactivity Limits: >200 mrem/hr, <1000 R/hr at contact. Actual dose rates 0.5 - 71.0 R/hr at 3 ft. Avg. 3 ft dose = 16.6 R/hr. Average dose rate = 3.9 R/hr at 3 ft. Radionuclides - see Table 3.48.

Table 3.55

Category	Number of Items	Total Volume	Ref.
LANL Concrete Cylinders	6	7.9 m ³	9,10

Description of Category:

Steel casks encased in concrete.

Overall: 0.61 m x 4.4 m, including lifting fixtures

Dimensions: Pipe - (2) one 0.23 - 0.30 m ID x 3.66 m L

one 0.61 m OD x 4.27 m L

Both pipes are sealed at one end with steel plate. Smaller pipe is centered in large pipe, partially enclosed in concrete.

Placement:

Casks stand vertically in individual shafts 0.76 m diameter x 4.2 to 4.3-m deep. Concrete is used to seal around the cask tops in the shafts. This is a very thin layer of concrete, leaving the cask retrievable without extensive removal methods.

Inside Configuration:

Hot cell wastes packaged in 3.8 & paint cans, sealed in plastic container and bagged.

Content Data:

Includes hot-cell trash, wipes, glassware, small tools, absorbed liquids, and plastics. See Table 2.22 for description of one year. Activity - not available Beta-gamma activity - not available. Radiation level - 0.2-100 R/hr gamma at contact.

Table 3.56

	Category	Number of Items	Total Volume	Ref.
ORNL	Concrete Casks	196	528.8 m ³	12

Description of Category:

Reinforced Concrete Casks.

Dimensions: 1.27 m to 1.37 m ID x 2.13 m to 2.44 m L

Wall thickness: (3 types used) 0.114 m, 0.152 m, 0.305 m

Placement:

87 in unlined trenches with concrete pour over top; these are considered nonretrievable (buried).

183 in trenches without concrete pour.

13 in underground storage building. Use began in 1980.

Inside Configuration:

Waste placed in 3.8 l metal paint cans. Sealed with metal lids, and heat sealed in polyethylene plastic.

Content Data:

Specific contents unknown. Table 2.23 shows the estimates for a one-year period. There are no sludges. Estimated metal content is 10% of the volume. Twenty casks contain large equipment items such as pumps and furnaces. Remainder is similar to Table 2.23. Activity - Avg. of 0.382 Ci/m³. Radiation level - was greater than 200 mR/hr. Decay may have reduced this to less than 200 mR/hr.

Table 3.57

	Category	Number of Items	Total Volume	Ref.
ORNL	Stainless Steel Capsules	32	3.4 m ³	12

Description of Category:

Stainless steel capsules

Dimensions vary: Smallest - 6-in. diameter x 30 in. long
 Largest (dia.) - 8-in. diameter x 100 in. long
 Largest - 5-in. diameter x 144 in. long

Placement:

Placed in stainless steel wells; tops of wells are at ground level and surrounded by a concrete pad. Wells are closed with a concrete shielding plug.
 Dimensions of well: 3 to 4.6 m L x 0.2 to 0.75 OD

Inside Configuration:

Capsules are welded or flanged and bolted. Waste is packaged on a case by case basis. May be bagged, canned, or loose.

Content Data:

Contents are mostly fuel elements which have been cut up for examination. Associated hardware may be present. See Table 2.23 for one year description. Activity - Avg of 0.382 Ci/m³. Radiation level - was >200 mR/hr. Could be less now due to beta-gamma products decay.

4. CHARACTERISTICS OF BURIED TRU WASTE

Since weapons research began in the 1940's, land burial has been used to dispose of radioactive wastes. As used in this document, the term "buried," refers to those radioactive TRU wastes which have not been segregated into designated retrieval locations. In some cases, "stored" wastes are kept in underground trenches, and to the casual observer, these wastes would appear to be buried.

Prior to 1970, solid waste was buried such that no reliance was placed on the integrity of the container after burial. The containers were intended only to provide confinement for transportation to the burial ground. Most containers have been cardboard boxes, but wooden boxes, fiber drums, metal drums, plastic bags, and sprayed coatings have been used. Also, large pieces of equipment were often buried with no barrier, or encased in cement. Packages of waste contain rags, paper, gloves, supplies, tools, filters, and equipment, much the same as the stored wastes. Experimental retrieval studies have indicated that most of the original containers have deteriorated, but in many cases the plastic (bag) liners are still intact.^{24,25} Trenches of various depths have been used with 12 feet being the most common depth. Three feet of soil is commonly used to cover buried waste, but this can also vary greatly.

Because of these burial practices, a second large category of buried waste exists. Large quantities of soil have been contaminated not only from these buried wastes, but as a result of liquid waste disposal practices. Contaminated soil has resulted from liquids being sent directly to trenches, from cribs designed to hold or evaporate liquids, and from accidental leaks in tanks or pipes.

Table 4.1 shows the estimated volumes and TRU content of contaminated soil at the various sites. These totals cover a large range. The lower value is an estimate of the amount of soil probably contaminated

to a TRU radioactivity level greater than 10 nCi/g; the upper value is the amount of soil that might have to be handled if the waste were exhumed, depending on the exhumation method chosen. In cases where TRU-contaminated liquid waste was disposed of in soil (footnotes b, c, and d of Table 4.1), the contaminated areas are more precisely known. Yet, it is not possible to determine how much soil must be disposed of (or processed) as TRU waste. Additional characterization data for disposal sites can be expected to define the subsurface contamination more accurately.⁶

Table 4.2 shows the data that are available on the waste containers. Savannah River and Oak Ridge provide data other than general information because they began segregating some TRU waste during the burial period 1965 to 1970. H. M. Batchelder of EG&G, Idaho, provided a table showing shipments of waste from Rocky Flats Plant, Colorado, to the INEL storage site from 1954 to 1970.²⁶ The purpose of including this table is to give an indication of the types of packages that were buried in this early period. The total volumes do not match those of current inventories. The data are shown in Table 4.3. Table 4.4 gives the key dates affecting buried wastes at the various sites. Little more is known of the history or makeup of buried wastes.

Table 4.1 Estimated Amounts of Buried TRU Waste

Burial Site	Solid waste emplaced (m ³)	Contaminated soil from waste burial ^a (m ³)	Mass of TRU elements (kg)	Radioactivity (Ci)	Reference
Hanford	193,120	57,200-500,000 ^b	605	160,000	8
INEL	57,100	56,640-156,000	357	178,000	22
LANL	11,500	5,910-301,000 ^c	13	49,200	10
NTS	0	0	0	0	21
ORNL	6,200	11,770-1,600,000	5 ^d	2,100	12
SRP	31,000	Up to 38,000	9	23,516	14
Sandia	3		<<1		1
TOTAL	298,933 ^e	574,320-2,595,000	1,000	412,816	

^a The volumes shown cover a range bounded by (1) the quantity of soil probably now contaminated to a level >10 nCi/g and (2) the amount of soil that might have to be handled during exhumation of TRU waste until assay and TRU/LLW segregation are complete.

^b Also at Hanford there are an estimated 2 to 7 million cubic meters of contaminated soil, containing less than 200 kg of plutonium resulting from early liquid waste disposal practices.

^c In addition, there is an estimated 175-7,000 m³ of contaminated soil from liquid waste disposal, containing ~0.14 kg of TRU elements.

^d In addition, it is estimated that there is up to 1,000 m³ of contaminated soil from liquid waste disposal, containing ~0.3 kg of TRU elements.

^e There are some weapon accident residues (<33 m³) in plywood boxes at the Pantex Plant, Amarillo, TX, pending retrieval, identification, and shipment to NTS.

Table 4.2 Buried Waste Categories at DOE Storage Sites

Sites	Cardboard Boxes, Drums Miscellaneous		Concrete Monoliths		Reference
	Vol (m ³)	TRU Activity (Curies)	Vol (m ³)	TRU Activity (Curies)	
INEL	57,100	230,000*	0	0	22
LANL	11,500	18,800**	0	0	10
NTS	0	0	0	0	21
ORNL	5,954	754**	246	Included in box, drum, and misc total	12
Hanford	193,120	256,562	0	0	8
SRP	25,800	144,000	850	Included in box, drum, and misc total	14
TOTAL	272,800	1,224,841	850	253,879	

Table 4.3 Summary of Containers of Solid Waste Shipped from Rocky Flats Plant to the INEL Storage Site, 1954 to 1970²⁶

Calendar Year	55-Gal No.	Drums Cu.Ft.	30-Gal No.	Drums Cu.Ft.	40-Gal No.	Drum Cu.Ft.	Boxes (Std) ^a No.	Cu.Ft.	Boxes (>Std) No.	Cu.Ft.	Boxes (>Std) No.	Cu.Ft.	Cartons of No.	Fibers Cu.Ft.	Cartons No.	Cu.Ft.	Total Cu.m
1954	1,705	12,617	2,265	11,325	--	--	--	--	5	50	--	--	--	--	--	--	679.5
1955	4,381	32,419	174	870	53	318	--	--	7	186	--	--	1,205	5,664	--	--	1117.5
1956	4,773	35,320	11	55	1,054	6,324	--	--	8	106	--	--	2	9	--	--	1184.2
1957	7,138	52,821	535	2,925	--	--	--	--	61	2,367	3	672	1,251	5,880	101	2,112	1891.2
1958	6,096	45,110	303	1,515	43	259	--	--	131	4,073	9	1,797	1,042	4,932	123	554	1649.4
1959	7,883	58,334	119	595	5	30	--	--	139	5,399	7	1,268	1,679	7,891	--	--	2082.0
1960	7,689	56,399	30	150	1	6	--	--	160	8,104	22	3,257	130	611	34	156	1959.3
1961	9,566	70,788	22	110	17	102	--	--	153	5,824	12	1,850	1,592	7,450	--	--	2439.1
1962	10,752	79,565	15	75	1	6	--	--	166	9,351	34	5,692	549	2,557	7	35	2755.1
1963	12,012	88,889	4	20	--	--	--	--	199	13,835	87	13,732	535	2,065	--	--	3357.2
1964	11,383	84,234	2	10	--	--	--	--	168	10,120	211	33,645	1,023	4,927	--	--	3784.8
1965	9,784	72,402	--	--	--	--	--	--	91	4,493	280	41,476	762	3,581	--	--	3453.8
1966	13,596	100,610	12	60	--	--	--	--	59	3,344	454	64,345	575	3,101	10	95	4858.5
1967	18,350	135,790	3	15	--	--	1	112	32	1,519	391	51,615	990	4,980	948	11,670	5825.6
1968	19,118	141,473	66	330	--	--	425	47,600	76	5,850	588	95,565	323	2,433	4,267	52,484	9791.1
1969	17,564	129,974	2,855	14,275	--	--	665	74,480	30	1,611	63	14,109	209	1,528	249	3,056	7052.8
1970	22,321	165,175	741	3,705	--	--	1,380	154,560	59	3,431	62	15,686	641	4,679	43	529	9848.9
Total No.	184,111		7,207		1,174		2,471		1,544		2,223 ^b		12,508 ^c		5,782 ^d		
Total Cu.Ft.		1,362,420		36,035		7,045		276,752		79,663		344,699		62,288		70,691	

^a Standard Box - 84 in. x 48 in. x 48 in.

^b 875 Boxes 84 in. x 48 in. x 52 in. and 273 Boxes 84 in. x 48 in. x 50 in.

^c Cartons of Filters - 24 in. x 24 in. x 14 in., 24 in. x 24 in. x 16 in., 24 in. x 24 in. x 28 in., 28 in. x 28 in. x 16 in.

^d Includes 5,496 Cartons containing 55-gallon drums ~65,952 cu. ft.

Table 4.4 Significant Dates and Events Affecting Buried Wastes

TRU Burial Sites	1944-45	1952-56	1958-67	1970 *-74	1978-	Reference
Hanford	Hanford begins solid waste burial. TRU waste is mixed with beta- and gamma-emitting waste.		1967-Hanford ends solid waste burial in 300 Area (much closer to City of Richland than current 200 Area).	'67-70 separate "alpha" trenches are established Nov. 1970. TRU waste segregated and stored.		7,27
INEL		1952-INEL begins solid waste burial. TRU and beta-gamma waste are combined.	1958 to 1963 INEL stacks waste drums, rather than merely dumping. 1963-They resume dumping. 1964-Separate "alpha" trenches established.	Nov. 1970-TRU is segregated and stored.	1978-Approx. 4700 m ³ of buried waste is retrieved in experimental projects and put in storage.	25,28
LANL	LANL begins solid waste burial. TRU waste is buried with beta-gamma-contaminated waste. Plutonium contaminated liquid waste disposed of in beds or trenches.	1952-Residues from liquid waste (TRU) mixed with cement and buried. 1956-Waste with 1 milligram plutonium or more buried in special shafts or holes.	1968-Cemented sludges and raffinate are mixed with cement pumped into deep holes.	Mid-1971. TRU segregated and stored.		27,29
ORNL	ORNL begins solid waste burial. TRU waste mixed with beta-gamma. Exact location not well defined.		1966-Liquid supernate is disposed of by shale fracturing, fixing the waste in shale at approx. 300 m below ground.	Oct. 1970-TRU segregated and stored.		12,27
SRP		1953-SRP begins solid waste burial. TRU and beta-gamma contaminated waste.	1965, SRP segregates into retrievable and nonretrievable. Waste greater than .1 curie/package put in concrete containers or encapsulated in concrete monoliths	1974-Monoliths discontinued. TRU >10 nCi/g segregated and stored.		30

* 1970 AEC edict on storage of materials suspected to contain TRU radionuclides.
1973-AEC edict on 10 nCi/g limit.

5. ADDITIONAL SOURCES OF TRU WASTE INFORMATION

5.1 Further Reports on Subjects Not Covered in This Document

The information found in this section is not intended to represent an exhaustive compilation of TRU waste information. It represents a sampling of the most informative data that the author has seen while assembling this document. It focuses on information about the waste itself or the containers used to store the waste.

The DOE has a program in place to maintain a file of pertinent data on current and projected nuclear waste inventories. The 1981 report is "Spent Fuel and Radioactive Waste Inventories and Projections as of December 31, 1980," DOE/NE-0017, and is available from the ORNL. This is the official source for TRU waste data which is intended to be updated on an annual basis. In addition, the DOE also sponsors the Solid Waste Information Management Systems (SWIMS) at INEL.³¹ This system provides volumes and radionuclide data for all buried and stored solid radioactive wastes. The TWSO has published a Long Range Master Plan for the long-term disposal of TRU wastes.³² This document contains a comprehensive plan, covering R&D, analysis, decision making, design, construction, operations, and decommissioning for all aspects of TRU waste management.

Anticipating the eventual retrieval and shipping of all its waste, EG&G-Idaho has done a useful study on the nonradiological hazards of TRU waste.³³ Another report done at INEL contains valuable data on retrieving buried wastes. The document was referred to earlier, and is titled "Initial Drum Retrieval, Final Report," by K. B. McKinley and J. D. McKinney.²⁵ Additional reports may be available from these authors.

The TERA Advanced Services Corporation in Berkely, California, has published a very comprehensive document on waste container characteristics. It gives a detailed look at the containers which are presently approved by the Department of Transportation (DOT). It is titled, "Transuranic Contaminated Waste Container Characterization and Data Base," by B. G. Kniazewycz.³⁴ Two summary reports that have been used extensively in the past are "Inventory and Sources of Transuranic Solid Waste," by the TERA Advanced Services Corporation,²⁷ and "Preliminary Evaluation of the Characteristics of Defense Transuranic Waste," by H. C. Shefelbine.¹⁵ This report was referred to earlier in this document. Parts of these documents are now somewhat outdated, but they do contain some information not included in this report. Finally, a document has been published by the Brookhaven National Laboratory that shows the relationship of TRU waste and high-level nuclear waste. The document gives inventories of both high-level and TRU waste. It is titled "Nuclear Waste Management Technical Support in the Development of Nuclear Waste Form Criteria for the NRC."³⁵

5.2 Information Available at Individual Sites

All of the major storage sites, and many of the generating sites, have data in their data management (computer) centers. Sometimes a separate small computer is used, but often the system is part of a large site system.

Generally speaking, this report includes nearly all the data available on the specific contents of waste containers at storage sites. The one exception is the data system at INEL. They have much more information, and H. M. Batchelder should be contacted for specific needs. In the area of radionuclide data, almost all sites have additional specific data for certain years, packages, or locations. Also, most systems include data identifying the location of the waste at each of the sites. Concerning the origin of the waste, most readily available data were included in this report. A much more detailed picture could be

Table 5.1 Description of Site Automated Data Systems

<u>Site</u>	<u>Data System</u>	<u>Person to Contact</u>
Argonne National Laboratory-East	Most historical records available from H. M. Batchelder at INEL. Some recent data on computer at ANL-East.	L. M. Cheevers
Hanford	Waste burial in the 200 Areas. Includes Battelle-PNL, UNC, and Westinghouse-Hanford. Printout included in Appendix.	B. M. Poremba
INEL	Several systems which are currently being combined in one called NOMAD. Have data on all sites that ship to INEL and the SWIMS. Very extensive data.	H. M. Batchelder
Los Alamos National Laboratory	New system that includes all LANL records. Data in appendix are typical of what is available.	J. F. Warren
Mound Facility	Historical records are at INEL.	
Oak Ridge National Laboratory	ORNL Solid Radioactive Waste Summary. Primary records on location, radionuclides, volumes, and location of generation.	E. M. King
Rocky Flats Plant	Extensive system on waste forms and building of generation. Also have detailed data on individual packages.	M. A. Aguilar
Savannah River Plant	System primarily records Volumes and location of burials, but has some data on stored radionuclide content, and location of generation. Called the COBRA system.	B. D. Helton

obtained by conducting further specific research such as sampling studies. Table 5.1 shows the major sites, the name or description of their data system, and the person to contact to get more information on the kinds of data available.

Most of the sites have published, or are in the process of preparing, environmental impact statements or environmental assessments. These documents usually contain data on risk assessment which has not been covered in this document. They also include a large amount of information on the physical location and future impacts of the site on the environment. Waste management site plans contain similar information, and they are available at Hanford, INEL, RFP, LANL, SRP, and ORNL. A listing of each of these documents can be found in Appendix C. The Mound Facility program plan for D&D is a similar document which explains site plans and impacts.³⁶

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APPENDIX A

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AEC	-	Atomic Energy Commission
ALO	-	Albuquerque Operations Office
APL	-	(Bettis) Atomic Power Laboratory
Am	-	Americium
CH	-	Contact Handled
D&D	-	decontamination and decommissioning
DOE	-	Department of Energy
DOT	-	Department of Transportation
FRP	-	Fiberglass Reinforced Plastic
FFTF	-	Fast Flux Test Facility
FMEF	-	Fuels and Materials Examination Facility
HEPA	-	high efficiency particulate air
HEDL	-	Hanford Engineering Development Laboratory
ICPP	-	Idaho Chemical Processing Plant
INEL	-	Idaho National Engineering Laboratory
LANL	-	Los Alamos National Laboratory
LLNL	-	Lawrence Livermore National Laboratory
N/A	-	not available
N/R	-	not reported
NTS	-	Nevada Test Site
PNL	-	Pacific Northwest Laboratory
Pu	-	Plutonium
ORNL	-	Oak Ridge National Laboratory
R&D	-	Research and Development
RFP	-	Rocky Flats Plant
RH	-	Remote Handled
RHO	-	Rockwell Hanford Operations
RI-RFP	-	Rockwell International - Rocky Flats Plant
SRL	-	Savannah River Laboratory
SRP	-	Savannah River Plant
SWIMS	-	Solid Waste Information Management Systems
TRU	-	transuranic
TWSO	-	Transuranic Waste Systems Office
UNC	-	United Nuclear Company
WHC	-	Westinghouse Hanford Company
WIPP	-	Waste Isolation Pilot Plant

APPENDIX B

Tables Compiled from Computer Data
at INEL, Los Alamos, Hanford, and Savannah River

DATA COMPILED BY H. M. BATCHELDER
FROM EG&G, IDAHO WMIS SYSTEM

TRANSURANIC STORAGE AREA (TSA) DATA(1)
9-71 thru 12-81
TABULATED BY CONTENT CODE

Page 1 of 8

Generator*	Content Code	Content Description	Drums			Boxes			Pu (gm)	Am (gm)
			Number of	Volume (ft ³)	Weight (lb)	Number of	Volume (ft ³)	Weight (lb)		
WMC	0	Not Recorded - Unknown	18,972	146,033	4,066,585				24,958	108
RFO	1	First Stage Sludge	7,750	58,353	3,804,908				33,996	14,493
RFO	2	Second Stage Sludge	7,688	57,784	4,066,629				1,957	88
RFO	3	Organic Set Ups (oil solids)	5,621	42,363	2,865,509				2,024	1
RFO	4	Special Set Ups (cement)	1,237	9,650	724,090				1,261	7
RFO	5	Evaporated Salts	52	401	21,218	1	112	4,060	6	7
BET	10	Combustibles (rags, gloves, poly)	912	6,968	173,533				0	0
BET	20	Noncompressible, Noncombustible	793	5,880	188,011				0	0
BET	30	Solidified Grinding Sludge, etc.	45	335	10,849				0	0
BET	40	Solid Binary Scrap Powder, etc.	172	1,728	83,706				0	0
RFO	90	Dirt	135	993	83,535				0	0
RFO	95	Sludge	23	169	8,880				0	0
ALE	102	Absorbed Liquids	26	205	6,154				526	0
ALE	104	Alpha Hot Cell Waste	190	745	18,333				24	0
ALE	105	Empty Bottles & Absorbent	3	27	372				24	0

TRANSURANIC STORAGE AREA (TSA) DATA(1) (Cont'd)
TABULATED BY CONTENT CODE

Page 2 of 8

Generator*	Content Code	Content Description	Drums			Boxes			Pu (gm)	Am (gm)
			Number of	Volume (ft ³)	Weight (lb)	Number of	Volume (ft ³)	Weight (lb)		
INEL	150	Laboratory Waste	20	138	3,980				444	0
INEL	151	Solidified Fuel Sludge	2	8	700				6	0
INEL	152	Pu Neutron Sources	8	58	1,470				221	0
INEL	153	Combustible Lab Waste	28	116	1,970				7	0
INEL	154	Sample Fuel	2	14	800				0	0
INEL	155	TRU Scrap	5	36	545	1	112	150	2	0
INEL	156	Chem Cell Rip-out				7	896	18,550	9	0
BCL	200	Americium Sources	1	7	50				0	0
BCL	201	Noncombustible Solids	54	397	17,576				219	0
BCL	202	Combustible Solids	8	59	1,374				16	0
BCL	203	Paper, Metals, Glass	26	191	5,429				83	0
BCL	204	Solidified Solutions	28	206	15,801				10	0
RFO	241	Americium Process Residue	120	897	43,997				150	0
RFO	290	Sludge, Filter	1	7	145				14	0
RFO	292	Cemented Sludge	275	2,022	73,136				6,496	2

TRANSURANIC STORAGE AREA (TSA) DATA(1) (Cont'd)
TABULATED BY CONTENT CODE

Page 3 of 8

Generator*	Content Code	Content Description	Drums			Boxes			Pu (gm)	Am (gm)
			Number of	Volume (ft ³)	Weight (lb)	Number of	Volume (ft ³)	Weight (lb)		
RFO	300	Graphite	1,180	8,722	300,437				11,712	0
RFO	301	Graphite Cores	33	243	8,606				418	0
RFO	302**	Benelex and Plexiglass	19	140	4,922	16	1,792	59,460	68	0
RFO	310	Graphite Scarfings	16	118	3,827				81	0
RFO	311	Graphite Heels	6	55	1,998	1	112	1,940	1,140	0
RFO	320	Tantalum	347	2,552	77,352				10,422	34
RFO	330	Paper and Rags - Dry	5,074	37,783	930,070	1,201	134,344	2,212,390	17,758	1,008
RFO	335	Filters, Absolute (8" x 8")	110	809	16,912				215	7
RFO	336	Paper and Rags - Moist	7,393	54,473	1,457,785	9	1,008	18,160	2,689	51
RFO	337	Plastics, Teflon, Wash, PVC	2,142	15,904	365,354	9	1,008	18,080	1,892	82
RFO	338	Insulation and CWS Filter Media	253	1,860	41,884	78	8,736	153,890	6,501	0
RFO	339	Leaded Rubber Gloves and Aprons	656	4,824	222,973				16,122	16
RFO	360	Insulation	239	1,761	34,278	1	112	1,860	217	0
RFO	361	Insulation Heel	1	11	411				199	0

TRANSURANIC STORAGE AREA (TSA) DATA(1) (Cont'd)
TABULATED BY CONTENT CODE

Page 4 of 8

Generator*	Content Code	Content Description	Drums			Boxes			Pu (gm)	Am (gm)
			Number of	Volume (ft ³)	Weight (lb)	Number of	Volume (ft ³)	Weight (lb)		
RFO	370	Crucible, Leco	34	250	12,199	.			245	0
RFO	371	Brick, Fire	958	7,048	346,619	24	2,688	54,760	3,703	0
RFO	372	Grit	5	37	2,220				21	0
RFO	374	Blacktop, Concrete, Dirt, and Sand	1,097	8,067	428,348	46	5,152	148,420	714	2
RFO	375	Oil Dri Residues from Incinerator	14	103	4,953				91	0
RFO	376	Cement Insul. and Filter Media	1,049	7,714	210,802	7	784	16,733	23,650	128
RFO	391	Crucible and Sand	19	140	6,510				718	91
RFO	392	Sand, Slag, and Crucibles	7	74	2,947				1,233	0
RFO	393	Sand, Slag, and Crucible Heels	20	147	4,494				3,527	0
RFO	410	Molten Salts	22	162	6,637				233	21
RFO	411	Electrorefining Salt	2	15	475				24	0
RFO	412	Gibson Salts	1	7	250				21	0
RFO	416	Zinc Manganese Alloy Metal	1	7	484				170	31
RFO	420	Ash, Incinerator (virgin)	9	66	3,421				480	0
RFO	421	Heels, Ash (2 percent G/G)	101	743	21,451				17,765	0
RFO	422	Soot	15	110	3,170				807	0

TRANSURANIC STORAGE AREA (TSA) DATA(1) (Cont'd)
TABULATED BY CONTENT CODE

Page 5 of 8

Generator*	Content		Drums			Boxes			Pu (gm)	Am (gm)
	Code	Content Description	Number of	Volume (ft ³)	Weight (lb)	Number of	Volume (ft ³)	Weight (lb)		
RFO	425	Fluid Bed Ash	8	59	3,134				3	0
RFO	430	Resin, Ion Column Unleached	29	266	11,528				2,716	0
RFO	431	Resin, Leached	6	59	2,387				263	0
RFO	432	Resin, Leached and Cemented	229	1,684	62,616				7,158	82
RFO	440	Glass	1,098	8,359	255,285	1	112	2,290	5,731	26
RFO	441	Raschig Rings, Unleached	1,573	11,575	306,024				12,453	9
RFO	442	Raschig Rings, Leached	853	6,276	155,544				1,819	14
RFO	460	Washables, Rubber, Plastics	6	67	2,813				81	0
RFO	463	Gloves, Drybox	53	510	19,533				759	0
RFO	464**	Plexiglass and Benelex	48	364	12,971				90	0
RFO	480	Metal Scrap (Non SS)	2,117	16,013	536,508	3,116	347,214	9,016,490	35,038	73
RFO	481	Metal, Leached (Non SS)	842	6,192	249,048	1	112	3,080	15,949	11
RFO	490	Filters, CWS	58	460	11,626	717	80,304	1,357,240	9,504	17
MND	801	Rags, Paper. Wood, etc.	31	228	3,601				28	0
MND	802	Dry Box Gloves and O-Rings	110	817	13,725				394	0

TRANSURANIC STORAGE AREA (TSA) DATA(1) (Cont'd)
TABULATED BY CONTENT CODE

Page 6 of 8

Generator*	Content Code	Content Description	Drums			Boxes			Pu (gm)	Am (gm)
			Number of	Volume (ft ³)	Weight (lb)	Number of	Volume (ft ³)	Weight (lb)		
MND	803	Metal, Equip., Pipes, Valves, etc.	160	1,185	25,916				1,296	0
MND	804	Plastic, Tygon, Manipulator Boots, etc.	210	1,558	23,522				265	0
MND	805	Asbestos Filters	34	252	4,947				220	0
MND	810	Glass, Flasks, Sample Vials, etc.	13	96	2,124				96	0
MND	811	Evaporator and Dissolver Sludge	4	29	668				39	0
MND	813	Glass Filters and Fiberglass	3	22	364				29	0
MND	814	Contaminated Mercury	2	15	268				111	0
MND	824	Equipment Boxes				201	34,888	431,453	781	0
MND	825	Equipment	169	1,291	32,935	1	121	1,809	231	0
MND	826	Equipment Boxes-Combustible	2	16	772	7	743	13,068	1	0
MND	834	High Level Acid	901	6,626	381,729				118	0
MND	835	High Level Caustic	1,486	11,060	574,546				114	0
MND	836	High Level Sludge/Cement	3,760	27,957	2,363,946				16	0
MND	838	<10 nCi/gm Noncombustible	1	7	335				0	0

TRANSURANIC STORAGE AREA (TSA) DATA⁽¹⁾ (Cont'd)
TABULATED BY CONTENT CODE

Page 7 of 8

Generator*	Content		Drums			Boxes			Pu (gm)	Am (gm)
	Code	Content Description	Number of	Volume (ft ³)	Weight (lb)	Number of	Volume (ft ³)	Weight (lb)		
MND	842	Contaminated Soil				36	3,780	159,986	1	0
MND	847	LSA < 100 nCi/gm Combustible	664	4,958	167,105				2	0
MND	848	LSA < 100 nCi/gm Noncombustible	129	951	26,483				0	0
RFO	900	LSA Paper, Plastics, etc.	351	2,603	70,695	6	672	11,402	1	0
RFO	950	LSA Metal, Glass, etc.	110	809	28,066	334	37,492	890,870	68	0
RFO	960	Concrete, Asphalt, etc.	704	5,233	309,123	171	10,426	713,250	326	0
RFO	970	Wood	24	176	4,762	62	6,839	131,690	468	0
RFO	976	Bldg. 776 Process Sludge	7	51	3,168	20	2,240	90,940	23	0
RFO	978	Laundry Sludge				11	1,232	46,980	43	0
RFO	980	Equipment	1	7	178				11	0
RFO	990	Dirt	470	3,456	255,463				0	0
RFO	995	Sludge	296	2,177	141,571	8	896	35,180	64	0
TOTALS			<u>81,582</u>	<u>613,200</u>	<u>26,876,103</u>	<u>6,093</u>	<u>683,927</u>	<u>15,614,181</u>	<u>291,597</u>	<u>16,407</u>

TRANSURANIC STORAGE AREA (TSA) DATA(1) (Cont'd)
TABULATED BY CONTENT CODE

Page 8 of 8

*Generator Acronyms

ALE Argonne National Laboratory-East
BCL Battelle Columbus Laboratories
BET Bettis Atomic Power Laboratory
INEL Idaho National Engineering Laboratory
MND Mound Laboratories
RFO Rocky Flats Operations (Plant)
WMC Waste Management Complex - Retrieved Drums

** SEE ALSO: Content Code 302/Content Code 464

(1) Content code data is unavailable for the first year of TSA operation (11/70-9/71).

DATA COMPILED BY J. F. WARREN FROM
LOS ALAMOS NATIONAL LABORATORY
WASTE MANAGEMENT SYSTEM

WASTE CODE	PACKAGES, VOLUME, AND WEIGHT				RADIONUCLIDE CONTENT (GRAMS)					PACKAGE RADIATION (mr/hr)		
	Package	Number of Packages	Volume(m ³)	Weight(kg)	PU-239 *	PU-238**	AM-241	U-233	Other	Surface Dose Range		
										High	Low	Average
A10 Graphite	30 gal drum											
	55 gal drum	1.0	0.2	70.3	8.7					1.0	1.0	1.0
	FRP box											
	Culvert ^a											
	Other											
Subtotal:		1.0	0.2	70.3	8.7							
A15 Mixed Cellulosics	30 gal drum	124.0	12.5	3862.0	99.3	1.0				4.0	1.0	1.1
	55 gal drum	222.0	44.1	11730.0	705.0	17.0				18.0	1.0	1.3
	FRP box											
	Culvert ^a	11.0	11.1	14140.0		240.8				12.0	1.0	1.7
	Other											
Subtotal:		357.0	67.7	29732.0	804.3	258.8						
A16 Plastic Material	30 gal drum	9.0	1.0	244.8	21.6					1.0	0.0	0.1
	55 gal drum	19.0	3.8	1017.0	81.2					150.0	1.0	11.1
	FRP box											
	Culvert ^a	2.5	2.4	3142.0		112.2				5.0	0.0	1.7
	Other											
Subtotal:		30.5	7.2	4403.8	102.8	112.2						
A17 Rubber Material	30 gal drum											
	55 gal drum											
	FRP box											
	Culvert ^a	15.5	17.1	19990.0		122.1				1.0	0.0	0.1
	Other											
Subtotal:		15.5	17.1	19990.0		122.1						

WASTE CODE	PACKAGES, VOLUME, AND WEIGHT				RADIONUCLIDE CONTENT (GRAMS)					PACKAGE RADIATION (mr/hr)		
	Package	Number of Packages	Volume(m ³)	Weight(kg)	PU-239 *	PU-238**	AM-241	U-233	Other	Surface Dose Range		
										High	Low	Average
A18 Mixed Paper, Plastic, Rubber, etc.	30 gal drum	9.0	1.0	288.1	13.6					10.0	0.0	1.1
	55 gal drum	135.0	27.8	7923.0	289.2		<0.1			300.0 ^k	0.0	8.5
	FRP box											
	Culvert ^a	48.0	51.8	61160.0		598.0				0.0	0.0	0.0
	Other											
Subtotal:		192.0	80.6	69371.1	302.8	598.0	<0.1					
A19 Mixed Combustible Non-Combustible	30 gal drum	38.0	4.3	1068.0	82.8					5.0	0.0	0.2
	55 gal drum	75.0	15.6	4068.0	134.8	<0.1				50.0	0.0	1.2
	FRP box	4.0	13.6	881.9	2001.3					0.0	0.0	0.0
	Culvert ^a	38.0	40.8	47880.0		1314.3				1.0	0.0	<0.1
	Other											
Subtotal:		155.0	74.3	53897.9	2218.9	1314.3						
A20 Hydrocarbon Oils	30 gal drum											
	55 gal drum	8.0	1.7	1412.7	1.3					1.0	0.0	1.3
	FRP box											
	Culvert ^a											
	Other											
Subtotal:		8.0	1.7	1412.7	1.3							
A21 Silicon Oils	30 gal drum	1.0	0.1	123.9		<0.1				1.0	1.0	1.0
	55 gal drum	3.0	0.6	681.6	20.0					5.0	0.0	2.0
	FRP box											
	Culvert ^a											
	Other											
Subtotal:		4.0	0.7	805.5	20.0	<0.1						

WASTE CODE	PACKAGES, VOLUME, AND WEIGHT				RADIONUCLIDE CONTENT (GRAMS)					PACKAGE RADIATION (mR/hr)		
	Package	Number of Packages	Volume(m ³)	Weight(kg)	PU-239 *	PU-238 **	AM-241	U-233	Other	Surface Dose Range		
										High	Low	Average
A25 Leached Process Residues	30 gal drum	232.0	26.0	11070.0	6778.0	0.3				45.0	0.0	1.1
	55 gal drum	364.0	73.5	38350.0	22527.0	6.1	278.2			100.0	0.0	3.7
	FRP box											
	Culvert ^a	2.0	1.6	2521.0	3.0	21.2				15.0	1.0	4.8
	Other											
Subtotal:		598.0	101.1	51941.0	29308.0	27.6	278.2					
A30,31 Equipment	30 gal drum	10.0	1.0	599.5	14.7	0.2				2.0	0.0	0.8
	55 gal drum	199.0	39.8	16249.1	528.5	22.5				10.0	0.0	1.0
	FRP box	230.0	2069.3	198093.2	7959.4	160.0	0.3			1500.0 ^b	0.0	7.1
	Culvert ^a	17.0	17.3	22470.0		99.1				4.0	0.0	0.5
	Other ^c	5.0	7.8	4536.0						0.0	0.0	0.0
Subtotal:		461.0	2135.2	241947.8	8502.6	281.8	0.3					
A35 Combustible Building Debris	30 gal drum											
	55 gal drum											
	FRP box	2.0	7.3	51.7	8.8					0.0	0.0	0.0
	Culvert ^a											
Subtotal:		2.0	7.3	51.7	8.8							
A36 Non-Combustible Building Debris	30 gal drum											
	55 gal drum											
	FRP box	3.0	22.7	2127.0	344.4	<0.1				3.0	0.0	1.0
	Culvert ^a											
Subtotal:		4.0	24.8	3941.4	344.4	<0.1						

WASTE CODE	PACKAGES, VOLUME, AND WEIGHT				RADIONUCLIDE CONTENT (GRAMS)					PACKAGE RADIATION (mr/hr)		
	Package	Number of Packages	Volume(m ³)	Weight(kg)	PU-239*	PU-238**	AM-241	U-233	Other	Surface Dose Range		
A46 Skull & Oxide	30 gal drum	1.0	0.1	47.7	9.4					0.0	0.0	0.0
	55 gal drum											
	FRP box											
	Culvert ^a											
	Other											
Subtotal:		1.0	0.1	47.7	9.4							
A50 Metal Crucibles, Scrap, Dies	30 gal drum	45.0	4.5	2042.0	159.7	0.6				5.0	0.0	1.3
	55 gal drum	133.0	26.6	9067.5	1171.5	21.6				9.0	0.0	1.4
	FRP box											
	Culvert ^a	3.0	3.4	3764.0		132.5				0.0	0.0	0.0
	Other											
Subtotal:		181.0	34.5	14873.5	1331.2	154.7						
A51 Precious Metal	30 gal drum	1.0	0.1	47.9		6.6				2.0	2.0	2.0
	55 gal drum											
	FRP box											
	Culvert ^a											
	Other											
Subtotal:		1.0	0.1	47.9		6.6						
A52 Other Scrap Metal	30 gal drum	1.0	0.1	43.4	0.2					0.0	0.0	0.0
	55 gal drum	23.0	4.6	1830.0	276.2					2.0	1.0	1.1
	FRP box	4.0	27.6	3084.0	126.3					0.0	0.0	0.0
	Culvert ^a	29.5	32.3	38290.0	3.0	549.7				4.0	0.0	0.4
	Other											
Subtotal:		57.5	64.6	43247.4	405.7	549.7						

WASTE CODE	PACKAGES, VOLUME, AND WEIGHT				RADIONUCLIDE CONTENT (GRAMS)					PACKAGE RADIATION (mr/hr)		
	Package	Number of Packages	Volume(m ³)	Weight(kg)	PU-239 *	PU-238 **	AM-241	U-233	Other	Surface Dose Range		
A55 Filter Media	30 gal drum	1.0	0.1	99.0	0.6					0.0	0.0	0.0
	55 gal drum	8.0	1.7	1451.0	0.3	<0.1	<0.1		2.0 ^e	2.0	0.0	0.5
	FRP box	35.0	117.4	7857.0	1.1	<0.1				0.0	0.0	0.0
	Culvert ^a	8.0	4.5	11170.0		113.5				0.0	0.0	0.0
	Other											
Subtotal:		52.0	123.7	20577.0	2.0	113.5	<0.1		2.0			
A56 Filter Media Residues	30 gal drum											
	55 gal drum	3.0	0.6	138.9	5.6					0.0	0.0	0.0
	FRP box											
	Culvert ^a											
	Other											
Subtotal:		3.0	0.6	138.9	5.6							
A60 Other Combustibles	30 gal drum	2.0	0.2	65.2	10.7					0.0	0.0	0.0
	55 gal drum	1315.0	264.0	74015.1	12926.0	25.3	2.1			150.0	0.0	3.3
	FRP box											
	Culvert ^a	23.0	18.7	29120.0	43.0	303.9				40.0	0.0	6.9
	Other											
Subtotal:		1340.0	282.9	103200.3	12979.7	329.2	2.1					
A61 Other Noncombustibles	30 gal drum	33.0	3.8	1181.0	32.9				<0.1 ^f	100.0	0.0	10.5
	55 gal drum	1173.0	236.2	82400.0	9567.2	69.8	13.2	1.0	3.0 ^g	250.0 ¹	0.0	3.0
	FRP box											
	Culvert ^a	107.0	92.8	135600.0	250.0	2389.6		4302.0		250.0	0.0	12.2
	Other											
Subtotal:		1313.0	332.8	219181.0	9850.1	2459.4	13.2	4303.0	3.0			

WASTE CODE	PACKAGES, VOLUME, AND WEIGHT				RADIONUCLIDE CONTENT (GRAMS)					PACKAGE RADIATION (mr/hr)		
	Package	Number of Packages	Volume(m ³)	Weight(kg)	PU-239 *	PU-238 **	AM-241	U-233	Other	Surface Dose Range		
										High	Low	Average
A70 Chemical Waste	30 gal drum	2.0	0.2	99.3	3.9					1.0	1.0	1.0
	55 gal drum	5.0	1.0	293.1	54.7					2.0	1.0	1.2
	FRP box											
	Culvert ^a											
	Other											
Subtotal:		7.0	1.2	392.4	58.6							
A75 Chemical Treatment Sludge	30 gal drum											
	55 gal drum	1111.0	231.5	225977.0	192.1	0.3	18.4			12.0	0.0	1.9
	FRP box											
	Culvert ^a											
	Other ^h	2.0	0.6	424.1	0.5	< 0.1	< 0.1			3.0	2.0	2.5
Subtotal:		1113.0	232.1	226401.1	192.6	0.3	18.4					
A76 Cement Paste	30 gal drum											
	55 gal drum	357.0	74.1	88150.0	69.1	0.2	6.5	2.1		5.0	0.0	0.8
	FRP box											
	Culvert ^a	211.0 ⁱ	590.8	956200.0	976.1	1.9	3209.7			1.0	0.0	< 0.1
	Other	8.0 ^h	2.5	2000.0	0.6	< 0.1	0.1			1.0	0.0	0.9
Subtotal:		576.0	667.4	1046350.0	1045.8	2.1	3216.3	2.1				
A85 Firing Point Residue	30 gal drum											
	55 gal drum											
	FRP box	2.0	3.2	453.6	106.0					0.0	0.0	0.0
	Culvert ^a											
	Other											
Subtotal:		2.0	3.2	453.6	106.0							

WASTE CODE	PACKAGES, VOLUME, AND WEIGHT				RADIONUCLIDE CONTENT (GRAMS)					PACKAGE RADIATION (mr/hr)		
	Package	Number of Packages	Volume(m ³)	Weight(kg)	PU-239 [*]	PU-238 ^{**}	AM-241	U-233	Other	Surface Dose Range		Average
A90 Contaminated Soil	30 gal drum											
	55 gal drum	46.0	9.6	8610.0	0.6					0.0	0.0	0.0
	FRP box	27.0	69.4	42910.5	98.3					0.0	0.0	0.0
	Culvert ^a											
	Other											
ubtotal:		73.0	79.0	51520.5	98.9							
A95 Glass	30 gal drum	3.0	0.3	88.5	1.7					1.0	0.0	0.3
	55 gal drum	11.0	2.2	669.5	52.0	0.1	0.2			2.0	0.0	1.0
	FRP box											
	Culvert ^a	1.0	1.1	1342.0		6.9				0.0	0.0	0.0
	Other											
ubtotal:		15.0	3.6	2100.0	53.7	7.0	0.2					
A99 Unidentified Material	30 gal drum	2.0	0.2	77.2	0.3				0.3	1.0	0.0	0.5
	55 gal drum	5.0	1.0	248.5	0.2					1.0	0.0	0.2
	FRP box	1.0	3.6	332.3						0.0	0.0	0.0
	Culvert ^a											
	Other											
ubtotal:		8.0	4.8	658.0	0.5				0.3			
TOTALS:		6570.5	4348.5	2206754.5	67762.4	6337.3	3528.7	4305.1	5.3			

* PU - 239 : Total grams of material types 51-57. (NU - SWG).

** PU - 238 : Heat source grade material (i.e. 80% Pu-238)

Footnotes:

- a. The culverts are concrete culvert-like casks placed vertically in the ground, each containing two 30 gallon black steel drums of waste. The volumes listed include the cask, and have been entered in the data base that way. The weights are for the 30 gallon drum, the waste inside the drum, and the culvert. The package radiation is the dose rate of the drums and not the cask, as it is impossible to measure cask dose rates since they already are partially buried when the drums are emplaced. The original intent in the use of these casks was that they became the retrievable container that would be sent to a repository. Based upon the current WIPP-WAC, it now may be desirable to devise a means of "retrieving" the stored 30 gallon drums from the culverts.
- b. One package has surface dose rate at 1500 mr/hr; the next highest dose rate for a package is 70 mr/hr.
- c. Three metal drum type containers measuring 4 feet in diameter by 6 feet high and two metal drum type containers measuring 3 feet in diameter by 6 feet high.
- d. Same type drum as in "c", measuring 4 feet in diameter by 6 feet high.
- e. The "other" radionuclide is NP-237.
- f. The "other" radionuclide is AC-227.
- g. The "other" radionuclides include 3.0 grams NP-237, .031 grams CM-242, and trace amounts of BK-249, CF-249, and CM-244.
- h. Containers are 83 gallon steel overpack drums measuring .95 meter in length and .7 meter in diameter.
- i. Corrugated Metal Pipe containers measuring 6.1 meters in length by .76 meter in diameter.
- j. The material in the category was from very early disposals where the records were not complete.
- k. One drum has a listed dose rate of 300 mr/hr; the next highest is 120 mr/hr.
- l. Two drums have a listed dose rate of 250 mr/hr; the next highest is 100 mr/hr.

JW/mlb

SUMMARY
 200 AREAS SEGREGATED NONCOMBUSTIBLE LAND BURIAL FROM 1970-TO DATE
 CPD RADIOACTIVE WASTE BURIAL GROUNDS, INCLUDING V7 TRENCH

BURIAL GROUND	SURFACE AREA (SQUARE FT)	VOLUME (CUBIC FT)	URANIUM (GRAMS)	PLUTONIUM (GRAMS)	OTHER RADIOACTIVITY (GRAMS)
200 WEST AREA					
DRY WASTE NO. 03A					
TRANSURANIC		8.87E+04		8.21E+03	*1
TRANSURANIC-OFFSITE		7.25E+03	7.14E+06	5.62E+03	
TOTAL		9.59E+04	7.14E+06	1.38E+04	2.26E+04
DRY WASTE NO. 04B					
TRANSURANIC		1.46E+04	3.31E+05	1.30E+04	*2
TRANSURANIC-OFFSITE		4.79E+02	7.57E+03	7.13E+02	*3
TRANSURANIC-CAISSON		2.47E+02	7.33E+03	2.03E+03	*4
TOTAL		1.53E+04	3.46E+05	1.57E+04	4.84E+05
DRY WASTE NO. 04C					
TRANSURANIC	2.92E+03	1.33E+04	5.65E+03	7.82E+04	*5
TRANSURANIC-OFFSITE		1.55E+02	3.06E+02	1.69E+02	
TOTAL	2.92E+03	1.34E+04	5.95E+03	7.84E+04	5.23E+03
TOTAL 200-W	2.92E+03	1.24E+05	7.49E+06	1.08E+05	5.12E+05

*1 (TH, 2.26E+04)(U-233, 4.00E+00)
 *2 (TH, 4.77E+05)(NP-237, 7.10E+01)(U-233, 7.28E+03)
 *3 (TH, 1.32E+02)
 *4 (TH, 2.80E+01)
 *5 (PU-238, 7.99E+03)

DATA COMPILED BY J. D. ANDERSON FROM
 ROCKWELL-HANFORD
 WASTE INFORMATION SYSTEM

SUMMARY
200 AREAS SEGREGATED COMPOSTIBLE LAND BURIAL FROM 1970-TO DATE
CPD RADIOACTIVE BURIAL GROUNDS, INCLUDING V7 TRENCH

BURIAL GROUND	SURFACE AREA (SQUARE FT)	VOLUME (CUBIC FT)	URANIUM (GRAMS)	PLUTONIUM (GRAMS)	OTHER RADIOACTIVITY (GRAMS)
200 EAST AREA					
DRY WASTE NO. 12B TRANSURANIC	2.28E+04	2.27E+04		1.12E+02	*1
TOTAL 200-E	2.28E+04	2.27E+04		1.12E+02	5.60E+01
*1 (U-233, 5.60E+01)					

SUMMARY
200 AREAS SEGREGATED COMBUSTIBLE LAND RUPIAL FROM 1970-TO DATE
CPD RADIOACTIVE BURIAL GROUNDS, INCLUDING V7 TRENCH
(CONTINUED)

BURIAL GROUND	SURFACE AREA (SQUARE FT)	VOLUME (CUBIC FT)	URANIUM (GRAMS)	PLUTONIUM (GRAMS)	OTHER RADIOACTIVITY (GRAMS)
200 WEST APLA					
DRY WASTE NO. 03A					
TRANSURANIC	7.96E+04	3.12E+04	9.90E+03	<3.50E+03	*1
TRANSURANIC-OFFSITE	1.96E+04				
TOTAL	9.92E+04	3.12E+04	9.90E+03	<3.50E+03	7.77E+02
DRY WASTE NO. 04B					
TRANSURANIC	6.11E+04	9.42E+04	5.18E+05	2.99E+04	*2
TRANSURANIC-OFFSITE		2.96E+03	2.00E+06	3.45E+02	*3
TRANSURANIC CAISSON		4.45E+02	4.42E+04	<2.42E+03	*4
TOTAL	6.11E+04	9.76E+04	2.57E+06	3.27E+04	7.15E+04
DRY WASTE NO. 04C					
TRANSURANIC	1.16E+04	3.31E+04	2.44E+05	<7.15E+04	*5
TRANSURANIC-OFFSITE		4.56E+02	4.64E+02	<1.35E+02	
TOTAL	1.16E+04	3.35E+04	2.44E+05	<7.17E+04	6.89E+03
DRY WASTE NO. 212-N					
TRANSURANIC		7.65E+03		4.00E+01	
TOTAL 200-W	1.72E+05	1.70E+05	2.82E+06	<1.08E+05	7.91E+04
TOTAL 200 AREAS	1.94E+05	1.92E+05	2.82E+06	<1.08E+05	7.92E+04

SUMMARY
 200 AREAS SEGREGATED COMBUSTIBLE LAND BURIAL FROM 1970-TO DATE
 CPU RADIOACTIVE BURIAL GROUNDS, INCLUDING V7 TRENCH
 (CONTINUED)

BURIAL GROUND	SURFACE AREA (SQUARE FT)	VOLUME (CUBIC FT)	URANIUM (GRAMS)	PLUTONIUM (GRAMS)	OTHER RADIOACTIVITY (GRAMS)
200 WEST AREA					
*1	(TH, 7.77E+02)	(NP-237, 1.00E-05)			
*2	(TH, 3.64E+04)	(U-233, 1.78E+02)	(AM-241, 6.13E-01)	(PU-238, 2.99E-01)	
*3	(TH, 2.40E+04)	(LI, 2.00E+03)			
*4	(TH, 8.86E+03)	(NP-237, 2.06E+01)	(PU-238, 2.99E-01)	(U-233, 2.14E+01)	
*5	(TH, 6.86E+03)	(U-233, 1.18E+01)	(CM-245, 2.00E+00)	(AM-241, 8.50E+00)	

LAND BURIAL OF SOLID RADIOACTIVE WASTES FROM 1/1 TO 12/31 1980

BURIAL GROUND 04C , AREA 200-W, WASTE TYPE - TRANSURANIC

TRENCH 1, PERIOD 01/01/80 TO 12/31/80

(N-40190 TO N-40190), (W-77480 TO W-77583)

TRENCH 4, PERIOD 04/01/80 TO 12/31/80

(N-40070 TO N-40070), (W-77640 TO W-77721)

SHIPPER	TYPE*	VOLUME CU.FT	PU GRAMS	TOTAL CURIES	SR-90 CURIES	RU-106 CURIES	CS-137 CURIES	URANIUM GRAMS	OTHER CURIES	OTHER GRAM
PNL , 1700-K, 100-K	3	2.22E+01	1.00E-02	3.00E-02	5.97E-04	1.28E-03	6.37E-04			
PNL , 209-E , 200-E	3	8.10E+01	2.10E+01							
PNL , 231-Z , 200-W	3	2.31E+02	4.11E+01							
PNL , 324 , 300	3	1.50E+02	1.60E+01	3.80E+05	7.55E+03	1.62E+04	8.07E+03	2.00E+03E		
PNL , 325 , 300	3	1.27E+02	5.40E+00	9.63E+02	1.91E+01	4.12E+01	2.04E+01	8.26E+03D		
PNL , 340 , 300	3	2.40E+02	1.00E-02	6.00E-01	1.19E-02	2.57E-02	1.27E-02	1.30E+03E		*1
RHO , 21649 , 200-W	3	1.04E+03	2.28E+04							
RHO , 233-S , 200-W	1	2.89E+02	5.10E+01							
RHO , 234-52, 200-W	3	1.15E+04	5.81E+04					8.15E+02N		*2
								8.70E+01D		
								2.57E+02E		
RHO , 24TF , 200-W	3	2.07E+02	9.30E+01							
WHC , 325 , 300	3	1.23E+03	1.37E+03	1.43E+03	2.86E+01	6.15E+01	3.05E+01	8.20E+02N		*3
								4.00E+00D		
								4.26E+02E		
WHC , 340 , 300	3	5.82E+02	1.01E+03	4.41E+02	8.77E+00	1.89E+01	9.37E+00	1.15E+04N		*4
								6.73E+04D		
								3.73E+02E		
TOTAL (1.22-001 ACRES)		1.57E+04	8.35E+04	3.82E+05	7.61E+03	1.64E+04	8.13E+03	9.32E+04		6.63E+03

*1 (PU-238, 3.50E+00)(TH, 3.00E+00)

*2 (PU-238, 5.23E+03)(TH, 2.00E+00)

*3 (TH, 8.80E+01)

*4 (TH, 1.30E+03)(U-233, 2.40E-01)

*TYPE SEE APPENDIX-A

APPENDIX-A

1. MISCELLANEOUS WASTE INCLUDING RAGS, PAPER, RUBBER GLOVES, DISPOSABLE SUPPLIES, BROKEN TOOLS, GLASS FILTERS, DIRT, ETC.
2. FAILED EQUIPMENT AND OBSOLETE EQUIPMENT OR MATERIALS INCLUDING TANKS, PUMPS, AGITATORS, OVENS, HEATERS, HOODS, JUMPERS, AND ACCESSORIES.
3. COMBINATIONS OF TYPE 1 AND TYPE 2.
4. RADIOACTIVE ELEMENTS

DATA COMPILED BY G. F. MOLEN FROM
SAVANNAH RIVER COBRA SYSTEM

TABLE 4

**Current Trends in the Generation of ^{239}Pu Contaminated Solid Waste
Quantity (Ci), Volume (ft^3) and Concentration (Ci/ft^3)
as a Function of Time Period (All Facilities)
Data Based on COBRA* Records**

Time Period	Report Code 24** ^{239}Pu in Culverts			Report Code 25† ^{239}Pu in Combustibles		
	Ci	ft^3	Ci/ft^3	Ci	ft^3	Ci/ft^3
1975	146	834	1.17	121	23946	0.0050
1976	173	819	0.21	179	21309	0.0084
1977	262	865	0.30	260	26220	0.0099
1978	278	1032	0.27	276	34495	0.0080
1979	170	945	0.18	181	37194	0.0049
1980††	452	1432	0.32	448	63216	0.0071

* COBRA-Computerized Radioactive Waste Burial Records Analysis System.
Values are as buried and are not decayed.

** COBRA Report Code 24, "Variety of Contamination vs. Burial Code."
Includes combustibles and noncombustibles.

† COBRA Report Code 25, "Variety of Contamination vs. Combustion Code."
Includes combustibles in drums in culverts and drums on pads.

†† Estimated projections based on data from January-March 1980.

TABLE 3

Current Trends in the Generation of ^{238}Pu Contaminated Solid Waste
 Quantity (Ci), Volume (ft^3) and Concentration (Ci/ft^3)
 as a Function of Time Period (All Facilities)
 Data Based on COBRA* Records

Time Period	Report Code 24** ^{238}Pu in Culverts			Report Code 25† ^{238}Pu in Combustibles			Report Code 45†† Combustibles in Culverts		
	Ci	ft^3	Ci/ft^3	Ci	ft^3	Ci/ft^3	Ci	ft^3	Ci/ft^3
1975	4149	778	5.3	3794	13962	0.27	3880	1104	3.5
1976	6424	662	9.7	6327	23697	0.27	6436	1374	4.7
1977	7557	936	8.1	4234	23168	0.18	4466	1373	3.2
1978	7486	869	8.6	6203	20595	0.30	6469	1904	3.4
1979	24500	1651	14.8	21904	25886	0.85	22070	2445	9.0
1980‡	46972	2428	19.4	31928	32928	0.97	32336	3332	9.7

* COBRA-Computerized Radioactive Waste Burial Records Analysis System. Values are as buried and are not decayed.

** COBRA Report Code 24, "Variety of Contamination vs. Burial Code." Includes combustibles and noncombustibles.

† COBRA Report Code 25, "Variety of Contamination vs. Combustion Code." Includes combustibles in drums in culverts and drums on pads.

†† COBRA Report Code 45, "Burial Code vs. Combustion Code." Includes all TRU isotopes.

‡ Estimated projections based on data from January-March 1980.

APPENDIX C
STORAGE SITE ENVIRONMENTAL IMPACT REVIEWS

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