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Hazardous Waste Inventory, Characteristics, Generation, and Facility Assessment for Treatment, Storage, and Disposal Alternatives Considered in the U.S. Department of Energy Waste Management Programmatic Environmental Impact Statement

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CONTENTS

NOTATION	vii
ABSTRACT	1
1 INTRODUCTION	3
1.1 Report Organization	3
1.2 Definition of Hazardous Waste Types	4
2 SUMMARY OF INVENTORY AND GENERATION OF HAZARDOUS WASTES	6
2.1 Assumptions	6
2.2 Hazardous Waste Inventory Data	6
2.3 Hazardous Waste Generated and Off-Site Shipment by Installation	8
2.4 Hazardous Waste Amount Estimates by Treatment-Disposal- Technology Groups	9
2.5 On-Site Versus Off-Site Treatment of Hazardous Waste	13
2.6 Validation of Hazardous Waste Totals	15
3 EXISTING AND PLANNED CAPABILITIES FOR TREATMENT AND STORAGE	19
3.1 Existing DOE Facilities	19
3.2 New and Planned DOE Facilities	26
3.3 Use of Commercial Treatment, Storage, and Disposal Facilities	28
4 APPLICABLE TECHNOLOGIES FOR HAZARDOUS WASTE MANAGEMENT	29
4.1 Overview	29
4.1.1 Destruction of Organics	29
4.1.2 Aqueous Treatment	30
4.1.3 Deactivation or Neutralization	30
4.1.4 Removal and Recovery of Organics	30
4.1.5 Metal Removal and Recovery	30
4.1.6 Mercury Removal and Recovery	30
4.1.7 Stabilization or Solidification	31
4.1.8 Recycling	31
4.1.9 Land Disposal	31
4.2 WM PEIS Treatment-Disposal Technologies	32
4.2.1 Destruction of Organics	32

CONTENTS (Cont.)

4.2.2 Aqueous Liquid Treatment	33
4.2.3 Deactivation or Neutralization	33
4.2.4 Removal and Recovery of Organics	34
5 WASTE LOADS BY ALTERNATIVES	35
5.1 Hazardous Waste Management Alternatives	35
5.1.1 No Action Alternative	35
5.1.2 Decentralized Alternative	36
5.1.3 Regionalized 1 Alternative	37
5.1.4 Regionalized 2 Alternative	37
5.2 No Action and Decentralized Alternatives	37
5.3 Regionalized 1 Alternative	43
5.4 Regionalized 2 Alternative	46
6 COMPUTATION OF AIR EMISSIONS	49
7 AIR EMISSION RATES	54
8 WASTE MANAGEMENT PRACTICES — TODAY AND TOMORROW	76
9 REFERENCES	79

TABLES

1.1 RCRA Hazardous Waste Categories	5
2.1 Ranking of the Top 13 DOE Sites by HW Generation Rates and Off-Site Shipments to Commercial TSD Facilities	9
2.2 HW Generation and Treatment, Storage, and Shipment Data for the Top 13 DOE HW Generators in 1991	12
2.3 On-Site versus Off-Site Treatment and Disposal of DOE HW	15
2.4 DOE Data on HW Generated in 1991 and 1992	16
2.5 ANL Data on HW Generated and Shipped Off-Site in 1991 and 1992	17

TABLES (Cont.)

2.6 Comparison of DOE and Argonne Data on Ranking of DOE Sites Based on Combined HW	18
3.1 Existing and Planned HW Storage Facilities for the Top 11 DOE Sites	20
3.2 Existing and Planned HW Treatment Facilities for Various DOE Sites	23
3.3 Top 10 Commercial TSD Facilities Used by DOE Installations in FY 1992	28
5.1 No Action Alternative: HW Load Transfers/Treatment Technology Matrix for Major DOE Generator Installations	39
5.2 Decentralized Alternative: HW Load Transfers/Treatment Technology Matrix for Major DOE Generator Installations	41
5.3 Change in Use of Onsite Thermal Destruction and Waste-Fuel Burning under No Action and Decentralized Alternatives	43
5.4 Regionalized 1 Alternative: HW Load Transfers/Treatment Technology Matrix for Major DOE Generator Installations	45
5.5 Regionalized 2 Alternative: HW Load Transfers/Treatment Technology Matrix for Major DOE Generator Installations	47
6.1 Source Terms for Incineration and Fuel Burning	50
6.2 Source Terms for Open Burning of Explosive Waste, by Explosive Type	51
6.3 Source Terms for Open Detonation of Explosive Waste	52
7.1 Air Emissions from On-Site Incineration of HW under the No Action Alternative, by Treatment Site	55
7.2 Air Emissions from On-Site Incineration and Fuel Burning of HW under the Decentralized Alternative, by Treatment Site	56
7.3 Air Emissions from On-Site Incineration and Fuel Burning of HW under the Regionalized 1 Alternative, by Treatment Site	59

TABLES (Cont.)

7.4 Air Emissions from On-Site Incineration and Fuel Burning of HW under the Regionalized 2 Alternative, by Treatment Site 64

7.5 Air Emissions from On-Site Open Detonation and Burning of Explosives and Explosives-Contaminated Wastes under the No Action/Decentralized Alternative, by Treatment Site 66

7.6 Air Emissions from On-Site Open Detonation and Burning of Explosives and Explosives-Contaminated Wastes under the Regionalized 1 Alternative, by Treatment Site 70

7.7 Air Emissions from On-Site Open Detonation and Burning of Explosives and Explosives-Contaminated Wastes under the Regionalized 2 Alternative, by Treatment Site 72

8.1 Current and Future Use of Technologies for DOE HW Treatment 77

FIGURE

2.1 On-Site versus Off-Site HW by Treatment Group 14

NOTATION

The following is a list of acronyms, initialisms, and abbreviations (including units of measure) used in this document. Some acronyms used only in tables are defined in those tables.

ACRONYMS, INITIALISMS, AND ABBREVIATIONS

ANL	Argonne National Laboratory
ANL-E	Argonne National Laboratory-East
BNL	Brookhaven National Laboratory
BPA	Bonneville Power Administration
CAI	Controlled Air Incinerator
CFR	Code of Federal Regulations
CIF	Consolidated Incineration Facility
CWMC	consolidated waste management complex
CY	calendar year
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
EF	emission factor
EM	Environmental Management
EPA	U.S. Environmental Protection Agency
ER	environmental restoration
ETEC	Energy Technology Engineering Center
FEMP	Fernald Environmental Management Project
FNAL	Fermi National Accelerator Laboratory
FY	fiscal year
Hanford	Hanford Site
HaWRAM	Hazardous Waste Risk Assessment Modeling database
Hg	mercury
HW	hazardous waste
HWMF	hazardous waste management facility
HWTF	hazardous waste treatment facility
INEL	Idaho National Engineering Laboratory

K-25	K-25 Site
KCP	Kansas City Plant
LANL	Los Alamos National Laboratory
LDR	land disposal restriction
LLMW	low-level mixed waste
LLNL	Lawrence Livermore National Laboratory
Mound	Mound Plant
NEPA	National Environmental Policy Act
NPR #1	Naval Petroleum Reserve Number 1
NTS	Nevada Test Site
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
Pantex	Pantex Plant
PCB	polychlorinated biphenyl
PEIS	Programmatic Environmental Impact Statement
PGDP	Paducah Gaseous Diffusion Plant
PL	Public Law
PNNL	Batelle Pacific Northwest National Laboratory
PORTS	Portsmouth Gaseous Diffusion Plant
RCRA	Resource Conservation and Recovery Act
R&D	research and development
RFETS	Rocky Flats Environmental Technology Site
RHWSF	RCRA Hazardous Waste Storage Facility
RMMA	radiological material management area
SNL-NM	Sandia National Laboratory (New Mexico)
SRS	Savannah River Site
TDT	treatment-disposal-technology
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal

WAPA	Western Area Power Administration
WIPP	Waste Isolation Pilot Plant
WM	waste management
WMF	waste management facility
Y-12	Y-12 Plant

UNITS OF MEASURE

°C	degree(s) Celsius
d	day(s)
°F	degree(s) Fahrenheit
ft ²	square foot (feet)
ft ³	cubic foot (feet)
gal	gallon(s)
h	hour(s)
kg	kilogram(s)
L	liter(s)
lb	pound(s)
m ²	square meter(s)
m ³	cubic meter(s)
mg	milligram(s)
mo	month(s)
ppm	part(s) per million
t	tonne(s) (metric ton[s])
ton	ton(s) (short)
yd ³	cubic yard(s)
yr	year(s)

**HAZARDOUS WASTE INVENTORY, CHARACTERISTICS, GENERATION, AND
FACILITY ASSESSMENT FOR TREATMENT, STORAGE, AND DISPOSAL
ALTERNATIVES CONSIDERED IN THE U.S. DEPARTMENT OF
ENERGY WASTE MANAGEMENT PROGRAMMATIC
ENVIRONMENTAL IMPACT STATEMENT**

by

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ABSTRACT

This report focuses on the generation of hazardous waste (HW) and the treatment of HW being generated by routine U.S. Department of Energy (DOE) facility operations. The wastes to be considered are managed by the DOE Waste Management (WM) Division (WM HW). The waste streams are to be sent to WM operations throughout the DOE complex under four management alternatives: No Action, Decentralization, Regionalized 1, and Regionalized 2. On-site and off-site capabilities for treatment are examined for each alternative. This report (1) summarizes the HW inventories and generated amounts resulting from WM activities, focusing on the largest DOE HW generators; (2) presents estimates of the annual amounts shipped off-site, as well as the amounts treated by various treatment technology groups; (3) describes the existing and planned treatment and storage capabilities of the largest HW-generating DOE installations, as well as the use of commercial treatment facilities by DOE sites; (4) presents applicable technologies (destruction of organics, deactivation/neutralization of waste, removal/recovery of organics, and aqueous liquid treatment); and (5) describes the four alternatives for consideration for future HW management, and for each alternative provides the HW loads and the approach used to estimate the source term for routine treatment operations. In addition, potential air emissions, liquid effluents, and solid residuals associated with each alternative are presented. This report is supplemented with an addendum that includes detailed information related to HW inventory, characteristics, generation, and facility assessment for the treatment alternatives. The addendum also presents source terms, emission rates, and throughput totals by alternative and treatment installation.

1 INTRODUCTION

This report focuses on the generation of hazardous waste (HW) and the treatment of HW being generated by routine U.S. Department of Energy (DOE) facility operations and managed by the DOE Waste Management (WM) Division (WM HW). The waste streams are to be sent to WM operations throughout the DOE complex under four alternatives for management: No Action, Decentralized, Regionalized 1, and Regionalized 2. On-site and off-site capabilities for treatment are examined for each alternative.

The DOE facility files and U.S. Environmental Protection Agency (EPA) public records were used to identify and characterize typical waste streams generated by DOE facilities and the types of technologies that can be used to treat those wastes. The characterization parameters included chemical composition of the wastes, physical state, volumes and potential air pollutant emissions, liquid effluents, and solid residuals. This information supported two interrelated aspects of the WM PEIS: development of a baseline risk assessment to characterize potential impacts of existing DOE HW management practices, and evaluation of alternatives for consolidating treatment activities as a means of controlling the risk, potential liability, and cost.

Each DOE site retains detailed information about HW management; no centralized database is available. However, data that characterize HW streams typically generated and transported at DOE sites were obtained from the Hazardous Waste Risk Assessment Modeling (HaWRAM) database (Lazaro et al. 1994) developed primarily for data collected and reported on DOE uniform HW shipment manifests. The treatment parameters applicable to DOE HW waste were obtained from information in biennial reports to EPA, as required under the Resource Conservation and Recovery Act (RCRA).

1.1 REPORT ORGANIZATION

Section 1.2 defines the HW types generated throughout the DOE complex. Section 2 summarizes the HW inventories and generated amounts resulting from WM activities, focusing on the largest DOE HW generators, and validates HW totals by DOE site and HW class. Section 2 also presents estimates of the annual amounts shipped off-site, as well as the amounts treated by various treatment technology groups.

Section 3 describes the existing and planned treatment-and-storage capabilities of the largest HW generating DOE installations, as well as the use of commercial treatment facilities by DOE sites. Section 4 presents applicable technologies: the destruction of organics; deactivation or neutralization of explosive, corrosive, or reactive wastes; removal and recovery of organics; and aqueous liquid treatment. These are the most suitable of the nine HW treatment-disposal-technology

(TDT) groups for on-site utilization and examination of the four WM PEIS alternatives. Section 5 describes the four alternatives for future HW management and provides the assumptions used in their development. The HW loads and the approach used to estimate the source term for routine treatment operations are given for each alternative. Potential air emissions, liquid effluents, and solid residuals associated with each alternative are also presented in this section. Issues arising from the application of each alternative are also discussed.

Section 6 describes the methodology followed to compute air emissions from incineration of HW at certain DOE installations, and Section 7 lists detailed information for HW (including explosives and explosives-contaminated wastes) on air emission rates by DOE site, pollutant, and HW management alternative. Section 8 examines anticipated changes in waste management practices and their likely impacts.

1.2 DEFINITION OF HAZARDOUS WASTE TYPES

Congress provided a broad definition of HW in the RCRA (Public Law [PL] 94-580) as "a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may: (1) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (2) pose a substantial or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed." RCRA defines a solid waste to include solid, liquid, semi-solid, or containing gaseous material.

A specific definition of HW was created when EPA was directed by Congress to follow a two-step process in identifying HW. First, EPA was directed to establish criteria for identifying HW characteristics and to list HWs generated by specific sources or activities. In establishing the criteria, EPA had to consider the following factors: toxicity, persistence, and degradability in nature; potential for accumulation in tissue; and other related factors, such as flammability, corrosiveness, and similar hazardous characteristics.

Next, EPA was required to promulgate regulations (based on the criteria) that listed particular HWs, that specified characteristic HWs, and that identified other HWs. The categorization of HW, as listed, is based on the hazardous components contained in the waste stream and on the definitions EPA established. These categories are wastes that are hazardous by characteristic and those that are specified as listed HW according to the *Code of Federal Regulations* (40 CFR Part 261). Table 1.1 summarizes the factors identifying the three RCRA HW categories (listed HW, characteristic HW, and other HW).

TABLE 1.1 RCRA Hazardous Waste Categories

Listed HWs
Nonspecific sources (F codes)
Specific sources (K codes)
Commercial chemical products
Acutely hazardous (P codes)
Nonacutely hazardous (U codes)
Characteristic HWs
Ignitable
Corrosive
Reactive
Toxic
Other HWs
Mixtures (hazardous and nonhazardous)
Derived from wastes (treatment residues)
Materials containing listed HWs

Notes: EPA hazardous RCRA waste codes:
 F code = HW from nonspecific sources;
 K code = HW from specific sources; P code =
 discarded commercial chemical products, off-
 specification species, container residuals, and
 spill residues of acutely toxic HWs; and
 U code = discarded commercial chemical
 products, off-specification species, and spill
 residues of toxic wastes.

The WM PEIS HW inventory in the PEIS focuses primarily on those wastes governed by Federal RCRA regulations; however, the inventory also includes state-regulated wastes (not currently regulated under RCRA, such as petroleum-contaminated soils and waste oil) and wastes defined as toxic by the Toxic Substances Control Act (TSCA) (PL 94-469). The TSCA regulates special commercial chemical substances and chemical mixtures that present an unreasonable risk of injury or an imminent hazard to public health or the environment if improperly managed. Examples of TSCA waste existing at DOE installations are polychlorinated biphenyls (PCBs).

This DOE HW inventory (as determined by DOE's performance objective of no added radioactivity due to DOE operations) does not include any mixed wastes, such as low-level mixed waste (LLMW), which is regulated under RCRA and the Atomic Energy Act. These wastes are addressed separately in the LLMW technical report (Wilkins et al. 1996).

2 SUMMARY OF INVENTORY AND GENERATION OF HAZARDOUS WASTES

The types and quantities of HW generated vary greatly throughout the DOE Complex; for example, Argonne National Laboratory (ANL) and Sandia National Laboratory-New Mexico (SNL-NM) generate HW as a result of research and development (R&D) activities, processing operations, and other projects. The Savannah River Site (SRS) and the Mound Plant (Mound) generate HW as a result of programs connected with manufacturing and retiring weapons and materials for weapons, nuclear fuel, and other production operations (production programs). Some sites, such as the Waste Isolation Pilot Plant (WIPP), generate very little HW and may qualify for the status of a conditionally exempt EPA small-quantity generator (one that generates no more than 0.1 t (220.46 lb) of HW per month, exempt from full RCRA coverage but still required to maintain a manifest of the HW generated and shipped off-site).

Inventory data on HW generated and treated by DOE sites are presented in this section. Amount estimates of HW processed by TDT groups are also included.

2.1 ASSUMPTIONS

For purposes of the WM PEIS, future HW generation and burial rates are assumed to be the same as those identified in Section 2.2. This assumption does not take into consideration several factors that could affect the quantities of HW generated within DOE. Factors that could cause a decline in HW quantities are efforts at waste minimization, reconfiguration of the DOE nuclear weapons complex, and reductions in generated HW from weapons program cancellations. Factors that could result in an increase in HW quantities are the reclassification of LLMW as HW on the basis of the approval and implementation of radioactive contamination-and-certification procedures, acceptance of an exempt quantity of radioactivity, improved waste analysis, and HW generated from D&D activities, as well as from weapons dismantlement.

2.2 HAZARDOUS WASTE INVENTORY DATA

Analysis of the WM PEIS HW alternatives required collecting and compiling a representative detailed HW inventory. Data for the inventory were obtained primarily from RCRA uniform HW manifests and RCRA facility reports submitted annually or biennially to EPA and the States on the quantities of RCRA HW generated and treated by DOE facilities. Information from these sources was verified (to the extent possible) and supplemented when ANL personnel visited selected sites. Additional sources of information included:

- DOE site records and publications,

- Argonne personal communications with DOE officials.
- Argonne's Hazardous Waste Risk Assessment Modeling (HaWRAM) database,
- Battelle Pacific Northwest National Laboratory (PNNL) model output, and
- Idaho National Engineering Laboratory (INEL) database.

To ensure that HW destined for off-site treatment actually reaches its destination, RCRA (40 CFR 262.20-262.23) requires the use of a system of uniform manifests. The manifest is a control and transport document that accompanies the HW at all times from the generator's facility to the final treatment facility. The regulations impose on the generator the responsibility of ensuring that a manifest has been prepared before any HW is shipped off-site. A HW generator must submit biennial reports, covering waste generation and management activities during the preceding year, to EPA (if EPA is the regulatory authority in the State in which the generating facility is located), on March 1 of each even-numbered year.

Many states have been given federal authority to administer the RCRA program and have adopted an annual reporting requirement in their State programs. The biennial or annual reports submitted to EPA or the states must be certified by the generator or its authorized representative as true, accurate, and complete and must be based on personal familiarity with the information and personal inquiry of those responsible for obtaining the information (40 CFR 262.41).

The HaWRAM database was developed at ANL-East (ANL-E) to facilitate the use of the HW inventory data in support of the WM PEIS environmental assessments (Lazaro et al. 1994). The database was designed to provide the modeling parameters necessary to support risk assessments of HW transportation accidents. With data obtained primarily from the biennial and annual reports, the HaWRAM database also helps to support assessments of WM PEIS alternatives for treatment technologies, as well as for siting, sizing, and costing of facilities.

The primary intent in developing the HaWRAM database as a transportation risk assessment modeling database required it to:

- Identify the quantities of off-site HW shipments, the key physical and chemical characteristics of HW that is shipped, and the treatment technologies used by commercial treatment facilities
- Provide the data, such as chemical name, container size, chemical state, and chemical hazard designation (for example, "poison inhalation hazard"),

necessary for completing a transportation risk assessment that covers existing as well as future condition

- Furnish data for determining the degree and type of treatment (on-site versus off-site treatment at commercial facilities)
- Supply data on "operational" HW generated from industrial processes or from laboratory research, versus "remediation" HW generated from decommissioning or Superfund cleanup

2.3 HAZARDOUS WASTE GENERATED AND OFF-SITE SHIPMENT BY INSTALLATION

A review of previous DOE records on HW management revealed that about 45 sites in the DOE Complex generate HW, but only 11 (Oak Ridge Reservation [ORR], Kansas City Plant [KCP], SNL-NM, SRS, Idaho National Engineering Laboratory [INEL], Pantex Plant [Pantex], Lawrence Livermore National Laboratory [LLNL], Hanford Site [Hanford], Los Alamos National Laboratory [LANL], ANL-E, and Fermi National Accelerator Laboratory [FNAL]) are believed to be responsible for generating about 90% of the DOE complexwide HW total (this total does not include that associated with fossil energy and the power administration).

Nearly all HW destined for off-site treatment is stored temporarily at on-site storage facilities for less than 90 days, except for those installations affected by the mixed-waste moratorium. (In May 1991, DOE imposed a program [moratorium] to certify waste as nonradioactive before off-site shipment to minimize the potential for shipping mixed waste [radioactively contaminated HW] to commercial facilities.) The influence of the moratorium on HW shipments to commercial treatment facilities varied from the prohibition of nearly all shipments (from ORR and SRS) to no influence on shipments to commercial facilities.

Installation-specific waste loads and off-site shipment to commercial treatment facilities were identified with the HaWRAM database. Table 2.1 gives the ranking for the top 13 DOE HW generators, shown alongside the rankings of off-site shipments for calendar year (CY) 1991 and fiscal year (FY) 1992. The larger 1992 off-site shipments from Pantex, FNAL, SNL-NM, LANL, LLNL, ANL-E, and SRS, when compared with corresponding 1991 off-site shipments, are most likely caused by the significant other-than-RCRA component (State-regulated and TSCA HW) of HW reported on the uniform HW manifest forms and by the presence of ER wastes in the system.

TABLE 2.1 Ranking of the Top 13 DOE Sites by HW Generation Rates (1991) and Off-Site Shipments to Commercial Treatment Facilities (1991 and 1992)

Ranking of DOE Site	HW Generated in 1991 (t)	Ranking of DOE Site	HW Shipped Off-site in 1991 (t)	Ranking of DOE Site	HW Shipped Off-site in 1992 (t)
ORR ^a	639,330	LLNL	1,200	LANL	2,070
KCP	343,000	KCP	566	Pantex	1,774
SNL-NM	130,000	Pantex	562	LLNL	1,560
SRS	59,000	Hanford	186	INEL	782
RFETS	43,100	ORR ^{a,b}	132	KCP	617
INEL	33,500	LANL	121	Hanford	463
Pantex	6,430	SNL-A	87.8	SNL-NM	310
LLNL	1,670	SRS	86.8	ANL-E	262
LANL	527	ANL-E	55.7	FNAL	171
Hanford	328	INEL	66.3	SRS	160
ANL-E	57.3	NTS	47.0	ORR ^a	119
NTS	49.3	RFETS	17.1	NTS	97.3
FNAL	28.5	FNAL	16.6	RFETS	67.9
Other sites	Unknown		Unknown		586.7
Total	1,260,000	Total	5,007.6	Total	9,094

Notes: t = metric ton = 1,000 kg = 2,205 lb.

^a Combined total for three ORR sites (Oak Ridge National Laboratory [ORNL], K-25 Site, and Y-12 Plant).

^b An additional 426 t (939,000 lb) was shipped for on-site storage or incineration at the K-25 Site.

Source: 1991 data taken from biennial and annual reports; 1992 data from manifests.

2.4 HAZARDOUS WASTE AMOUNT ESTIMATES BY TREATMENT-DISPOSAL TECHNOLOGY GROUPS

The biennial and annual reports reveal that six sites (ORR, KCP, SNL-NM, SRS, Rocky Flats Environmental Technology Site [RFETS], and INEL) provide some type of on-site treatment for more than 80% of their generated HW (five of these installations treated more than 99%). Aqueous treatment of hazardous wastewater containing organics or inorganics accounted for most of this on-site treatment. Only three sites (Hanford, ANL-E, and FNAL) relied on off-site treatment for all waste generated. Overall, more than 99% of the waste DOE generated in CY 1991 was managed (treated) on-site.

The biennial and annual reports indicate that the following technologies were used for on-site treatment of DOE HW waste during CY 1991 (the order of appearance reflects the overall ranking of each technology on the basis of waste amounts treated):

- ***Aqueous Treatment of Organics and Inorganics*** (1.24 E + 06 t) (2.73E+09 lb). Aqueous treatment is most commonly employed in the treatment of hazardous wastewater at ORR, KCP, SNL-NM, SRS, RFETS, INEL, and Pantex. The figures do not include groundwater treatment associated with remediation.
- ***Deactivation*** (476 t) (1.05E+06 lb). Deactivation is used primarily for controlled detonation or destruction of explosives at Pantex (95.6 t) (2.11E+06 lb), LANL (1.23 t) (2,710 lb), LLNL-300 Site (1.19 t) (2,620 lb), SNL-NM (0.13 t) (276 lb), and Nevada Test Site (NTS) (0.054 t) (119 lb)—as well as at the Y-12 Plant (Y-12) of ORR, which reported 328 t (7.23E+05 lb) of explosive wastes treated but characterized as radioactively contaminated and, therefore, not included under this treatment—and for neutralization of corrosive waste (more than 50 t) (1.10E+05 lb) at SNL-NM, ORR, and FNAL.
- ***Incineration*** (70.4 t) (1.55E+05 lb). (Because of the HW moratorium, all waste thermally destructed in the K-25 Site incinerator at ORR was classified as mixed waste. Unknown is how much of the 53 t (1.17E+05 lbs) incinerated in 1991 was, in fact, noncontaminated HW. Incineration capabilities exist at ORR, SRS (incinerator is under construction), INEL, and LANL. The incinerator at ORR (and SRS will be) is of the type suitable for destroying laboratory packs, which contain HW from routine laboratory activities (the largest category or type of DOE-generated HW that routinely requires incineration). The incinerator at ORR does not currently burn lab packs.
- ***Removal and Recovery of Organic Waste*** (12.3 t) (2.71E+04 lb). Removal and recovery of organics was primarily batch distillation of spent solvents at LANL, KCP, SRS, and NTS.
- ***Metal Removal and Recovery*** (7.83 t) (1.73E+04 lb). Metal removal and recovery was primarily silver removal and recovery from photographic solutions at SRS.
- ***Stabilization*** (2.32 t) (5,120 lb). Stabilization occurred only at INEL.

Table 2.2 shows a preliminary ranking by HW generation rate and data for on-site treatment, on-site storage, and off-site treatment for the top DOE HW generators in CY 1991, summarized from the available biennial and annual reports. These data appear to indicate that the installations with the highest HW generation rates accounted for most of the DOE complexwide HW generation. These generators had large HW water-treatment operations, handling more than 97% of their total HW generation.

Explosives and corrosives at DOE sites are assumed to be deactivated or neutralized separately from radioactively contaminated waste to eliminate or minimize any potential cumulative impacts. In 1991 the Y-12 Plant thermally destroyed 328 t (7.23E+05 lb) of explosives wastes. Since these wastes were characterized as radioactive, they were not included in this inventory.

The manifest information in the HaWRAM database was used to estimate off-site-shipped waste amounts that were treated using various commercial technologies in FY 1992. Note that the manifests themselves do not specifically indicate how a particular waste was treated. By referring to the U.S. Department of Transportation shipping description of the waste, to the EPA HW code(s), and to the facility to which the waste was shipped, assumptions were made about how the waste was most likely managed. The following lists technologies or technology groups that were routinely used for the off-site treatment of more than 3,000 t (6.61E+06 lb) of DOE HW waste in FY 1992 (once again, the order of listing reflects the overall ranking of each technology on the basis of waste amounts treated):

- **Incineration** (1,580 t) (3.48E+06 lb). Incineration was the principal form of treatment for a wide range of organic wastes.
- **Removal and Recovery of Organic Waste** (944 t) (2.08E+06 lb). Removal and recovery of organic waste was primarily fuel blending or burning and solvent recycling or distillation treatment.
- **Stabilization** (376 t) (8.30E+05 lb). Stabilization is most commonly used for inorganic waste. Waste is mixed with a solidification agent, such as Portland cement or cement kiln dust, before land disposal.
- **Deactivation** (173 t) (3.82E+05 lb). Deactivation is primarily used for corrosive wastes (neutralization) and explosives (controlled detonation, reaction, or deactivation); limited DOE application is for cyanide or sulfide wastes.

TABLE 2.2 HW Generation and Treatment, Storage, and Shipment Data for the Top 13 DOE HW Generators in 1991^a

DOE Site	Generated (t)	On-site Wastewater Treatment (t [%])	Other On-site Treatment (t [%])	Shipped Off-site (t [%])	Stored On-site (t [%])
ORR ^b	6.39E+05	6.24E+05 (97.6)	3.95E+02 (0.1)	5.58E+02 ^c (0.1)	1.42E+04 (2.2)
ORNL	5.69E+05	5.67E+05 (99.8)	0 (0.0)	5.42E+02 ^c (0.1)	7.35E+02 (0.1)
K-25	6.25E+04	5.01E+04 (80.1)	6.70E+01 (0.1)	0 (0.0)	1.24E+04 (19.8)
Y-12	7.10E+03	5.67E+01 (79.9)	3.28E+02 (4.6)	1.60E+01 (0.2)	1.09E+03 (15.3)
KCP ^d	3.43E+05	3.43E+05 (99.8)	4.00E+00 (~0.0)	5.66E+02 (0.18)	7.80E+01 (002)
SNL-NM	1.30E+05	1.30E+05 (99.9)	7.00E+00 (0.0)	8.80E+01 (0.1)	0 (0.0)
SRS ^d	5.91E+04	5.89E+04 (99.8)	3.40E+01 (0.06)	8.70E+01 (0.15)	2.0E+00 (0.02)
RFETS	4.31E+04	4.31E+04 (99.9)	1.00E+00 (0.0)	1.70E+01 (0.1)	8.00E+00 (0.0)
INEL	3.35E+04	3.34E+04 (99.7)	2.00E+01 (0.0)	6.63E+01 (0.1)	6.30E+01 (0.2)
Pantex	6.43E+03	3.06E+03 (47.5)	1.79E+02 (2.8)	2.43E+03 (8.7)	2.64E+03 (41.0)
LLNL	1.67E+03	2.46E+02 (14.7)	4.50E+01 (2.6)	1.20E+03 (71.6)	1.85E+02 (11.1)
Hanford	3.28E+02	0 (0.0)	0 (0.0)	1.86E+02 (56.7)	1.42E+02 (43.3)
LANL	5.27E+02	0 (0.0)	3.00E+00 (1.8)	1.21E+02 (73.8)	4.03E+02 (24.4)
ANL-E	5.70E+01	0 (0.0)	0 (0.0)	5.60E+01 (98.2)	1.00E+00 (1.8)
NTS	4.90E+01	0 (0.0)	2.00E+00 (4.0)	4.70E+01 (96.0)	0 (0.0)
FNAL	2.90E+01	0 (0.0)	0 (0.0)	1.70E+01 (58.6)	1.20E+01 (41.4)
Total	1.26E+06	1.24E+06 (98.2)	6.90E+02 (0.1)	5.44E+03 (0.3)	1.77E+04 (1.4)

^a From 1991 biennial and annual reports; all amounts are in metric tons (t).

^b Oak Ridge National Laboratory (ORNL), the K-25 Site, and Y-12 Plant make up ORR.

^c Amount includes 4.26E+02 t (9.38E+05 lb) shipped for on-site storage or incineration at the K-25 Site.

^d Excludes wastewater treatment of groundwater remediation waste reported in KCP and SRS biennial reports.

- ***Metal Removal and Recovery*** (118 t) (2.61E+05 lb). Metal removal and recovery often involves precipitation of heavy metals from aqueous solutions. Resulting precipitate may be further treated to recover metals or stabilized before land disposal. Many DOE sites generate silver-bearing wastes amenable to other types of common metal recovery technologies.
- ***Mercury Removal and Recovery*** (121 t) (2.66E+05 lb). Mercury (Hg) removal and recovery is a specialized treatment (for example, mercury roasting or retorting, amalgamation, or incineration of organic wastes containing mercury) offered by only a few commercial facilities in the United States.
- ***Aqueous Treatment*** (48.6 t) (1.07E+05 lb). Aqueous treatment covers a wide range of technologies, including biological treatment, wet air oxidation, and chemical oxidation or reduction (some of the metal removal technologies noted previously could be considered a form of aqueous treatment).
- ***Direct Land Disposal*** (33.6 t) (7.43E+04). Future amounts will likely diminish with the FY 1994 development of land disposal requirement (LDR) treatment standards for "newly identified" wastes.
- ***Recycling*** (12.5 t) (2.75E+04 lb). Most DOE "recycled" wastes are lead-acid storage batteries and scrap metal (not regulated as a HW when recycled).

The previous information indicates that almost 97% of the HW generated is aqueous and more than 99% of that is treated in on-site wastewater treatment systems at the DOE facility where the HW is generated (primarily at KCP, ANL-E, ORR, SRS, RFETS, and INEL). Off-site treatment, while a critical part of the overall program of WM, currently accounts for less than 1% of the total amount of HW generated. This information is consistent with a study recently conducted by Environmental Information, Ltd. (1993), on behalf of the National Solid Waste Management Association. Although the study concluded that more than 95% of the U.S. manufacturing facilities that generate HW send all waste off-site for treatment or disposal, the study also noted that larger generators with in-house plants for wastewater treatment or with underground injection wells treat approximately 95% of their HW on-site.

2.5 ON-SITE VERSUS OFF-SITE TREATMENT OF HAZARDOUS WASTE

Figure 2.1 compares the differences between off-site and on-site treatment of HW within each of the eight TDT groups. Although the comparison is based on data derived from biennial and annual reports for the on-site waste treated during CY 1991 and on manifests for HW shipped and

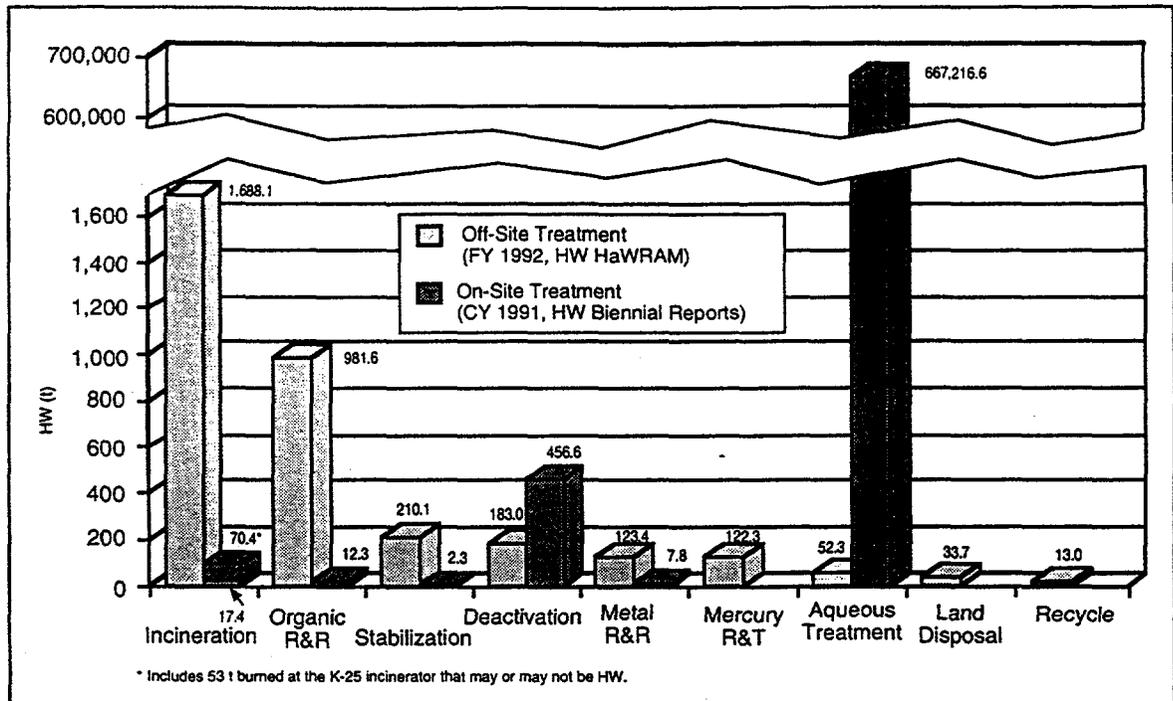


FIGURE 2.1 On-Site versus Off-Site HW by Treatment Group

treated off-site during FY 1992, a picture of DOE's HW treatment overall can be discerned. The table also shows that the other types of HW are being disposed of off-site at a much higher rate than RCRA HW. About 6,650 metric tons (9.26E+06 lb) of other waste per year (yr) were sent off-site for disposal in FY 1992 and treated off-site during FY 1992. Except for HW in the aqueous and the deactivation-or-neutralization treatment groups, most of the HW was treated by commercial facilities, rather than by DOE facilities. In the case of incineration, the thermally destroyed waste (in the TSCA incinerator at ORR K-25) was characterized as mixed HW in the biennial report.

The 1992 HW manifests show that significant volumes of "other" toxic wastes and HWs are being generated by DOE and sent off-site to RCRA-permitted treatment, storage, and disposal (TSD) facilities for treatment and disposal. These "other" wastes have been identified as TSCA wastes, State-regulated wastes, and ER wastes. Table 2.3 was assembled in an effort to provide a complete picture of all types and volumes of HWs being generated by DOE and treated off-site. In this table, the volumes of RCRA HW and other HW being treated off-site are of the same order of magnitude. Future plans for on-site treatment of DOE HWs must take these "other" wastes into account.

TABLE 2.3 On-Site versus Off-Site Treatment and Disposal of DOE HW

Treatment	RCRA HW On-Site (CY 1991) (t/yr)	RCRA HW Off-Site (FY 1992) (t/yr)	Other HW Off-Site ^a (FY 1992) (t/yr)	Total (t/yr)
Aqueous treatment	1.24E+06	4.90E+01	5.80E+01	1.24E+06
Deactivation	4.76E+02	1.73E+02	6.00E+00	6.55E+02
Incineration	7.00E+01	1.58E+03	1.44E+03	3.09E+03
Organic R&R ^b	1.20E+01	9.44E+02	5.60E+02	1.52E+03
Metal R&R	8.00E+00	2.39E+02	6.80E+01	3.15E+02
Stabilization	2.00E+00	3.76E+02	2.82E+02	6.60E+02
Recycling	0.00E+00	1.20E+01	1.80E+01	3.00E+01
Subtotal	1.24E+06	3.37E+03	2.43E+03	1.24E+06
Disposal (LF) ^b	0.00E+00	3.40E+01	4.21E+03	4.25E+03
Total	1.24E+06	3.41E+03	6.65E+03	1.25E+06

^a Other includes TSCA, ER, and state-regulated wastes.

^b R&R = removal and recovery; LF = landfill.

2.6 VALIDATION OF HAZARDOUS WASTE TOTALS

During the preparation of the main report and the development of the HaWRAM database for the WM PEIS, data collected from reports, shipment manifests, site visits, and phone conversations with DOE installation officials were considered and analyzed. Because the information concerning HW for 1993 was incomplete and fragmentary, a decision was made to use the 1991 and 1992 data as the basis on which to build the HW management alternatives and accident risk analyses. This does not mean that the analyses stopped using any information beyond 1992. On the contrary, as new data become available, the HaWRAM database was updated and, accordingly, the relevant reports and data deliverables were revised and supplemented.

The August and December 1993 versions of the DOE Office of the Secretary's *Annual Report on Waste Generation and Waste Minimization, 1991-1992* (DOE 1993a,b) were among the references considered. Recently, the February 1994 version of the same report (DOE 1994) was taken into account. The report presents mass generation rates of HW at each DOE site from the activities of various programs (including Defense, Energy Efficiency and Renewable Energy, Environmental Restoration and Waste Management, Energy Research, Science Education and

Technical Information, Fossil Energy, Nuclear Energy, Civilian Radioactive Waste Management, and Power Marketing), and under RCRA, state, and TSCA regulations. It does not provide information regarding the description and amount of each chemical involved, the treatment (if any) received, the amount stored and disposed of, and the amount shipped for treatment and disposal at commercial facilities. Furthermore, it does not include amounts of wastewater (containing HW chemicals) generated and treated.

As noted in the WM PEIS, HW data were primarily retrieved from the collected uniform hazardous waste manifests (for FY 1992) and the EPA and state HW biennial and annual reports (for CY 1991), supplemented with visits to selected DOE sites. There are differences in the HW totals and site rankings listed in DOE's annual report (DOE 1994) compared with those reported in the main report and Appendix C, as shown in Tables 2.4, 2.5, and 2.6.

TABLE 2.4 DOE Data on HW Generated in 1991 and 1992

Site ^a	1991				1992				
	RCRA (t) ^b	State (t)	TSCA (t)	Total (t)	Site (t)	RCRA (t)	State (t)	TSCA (t)	Total (t)
Pantex	444.6	5,328.0	46.0	5,818.6	Pantex	423.3	3,617.4	68.5	4,109.2
ORR ^c	906.4	47.0	1,134.8	2,088.2	LANL	153.3	1,283.9	276.4	1,713.6
LANL	284.5	987.0	123.3	1,394.8	ORR ^c	928.0	63.3	434.5	1,425.8
LLNL	500.5	442.2	39.1	981.8	KCP	396.3	304.1	531.1	1,231.5
KCP	685.7	183.1	78.5	947.3	LLNL	653.2	268.8	32.7	954.7
SNL-NM	158.3	188.8	216.9	564.0	SNL-NM	147.4	346.2	128.3	621.9
SRS	464.1	0	1.6	465.7	Hanford	45.1	541.0	110.5	696.3
FNAL	31.5	147.0	175.5	354	NTS	95.9	2.5	176.9	275.3
NTS	97.3	217.7	10.4	325.4	FNAL	45.6	72.1	55.1	172.8
Hanford	149.6	22.4	46.4	218.4	INEL	139.2	11.3	3.4	154.0
INEL	119.8	26.2	5.5	151.5	ANL-E	95.7	0	3.2	98.9
ANL-E	103.1	0	4.9	108.0	SRS	29.4	0	1.7	31.1
RFP	39.0	0	21.1	60.1	RFP	21.8	0	1.5	23.0

^a Pantex = Pantex Plant; ORR = Oak Ridge Reservation; LANL = Los Alamos National Laboratory; LLNL = Lawrence Livermore National Laboratory; KCP = Kansas City Plant; SNL-NM = Sandia National Laboratory-New Mexico; SRS = Savannah River Site; FNAL = Fermi National Accelerator Laboratory; NTS = Nevada Testing Site; Hanford = Hanford Site; INEL = Idaho National Engineering Laboratory; ANL-E = Argonne National Laboratory-East; RFP = Rocky Flats Plant; ORNL = Oak Ridge National Laboratory; Y-12 = Y-12 Site; K-25 = K-25 Site.

^b metric tons (t)

^c For ORR, RCRA- and state-regulated HW does not include the K-25 Site, while TSCA are from all three ORR sites (ORNL, Y-12 Plant, and K-25 Site).

Source: DOE (1994).

TABLE 2.5 ANL Data on HW Generated and Shipped Off-Site in 1991 and 1992

Site ^a	1991			Site	1992			
	Generated (t)	No Waste-water (t)	Shipped (t)		RCRA (t)	Non-RCRA (t)	TSCA (t)	Shipped (t)
ORR ^b	638,706.3	15,165.3	131.7 ^c	Pantex	576.9	2,201.7	5.7	2,784.3
KCP	343,229.2	647.0	565.5	LANL	173.1	1,019.7	876.4	2,069.2
SNL-NM	130,271.0	95.0	87.8	LLNL	634.6	683.2	243.5	1,561.3
SRS	59,073.7	132.1	86.8	INEL	183.7	2.2	596.2	782.1
RFP	43,127.8	25.8	17.1	KCP	589.0	14.0	13.5	616.5
INEL	33,490.0	117.2	34.7	Hanford	184.6	264.7	14.0	463.3
Pantex	6,434.4	3,376.4	562.0	SNL-NM	141.6	167.2	1.2	310.0
LLNL	1,674.4	1,428.4	1,199.0	ANL-E	199.2	55.7	7.3	262.1
Hanford	327.6	327.6	185.5	ORR ^b	259.1	0	0	118.6
LANL	162.4	162.4	121.0	FNAL	45.2	94.2	31.9	171.4
ANL-E	57.3	57.3	55.7	SRS	132.4	25.9	1.6	159.9
NTS	49.3	49.3	47.0	NTS	77.5	17.5	2.3	97.2
FNAL	28.5	28.5	16.6	RFP				67.9
Total	1,256,633.2	21,613.4	3,110.4					9,463.8

^a For explanation of acronyms see footnote on Table 2.4.

^b Combined total for three ORR installations: ORNL, K-25 Site, and Y-12 Plant.

^c An additional 425.7 t was shipped for on-site storage or incineration at the K-25 Site.

Sources: Biennial reports to EPA and annual reports to states for CY 1991; uniform hazardous waste manifests for FY 1992.

Table 2.4 presents a ranking of the 13 major DOE sites according to HW generated in CY 1991 and 1992 as recorded in the DOE report (DOE 1994). The Pantex Plant is reported to be the top HW generator for both years, followed by the Oak Ridge Reservation (ORR) and Los Alamos National Laboratory (LANL). Table 2.5 shows the HW ranking of DOE generators in CY 1991 and FY 1992. Table 2.6 compares HW data recorded in DOE's report (DOE 1994) with data for 1991 and 1992 included previously in the main report.

It is believed that these discrepancies arise from differences in classification of the waste and the years to which the waste is attributed. For example, several of the manifests registered HW that was generated partially during the previous year. Some DOE sites, in particular ORR's Y-12 Plant, have answered the "RCRA-radioactive mixed?" question in the EPA biennial report questionnaire with "unknown," which means that the waste could be either HW or mixed waste. Additionally, wastewater and similar aqueous HW was not taken into account in DOE's report (DOE 1994).

TABLE 2.6 Comparison of DOE and Argonne Data on Ranking of DOE Sites Based on Combined HW (RCRA+State+TSCA)

DOE				Argonne			
1991		1992		1991 ^a		1992 ^b	
Site ^c	Reported HW Generation (t)	Site	Reported HW Generation (t)	Site	Reported HW Generation (t)	Site	Reported HW Generation (t)
BPA	5,971.02	BPA	21,548.15	ORR	15,165.8	Pantex	2,784.3
Pantex	5,818.57	Pantex	4,109.21	Pantex	3,376.4	LANL	2,069.2
WAPA	3,106.18	LANL	1,713.62	LLNL	1,428.4	LLNL	1,561.3
ORR	2,088.71	ORR	1,425.87	KCP	647.0	INEL	782.1
Y-12	1,094.39	Y-12	940.68	Hanford	327.6	KCP	615.5
K-25	805.37	K-25	334.15	LANL	163.7	HS	463.3
ORNL	188.95	ORNL	151.04	SRS	132.1	SNL-NM	310.0
LANL	1,394.78	KCP	1,231.49	INEL	117.0	ANL-E	262.2
SLAC	1,285.12	LLNL	954.71	SNL-NM	95.0	ORR	118.6
LLNL	981.77	HS	696.60	ANL-E	57.3	FNAL	171.4
KCP	947.31	WAPA	656.28	NTS	49.3	SRS	159.3
SNL-NM	563.97	SNL-NM	621.86	FNAL	28.5	NTS	97.2
SRS	465.70	ETEC	462.13	RFP	25.8	RFP	67.9
FNAL	353.95	NPR #1	411.90				
NTS	325.46	SLAC	300.22				
PORTS	247.99	Ports	295.10				
Hanford	218.43	NTS	275.26				

^a ANL 1991 data were extracted from EPA and state HW biennial and annual reports, and are referred to as "CY 1991." These data are reported minus the wastewater amounts.

^b ANL 1992 data reflect the amounts that were shipped off-site during FY 1992.

^c BPA = Bonneville Power Administration; WAPA = Western Area Power Administration; SLAC = Stanford Linear Accelerator Center; SNL-NM = Sandia National Laboratory-New Mexico; PORTS = Portsmouth Gaseous Diffusion Plant; ETEC = Energy Technology Engineering Center; NPR #1 = Naval Petroleum Reserve Number 1. For the rest of the acronyms and initialisms see footnote a on Table 2.4.

3 EXISTING AND PLANNED CAPABILITIES FOR TREATMENT AND STORAGE

3.1 EXISTING DOE FACILITIES

Waste quantities treated and stored on-site at existing TSD facilities are summarized in Section 2.1.4. In CY 1991 on-site facilities for aqueous treatment at eight DOE sites treated more than 99% of the DOE complexwide hazardous waste. Facilities for deactivation or neutralization covered most of the small remaining amount of on-site treatment. Approximately two% of the annual waste generated is stored on-site at any one time in centralized accumulation areas.

The usage and capacity of current storage (in metric tons per year) and the types of waste stored are shown for the installations in Table 3.1. The capacities reflect the total amount (in metric tons per year) capable of being stored in the facility at any one time of the year. To compare the current capacity with the current or planned usage, one must consider the ability of the WM system to move the waste in and out of the facility. Some sites indicated that their off-site transporters could pick up waste every day, if necessary; however, the throughput of HW in other storage facilities depends on the operation backlog of an on-site incinerator (that is, the ORR K-25 Site [K-25] TSCA incinerator).

Several types of storage areas exist in the DOE Complex. Some storage areas are centralized 90-day accumulation facilities, where the waste awaits pickup for off-site shipment to commercial treatment facilities. Certain sites have HW storage areas specifically delineated for receipt of HW only from nonradiological material management areas (non-RMMAs). Other sites have storage facilities with waste believed not to be radioactively contaminated but awaiting certification that the waste does not have activity levels above certain specified limits. Still other sites have storage facilities that house both non-RMMA HW and LLMW.

The data collected for the annual usage of a storage facility also differ in meaning from site to site. Some sites reported numbers for the throughput of HW in a typical year. Other sites gave the amount accumulated up to the end of FY 1992, as a result of the moratorium; this number would not indicate the average throughput if the TSD waste stream were running normally.

Some HW treatment facilities, such as incineration and wastewater treatment facilities, handle both HW and mixed wastes. Often, the contamination levels are not specifically measured to delineate whether the waste input is hazardous or mixed. Thus, the annual rates of usage of these waste treatment facilities, listed in Table 3.2, are merely estimates of the nonradioactive constituents. The listed capacities in Table 3.2 are the total capacity of each facility, regardless of waste type.

TABLE 3.1 Existing and Planned HW Storage Facilities for the Top 11 DOE Sites

Site and Facility	Temporary Storage ^a		Status	Waste Type	Moratorium
	Current				
	Capacity (t)	Usage (t/yr)			
ORR Y-12					Yes
Bldg 9720-9	4.99E+02	3.99E+02	Operational	Oil and solvent drums	
Bldg 9404-7	4.60E+01	4.95E+01	Operational	PCB storage	
CSWA	5.66E+02	5.68E+02	Operational	Miscellaneous waste	
LSF	9.46E+03	3.97E+03	Operational	NA	
Bldg 9720-31	8.85E+01	2.13E+02	Operational	Miscellaneous RCRA HW and PCBs	
Bldg 9881-1 (OD-8)	2.37E+02	2.31E+02	Operational	Waste oil solvent drum with PCBs	
Bldg 9720-58	1.67E+02	1.61E+02	Operational	RCRA/PCB containers	
OD-7	1.42E+02	5.68E+02	Operational	Organic liquids with PCBs	
OD-9	6.22E+02	7.57E+02	Operational	Organic liquids with PCBs and RCRA HW	
OD-10	9.95E+01	1.21E+02	Operational	Organic liquid waste oil	
ORNL					Yes
HWSC	1.35E+02	1.35E+02	Operational	80% solid; 20% liquid	
Bldg 7651	4.70E+01	NA	Operational	Used oil	
Bldg 7652	NA	NA	Operational	NA	
Bldg 7653	2.20E+01	N/A	Operational	Laboratory and process chemical waste	
Bldg 7654	NA	NA	Operational	NA	
Bldg 7666	NA	NA	Operational	Emergency storage	
Bldg 7507	6.85E+01	NA	Operational	PCBs	
Bldg 7823	NA	NA	Operational	NA	
Bldg 7934	NA	NA	Operational	Photographic waste	
K-25					Yes
K-1420-A	1.14E+02	2.27E+02	Operational	Flammable wastes (TSCA staging)	
K-1425	NA	NA	Operational	Oil; solvents; organics (TSCA staging)	
K-33	NA	NA	Operational	NA	
K-711 (HWSF)	NA	NA	Operational	Ignitable PCBs; beryllium sludge	
K-726	NA	NA	Operational	PCB transformer storage	
K-25 C Area	NA	NA	Operational	D003 reactives and toxics	
K-1302 (CGCS)	NA	NA	Operational	Storage of gas cylinders	

TABLE 3.1 (Cont.)

Site and Facility	Temporary Storage ^a		Status	Waste Type	Moratorium
	Current				
	Capacity (t)	Usage (t/yr)			
LANL					No
Drum Storage Bldg	NA	0	Operational	NA	
PCB storage	3.80E+01	0	Operational	Nonradioactive PCBs	
CN storage	N/A	0	Operational	Cyanide wastes	
HW Oil Storage Facility	9.45E+01	N/A	Operational	Ignitables, organics, PCBs	
TA-54-31	2.00E+00	NA	Operational	Ignitables, corrosives, toxics	
TA-54-32	8.15E+01	NA	Operational	Ignitables, corrosives, toxics	
TA-54-68	7.80E+00	NA	Operational	Ignitables, corrosives, toxics	
TA-54-69	NA	NA	Operational	Ignitables, corrosives, toxics	
INEL					Yes
HWSF (CFA 637)	1.14E+02	NA	Closed FY 1996	Central storage for most waste	
HWSA (TAN-628)	1.25E+02	2.30E+01	Will close 2005	Ignitables, corrosives, toxics	
HCRWSF (CPP-1619)	4.60E+01	355	Operational	Ignitables, corrosives, toxics	
RMWS F (CPP-1617)	5.05E+02	Currently 260 tons/yr (expected 8,000 tons/yr)	Awaiting RCRA Part B permit	Ignitables, corrosives, toxics	
LLNL					No
HWSF	1.10E+02	5.00E+01	Operational	NA	
KCP					No
Tank farm	NA	NA	Operational	Cl ⁻ solvents; PCBs; CN ⁻ ; acids	
Acid pad	NA	NA	Operational	Acid, alkaline, and CN-container	
Red-X lot	NA	NA	Operational	Hg debris ignitable wastes	
L-Lot	NA	NA	Operational	Pb-acid batteries; oil; alkalines	
Test cells	NA	NA	Operational	Acid, alkaline, and PCB wastes	
Reclamation area	NA	NA	Operational	Acid, alkaline, and CN-wastes	
Demolition lot	NA	NA	Operational	PCBs	

TABLE 3.1 (Cont.)

Site and Facility	Temporary Storage ^a		Status	Waste Type	Moratorium
	Current				
	Capacity (t)	Usage (t/yr)			
NTS					No
HWAS	1.00E+02	NA	Operational	NA	
SRS ^b					Yes
645-N	5.06E+02	9.25E+01	Operational	NA	
645-4N	1.96E+03	2.32E+02	Operational	NA	
SWSP	3500	1590	Operational	NA	
710-B	285	112	Operational	NA	
HWSF	1,171 m ³	25%-35%	Operational	Mixed waste	
RFETS					Yes
Bldg 666	NA	NA	Operational	PCBs and asbestos	
Unit 1 main HWSA	321	309	Operational	NA	
CWSF	NA	0	Operational	NA	
Drum Storage Area Facility	NA	0	Planned	NA	
SNL-NM					No
HWMF	650	500	Operational	D003; D001; P073; non-RCRA HW	
CWMC	NA	0	Planned FY 2004		
INEL					No
Reactive Storage and Treatment Area	NA	0	Planned FY 2000	Reactive materials; explosives	
Hanford					Yes
NRDWSF (Bldg 616)	NA	NA	Operational	NA	
305-B	NA	NA	Operational	NA	NA

Notes: Bldg = building; CFA = Central Facility Area; Cl⁻ = chlorine; CN⁻ = cyanide; CGCS = compressed-gas cylinder storage; CPP = central processing plant; CSWA = central storage waste area; CWMC = chemical WM center; CWSF = containerized waste storage facility; HCSF = hazardous chemical storage facility; HCRWSF = Hazardous Chemical Removal Waste Storage Facility; HCWHF = hazardous chemical waste-handling facility; Hg = mercury; HWAS = HW accumulation site; HWMF = HW management facility; HWSA = HW storage area; HWSC = HW storage center; HWSF = HW storage facility; LSF = liquid storage facility; NA = not available; NRDWSF = nonradioactive dangerous waste storage facility; OD = oil dike; Pb = lead; PCB = polychlorinated biphenyls; RCRA = Resource Conservation and Recovery Act; SWSP = solid waste storage program; and TA = technical area.

^a Primarily less than 90 days.

^b Usage in this table for SRS reflects the accumulation in their storage facilities because of the moratorium. These numbers do not reflect throughput in a typical year without the moratorium.

TABLE 3.2 Existing and Planned HW Treatment Facilities for Various DOE Sites

Site and Facility	Treatment		Status	Waste Type	Treatment Method
	Current				
	Capacity (t)	Usage (t/yr)			
ORR Y-12					
CPCF	9.50E+03	3.80E+03	Operational	Nonnitrate aqueous	OH-precipitation; C adsorption
PRTF	9.50E+03	2.30E+03	Operational	Nonnitrate aqueous	Electrochemical precipitation; C adsorption
WETF	8.30E+03	4.70E+03	Rehab FY 1996	Nitrate aqueous	NO _x anaerobic destruction
WCRF	4.00E+03	4.0E+03	Operational	Organic coolant waste	Organic pretreatment
GWTF	1.77E+04	9.46E+03	Operational	Contaminated runoff	Precipitation/ adsorption
ORNL					
PWTF	3.98E+03	NA	Operational	Heavy-metal waste	Cation exchange precipitation
NRWTF	1.50E+06	5.68E+05	Operational	Nonvolatile organics; Hg	Clarification; air stripping
CDF	NA	NA	Operational	No waste (detonated)	NA
K-25		5.01E+04	Operational	NA	Wastewater treatment
K1232 WTU	NA	1.40E+01	Operational	Organic and corrosive	Neutralization; precipitation; adsorption
K-1435 TSCA ^a	1.54E+03	8.00E+02	Operational	Mixed and non- radioactive liquid	Incineration
K-1407 CNF	NA	NA	Operational	NA	NA
LLNL					
--	1.10E+01	4.30E+00	Operational	NA	Metal recovery
--	NA	3.90E+01	Operational	NA	Oxidation/ precipitation
--	NA	2.46E+02	Operational	NA	Wastewater treatment
LANL					
CAI (TA-50-37)	9.46E+02	0	Operational	PCBs; U-listed toxics	Incineration (mixed- waste FY 1995)
TA-14 burn pad	6.55E+02	5.70E-02	Operational	Barium sand	Open burning; detonation
TA-16	NA	NA	Operational	Reactive sand	Open burning; flashing; filtration
TA-39 open detonation	NA	NA	Operational	Reactive scrap	Detonation

TABLE 3.2 (Cont.)

Site and Facility	Temporary Storage		Status	Waste Type	Treatment Method
	Current				
	Capacity (t)	Usage (t/yr)			
TA-54 treatment tanks	NA	NA	Operational	Toxics	Neutralization; precipitation; evaporation; solidification
Batch treatment system	NA	0	Operational	Corrosive and toxic listed	Neutralization; oxidation/reduction
Reactive waste treatment	1.75E+01	0	Operational	Reactive (Na metal; LiH)	Oxidation/ reduction
Wastewater treatment plant	7.13E+02	NA	Operational	Reactive	Centrifugation
HWTF	NA	NA	Complete construction by FY 1997	NA	NA
KCP					
Liquid treatment facility	1.50E+01	2.63E+00	Operational	NA	Solvent recovery
Wastewater treatment facility	1.48E+03 5.28E-01	3.43E+05	Operational	NA	Wastewater treatment
Tank farm	NA	NA	Upgrade HW tank farm	NA	NA
NTS					
None	NA	NA	Operational	NA	NA
SRS					
PWIT-SF	NA	NA	Operational	Wastewater and sludge	NA
7.5-gal degreaser	3.25E+01	1.70E+00	Operational	NA	Solvent distillation
	4.18E+01	4.20E-01	Operational	NA	Silver recovery
Neutralization Facility	1.60E+01	0	Operational	NA	Wastewater neutralization
CIF	6.62E+03	0	Planned opening summer 1997	Organic solid and liquid	Incineration of HW and mixed waste
HWTF	1.36E+03	NA	Probably won't be built	NA	Both HW and mixed-waste treatment by encapsulation/ stabilization

TABLE 3.2 (Cont.)

Site and Facility	Temporary Storage		Status	Waste Type	Treatment Method
	Current				
	Capacity (t)	Usage (t/yr)			
RFETS					
Bldg 374 LWO	NA	NA	Operational	NA	NA
Bldg 774 LWTO	NA	NA	Operational	NA	NA
Bldg 776/777 WP	NA	NA	Operational	NA	NA
Unit 39	NA	NA	Operational	NA	Filtration
SNL-NM					
Explosive facility	3.65E+01	1.25E-01	Operational	Unstable explosive waste	Thermal treatment (Open burning)
HWTF	4.70E+00	4.60E+00	Operational	Hydrofluoric acid waste	Neutralization/ precipitation
INEL					
Naval ordnance disposal	NA	NA	Operational	Reactive liquids	Open burning
HCRWF compactor	NA	0	Operational	Toxic solids	Physical compaction
Reactive storage and treatment	NA	0	Planned FY 2000	Reactive liquids	Open burning
Hanford					
HWTF	N/A	0	Operational	NA	Vitrification

Notes: C = carbon; CAI = Controlled Air Incinerator; CDF = Chemical Detonation Facility; CIF = Consolidated Incinerator Facility; CNF = Central Neutralization Facility; CPCF = Central Pollution Control Facility; GWTF = Gaseous Waste Treatment Facility; HCRWF = Hazardous Chemical Removal Waste Facility; Hg = mercury; HWTF = HW treatment facility; LiH = lithium hydride; LWO = liquid waste operations; LWTO = liquid waste treatment operations; Na = sodium; NA = not available; NO_x = nitrogen oxides; NRWTP = nonradiological wastewater treatment plant; NTS = Nevada Test Site; OH⁻ = hydroxide; PRTF = Plating Rinse Water Treatment Facility; PWIT-SF = Process Waste Interim Treatment and Storage Facility; PWTP = Production Waste Treatment Plant; TA = technical area; WCRF = Waste Containerized Removal Facility; WETF = West End Treatment Facility; and WTU = waste treatment unit.

^a Capacity and usage numbers for the TSCA incinerator include mixed waste.

A substantial quantity of ORR's HW and mixed HW is burned in the K-25 Site TSCA incinerator. The facility has accepted a limited amount of waste for thermal destruction from other DOE sites. The incinerator was completed in 1988 and received permit authorization to burn RCRA- and TSCA-designated waste in 1989. The principal objectives of the TSCA incinerator program for FY 1992 were to continue thermally destroying hazardous, RCRA-hazardous, and TSCA waste materials (including mixed waste) from the ORR mixed-waste generators.

During FY 1992, the Pinellas Plant completed the construction upgrade of the Neutralization Facility, the construction of a new container/90-day storage facility, and the closure of RCRA HW storage tanks.

3.2 NEW AND PLANNED DOE FACILITIES

Tables 3.1 and 3.2 also list the new and planned HW storage and treatment facilities for the top DOE HW generators. New and planned facilities include currently dormant, but previously operating, existing facilities with plans to restart operation.

On the basis of the data available in the 5-year and site-specific DOE plans for WM and the data collected from a limited number of site visits, the following is a summary of new or planned treatment facilities in the DOE complex. Note that this summary is not comprehensive and may not cover smaller treatment operations.

The proposed HW treatment facility (HWTF) at LANL is intended to provide for on-site treatment and storage of both HW and LLMW. The latest estimated projection for operation is sometime in FY 1999 (Tegtmeier 1993). The primary purpose of the facility is LLMW treatment. To prevent cross-contamination, the treatment building (360 m^3 [$1.20\text{E}+04 \text{ ft}^3$]) will be divided into four independent areas, each with removable treatment skids, for treating four waste types: (1) RCRA characteristic but nonradioactive waste, (2) nonradioactive but RCRA-listed waste, (3) radioactive and RCRA characteristic waste, and (4) radioactive RCRA-listed waste. This design allows for maximum flexibility in treatment. The HWTF capabilities would include (1) destruction of organics, (2) recycling, (3) decontamination, (4) stabilization, (5) Hg treatment and recovery, and (6) deactivation or neutralization. If all four rooms were used to treat HW, the facility would have a capacity of approximately 40,000 drums per year. The HWTF is also to include two separate buildings for pretreatment storage, one for HW and one for LLMW, each with a 2,500-drum storage capacity (30-gal [114-L] drums) (Lussiez 1993). The planned facility also includes cyanide storage sheds. To avoid contamination, no radioactive wastes will be stored in the HW building or drum storage sheds. Conceptually, if both buildings were used to store HW before treatment, the facility would have a 5,000-drum capacity (30-gal [114-L] drums).

The Controlled Air Incinerator (CAI) at LANL is (primarily for mixed waste) currently in operation. The current upgrade began in 1987, and permits have been granted for TSCA and RCRA permit part B for HW, and interim status for mixed waste. The facility will process transuranic material, HW, and LLMW but no high-level wastes. The primary combustion chamber will have temperatures of 760 to 1,093°C (1,400 to 2,000°F) and will be able to process solid waste at up to 0.054 t per hour (h) (120 lb/h) or liquid waste at 0.091 t/h (200 lb/h). Off-gases will pass into a secondary chamber to destroy remaining volatile organics, and then a filtering system will remove remaining particulates.

SRS will incinerate HW, and LLMW. Both National Environmental Policy Act (NEPA) approval and RCRA permit part B have been received. Construction began in January 1993, with startup scheduled for February 1996. Average RCRA feed rates are 0.36 t/h (720 lb/h) for solids and 0.21 t/h (412 lb/h) for liquids, with a destruction efficiency of 99.99%. The primary combustion chamber will operate at temperatures ranging from 871 to 1,000°C (1,600 to 1,832°F), and the temperature of the secondary combustion chamber will be 982 to 1,100°C (1,800 to 2,012°F).

The Pantex Plant is scheduled to begin construction of a hazardous waste treatment processing facility in mid-FY 1998, with completion by the end of FY 1999. This treatment facility will include features to accommodate operation of mobile treatment units which will be developed in 1994. Plans also exist for construction of the RCRA Hazardous Waste Storage Facility (RHWSF) adjacent to the aforementioned treatment facility. The RHWSF is scheduled for start of construction in second quarter of FY 1995, with completion by second quarter of FY 1996. This facility will provide additional storage capacity for hazardous and mixed waste.

At SNL-NM, a preliminary conceptual design study was prepared for a consolidated waste management complex (CWMC) that will be used to manage all regulated waste generated by SNL-NM and will provide a full range of collection, characterization, packaging, and storage functions. The CWMC is expected to be operational by FY 2004.

Brookhaven National Laboratory (BNL) has requested authority to begin a multiyear construction project for a new waste management facility (WMF) at a more suitable location. By FY 1996, BNL intends to complete construction of the WMF, phase 2.

At INEL, a new HW storage facility to replace the existing facility is scheduled for construction in FY 1997. The new building will be RCRA-permitted and will comply with all applicable DOE orders and guidance. The facility will contain eight waste segregation areas separated by fire walls, leak containment, a system for collecting water if sprinklers are activated, and other safety features. The facility will also provide improvements for loading and handling, storage capacity, and coordination of mixed-waste storage.

At SRS, a HW/mixed-waste facility to treat and dispose of HW and mixed waste is being designed. The project will provide RCRA-permitted treatment and disposal for solid waste, HW, and mixed waste that cannot be disposed of in existing or planned facilities (cannot meet the criteria for waste acceptance at the CIF) and will eliminate the need to transport HW off-site. Identification of current and future hazardous and mixed waste streams is being conducted so that treatment equipment and processes can be developed.

In addition to the three new incinerators, several sites have obtained approval and are in the process of expanding or updating (or both) storage facilities, as well as treatment facilities (mainly wastewater treatment facilities). The expansions or updatings of the facilities are of restricted scale because of funding constraints.

3.3 USE OF COMMERCIAL TREATMENT, STORAGE, AND DISPOSAL FACILITIES

Hazardous waste not treated on-site by DOE installations is shipped off-site to be processed by TSD commercial facilities. During the past years, the DOE Complex has used more than 100 different approved commercial vendors to treat and dispose DOE-generated waste. The top 10 of the existing commercial facilities used during FY 1992 by DOE installations are listed in Table 3.3. Data included in the table were compiled from the waste manifests and from information obtained from site visits.

The DOE waste amounts listed in the table typically represent less than 5% of the total waste volume treated at the listed facility. For example, the DOE portion of the treated volumes at the Rollins' Deer Park and Baton Rouge facilities and Chem Waste's Port Arthur facility are less than 1%, 1.5%, and 3.8%, respectively, of the waste treated at these facilities in FY-92.

TABLE 3.3 Top 10 Commercial TSD Facilities Used by DOE Installations in FY 1992

Commercial TSD Facility	Total Waste (t)
Chemical Waste Management Inc., Port Arthur, Texas	1.38E+03
Chemical Waste Management Inc., Carlyss, La.	1.18E+03
US Pollution Control, Grassy Mountain Site, Clive, Utah	9.68E+02
Oil and Solvent Process Co., Henderson, Colo.	6.35E+02
Chemical Waste Management Inc., Kettleman City, Calif.	6.17E+02
Enviro Safe of Idaho, Grandview, Idaho	5.77E+02
Keers Environmental Inc., Albuquerque, N.M.	4.97E+02
Rollins Environmental Services (La.) Inc., Baton Rouge, La.	4.35E+02
Rollins Environmental Services (Texas) Inc., Deer Park, Texas	4.15E+02
Solvent Services Inc., San Jose, Calif.	3.23E+02
Others	3.44E+03
Total	1.05E+04

4 APPLICABLE TECHNOLOGIES FOR HAZARDOUS WASTE MANAGEMENT

This section identifies and describes HW management technologies. Technologies are described as a function of input waste feed in terms of emissions, residual wastes, and changes in waste amount. This description provides a generic (as opposed to a site-specific) method for developing estimates of waste loads, emissions, and resource requirements for a spectrum of HW management technologies that are applied to the HW inventories for the alternative analysis in the WM PEIS. The rationale behind this approach is the generic, or representative, nature of the analysis appropriate to decide among alternatives for a programmatic analysis, as opposed to the more detailed information that would be used in an analysis for a specific site or WM facility. The level of complexity of the evaluation is also consistent with the level of detail in the data that can be generalized for the entire DOE HW management system. More detailed calculations and procedures would be appropriate for analyzing the potential impacts of a specific facility, where a significant level of detail and specific designs would be available; however, for an analysis to support determination of the relative costs and benefits of programmatic alternative actions, the representative-technology approach used for the WM PEIS was considered appropriate.

4.1 OVERVIEW

Under RCRA, most all HW must be treated to meet certain standards before the waste (or the residues from its treatment) may be placed on the land. Standards for treatment may be either concentration-based or technology-based. The list of technology-based standards is contained in 40 CFR 268.42. This comprehensive list identifies the treatment technologies recognized by EPA as appropriate for treating HW. These technologies served as the basis for the DOE TDT groups. The approach in the assignment of DOE waste into the TDT groups and a description of the specific treatment technologies included in the analysis of the four WM PEIS alternatives are given in the following text. The nine major groups (Sections 4.1.1 to 4.1.9), along with a brief description of each, are listed below.

4.1.1 Destruction of Organics

Destruction of organic liquids and solids can be accomplished by a broad spectrum of technologies that includes the following subgroups: incineration, other thermal technologies (for example, calcination), biological treatment, chemical destruction, and cold plasma treatment. In addition to neutralizing the toxic organic constituents in the waste, destruction of organics can significantly reduce the primary waste volume.

4.1.2 Aqueous Treatment

This group incorporates a number of specialized treatment technologies. Examples include biological treatment, wet oxidation, and chemical oxidation or reduction. These technologies are often very specialized and waste specific. As such, they are generally not as readily available on a commercial basis as some of the other technologies.

4.1.3 Deactivation or Neutralization

The technologies in this group refer to processes that remove hazardous characteristics of a waste when these characteristics are based on ignitability, explosivity, corrosivity, or reactivity. Commercially, deactivation or neutralization is most commonly employed in neutralizing corrosive wastes. Deactivation is also the preferred technology for most reactive wastes.

4.1.4 Removal and Recovery of Organics

Along with incineration, treatment for the removal and recovery of organics comprises one of the most common forms of commercial treatment for organic liquids. This group encompasses a wide range of technologies, including solvent recycling and distillation, fuel substitution (organic liquid HWs with high energy content are substituted for virgin fuels in industrial equipment permitted by EPA to burn HW as fuel), carbon absorption, steam stripping, liquid-liquid extraction, and chemical or physical phase separation. Of these technologies, solvent distillation and fuel substitution are the most readily available on a commercial basis.

4.1.5 Metal Removal and Recovery

This technology group incorporates processes designed to remove and recover heavy metals from RCRA wastes. The technologies most commonly used for metal removal and recovery include ion exchange, resin or solid adsorption, reverse osmosis, chelation or solvent extraction, ultrafiltration, or simple chemical precipitation. Some thermal processes may be used as well. Frequently, some form of physical phase separation or concentration techniques, such as decantation, filtration, and centrifugation, are used in conjunction with the previously noted technologies.

4.1.6 Mercury Removal and Recovery

The technology group of mercury (Hg) removal and recovery is actually a subset of the metal removal-and-recovery group. From a practical standpoint, Hg is addressed separately because

the commercial facilities that manage waste with high levels of Hg are usually very specialized. The actual technologies employed include amalgamation and recovery, Hg retorting, and incineration with specialized control equipment.

4.1.7 Stabilization or Solidification

Stabilization or solidification refers to processes that tend to immobilize waste through chemical or physical means (or both). Stabilization is one of the most common forms of treatment for inorganic wastes. Stabilization occurs when HW is mixed with a solidification agent such as Portland cement, fly ash, or cement kiln dust to form a solid. Stabilization generally requires a special design mix between the waste and the solidification agent to ensure that the concentration-based standards of the LDRs are met. Stabilization is followed by land disposal at an HW landfill when the stabilized wastes are listed wastes.

4.1.8 Recycling

Many of the technologies and technology groups described previously incorporate some type of recycling (for example, metal removal and recovery, removal and recovery of organics). Recycling, in the context of this study, refers to the use of materials (that would otherwise be HW) as a direct substitute for raw materials. In addition to on-site storage permits, certain waste that meets this criterion would be exempt from regulation under the RCRA, although many state regulations would require that a HW manifest be used when the waste is transported.

4.1.9 Land Disposal

Although not an actual form of treatment, land disposal was included as a technology group because some direct disposal of HW to permitted landfills still occurs. Types of HWs that might be deposited directly into a landfill include newly identified wastes (wastes that have been identified since 1984) for which no treatment standards have been established and wastes that are covered by a variance under the LDRs. During FY 1992, large quantities of non-RCRA waste were also deposited directly into HW landfills by DOE. Examples of this non-RCRA waste include asbestos and petroleum-contaminated soil.

Of the nine TDT groups previously identified, aqueous treatment overwhelmingly predominates existing on-site HW treatment in the DOE Complex. The only other significant on-site treatment group is deactivation of explosive wastes, followed by incineration of organic wastes. Less than 10 t (11 tons) of HW per year is treated by stabilization and by metal removal and recovery.

4.2 WM PEIS TREATMENT-DISPOSAL TECHNOLOGIES

Each of the HW management modules used in the WM PEIS is described in Sections 4.2.1 through 4.2.4. Reduction (or increase) in waste amounts, emissions, and resource requirements for a generic input waste stream in terms of the input waste stream properties are identified. Emissions control devices are assumed for all airborne emissions. The representative waste streams developed in Section 2 and the inventories developed for each WM alternative can then be applied to each module, as appropriate, to generate expected waste amounts, emissions, and resource requirements for a particular alternative. This process is discussed further in Section 5.

The WM PEIS considers four major technology groups to represent on-site treatment at DOE installations for the HW alternatives. These groups are destruction (incineration) of organics, removal and recovery of organics (fuel burning or blending and solvent recovery), deactivation or neutralization, and aqueous liquid treatment. The last two treatment groups are largely in-place technologies that treat more than 99% of the RCRA HW generated throughout the DOE Complex.

The specific technologies evaluated in the WM PEIS were selected from the many possible technologies, in each of the four major groups mentioned, on the basis of current usage and RCRA compliance. Throughout the DOE Complex, HW treatment technologies are used for removal of volatile organic compounds, heavy metals, and other inorganics from aqueous wastewater, for neutralization or deactivation of explosive and reactive wastes, and for destruction of organic liquids and solids. Current treatment technologies used in the DOE Complex include wastewater treatment, incineration, explosive detonation, and evaporation. No RCRA part B permitted landfills are currently operating in the DOE Complex.

4.2.1 Destruction of Organics

Destruction of organic compounds (that is, breaking their chemical bonds) can be accomplished by a broad spectrum of technologies, including incineration, biological destruction, chemical destruction, and cold plasma destruction.

Since implementation of the LDRs, incineration has become one of the most widely used technologies for destroying organic HW. While the primary function of incineration is to destroy organics, the technology may also be used to destroy, deactivate, or reduce the amount of nonorganic waste.

Incineration of RCRA waste leads to the generation of treatment residues (fly ash, waste from pollution control equipment, and so on) that are also regulated as HW. To meet the LDR treatment standards, these residues may generally be stabilized before disposal at a HW landfill.

Thermal destruction of organics is a rapidly emerging technology. Several different types of incinerators are employed for treating HWs. The DOE installations are currently using commercial vendors with liquid-injection or rotary kiln incinerators.

Liquid-injection incinerators are usually refractory-lined chambers, generally cylindrical and equipped with a primary combustor and a secondary combustor or injection nozzles for aqueous wastes containing organic or inorganic compounds (or both). Liquid waste is burned directly in a combustor or is injected into the flame zone or combustion zone of the incinerator chamber via nozzles. Most liquid-injection incinerators do not generate solids or ash.

Rotary kiln incinerators are most often selected where a wide range of feed properties is expected. These incinerators can effectively treat liquids, gases, and solids and are used extensively for treating contaminated soils, sludge, and sediments. Rotary kilns are inclined, cylindrical refractory-lined shells where initial thermal treatment takes place. Rotary kilns may be designed to operate in an oxidative or pyrolytic mode.

4.2.2 Aqueous Liquid Treatment

This category incorporates a number of specialized treatment technologies. Examples include biological treatment, wet oxidation, and chemical oxidation or reduction. These technologies are often very specialized and waste specific. As such, they generally are not as readily available on a commercial basis as some of the other technologies. Some of the technologies in this group may be especially suited for on-site remediation projects. This category, along with destruction of organics, deactivation or neutralization, and removal and recovery of organics, is a suitable HW treatment technology for the WM PEIS alternatives.

4.2.3 Deactivation or Neutralization

Deactivation refers to processes that remove the hazardous characteristics of a waste when that characteristic is based on ignitability, corrosivity, or reactivity. Commercially, deactivation is most commonly used to neutralize corrosive wastes. Deactivation is also the preferred technology for most reactive wastes.

Current data indicate that all treatment involving deactivation or neutralization for characteristic HW generally produces non-hazardous residues, and do not involve on-site shipping for further treatment. Therefore, the potential health and environmental risks associated with this treatment group do not vary with alternative; however, the same conclusion cannot be confirmed, at this time, for wastewater treatment.

Some installations do ship relatively small quantities of wastewater on-site for treatment. Residual wastewater sludge, representing approximately 0.6% of throughput by volume, is also generated from on-site treatment. This sludge would have to be stabilized and sent to a landfill. Currently, little or no on-site stabilization is done or planned at DOE installations. This fact would require the wastewater sludge to be shipped to commercial sites for stabilization and disposal in accordance with RCRA requirements. If a significant amount is shipped on-site, the relative risks between alternatives cannot be assumed to be equal for wastewater treatment. Because treatment does not vary with alternatives, the air, water, and solid residual releases will have to be estimated. The significance associated with the shipment of sludge and wastewater for commercial treatment is currently being investigated.

The assumption is made that explosives and corrosives treated with deactivation or neutralization are processed with separate technologies from the treatment of radioactively contaminated waste. This segregation will minimize any potential cumulative impacts.

4.2.4 Removal and Recovery of Organics

Along with incineration, treatment for the removal and recovery of organics comprises one of the most common forms of commercial treatment for organic liquids. This group encompasses a wide range of technologies, including solvent recycling and distillation, fuel substitution (organic liquid HWs with high energy content are substituted for virgin fuels in industrial equipment permitted by EPA to burn HW as fuel), carbon absorption, steam stripping, liquid-liquid extraction, and chemical or physical phase separation. Of the previous treatments, solvent distillation and fuel substitution are the most readily available on a commercial basis. Most spent solvents, one of the largest categories of HW generated in the United States, are treated by one of these two technologies.

5 WASTE LOADS BY ALTERNATIVES

The analysis of alternative management strategies in the WM PEIS focuses on the types and volumes of HW generated and managed by the largest DOE HW shippers and generators. For the HW, the following DOE sites were considered: Hanford, INEL, KCP, LANL, LLNL, ORR, Pantex, ANL-E, FNAL, SNL-NM, and SRS. These 11 installations generate more than 90% of all HW produced by DOE facilities nationwide.

As noted earlier, the WM PEIS is considering four major technology groups for on-site treatment of those HWs currently going on-site for such treatment. The on-site treatment technologies that would be added or upgraded at designated DOE facilities are (1) destruction (incineration) of organics, (2) removal and recovery of organics (fuel substitution/burning and solvent recovery), (3) deactivation and neutralization, and (4) wastewater treatment. Other required forms of treatment for DOE HWs, such as stabilization and metal removal and recovery, would continue to be performed on-site at commercial facilities.

By using the sites, wastes, and treatment regimes outlined previously as a framework for study, four HW management alternatives have been developed and evaluated. These alternatives were selected to provide representative results for the range of onsite options. Thus, the alternatives evaluate 3%, 9%, 50%, and 90% of the DOE HW (excluding wastewater) being treated on-site.

5.1 HAZARDOUS WASTE MANAGEMENT ALTERNATIVES

5.1.1 No Action Alternative

The No Action Alternative is required by NEPA to provide a baseline against which all other alternatives would be measured. Under this alternative, the status quo would be preserved. Hazardous wastes that are currently being treated on-site at DOE facilities will continue to be treated on-site, and all other wastes will continue to be treated and disposed of off-site at commercial facilities. In 1991, the following amounts of HWs (in metric tons [t]) were treated at DOE facilities, according to biennial RCRA HW management reports submitted to EPA:

Wastewater treatment	1,235,020 t
Deactivation	476 t
Incineration	70 t
Organic removal and recovery	12 t
Metal removal and recovery	8 t
Stabilization	2 t
Total	<u>1,235,588 t</u>

These volumes probably have not changed significantly since 1991 and therefore are assumed to be representative (baseline) of DOE's on-site HW treatment capabilities today.

In comparison, manifest records from FY 1992 show that over a year's time, about 3,400 t (7.50E+06 lb) of RCRA HW is being sent from DOE facilities to on-site commercial facilities for treatment. Half of this amount is being incinerated; another third is being treated to recover either solvents (distillation) or energy (phase separation and fuel blending); and the remainder is being treated by stabilization, metal removal and recovery, deactivation, and aqueous treatment methods. These quantities and waste treatment allocations are considered to be representative of the baseline conditions for HW. Approximately 34 t (7.50E+04 lb) was shipped on-site for direct disposal in commercially permitted HW landfills.

In addition, another 6,600 t (1.46E+07 lb) of PCB, ER, and state-regulated wastes were generated in 1992; about one-third of these wastes went to commercial facilities for treatment (in descending order: incineration, organic recovery, stabilization, metal recovery, aqueous treatment, and deactivation), while two-thirds of the wastes were sent directly to on-site RCRA and TSCA landfills for disposal.

In future years, overall HW generation rates are likely to remain rather constant; although DOE will continue its efforts to minimize the generation of WM HW, at the same time DOE will be stepping up implementation of its ER Program. Therefore, under the No Action alternative, approximately 1.2 million t (2.65E+09 lb) of hazardous wastewater and 600 t (1.32E+06 lb) of RCRA-regulated WM HWs will continue to be generated and treated on-site and disposed of at commercial facilities each year. Another 10,000 t (2.20E+07 lb) of assorted RCRA HWs, PCB waste, ER waste, and state-regulated wastes will be generated and sent on-site for treatment and disposal.

5.1.2 Decentralized Alternative

Under this alternative, currently available on-site treatment activities would be enhanced on the basis of the execution of the existing or planned programs. As a result of these enhancements, about five% more treatment capacity would be available on-site. In addition, the use of commercial treatment vendors would continue as needed, with greater DOE controls on the number of vendors used, the services provided, and the performance delivered, as well as the minimization of brokering and the improvement of DOE oversight of the waste treatment at these commercial treatment facilities.

5.1.3 Regionalized 1 Alternative

This alternative builds on the Decentralized Alternative by retaining on-site treatment at selected DOE facilities for approximately 50% of the total nonwastewater HW. This alternative means that an additional 1,700 t (3.75E+06 lb) of RCRA HW would be managed at five designated regionally representative DOE-owned-and-operated HW treatment facilities or hubs (Hanford, INEL, LANL, ORR, and SRS). Each regional hub would have to be permitted under RCRA. The additional treatment facilities would be geared primarily to incineration, organic removal and recovery, deactivation or neutralization, and aqueous treatment.

5.1.4 Regionalized 2 Alternative

Under this alternative, 90% of all nonwastewater HW presently going on-site (about 3,000 t/yr [7.29E+06 lb/yr]) would be retained and managed at two centrally located DOE installations—INEL and ORR. Commercial sites would still be used for disposal of the DOE-treated residuals, as well as for the remaining 10% of HW and any other PCB, or state-regulated HWs. All other DOE sites would ship their wastes to one of the centralized DOE sites or to approved commercial facilities. The additional treatment facilities at the two hubs would be geared primarily to incineration, organic removal and recovery, deactivation or neutralization, and aqueous treatment.

For each of the alternatives, a table has been developed to illustrate the annual volumes of HW that are allocated for treatment at DOE sites versus on-site commercial facilities. The tables provide on-site and off-site WM waste load transfers grouped by the treatment technology appropriate to the physical and chemical characteristics of the transported waste.

5.2 NO ACTION AND DECENTRALIZED ALTERNATIVES

Under both the No Action and the Decentralized alternatives, the smaller DOE sites would ship their waste to commercial sites as they are currently doing, and on-site treatment would continue as currently performed at some of the larger DOE facilities.

The main difference between the two alternatives is a 6% shift in the waste totals for incineration and fuel burning/blending from off-site treatment (No Action) to on-site treatment (Decentralized). Because of this relatively small difference, the No Action and Decentralized alternatives are discussed together; however, when transport miles and vehicle cargo content are considered, a significant distinction between these two alternatives exists (see Appendix E).

The WM strategy for the No Action and Decentralized alternatives can be summarized as follows:

- Manifest and package HW, and ship the bulk of HW to commercially permitted treatment facilities.
- Maintain and operate existing, approved DOE HW storage facilities and limited treatment facilities at DOE sites in accordance with applicable permit requirements for treatment facilities.
- Minimize generation of HW to the greatest extent possible.

Hazardous waste incineration is being done at DOE installations. Decentralization would add or increase incineration at three sites (INEL, SRS, and ORR) and eliminate incineration at LANL (the decision to retire the existing incinerator was made in June 1995). Information on waste streams sent to the ORR K-25 Site incinerator indicates that most of this waste transfer was probably for mixed-waste destruction.

Tables 5.1 and 5.2 depict the No Action and Decentralized alternatives in terms of WM waste load movement. Waste load transfers from DOE generators are identified in the extreme left column and are presented for seven treatment groups. The treatment group of removal and recovery of organics involves three types of treatment technology: fuel blending, fuel burning, and solvent recycling. Because HW treated by fuel blending is ultimately burned, the amounts for fuel blending are included in the fuel burning column. The totals for treatment at commercial treatment facilities are based on the overall amounts shipped off-site for FY 1992.

Tables 5.1 and 5.2 show that most of the HW loads at the top 11 DOE sites are transferred to commercial treatment facilities. Except for wastes to be incinerated or treated through fuel burning at INEL, ORR, and SRS, most wastes generated by the other eight DOE installations would be sent to commercial treatment facilities.

Tables 5.1 and 5.2 also include the use of existing or planned facilities to incinerate both HW and LLMW. This fact applies to three incinerators at INEL, ORR, and SRS. As shown in Table 5.2 under the Decentralized Alternative, the top 11 generators treat (by incineration and "waste-fuel" burning) HW at three existing installations. The change of use in these facilities between the No Action and Decentralized alternatives is summarized in Table 5.3. The total net change from the No Action Alternative to the Decentralized Alternative would be an increase of approximately 180 metric tons/yr in thermal treatment and 43 metric tons/yr in on-site fuel burning.

TABLE 5.1 No Action Alternative: HW Load Transfers/Treatment Technology Matrix for Major DOE Generator Installations (in metric tons)

Site and Location of HW Treatment	Organic Removal and Recovery				Metal Removal and Recovery				Total		
	Organic Destruction by Incineration ^a	Fuel Blending	Fuel Burning	Solvent Recycling ^b	Stabilization ^d	Deactivation	Non-Hg	Hg		Aqueous Treatment	Recycling (Batteries)
ANL-E											
On-site	0	0	0	0	0	0	0	0	0	0	0
ComTreat ^c	7.20E+01	0	0	1.20E+00	1.90E+01	2.00E+01	3.40E+00	9.00E+01	0	0	2.06E+02
Site total	7.20E+01	0	0	1.20E+00	1.90E+01	2.00E+01	3.40E+00	9.00E+01	0	0	2.06E+02
FNAL											
On-site	0	0	0	0	0	0	0	0	0	0	0
ComTreat	2.80E+01	0	0	1.06E+01	2.20E+00	7.50E+00	5.00E-02	5.50E-01	0	0	4.89E+01
Site total	2.80E+01	0	0	1.06E+01	2.20E+00	7.50E+00	5.00E-02	5.50E-01	0	0	4.89E+01
Hanford											
On-site	0	0	0	0	0	0	0	0	0 ^f	0	0
ComTreat	2.20E+01	0	1.52E+02	7.82E+01	3.00E+00	4.50E+01 ^e	1.00E-01 ^e	1.51E+00	0 ^f	7.00E-01	3.02E+02
Site total	2.20E+01	0	1.52E+02	7.82E+01	3.00E+00	4.50E+01	1.00E-01	1.51E+00	0 ^f	7.00E-01	3.02E+02
INEL											
On-site	1.74E+01	(3.05E+01) ^g	1.74E+01	0	0	0	0	0	0	0	3.50E+01
ComTreat	9.35E+01	0	1.31E+01	1.57E+01	9.25E+00	1.50E+01 ^e	7.40E+00 ^g	1.70E+00	3.95E+00 ^e	5.00E-01	1.60E+02
Site total	1.11E+02	(3.05E+01) ^g	3.05E+01	1.57E+01	9.25E+00	1.50E+01	7.40E+00	1.70E+00	3.95E+00	5.00E-01	1.95E+02
KCP											
On-site	0	0	0	0	0	0	0	0	0	0	0
ComTreat	3.80E+02	0	7.00E+01	3.50E+01	5.00E+01	1.20E+01 ^e	5.00E+01 ^e	2.50E+00	1.00E+00 ^f	0	6.01E+02
Site total	3.80E+02	0	7.00E+01	3.50E+01	5.00E+01	1.20E+01	5.00E+01	2.50E+00	1.00E+00	0	6.01E+02
LANL											
On-site	0 ^f	0	0	0	0	0	0	0	0	0	0
ComTreat	4.80E+01	(1.10E+02) ^g	1.10E+02	5.64E+01	1.10E+01	1.35E+01	2.00E+00	4.00E+00	0	7.00E-01	2.45E+02
Site total	4.80E+01	(1.10E+02) ^g	1.10E+02	5.64E+01	1.10E+01	1.35E+01	2.00E+00	4.00E+00	0	7.00E-01	2.45E+02
LLNL											
On-site	0	0	0	0	0	0	0	0	0	0	0
ComTreat	2.68E+02	0	1.60E+02	8.27E+01	5.70E+01	0	5.30E+00	4.30E+00	4.80E+01	2.00E+00	6.29E+02
Site total	2.68E+02	0	1.60E+02	8.27E+01	5.70E+01	1.19E+00	5.30E+00	4.30E+00	4.80E+01	2.00E+00	6.29E+02
ORR											
On-site	5.30E+01 ^e	(4.27E+01) ^g	1.26E+01	0	0	0	0	0	0	0	6.56E+01
ComTreat	1.02E+02	0	3.01E+01	2.28E+01	1.30E+01	2.08E+01 ^e	1.04E+01 ^e	2.30E+00	5.00E+00 ^e	7.00E-01	2.07E+02
Site total	1.55E+02	(4.27E+01) ^g	4.27E+01	2.28E+01	1.30E+01	2.08E+01	1.04E+01	2.30E+00	5.00E+00	7.00E-01	2.73E+02

TABLE 5.1 (Cont.)

Site and Location of HW Treatment	Organic Removal and Recovery				Metal Removal and Recovery				Total		
	Organic Destruction by Incineration ^a	Fuel Blending	Fuel Burning	Solvent Recycling ^b	Stabilization	Deactivation	Non-Hg	Hg		Aqueous Treatment	Recycling (Batteries)
Pantex											
On-site	0	0	0	0	0	0	0	0	0	0	0
ComTreat	3.19E+02 ^f	0	0	2.60E+01	6.00E+01	1.06E+01	0	6.00E-01	0	0	5.12E+02
Site total	3.19E+02	0	0	2.60E+01	6.00E+01	1.06E+02	0	6.00E-01	0	0	5.12E+02
SNL											
On-site	0	0	0	0	0	0	0	0	0	0	0
ComTreat	9.30E+01	0	0	1.70E+01	2.40E+01	1.10E+01	5.50E+00	9.00E-01	0	1.54E+00	1.53E+02
Site total	9.30E+01	0	0	1.70E+01	2.40E+01	1.10E+01	5.50E+00	9.00E-01	0	1.54E+00	1.53E+02
SRS^h											
On-site	0	0	0	0	0	0	0	0	0	0	0
ComTreat	1.55E+02	(4.27E+01) ^g	4.27E+01	2.28E+01	1.30E+01	2.09E+01	1.04E+01 ^e	2.30E+00	5.00E+00 ^c	7.00E-01	2.73E+02
Site total	1.55E+02	(4.27E+01) ^g	4.27E+01	2.28E+01	1.30E+01	2.09E+01	1.04E+01	2.30E+00	5.00E+00	7.00E-01	2.73E+02
Total											
On-site	7.05E+01	(7.32E+01) ^g	3.00E+01	0	0	0	0	0	0	0	1.0E+02
ComTreat	1.58E+03	(1.52E+02) ^g	5.78E+02	3.68E+02	2.61E+02	1.75E+02	9.45E+01	1.11E+02	6.27E+01	6.84E+00	3.34E+03
Site total	1.65E+03	(2.26E+02) ^g	6.08E+02	3.68E+02	2.61E+02	2.73E+02	9.45E+01	1.11E+02	6.27E+01	6.84E+00	3.44E+03

^a Assumes that this technology was the appropriate technology for 1992 amounts incinerated. Much of this waste could have gone to removal and recovery of organics or was corrosive and could have been deactivated.

^b At each location, some of these solvents (assuming approximately 10%) were also recycled by Safety-Kleen.

^c ComTreat = commercial treatment.

^d A significant portion of the amount in this treatment group was associated with remedial activities.

^e Although given amounts only reflect what was shipped on-site in FY 1992, a significant amount of waste in this treatment group was also treated on-site in 1992; that amount is unknown.

^f Assumes on-site incineration can destroy 50% of generated liquid HW that can be incinerated.

^g The amount blended is in parentheses because it was not counted in the total waste amount generation; amount was counted when burned as fuel.

^h Waste amounts were derived from manifests. Because of the moratorium, the precise amount of actual waste generated cannot be determined at this time. The SRS reported generating over 4.50E+03 t (1.00E+06 lb) of HW in CY 1991 (from biennial report). For this table, amounts for SRS are assumed to be the same as those for ORR. One wastestream alone accounted for over 1.60E+03 t (3.50E+06 lb) shipped on-site.

TABLE 5.2 Decentralized Alternative: HW Load Transfers/Treatment Technology Matrix for Major DOE Generator Installations (in metric tons)

Site and Location of HW Treatment	Organic Removal and Recovery				Metal Removal and Recovery				Total		
	Organic Destruction by Incineration ^a	Fuel Blending	Fuel Burning	Solvent Recycling ^b	Stabilization	Deactivation	Non-Hg	Hg		Aqueous Treatment	Recycling (Batteries)
ANL-E											
On-site	0	0	0	0	0	0	0	0	0	0	0
Comtreat ^c	7.20E+01	0	0	1.20E+00	1.90E+01	2.00E+01	3.40E+00	9.00E+01 ^d	0	0	2.06E+02
Site total	7.20E+01	NA	0	1.20E+00	1.90E+01	2.00E+01	3.40E+00	9.00E+01 ^d	0	0	2.06E+02
FNAL											
On-site	0	0	0	0	0	0	0	0	0	0	0
Comtreat	2.80E+01	0	0	1.06E+01	2.20E+00	7.50E+00	5.00E-02	5.50E-01	0	0	4.89E+01
Site total	2.80E+01	NA	0	1.06E+01	2.20E+00	7.50E+00	5.00E-02	5.50E-01	0	0	4.89E+01
Hanford											
On-site	0	0	0	0	0	0	0	0	0 ^f	0	0
Comtreat	2.20E+01	0	1.52E+02	7.82E+01	3.00E+00	4.50E+01 ^e	1.00E-01 ^e	1.51E+00	0 ^f	7.00E-01	3.02E+02
Site total	2.20E+01	NA	1.52E+02	7.82E+01	3.00E+00	4.50E+01	1.00E-01	1.51E+00	0 ^f	7.00E-01	3.02E+02
INEL											
On-site	1.74E+01	0	1.74E+01	0	0	0	0	0	0	0	3.48E+01
Comtreat	9.35E+01	0	1.31E+01	1.57E+01	9.25E+00	1.50E+01 ^e	7.40E+00 ^e	1.70E+00	3.70E+00 ^e	5.00E-01	1.59E+02
Site total	1.11E+02	NA	3.05E+01	1.57E+01	9.25E+00	1.50E+01	7.40E+00	1.70E+00	3.70E+00	5.00E-01	1.95E+02
KCP											
On-site	0	0	0	0	0	0	0	0	0	0	0
Comtreat	3.80E+02	0	7.00E+01	3.50E+01	5.00E+01	1.20E+01 ^e	5.00E+01 ^e	2.50E+00	1.00E+00 ^e	0	6.01E+02
Site total	3.80E+02	NA	7.00E+01	3.50E+01	5.00E+01	1.20E+01	5.00E+01	2.50E+00	1.00E+00	0	6.01E+02
LANL											
On-site	0	0	0	0	0	1.23E+00	0	0	0	0	0
Comtreat	4.80E+01	(1.10E+02)	1.10E+02	5.64E+01	1.10E+01	1.23E+01	2.00E+00	4.00E+00	0	7.00E-01	2.45E+02
Site total	4.80E+01	NA	1.10E+02	5.64E+01	1.10E+01	1.35E+01	2.00E+00	4.00E+00	0	7.00E-01	2.45E+02
LLNL											
On-site	0	0	0	0	0	1.19E+00	0	0	0	0	1.19E+00
Comtreat	2.68E+02	0	1.60E+02	8.27E+01	5.70E+01	0	5.30E+00	4.30E+00	4.80E+04	2.00E+00	6.28E+02
Site total	2.68E+02	NA	1.60E+02	8.27E+01	5.70E+01	1.19E+00	5.30E+00	4.30E+00	4.80E+04	2.00E+00	6.29E+02
ORR											
On-site	1.17E+02 ^h	(4.27E+01) ^g	2.77E+01	0	0	0	0	0	0	0	1.44E+02
Comtreat	3.89E+01	0	1.55E+01	2.28E+01	1.30E+01	2.08E+01 ^e	1.04E+01 ^e	2.30E+00	5.00E+00 ^e	7.00E-01	1.29E+02
Site total	1.55E+02	NA	4.27E+01	2.28E+01	1.30E+01	2.08E+01	1.04E+01	2.30E+00	5.00E+00	7.00E-01	2.73E+02

TABLE 5.2 (Cont.)

Site and Location of HW Treatment	Organic Destruction by Incineration ^a	Organic Removal and Recovery				Metal Removal and Recovery				Total	
		Fuel Blending	Fuel Burning	Solvent Recycling ^b	Stabilization	Deactivation	Non-Hg	Hg	Aqueous Treatment		Recycling (Batteries)
Pantex											
On-site	0	0	0	0	0	9.56E+01	0	0	0	0	9.56E+01
ComTreat	3.19E+02 ^f	0	0	2.60E+01	6.00E+01	1.03E+01	0	6.00E-01	0	0	4.16E+02
Site total	3.19E+02	NA	0	2.60E+01	6.00E+01	1.06E+02	0	6.00E-01	0	0	5.12E+02
SNL											
On-site	0	0	0	0	0	0	0	0	0	0	0
ComTreat	9.30E+01	0	0	1.70E+01	2.40E+01	1.10E+01	5.50E+00	9.00E-01	0	1.54E+00	1.53E+02
Site total	9.30E+01	NA	0	1.70E+01	2.40E+01	1.10E+01	5.50E+00	9.00E-01	0	1.54E+00	1.53E+02
SRS ^g											
On-site	1.17E+02 ^h	(4.27E+01) ^g	2.77E+01	0	0	1.25E-01	0	0	0	0	1.44E+02
ComTreat	3.89E+01	0	1.50E+01	2.28E+01	1.30E+01	2.08E+01 ^e	1.04E+01 ^e	2.30E+00	5.00E+00 ^e	7.00E-01	1.29E+02
Site total	1.55E+02	NA	4.27E+01	2.28E+01	1.30E+01	2.09E+01	1.04E+01	2.30E+00	5.00E+00	7.00E-01	2.73E+02
<i>Total</i>											
On-site	2.51E+02	NA	7.28E+01	0	0	9.81E+01	0	0	0	0	3.23E+02
ComTreat	1.40E+03	NA	5.35E+02	3.68E+02	2.61E+02	1.75E+02	9.45E+01	1.11E+02	6.27E+01	6.84E+00	3.11E+03
Total	1.65E+03	NA	6.08E+02	3.68E+02	2.61E+02	2.73E+02	9.45E+01	1.11E+02	6.27E+01	6.84E+00	3.44E+03

^a Assumes that this technology was the appropriate technology for 1992 amounts incinerated. Much of this waste could have gone to removal and recovery of organics or was corrosive and could have been deactivated.

^b At each location, some of these solvents (assuming approximately 10%) were also recycled by Safety-Kleen.

^c ComTreat = commercial treatment.

^d A significant portion of the amount in this treatment group was associated with remedial activities.

^e Although given amounts only reflect what was shipped on-site in FY 1992, a significant amount of waste in this treatment group was also treated on-site in 1992; that amount is unknown.

^f Assumes on-site incineration can destroy 50% of generated liquid HW that can be incinerated.

^g The amount blended was not counted in the total waste amount generation; amount was counted when burned as fuel.

^h Assumes that on-site incineration at ORR and SRS can destroy 75% of generated liquid HW that can be incinerated.

ⁱ Waste amounts were derived from manifests. Because of the moratorium, the precise amount of actual waste generated cannot be determined at this time. The SRS reported generating over 4.50E+03 t (1.00E+06 lb) of HW in CY 1991 (from biennial report). For this table, amounts for SRS are assumed to be the same as those for ORR. One wastestream alone accounted for over 1.60E+03 t (3.50E+06 lb) shipped on-site.

TABLE 5.3 Change in Use of Onsite Thermal Destruction and Waste-Fuel Burning Under No Action and Decentralized Alternatives

Site and Treatment	HW Treated by Thermal Destruction and Fuel Burning (metric tons/year)	
	No Action Alternative	Decentralized Alternative
INEL		
Thermal treatment	17.4	17.4
Fuel burning	17.4	17.4
ORR		
Thermal treatment	53	116.6
Fuel burning	12.6	27.7
SRS		
Thermal treatment	0	116.6
Fuel burning	0	27.7
Total		
Thermal treatment	70.4	250.6
Fuel burning	30.0	72.8

5.3 REGIONALIZED 1 ALTERNATIVE

Under this alternative, half of the complexwide HW generated by 11 DOE sites (Hanford, LLNL, INEL, LANL, SNL, Pantex, ORR, FNAL, KCP, ANL-E, and SRS) and currently going off-site for treatment would be retained and treated at five on-site DOE treatment centers or hubs (Hanford, INEL, LANL, ORR, and SRS). Treatment would be provided for about 1,700 t/yr (3.75E+06 lb/yr) of HW amenable to thermal destruction (incineration and fuel blending) or other forms of organic recovery, such as solvent recycling. Organic wastes exceeding the on-site treatment capacity and other HWs not suitable for treatment at these five treatment hubs would be sent off-site to commercial treatment facilities.

Data for the Regionalized 1 alternative are presented in Table 5.4. Under this alternative, the total quantity of waste to be treated through removal and recovery of organics from each of the DOE generators would be sent to the regional hub site, where two-thirds of the waste would be treated. The remaining one-third would be sent from the regional hub site to a commercial treatment facility for treatment. The regional hubs would also be responsible for two-thirds of total regional wastes to be incinerated; the other one-third would be sent directly from the generator to a commercial treatment facility. Under the categories of incineration and removal and recovery of organics, the amounts of waste for each region that would be treated at the DOE hub facility and at commercial treatment facilities are indicated after the appropriate facility. The total number of metric tons to be treated under the category is then given for each hub; for example, under the incineration treatment category for the Hanford Hub, a total of 290 t (6.39E+05 lb) of waste generated by Hanford and LLNL would be slated for incineration. Of that total, 191.5 t (4.22E+05 lb) would be incinerated at the hub (Hanford), and the remaining 98.5 t (2.17E+05 lb) would be sent to a commercial treatment facility.

As a net result of this management alternative, approximately 50% of the complexwide commercially treated HW would now be treated at designated DOE treatment facilities. To accomplish this target, two-thirds of the total waste requiring incineration or removal and recovery of organics ("waste-fuel" burning) from the top 11 sites would be treated by three designated DOE treatment Sites. Two sites—INEL and SRS—would treat only their own HW. The five DOE treatment facilities and the amount of waste they would treat are as follows:

- *LANL Hub*. Incineration, 303.6 t (6.69E+05 lb); "waste-fuel" burning, 90.8 t (2.00E+05 lb) (hub accepts HW from Pantex and SNL-NM).
- *ORR Hub*. Incineration, 420 t (9.26E+05 lb); "waste-fuel" burning, 78 t (1.72E+05 lb) (hub accepts HW from KCP, ANL-E, and FNAL).
- *Hanford Hub*. Incineration, 191.5 t (4.22E+05 lb); "waste-fuel" burning, 206 t (4.54E+05 lb) (hub accepts HW from LLNL).
- *SRS*. Incineration, 102.6 t (2.26E+05 lb); "waste-fuel" burning, 28 t (6.17E+04 lb) (SRS does not accept HW from other DOE installations).
- *INEL*. Incineration, 73.2 t (1.61E+05 lb); "waste-fuel" burning, 30.5 t (6.72E+04 lb) (INEL does not accept HW from other DOE installations).
- Remaining generators ship to permitted commercial treatment facilities.

TABLE 5.4 Regionalized 1 Alternative: HW Load Transfers/Treatment Technology Matrix for Major DOE Generator Installations (in metric tons)

Hub and Location of HW Treatment	Organic Destruction by Incineration ^a	Organic Removal and Recovery ^b					Metal Removal and Recovery					
		Fuel Blending	Fuel Burning	Solvent Recycling ^c	Stabilization	Deactivation	Non-Hg	Hg	Aqueous Treatment	Recycling (Batteries)	Total	
Hanford Hub (Hanford, LLNL)												
On-site	1.92E+02	(3.12E+03) ^d	2.06E+02	1.06E+02	0	0	0	0	0	0	0	5.03E+02
ComTreat ^e	9.85E+01	0	1.06E+02	5.47E+01	6.00E+01	4.62E+01	5.40E+00	5.81E+00	4.80E+01	2.70E+00	2.70E+00	4.27E+02
Hub total	2.90E+02	NA	3.12E+02	1.61E+02	6.00E+01	4.62E+01	5.40E+00	5.81E+00	4.80E+01	2.70E+00	2.70E+00	9.31E+02
INEL Hub (INEL)												
On-site	7.32E+01	(3.05E-01) ^d	3.05E+01	0	0	0	0	0	0	0	0	1.04E+02
ComTreat	3.77E+01	0	0	1.57E+01	9.25E+00	1.50E+01	7.40E+00	1.70E+00	3.70E+00	5.00E-01	5.00E-01	9.10E+01
Hub total	1.11E+02	NA	3.05E+01	1.57E+01	9.25E+00	1.50E+01	7.40E+00	1.70E+00	3.70E+00	5.00E-01	5.00E-01	1.95E+02
Los Alamos Hub (LANL, SNL, Pantex)												
On-site	3.04E+02	(1.38E+02) ^d	9.08E+01	4.69E+01	0	0	0	0	0	0	0	4.41E+02
ComTreat	1.56E+02	0	4.68E+01	2.41E+01	9.50E+01	1.31E+02	7.50E+00	5.50E+00	0	2.24E+00	2.24E+00	4.68E+02
Hub total	4.60E+02	NA	1.38E+02	7.10E+00	9.50E+01	1.31E+02	7.50E+00	5.50E+00	0	2.24E+00	2.24E+00	9.09E+02
Oak Ridge Hub (ORR; FNAL; KCP; ANL-E)												
On-site	4.20E+02	(1.20E+02) ^d	7.80E+01	4.08E+01	0	0	0	0	0	0	0	5.39E+02
ComTreat	2.15E+02	0	4.24E+01	2.11E+01	8.42E+01	6.03E+01	6.40E+01	9.54E+01 ^f	6.00E+00	7.00E-01	7.00E-01	5.89E+02
Hub total	6.35E+02	NA	1.20E+02	6.19E+01	8.42E+01	6.03E+01	6.40E+01	9.54E+01 ^f	6.00E+00	7.00E-01	7.00E-01	1.13E+03
Savannah Hub (SRS)												
On-site	1.03E+02	(4.27E+01) ^d	2.80E+01	1.50E+01	0	0	5.20E+00	0	0	0	0	1.51E+02
ComTreat	5.29E+01	0	1.47E+01	7.78E+00	1.30E+01	2.09E+01	5.20E+00	2.30E+00	5.00E+00	7.00E-01	7.00E-01	1.22E+02
Hub total	1.55E+02	NA	4.27E+01	2.28E+01	1.30E+01	2.09E+01	1.04E+01	2.30E+00	5.00E+00	7.00E-01	7.00E-01	2.73E+02
<i>Total</i>												
On-site	1.09E+03	(6.43E+02)	4.33E+02	2.09E+02	0	0	5.20E+00	0	0	0	0	1.74E+03
ComTreat	5.61E+02	(0)	2.10E+02	1.23E+02	2.61E+02	2.73E+02	8.95E+01	1.11E+02	6.27E+01	6.84E+00	6.84E+00	1.7E+03
<i>Total</i>	1.65E+03	NA	6.43E+02	3.32E+02	2.61E+02	2.73E+02	9.47E+01	1.11E+02	6.27E+01	6.84E+00	6.84E+00	3.44E+03

^a Assumes that 2/3 of all material that can be incinerated is incinerated at regional hub and 1/3 at commercial facilities.

^b Assumes that 2/3 of removal and recovery of organics is conducted on-site at regional hub and 1/3 at commercial facilities.

^c Some of these solvents (10%) are also recycled by Safety-Kleen at each individual site location.

^d This amount was not counted on overall treatment totals when blended. Rather, amount was counted when burned as fuel.

^e ComTreat = commercial treatment.

^f This figure, which is based on FY 1992 amounts, includes remediation waste.

Note that with this Regionalized 1 alternative, five installations would have incinerators.

- Total incineration for the five hubs:
 $303.6+420+191.5+102.6+73.2 = 1,090.9$ tons
- Total “waste fuel” burning for the five hubs:
 $90.8+78.0+206.0+28.0+30.5 = 433.3$ tons
- Total incineration + “waste fuel” burning for the five hubs:
 $1,090.9+433.3 = 1,524.2$ tons
- Total waste for the five hubs (see Table 5.2):
 $929.9+194.7+812.7+1,128.2+273.0 = 3,436$ tons

Hence, the percentage of waste treated at DOE installations would be 46% ($1,524.2/3,338.5$) which approximates the 50% goal of the alternative.

Under this alternative, all explosive waste expected to be generated (~ 100 t/yr [$2.20\text{E}+05$ lb/yr]) would be transported and thermally deactivated at commercial installations.

5.4 REGIONALIZED 2 ALTERNATIVE

Under this scenario, DOE would retain and treat on-site about 90% of the HW now going off-site for treatment ($\sim 3,000$ t/yr [$6.61\text{E}+06$ lb/yr]). To accomplish this, the treatment HW operations at two DOE installations—INEL or ORR—would be expanded and upgraded to provide additional capacity for the destruction of organics, deactivation or neutralization, and the removal and recovery of organics. Treatment capacity would be sufficient to handle essentially all complexwide generated organic HW. Metal recovery and recycling, battery recycling, and stabilization would continue to be provided by off-site commercial establishments, as would land disposal.

As depicted in Table 5.5, the Regionalized 2 Alternative would assign each DOE installation to one of two regions: a western (INEL) and an eastern (ORR) region. Either designated DOE installation—INEL or ORR—would be able to do most of the waste treatment for the entire DOE Complex. The top generators would ship HW to commercial sites or would treat (by incineration and “waste-fuel” burning) HW at the two expanded sites or hubs as follows:

- *ORR Hub*. Incineration, 710.0 t ($1.74\text{E}+06$ lb); “waste-fuel” burning, 163.1 t ($3.60\text{E}+05$ lb) (ORR Hub accepts HW from KCP, FNAL, ANL-E, SRS, and ORR).

TABLE 5.5 Regionalized 2 Alternative: HW Load Transfers/Treatment Technology Matrix for Major DOE Generator Installations (in metric tons)

Hub and Location of HW Treatment	Organic Destruction by Incineration ^a	Organic Removal and Recovery				Metal Removal and Recovery				Total	
		Fuel Blending ^b	Fuel Burning	Solvent Recycling ^b	Stabilization	Deactivation	Non-Hg	Hg	Aqueous Treatment		Recycling (Batteries)
INEL Hub (western region) (HS; INEL; LLNL; LANL; SNL-NM; Pantex)											
On-site	8.61E+02	(4.45E+02) ^c	4.45E+02	2.84E+02	0	1.92E+02	2.01E+01	0	5.17E+01	0	1.85E+03 ^a
ComTreat ^d	0	0	0	0	1.64E+02 ^a	0	0	1.30E+01	0	5.43E+00	1.82E+02
Hub total	8.61E+02	NA	4.45E+02	2.84E+02	1.64E+02	1.92E+02	2.01E+01	1.30E+01	5.17E+01	5.43E+00	2.04E+03
ORR Hub (eastern region) (KCP; FNAL; ANL-E; SRS; ORR)											
On-site	7.10E+02	(1.63E+02) ^c	1.63E+02	8.47E+01	0	8.11E+01	7.44E+01	0	1.10E+01	0	1.12E+02
ComTreat	0	0	0	0	9.71E+01	0	0	9.77E+01 ^e	0	1.40E+00	1.96E+02
Hub total	7.10E+02	NA	1.63E+02	8.47E+01	9.71E+01	8.11E+01	7.44E+01	9.77E+01 ^e	1.10E+01	1.40E+00	1.32E+03
<i>Total</i>											
<i>On-site</i>	1.65E+03	(6.08E+02)	6.08E+02	3.68E+02	0	2.73E+02	9.45E+01	0	6.27E+01	0	3.06E+03
<i>ComTreat</i>	0	(0)	0	0	2.62E+02	0	0	1.11E+02	0	6.84E+00	3.80E+02
<i>Total</i>	1.65E+03	NA	6.08E+02	3.68E+02	2.62E+02	2.73E+02	9.45E+01	1.11E+02	6.27E+01	6.84E+00	3.44E+03

^a In some cases, attaining 90% on-site treatment without conducting stabilization and land disposal may not be possible.

^b Some solvents (perhaps 10%) would still be handled on a decentralized basis through Safety-Kleen.

^c This amount is only counted in total when burnt as fuel.

^d ComTreat = commercial treatment.

^e This figure, which is based on FY 1992 amounts, includes large amounts of remediation waste.

- *INEL Hub*. Incineration, 860.921 t (1.90E+06 lb); "waste-fuel" burning, 444.5 t (9.80E+05 lb) (INEL Hub accepts HW from Hanford, INEL, LLNL, LANL, SNL-NM, and Pantex).

The remaining generators ship to a limited number of permitted commercial treatment facilities. In this alternative, only two incinerators would exist at DOE sites.

The criterion used for the allocation of explosives waste under the Regionalized 2 Alternative was that all deactivated waste would be treated at the appropriate hub. Air emissions from the thermal destruction of explosives waste are expected only from the INEL installation (one of the two treatment hubs) because the explosive-waste generators (Pantex, LANL, LLNL, SNL, and NTS) are all in the west and have been identified (under this alternative) to ship HW to the INEL Hub.

Although this alternative targets the on-site treatment of approximately 90% of the HW now going off-site for treatment, this analysis shows that the actual percentage that can be achieved is only 76%, given the types of wastes and treatment needs of past waste-generation patterns. To attain the 90% target, the DOE hub sites would need to also provide stabilization and land disposal capabilities.

6 COMPUTATION OF AIR EMISSIONS

Air emissions may occur at DOE installations as the result of incineration and open burning of HW as well as from detonation and open burning of explosives wastes and explosives-contaminated wastes. To compute air emissions from different sources and for each waste management alternative, emission factors were developed using data from a representative set of RCRA trial burns conducted for the HW incinerator at the Rollins Environmental Services, Inc., treatment facility (Deer Park, Texas). (The design of the Rollins incinerator is similar to the design for the Consolidated Incinerator Facility at SRS.) The emission factors were based on chlorinated organics and inorganics detected in flue gases during the trial runs.

Trial burn data were used only for waste feed characteristics similar to HW generated at DOE installations. The key assumption in the calculation of these emission factors is that the physical characteristics of the RCRA trial burn HW of the Rollins incinerator are similar to DOE HW. Although the chemistry of the trial burn waste was unknown, the industrial and drummed waste burned in the trials should be reasonably similar in organic composition. The calculated emission factors are assumed to apply to incineration of drummed nonvolatile organic liquids and waste solids, contaminated soils, and volatile high-heating-value organics used for "waste fuel" burning in incinerators. These waste types are typical of waste generated throughout the DOE complex. The emission factors developed from these data are summarized in Table 6.1.

Air emissions from the deactivation of explosives waste by thermal treatment (burning or detonation) were calculated from emission factors tabulated for various treatment methods using data on the amounts of explosives wastes and explosives-contaminated wastes on-site annually at DOE installations. These data were obtained from available EPA biennial reports and state annual summary reports.

Emission factors for explosives detonation were based on test chamber field measurements taken at Sandia National Laboratory-New Mexico (SNL-NM), Kirtland Air Force Base, and obtained from the U.S. Department of the Army (U.S. Army 1992). Emission factors for explosives burning were retrieved from Pantex documentation sent to the Texas Natural Resource Conservation Commission describing the plant's approach to quantifying emissions from open burning/open detonation of explosives and explosive components (Finn 1994). These factors were developed for the open burning of pure explosives, wet explosives, compounds resulting from burning of explosives in conjunction with metal and plastic compounds, and metal piping contaminated with explosives. Tables 6.2 and 6.3 summarize the emission factors developed for open burning and open detonation of explosive wastes.

**TABLE 6.1 Source Terms for
Incineration and Fuel Burning**

Chemical	Emission Factor (t released/ t burned)
Bromodichloromethane	5.53E-04
Chlorobenzene	2.28E-05
Chloromethane	8.93E-05
Chloroform	3.32E-04
Dibromochloromethane	2.53E-04
1,2-Dichloroethane	4.75E-05
Methylene chloride	5.25E-04
Tetrachloroethane	2.06E-05
1,1,1-Trichloroethane	6.93E-06
Trichloroethane	2.74E-05
Trichlorofluoromethane	1.71E-04
Hydrogen chloride	7.68E-02
Chlorine	9.16E-02
Vinyl chloride	1.65E-02
Cadmium	5.33E-05
Chromium	2.60E-04
Copper	1.46E-03
Lead	4.88E-04
Mercury	1.17E-04
Nickel	4.25E-03
Zinc	2.49E-03
Arsenic	4.63E-05
Carbon tetrachloride	5.63E-05
Iron	3.46E-03
Dioxins (PCDD)	4.81E-09
Furans (PCDF)	4.33E-08

**TABLE 6.2 Source Terms for Open Burning of Explosive Waste,
by Explosive Type**

	Emission Factor (t released/t burned) ^a			
	Pure Explosives	Wet Explosives	Compound Explosives (metal/plastic)	Metal Piping
1,3,5-Trinitrobenzene	5.30E-09	5.30E-09	-	-
2,4,6-Trinitrotoluene	6.40E-08	6.40E-08	-	-
2,4-Dinitrotoluene	1.60E-07	1.60E-07	-	-
2,6-Dinitrotoluene	1.40E-07	1.40E-07	-	-
2-Nitronaphthalene	8.30E-08	8.30E-08	-	-
Acetylene	-	-	6.10E-04	-
Aluminum	-	-	5.84E-04	-
Arsenic	0.00E+00	0.00E+00	0.00E+00	-
Benz(a)anthracene	1.40E-07	1.40E-07	-	-
Benzo(a)pyrene	8.10E-08	8.10E-08	-	-
Beryllium	0.00E+00	0.00E+00	0.00E+00	-
Butadiene	-	-	1.18E-07	-
Cadmium	0.00E+00	0.00E+00	0.00E+00	-
Chromium	0.00E+00	0.00E+00	1.64E-01	3.17E-07
Cyanogen	-	-	4.30E-05	-
Dibenzofuran	2.60E-07	2.60E-07	-	-
Ethylene	-	-	1.68E-08	-
Formaldehyde	-	1.56E-09	1.15E-06	-
Formic acid	-	2.20E-08	6.80E-07	-
Iron	-	-	5.03E-01	-
Ketene	-	-	2.73E-08	-
Lead	0.00E+00	0.00E+00	0.00E+00	1.36E-06
Mercury	0.00E+00	0.00E+00	0.00E+00	-
Methane	-	-	7.01E-07	-
Methyl cyanide	-	-	1.17E-08	-
Naphthalene	1.50E-06	1.50E-06	-	-
Nickel	0.00E+00	0.00E+00	0.9E+00	-
Phenol	8.00E-06	8.00E-06	-	-
Polychlorinated biphenyls	0.00E+00	0.00E+00	0.00E+00	-
Polychlorinated dioxins/furans	0.00E+00	0.00E+00	0.00E+00	-
Pyrene	3.20E-07	3.20E-07	-	-

^a "-" = below detection limits or not measured.

TABLE 6.3 Source Terms for Open Detonation of Explosive Waste

Chemical	Emission Factor (t released/t burned) ^a			
	Compound B	Explosive D	RDX	TNT
1,1,3-Trimethyl-3-phenylindane	-	-	-	5.70E-07
1,3,5-Trinitrobenzene	5.90E-08	1.80E-08	4.40E-08	2.75E-09
1- & 2-Methylnaphthalene	-	-	-	3.00E-05
1-Nitropyrene	5.60E-08	1.10E-08	5.00E-08	1.06E-06
2,4,6-Trinitrotoluene	2.50E-07	4.40E-08	9.80E-08	3.38E-06
2,4-Dinitrotoluene	4.50E-07	5.90E-07	2.10E-07	1.05E-06
2,5-Diphenyloxazole	-	-	-	7.23E-05
2,6-Dinitrotoluene	2.40E-08	8.00E-08	4.10E-08	4.39E-07
2-Nitrodiphenylamine	7.20E-08	5.80E-08	3.40E-08	-
2-Nitronaphthalene	8.60E-08	4.30E-08	4.90E-08	6.43E-07
2-Nitrophenol	-	-	-	2.59E-06
Acetylene	-	-	-	1.82E-05
Ammonia	-	-	-	2.92E-04
Antimony	-	-	-	1.06E-06
Arsenic	-	-	-	0.00E+00
Barium	-	-	-	9.31E-04
Benz(a)anthracene	7.40E-09	1.90E-08	9.30E-08	3.30E-08
Benzene	6.20E-05	1.10E-04	6.90E-05	8.67E-06
Benzo(a)pyrene	1.40E-08	3.80E-08	1.40E-07	3.01E-06
Biphenyl	-	-	-	5.20E-08
Cadmium	-	-	-	2.86E-06
Carbon dioxide	8.70E-01	9.90E-01	5.70E-01	1.33E+00
Carbon monoxide	3.10E-02	5.30E-02	3.10E-02	7.17E-03
Chromium	-	-	-	3.52E-06
Dibenz(a,h)anthracene	-	-	-	1.73E-06
Dibenzofuran	0.00E+00	1.10E-07	2.00E-06	1.32E-06
Diphenylamine	6.60E-08	1.90E-08	3.10E-07	-
Hydrogen cyanide	-	-	-	0.00E+00
Lead	-	-	-	1.97E-05
Methane	6.00E-04	2.40E-03	2.00E-04	1.31E-04
N-Nitrosodiphenylamine	3.60E-08	5.80E-08	0.00E+00	1.23E-06
Naphthalene	4.20E-07	6.30E-07	2.00E-07	1.50E-04
Nickel	-	-	-	2.54E-06
Nitrogen dioxide	1.00E-03	1.10E-03	6.00E-04	2.60E-03
Nitrogen oxide	8.00E-04	9.00E-04	9.00E-04	1.46E-02
Nonbenzene aromatic	-	-	-	2.99E-05

TABLE 6.3 (Cont.)

Chemical	Emission Factor (t released/t burned)			
	Compound B	Explosive D	RDX	TNT
Olefins	-	-	-	3.03E-05
Paraffins	-	-	-	1.45E-04
Phenanthrene	-	-	-	1.85E-07
Phenol	-	-	-	2.52E-05
Picric acid	-	5.00E-08	-	-
Pyrene	2.10E-07	1.80E-07	2.20E-07	2.02E-07
RDX	0.00E+00	-	2.10E-06	-
Sulfur dioxide	-	-	-	2.23E-04
Total nonmethane hydrocarbons	1.20E-03	2.00E-03	1.30E-03	-

^a "-" = below detection limits or not measured.

7 AIR EMISSION RATES

Air release data and solid residual (ash) data from HW treatment are summarized by WM PEIS alternative in Tables 7.1-7.4, and the throughput totals (in metric tons per year) for each host treatment site and alternative are provided. Annual air releases are given for the 26 chlorinated organics and inorganics. Each table identifies the host treatment installation and the origin of the HW being treated there.

Biennial and annual reports submitted by DOE sites to EPA and state agencies, indicate that for CY 1991 the following DOE installations thermally treated on-site explosives, explosives waste, and explosives-contaminated materials: Pantex, LANL, LLNL, SNL-NM, and NTS.

Annual air releases of volatile and semivolatile organic compounds, inorganic compounds, and metals from the thermal deactivation of explosives wastes have been calculated by DOE site for the No Action, Decentralized, Regionalized 1, and Regionalized 2 alternatives. During this analysis, it has been assumed that the air emissions for the Decentralized Alternative will be the same as those for the No Action Alternative. In the case of the Regionalized 2 Alternative, air emissions are expected only from the INEL installation (one of the two treatment hubs or host sites; the other is ORR), since the explosives waste generators (Pantex, LANL, LLNL, SNL-NM, and NTS) are all in the West and will ship HW to INEL. Results under the No Action/Decentralized, Regionalized 1, and Regionalized 2 alternatives are presented in Tables 7.5-7.7, in metric tons per year (t/yr).

The facility routine release analysis estimated the atmospheric release rates of approximately two-dozen potentially hazardous chemical compounds likely to be emitted from proposed DOE treatment facilities. The technologies of treatment groups for these facilities were proposed to meet the treatment needs identified from the HW inventory characterization evaluated under four WM PEIS HW alternatives. Systematic and stochastic uncertainties exist in both the waste inventory, and the model used to estimate residual emissions from the treatment technologies. Systematic uncertainties arise, for example, in the data collected from the HW manifests, including contaminants present and their concentrations, and assumptions used to determine whether a waste is hazardous or toxic and to estimate HW quantities. Examples of stochastic uncertainties come from variations in source operating parameters which influence technology release rates. Given the limitations of the HW data available, only a qualitative analysis of the level of uncertainty can be provided. The level uncertainty discussed below applies to the most significant technology group, from the expected waste loads and potential releases, of the three HW treatment groups considered in the WM PEIS. However, similar discussion and uncertainty levels would apply to the deactivation of explosive waste and to organic removal and recovery.

TABLE 7.1 Air Emissions from On-Site Incineration of HW under the No Action Alternative, by Treatment Site

Oak Ridge Reservation		Idaho National Engineering Laboratory	
Annual incineration of 5.30E+01 t/yr organic liquids and other HW from ORR.		Annual incineration of 1.74 E+01 t/yr organic liquids and other HW from INEL.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
Bromodichloromethane	2.9E-05	Bromodichloromethane	9.6E-06
Chlorobenzene	1.2E-06	Chlorobenzene	4.0E-07
Chloromethane	4.7E-06	Chloromethane	1.6E-06
Chloroform	1.8E-05	Chloroform	5.8E-06
Dibromochloromethane	1.3E-05	Dibromochloromethane	4.4E-06
1,2-Dichloroethane	2.5E-06	1,2-Dichloroethane	8.3E-07
Methylene chloride	2.8E-05	Methylene chloride	9.1E-06
Tetrachloroethane	1.1E-06	Tetrachloroethane	3.6E-07
1,1,1-Trichloroethane	3.7E-07	1,1,1-Trichloroethane	1.2E-07
Trichloroethane	1.5E-06	Trichloroethane	4.8E-07
Trichlorofluoromethane	9.0E-06	Trichlorofluoromethane	3.0E-06
Hydrogen chloride	4.1E-03	Hydrogen chloride	1.3E-03
Chlorine	4.9E-03	Chlorine	1.6E-03
Vinyl chloride	8.8E-04	Vinyl chloride	2.9E-04
Carbon tetrachloride	3.0E-06	Carbon tetrachloride	9.8E-07
Cadmium	2.8E-06	Cadmium	9.3E-07
Chromium	1.4E-05	Chromium	4.5E-06
Copper	7.8E-05	Copper	2.5E-05
Lead	2.6E-05	Lead	8.5E-06
Mercury	6.2E-06	Mercury	2.0E-06
Nickel	2.3E-04	Nickel	7.4E-05
Zinc	1.3E-04	Zinc	4.3E-05
Arsenic	2.5E-06	Arsenic	8.1E-07
Iron	1.8E-04	Iron	6.0E-05
Dioxins (PCDD)	2.5E-10	Dioxins (PCDD)	8.4E-11
Furans (PCDF)	2.3E-09	Furans (PCDF)	7.5E-10

TABLE 7.2 Air Emissions from On-Site Incineration and Fuel Burning of HW under the Decentralized Alternative, by Treatment Site

Idaho National Engineering Laboratory			
Incineration		Fuel Burning	
Annual incineration of 1.74E+01 t/yr organic liquids and other HW from INEL.		Annual fuel burning of 1.74E+01 t/yr organic liquids and other HW from INEL.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
Bromodichloromethane	1.0E-05	Bromodichloromethane	9.4E-06
Chlorobenzene	4.2E-07	Chlorobenzene	4.0E-07
Chloromethane	1.6E-06	Chloromethane	1.6E-06
Chloroform	6.0E-06	Chloroform	5.7E-06
Dibromochloromethane	4.6E-06	Dibromochloromethane	4.3E-06
1,2-Dichloroethane	8.7E-07	1,2-Dichloroethane	8.2E-07
Methylene chloride	9.6E-06	Methylene chloride	8.8E-06
Tetrachloroethane	3.7E-07	Tetrachloroethane	3.6E-07
1,1,1-Trichloroethane	1.3E-07	1,1,1-Trichloroethane	1.2E-07
Trichloroethane	4.9E-07	Trichloroethane	4.7E+07
Trichlorofluoromethane	3.1E-06	Trichlorofluoromethane	3.0E-06
Hydrogen chloride	1.4E-03	Hydrogen chloride	1.3E-03
Chlorine	1.6E-03	Chlorine	1.6E-03
Vinyl chloride	3.0E-04	Vinyl chloride	2.8E-04
Carbon tetrachloride	1.0E-06	Carbon tetrachloride	9.4E-07
Cadmium	9.7E-07	Cadmium	9.4E-07
Chromium	4.6E-06	Chromium	4.5E-06
Copper	2.7E-05	Copper	2.5E-05
Lead	8.8E-06	Lead	8.2E-06
Mercury	2.1E-06	Mercury	2.0E-06
Nickel	7.6E-05	Nickel	7.5E-05
Zinc	4.5E-05	Zinc	4.3E-05
Arsenic	8.4E-07	Arsenic	8.2E-07
Iron	6.3E-05	Iron	6.0E-05
Dioxins (PCDD)	8.7E-11	Dioxins (PCDD)	8.2E-11
Furans (PCDF)	7.8E-10	Furans (PCDF)	7.5E-10

TABLE 7.2 (Cont.)

Oak Ridge Reservation			
Incineration		Fuel Burning	
Annual incineration of 1.17E+02 t/yr organic liquids and other HW from ORR.		Annual fuel burning of 2.77E+01 t/yr organic liquids and other HW from ORR.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
Bromodichloromethane	6.7E-05	Bromodichloromethane	1.5E-05
Chlorobenzene	2.8E-06	Chlorobenzene	6.3E-07
Chloromethane	1.1E-05	Chloromethane	2.5E-06
Chloroform	4.0E-05	Chloroform	9.1E-06
Dibromochloromethane	3.1E-05	Dibromochloromethane	6.9E-06
1,2-Dichloroethane	5.8E-06	1,2-Dichloroethane	1.3E-06
Methylene chloride	6.4E-05	Methylene chloride	1.4E-05
Tetrachloroethane	2.5E-06	Tetrachloroethane	5.7E-07
1,1,1-Trichloroethane	8.4E-07	1,1,1-Trichloroethane	1.9E-07
Trichloroethane	3.3E-06	Trichloroethane	7.5E-07
Trichlorofluoromethane	2.1E-05	Trichlorofluoromethane	4.7E-06
Hydrogen chloride	9.3E-03	Hydrogen chloride	2.1E-03
Chlorine	1.1E-02	Chlorine	2.5E-03
Vinyl chloride	2.0E-03	Vinyl chloride	4.5E-04
Carbon tetrachloride	6.8E-06	Carbon tetrachloride	1.5E-06
Cadmium	6.5E-06	Cadmium	1.5E-06
Chromium	3.1E-05	Chromium	7.1E-06
Copper	1.8E-04	Copper	4.0E-05
Lead	5.9E-05	Lead	1.3E-05
Mercury	1.4E-05	Mercury	3.2E-06
Nickel	5.1E-04	Nickel	1.2E-04
Zinc	3.0E-04	Zinc	6.8E-05
Arsenic	5.6E-06	Arsenic	1.3E-06
Iron	4.2E-04	Iron	9.5E-05
Dioxins (PCDD)	5.8E-10	Dioxins (PCDD)	1.3E-10
Furans (PCDF)	5.2E-09	Furans (PCDF)	1.2E-09

TABLE 7.2 (Cont.)

Savannah River Site			
Incineration		Fuel Burning	
Annual incineration of 1.17E+02 t/yr organic liquids and other HW from SRS.		Annual fuel burning of 2.77E+01 t/yr organic liquids and other HW from SRS.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
Bromodichloromethane	6.7E-05	Bromodichloromethane	1.5E-05
Chlorobenzene	2.8E-06	Chlorobenzene	6.3E-07
Chloromethane	1.1E-05	Chloromethane	2.5E-06
Chloroform	4.0E-05	Chloroform	9.1E-06
Dibromochloromethane	3.1E-05	Dibromochloromethane	6.9E-06
1,2-Dichloroethane	5.8E-06	1,2-Dichloroethane	1.3E-06
Methylene chloride	6.4E-05	Methylene chloride	1.4E-05
Tetrachloroethane	2.5E-06	Tetrachloroethane	5.7E-07
1,1,1-Trichloroethane	8.4E-07	1,1,1-Trichloroethane	1.9E-07
Trichloroethane	3.3E-06	Trichloroethane	7.5E-07
Trichlorofluoromethane	2.1E-05	Trichlorofluoromethane	4.7E-06
Hydrogen chloride	9.3E-03	Hydrogen chloride	2.1E-03
Chlorine	1.1E-02	Chlorine	2.5E-03
Vinyl chloride	2.0E-03	Vinyl chloride	4.5E-04
Carbon tetrachloride	6.8E-06	Carbon tetrachloride	1.5E-06
Cadmium	6.5E-06	Cadmium	1.5E-06
Chromium	3.1E-05	Chromium	7.1E-06
Copper	1.8E-04	Copper	4.0E-05
Lead	5.9E-05	Lead	1.3E-05
Mercury	1.4E-05	Mercury	3.2E-05
Nickel	5.1E-04	Nickel	1.2E-04
Zinc	3.0E-04	Zinc	6.8E-05
Arsenic	5.6E-06	Arsenic	1.3E-06
Iron	4.2E-04	Iron	9.5E-05
Dioxins (PCDD)	5.8E-10	Dioxins (PCDD)	1.3E-10
Furans (PCDF)	5.2E-09	Furans (PCDF)	1.2E-09

TABLE 7.3 Air Emissions from On-Site Incineration and Fuel Burning of HW under the Regionalized 1 Alternative, by Treatment Site

Los Alamos National Laboratory			
Incineration		Fuel Burning	
Annual incineration of 3.04E+02 t/yr organic liquids and other HW from LANL, SNL-NM, and Pantex.		Annual fuel burning of 9.08E+01 t/yr organic liquids and other HW from LANL, SNL-NM, and Pantex.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
Bromodichloromethane	1.7E-04	Bromodichloromethane	5.0E-05
Chlorobenzene	7.1E-06	Chlorobenzene	2.1E-06
Chloromethane	2.8E-05	Chloromethane	8.2E-06
Chloroform	1.0E-04	Chloroform	3.0E-05
Dibromochloromethane	7.9E-05	Dibromochloromethane	2.3E-05
1,2-Dichloroethane	1.5E-05	1,2-Dichloroethane	4.3E-06
Methylene chloride	1.6E-04	Methylene chloride	4.8E-05
Tetrachloroethane	6.5E-06	Tetrachloroethane	1.9E-06
1,1,1-Trichloroethane	2.2E-06	1,1,1-Trichloroethane	6.3E-07
Trichloroethane	8.6E-06	Trichloroethane	2.5E-06
Trichlorofluoromethane	5.4E-05	Trichlorofluoromethane	1.6E-05
Hydrogen chloride	2.4E-02	Hydrogen chloride	7.0E-03
Chlorine	2.9E-02	Chlorine	8.4E-03
Vinyl chloride	5.2E-03	Vinyl chloride	1.5E-03
Carbon tetrachloride	1.8E-05	Carbon tetrachloride	5.1E-06
Cadmium	1.7E-05	Cadmium	4.9E-06
Chromium	8.2E-05	Chromium	2.4E-05
Copper	4.6E-04	Copper	1.3E-04
Lead	1.5E-04	Lead	4.5E-05
Mercury	3.7E-05	Mercury	1.1E-05
Nickel	1.3E-03	Nickel	3.9E-04
Zinc	7.8E-04	Zinc	2.3E-04
Arsenic	1.5E-05	Arsenic	4.2E-06
Iron	1.1E-03	Iron	3.2E-04
Dioxins (PCDD)	1.5E-09	Dioxins (PCDD)	4.4E-10
Furans (PCDF)	1.4E-08	Furans (PCDF)	3.9E-09

TABLE 7.3 (Cont.)

Oak Ridge Reservation			
Incineration		Fuel Burning	
Annual incineration of 4.2E+02 t/yr organic liquids and other HW from ORR, KCP, FNAL, and ANL-E.		Annual fuel burning of 7.8E+01 t/yr organic liquids and other HW from ORR, KCP, FNAL, and ANL-E.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
Bromodichloromethane	2.4E-04	Bromodichloromethane	4.3E-05
Chlorobenzene	9.9E-06	Chlorobenzene	1.8E-06
Chloromethane	3.9E-05	Chloromethane	7.0E-06
Chloroform	1.4E-04	Chloroform	2.6E-05
Dibromochloromethane	1.1E-04	Dibromochloromethane	2.0E-05
1,2-Dichloroethane	2.1E-05	1,2-Dichloroethane	3.7E-06
Methylene chloride	2.3E-04	Methylene chloride	4.1E-05
Tetrachloroethane	8.9E-06	Tetrachloroethane	1.6E-06
1,1,1-Trichloroethane	3.0E-06	1,1,1-Trichloroethane	5.4E-07
Trichloroethane	1.2E-05	Trichloroethane	2.2E-06
Trichlorofluoromethane	7.4E-05	Trichlorofluoromethane	1.3E-05
Hydrogen chloride	3.3E-02	Hydrogen chloride	6.0E-03
Chlorine	4.0E-02	Chlorine	7.2E-03
Vinyl chloride	7.2E-03	Vinyl chloride	1.3E-03
Carbon tetrachloride	2.4E-05	Carbon tetrachloride	4.4E-06
Cadmium	2.3E-05	Cadmium	4.2E-06
Chromium	1.1E-04	Chromium	2.0E-05
Copper	6.3E-04	Copper	1.1E-04
Lead	2.1E-04	Lead	3.8E-05
Mercury	5.1E-05	Mercury	9.2E-06
Nickel	1.8E-03	Nickel	3.3E-04
Zinc	1.1E-03	Zinc	2.0E-04
Arsenic	2.0E-05	Arsenic	3.6E-06
Iron	1.5E-03	Iron	2.7E-04
Dioxins (PCDD)	2.1E-09	Dioxins (PCDD)	3.8E-10
Furans (PCDF)	1.9E-08	Furans (PCDF)	3.4E-09

TABLE 7.3 (Cont.)

Savannah River Site			
Incineration		Fuel Burning	
Annual incineration of 1.03E+02 t/yr organic liquids and other HW from SRS.		Annual fuel burning of 2.8E+01 t/yr organic liquids and other HW from SRS.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
Bromodichloromethane	5.8E-05	Bromodichloromethane	1.6E-05
Chlorobenzene	2.4E-06	Chlorobenzene	6.5E-07
Chloromethane	9.4E-06	Chloromethane	2.5E-06
Chloroform	3.5E-05	Chloroform	9.4E-06
Dibromochloromethane	2.7E-05	Dibromochloromethane	7.2E-06
1,2-Dichloroethane	5.0E-06	1,2-Dichloroethane	1.4E-06
Methylene chloride	5.6E-05	Methylene chloride	1.5E-05
Tetrachloroethane	2.2E-06	Tetrachloroethane	5.9E-07
1,1,1-Trichloroethane	7.3E-07	1,1,1-Trichloroethane	2.0E-07
Trichloroethane	2.9E-06	Trichloroethane	7.8E-07
Trichlorofluoromethane	1.8E-05	Trichlorofluoromethane	4.9E-06
Hydrogen chloride	8.1E-03	Hydrogen chloride	2.2E-03
Chlorine	9.7E-03	Chlorine	2.6E-03
Vinyl chloride	1.7E-03	Vinyl chloride	4.7E-04
Carbon tetrachloride	6.0E-06	Carbon tetrachloride	1.6E-06
Cadmium	5.6E-06	Cadmium	1.5E-06
Chromium	2.7E-05	Chromium	7.4E-06
Copper	1.5E-04	Copper	4.2E-05
Lead	5.2E-05	Lead	1.4E-05
Mercury	1.2E-05	Mercury	3.3E-06
Nickel	4.5E-04	Nickel	1.2E-04
Zinc	2.6E-04	Zinc	7.1E-05
Arsenic	4.9E-06	Arsenic	1.3E-06
Iron	3.7E-04	Iron	9.9E-05
Dioxins (PCDD)	5.1E-10	Dioxins (PCDD)	1.4E-10
Furans (PCDF)	4.6E-09	Furans (PCDF)	1.2E-09

TABLE 7.3 (Cont.)

Hanford Site			
Incineration		Fuel Burning	
Annual incineration of 1.92E+02 t/yr organic liquids and other HW from HS and LLNL.		Annual fuel burning of 2.06E+02 t/yr organic liquids and other HW from HS and LLNL.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
Bromodichloromethane	1.1E-04	Bromodichloromethane	1.1E-04
Chlorobenzene	4.5E-06	Chlorobenzene	4.7E-06
Chloromethane	1.8E-05	Chloromethane	1.9E-05
Chloroform	6.6E-05	Chloroform	6.9E-05
Dibromochloromethane	5.0E-05	Dibromochloromethane	5.2E-05
1,2-Dichloroethane	9.4E-06	1,2-Dichloroethane	9.8E-06
Methylene chloride	1.0E-04	Methylene chloride	1.1E-04
Tetrachloroethane	4.1E-06	Tetrachloroethane	4.3E-06
1,1,1-Trichloroethane	1.4E-06	1,1,1-Trichloroethane	1.4E-06
Trichloroethane	5.4E-06	Trichloroethane	5.7E-06
Trichlorofluoromethane	3.4E-05	Trichlorofluoromethane	3.5E-05
Hydrogen chloride	1.5E-02	Hydrogen chloride	1.6E-02
Chlorine	1.8E-02	Chlorine	1.9E-02
Vinyl chloride	3.3E-03	Vinyl chloride	3.4E-03
Carbon tetrachloride	1.1E-05	Carbon tetrachloride	1.2E-05
Cadmium	1.1E-05	Cadmium	1.1E-05
Chromium	5.1E-05	Chromium	5.4E-05
Copper	2.9E-04	Copper	3.0E-04
Lead	9.6E-05	Lead	1.0E-04
Mercury	2.3E-05	Mercury	2.4E-05
Nickel	8.4E-04	Nickel	8.8E-04
Zinc	4.9E-04	Zinc	5.1E-04
Arsenic	9.2E-06	Arsenic	9.6E-06
Iron	6.8E-04	Iron	7.2E-04
Dioxins (PCDD)	9.5E-10	Dioxins (PCDD)	1.0E-09
Furans (PCDF)	8.6E-09	Furans (PCDF)	9.0E-09

TABLE 7.3 (Cont.)

Idaho National Engineering Laboratory			
Incineration		Fuel Burning	
Annual incineration of 7.32E+01 t/yr organic liquids and other HW from INEL.		Annual fuel burning of 3.05E+01 t/yr organic liquids and other HW from INEL.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
Bromodichloromethane	4.1E-05	Bromodichloromethane	1.7E-05
Chlorobenzene	1.7E-06	Chlorobenzene	6.9E-07
Chloromethane	6.7E-06	Chloromethane	2.7E-06
Chloroform	2.5E-05	Chloroform	1.0E-05
Dibromochloromethane	1.9E-05	Dibromochloromethane	7.7E-06
1,2-Dichloroethane	3.6E-06	1,2-Dichloroethane	1.4E-06
Methylene chloride	3.9E-05	Methylene chloride	1.6E-05
Tetrachloroethane	1.5E-06	Tetrachloroethane	6.3E-07
1,1,1-Trichloroethane	5.2E-07	1,1,1-Trichloroethane	2.1E-07
Trichloroethane	2.1E-06	Trichloroethane	8.3E-07
Trichlorofluoromethane	1.3E-05	Trichlorofluoromethane	5.2E-06
Hydrogen chloride	5.8E-03	Hydrogen chloride	2.3E-03
Chlorine	6.9E-03	Chlorine	2.8E-03
Vinyl chloride	1.2E-03	Vinyl chloride	5.0E-04
Carbon tetrachloride	4.2E-06	Carbon tetrachloride	1.7E-06
Cadmium	4.0E-06	Cadmium	1.6E-06
Chromium	1.9E-05	Chromium	7.9E-06
Copper	1.1E-04	Copper	4.5E-05
Lead	3.7E-05	Lead	1.5E-05
Mercury	8.8E-06	Mercury	3.6E-06
Nickel	3.2E-04	Nickel	1.3E-04
Zinc	1.9E-04	Zinc	7.6E-05
Arsenic	3.5E-06	Arsenic	1.4E-06
Iron	2.6E-04	Iron	1.1E-04
Dioxins (PCDD)	3.6E-10	Dioxins (PCDD)	1.5E-10
Furans (PCDF)	3.2E-09	Furans (PCDF)	1.3E-09

TABLE 7.4 Air Emissions from On-Site Incineration and Fuel Burning of HW under the Regionalized 2 Alternative, by Treatment Site

Oak Ridge Reservation			
Incineration		Fuel Burning	
Annual incineration of 7.10E+02 t/yr organic liquids and other HW from ORR, KCP, SRS, FNAL, and ANL-E.		Annual fuel burning of 1.63E+02 t/yr organic liquids and other ORR, SRS, FNAL, and ANL-E.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
Bromodichloromethane	4.9E-04	Bromodichloromethane	2.7E-04
Chlorobenzene	2.0E-05	Chlorobenzene	1.1E-05
Chloromethane	7.9E-05	Chloromethane	4.3E-05
Chloroform	2.9E-04	Chloroform	1.6E-04
Dibromochloromethane	2.2E-04	Dibromochloromethane	1.2E-04
1,2-Dichloroethane	4.2E-05	1,2-Dichloroethane	2.3E-05
Methylene chloride	4.7E-04	Methylene chloride	2.5E-04
Tetrachloroethane	1.8E-05	Tetrachloroethane	9.9E-06
1,1,1-Trichloroethane	6.1E-06	1,1,1-Trichloroethane	3.3E-06
Trichloroethane	2.4E-05	Trichloroethane	1.3E-05
Trichlorofluoromethane	1.5E-04	Trichlorofluoromethane	8.2E-05
Hydrogen chloride	6.8E-02	Hydrogen chloride	3.7E-02
Chlorine	8.1E-02	Chlorine	4.4E-02
Vinyl chloride	1.5E-02	Vinyl chloride	8.0E-03
Carbon tetrachloride	5.0E-05	Carbon tetrachloride	2.7E-05
Cadmium	4.7E-05	Cadmium	2.6E-05
Chromium	2.3E-04	Chromium	1.3E-04
Copper	1.3E-03	Copper	7.1E-04
Lead	4.3E-04	Lead	2.4E-04
Mercury	1.0E-04	Mercury	5.7E-05
Nickel	3.8E-03	Nickel	2.1E-03
Zinc	2.2E-03	Zinc	1.2E-03
Arsenic	4.1E-05	Arsenic	2.2E-05
Iron	3.1E-03	Iron	1.7E-03
Dioxins (PCDD)	4.3E-09	Dioxins (PCDD)	2.3E-09
Furans (PCDF)	3.8E-07	Furans (PCDF)	2.1E-08

TABLE 7.4 (Cont.)

Idaho National Engineering Laboratory			
Incineration		Fuel Burning	
Annual incineration of 8.61E+02 t/yr organic liquids and other HW from INEL, Hanford, LLNL, LANL, SNL-NM, and Pantex.		Annual fuel burning of 4.45E+02 t/yr organic liquids and other HW from INEL, Hanford, LLNL, LANL, SNL-NM, and Pantex.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
Bromodichloromethane	4.5E-04	Bromodichloromethane	9.1E-05
Chlorobenzene	1.9E-05	Chlorobenzene	3.7E-06
Chloromethane	7.3E-05	Chloromethane	1.5E-05
Chloroform	2.7E-04	Chloroform	5.4E-05
Dibromochloromethane	2.1E-04	Dibromochloromethane	4.1E-05
1,2-Dichloroethane	3.9E-05	1,2-Dichloroethane	7.8E-06
Methylene chloride	4.3E-04	Methylene chloride	8.6E-05
Tetrachloroethane	1.7E-05	Tetrachloroethane	3.4E-06
1,1,1-Trichloroethane	5.7E-06	1,1,1-Trichloroethane	1.1E-06
Trichloroethane	2.2E-05	Trichloroethane	4.5E-06
Trichlorofluoromethane	1.4E-04	Trichlorofluoromethane	2.8E-05
Hydrogen chloride	6.3E-02	Hydrogen chloride	1.3E-02
Chlorine	7.5E-02	Chlorine	1.5E-02
Vinyl chloride	1.4E-02	Vinyl chloride	2.7E-03
Carbon tetrachloride	4.6E-05	Carbon tetrachloride	9.2E-06
Cadmium	4.4E-05	Cadmium	8.7E-06
Chromium	2.1E-04	Chromium	4.3E-05
Copper	1.2E-03	Copper	2.4E-04
Lead	4.0E-04	Lead	8.0E-05
Mercury	9.6E-05	Mercury	1.9E-05
Nickel	3.5E-03	Nickel	7.0E-04
Zinc	2.0E-03	Zinc	4.1E-04
Arsenic	3.8E-05	Arsenic	7.6E-06
Iron	2.8E-03	Iron	5.7E-04
Dioxins (PCDD)	3.9E-09	Dioxins (PCDD)	7.9E-10
Furans (PCDF)	3.5E-08	Furans (PCDF)	7.1E-09

TABLE 7.5 Air Emissions from On-Site Open Detonation and Burning of Explosives and Explosives-Contaminated Wastes under the No Action/Decentralized Alternative, by Treatment Site

Los Alamos National Laboratory		Nevada Test Site	
Open Detonation			
Annual open detonation of 1.49E-00 t/yr explosives from LANL.		Annual open detonation of 5.40E-02 t/yr explosives from NTS.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
1,1,3-Trimethyl-3-phenylindane	2.34E-07	1,1,3-Trimethyl-3-phenylindane	8.46E-09
1,3,5-Trinitrobenzene	5.08E-08	1,3,5-Trinitrobenzene	1.84E-09
1- & 2-Methylnaphthalene	1.23E-05	1- & 2-Methylnaphthalene	4.46E-07
1-Nitropyrene	4.83E-07	1-Nitropyrene	1.75E-08
2,4,6-Trinitrotoluene	1.55E-06	2,4,6-Trinitrotoluene	5.60E-08
2,4-Dinitrotoluene	9.44E-07	2,4-Dinitrotoluene	3.42E-08
2,5-Diphenyloxazole	2.97E-05	2,5-Diphenyloxazole	1.07E-06
2,6-Dinitrotoluene	2.40E-07	2,6-Dinitrotoluene	8.67E-09
2-Nitrodiphenylamine	6.73E-08	2-Nitrodiphenylamine	2.44E-09
2-Nitronaphthalene	3.37E-07	2-Nitronaphthalene	1.22E-08
2-Nitrophenol	1.06E-06	2-Nitrophenol	3.85E-08
Acetylene	7.47E-06	Acetylene	2.70E-07
Ammonia	1.20E-04	Ammonia	4.34E-06
Antimony	4.35E-07	Antimony	1.57E-08
Arsenic	0.00E+00	Arsenic	0.00E+00
Barium	3.82E-04	Barium	1.38E-05
Benz(a)anthracene	6.25E-08	Benz(a)anthracene	2.26E-09
Benzene	1.02E-04	Benzene	3.71E-06
Benzo(a)pyrene	1.31E-06	Benzo(a)pyrene	4.75E-08
Biphenyl <	2.13E-08	Biphenyl	7.72E-10
Cadmium	1.17E-06	Cadmium	4.25E-08
Carbon dioxide	1.54E+00	Carbon dioxide	5.58E-02
Carbon monoxide	5.01E-02	Carbon monoxide	1.81E-03
Chromium	1.44E-06	Chromium	5.23E-08
Dibenz(a,h)anthracene	7.10E-07	Dibenz(a,h)anthracene	2.57E-08
Dibenzofuran	1.41E-06	Dibenzofuran	5.09E-08
Diphenylamine	1.62E-07	Diphenylamine	5.87E-09
Hydrogen cyanide	0.00E+00	Hydrogen cyanide	0.00E+00
Lead	8.08E-06	Lead	2.93E-07
Methane	1.37E-03	Methane	4.95E-05

TABLE 7.5 (Cont.)

Los Alamos National Laboratory		Nevada Test Site	
Open Detonation			
Annual open detonation of 1.49E-00 t/yr explosives from LANL.		Annual open detonation of 5.40E-02 t/yr explosives from NTS.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
n-Nitrosodiphenylamine	5.43E-07	n-Nitrosodiphenylamine	1.97E-08
Naphthalene	6.21E-05	Naphthalene	2.25E-06
Nickel	1.04E-06	Nickel	3.77E-08
Nitrogen dioxide	2.17E-03	Nitrogen dioxide	7.87E-05
Nitrogen oxide	7.06E-03	Nitrogen oxide	2.55E-04
Nonbenzene aromatic	1.23E-05	Nonbenzene aromatic	4.44E-07
Olefins	1.24E-05	Olefins	4.50E-07
Paraffins	5.95E-05	Paraffins	2.15E-06
Phenanthrene	7.59E-08	Phenanthrene	2.75E-09
Phenol	1.03E-05	Phenol	3.74E-07
Picric acid	2.05E-08	Picric acid	7.43E-10
Pyrene	3.33E-07	Pyrene	1.21E-08
RDX	8.62E-07	RDX	3.12E-08
Sulfur dioxide	9.15E-05	Sulfur dioxide	3.31E-06
Total nonmethane hydrocarbons	1.85E-03	Total nonmethane hydrocarbons	6.68E-05

TABLE 7.5 (Cont.)

Los Alamos National Laboratory		Pantex Plant	
Open Burning			
Annual open burning of 1.23E+00 t/yr explosives from LANL.		Annual open burning of 9.56E+01 t/yr explosives from Pantex.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
1,3,5-Trinitrobenzene	7.16E-09	1,3,5-Trinitrobenzene	4.06E-07
2,4,6-Trinitrotoluene	8.65E-08	2,4,6-Trinitrotoluene	4.90E-06
2,4-Dinitrotoluene	2.16E-07	2,4-Dinitrotoluene	1.22E-05
2,6-Dinitrotoluene	1.89E-07	2,6-Dinitrotoluene	1.07E-05
2-Nitronaphthalene	1.12E-07	2-Nitronaphthalene	6.35E-06
Acetylene	0.00E+00	Acetylene	1.84E-04
Aluminum	0.00E+00	Aluminum	1.76E-04
Arsenic	0.00E+00	Arsenic	0.00E+00
Benz(a)anthracene	1.89E-07	Benz(a)anthracene	1.07E-05
Benzo(a)pyrene	1.09E-07	Benzo(a)pyrene	6.20E-06
Beryllium	0.00E+00	Beryllium	0.00E+00
Butadiene	0.00E+00	Butadiene	3.55E-08
Cadmium	0.00E+00	Cadmium	0.00E+00
Chromium	0.00E+00	Chromium	4.94E-02
Cyanogen	0.00E+00	Cyanogen	1.29E-05
Dibenzofuran	3.51E-07	Dibenzofuran	1.99E-05
Ethylene	0.00E+00	Ethylene	5.06E-09
Formaldehyde	0.00E+00	Formaldehyde	3.49E-07
Formic acid	0.00E+00	Formic acid	2.38E-07
Iron	0.00E+00	Iron	1.51E-01
Ketene	0.00E+00	Ketene	8.22E-09
Lead	0.00E+00	Lead	4.10E-06
Mercury	0.00E+00	Mercury	0.00E+00
Methane	0.00E+00	Methane	2.11E-07
Methyl cyanide	0.00E+00	Methyl cyanide	3.52E-09
Naphthalene	2.03E-06	Naphthalene	1.15E-04
Nickel	0.00E+00	Nickel	3.22E-01
Phenol	1.08E-05	Phenol	6.12E-04
Polychlorinated aromatic hydrocarbons	0.00E+00	Polychlorinated aromatic hydrocarbons	0.00E+00
Polychlorinated biphenyls	0.00E+00	Polychlorinated biphenyls	0.00E+00
Polychlorinated dioxins/furans	0.00E+00	Polychlorinated dioxins/furans	0.00E+00
Pyrene	4.32E-07	Pyrene	2.45E-05

TABLE 7.5 (Cont.)

Sandia National Laboratory-New Mexico		Lawrence Livermore National Laboratory	
Open Detonation		Open Burning	
Annual open detonation of 1.25E-01 t/yr explosives from SNL-NM.		Annual open burning of 1.19E+00 t/yr explosives from LLNL.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
1,3,5-Trinitrobenzene	7.29E-10	1,3,5-Trinitrobenzene	3.13E-09
2,4,6-Trinitrotoluene	8.80E-09	2,4,6-Trinitrotoluene	3.78E-08
2,4-Dinitrotoluene	2.20E-08	2,4-Dinitrotoluene	9.45E-08
2,6-Dinitrotoluene	1.93E-08	2,6-Dinitrotoluene	8.27E-08
2-Nitronaphthalene	1.14E-08	2-Nitronaphthalene	4.90E-08
Acetylene	0.00E+00	Acetylene	0.00E+00
Aluminum	0.00E+00	Aluminum	0.00E+00
Arsenic	0.00E+00	Arsenic	0.00E+00
Benz(a)anthracene	1.93E-08	Benz(a)anthracene	8.27E-08
Benzo(a)pyrene	1.11E-08	Benzo(a)pyrene	4.79E-08
Beryllium	0.00E+00	Beryllium	0.00E+00
Butadiene	0.00E+00	Butadiene	0.00E+00
Cadmium	0.00E+00	Cadmium	0.00E+00
Chromium	0.00E+00	Chromium	0.00E+00
Cyanogen	0.00E+00	Cyanogen	0.00E+00
Dibenzofuran	3.58E-08	Dibenzofuran	1.54E-07
Ethylene	0.00E+00	Ethylene	0.00E+00
Formaldehyde	0.00E+00	Formaldehyde	5.87E-11
Formic acid	0.00E+00	Formic acid	8.28E-10
Iron	0.00E+00	Iron	0.00E+00
Ketene	0.00E+00	Ketene	0.00E+00
Lead	0.00E+00	Lead	0.00E+00
Mercury	0.00E+00	Mercury	0.00E+00
Methane	0.00E+00	Methane	0.00E+00
Methyl cyanide	0.00E+00	Methyl cyanide	0.00E+00
Naphthalene	2.06E-07	Naphthalene	8.86E-07
Nickel	0.00E+00	Nickel	0.00E+00
Phenol	1.10E-06	Phenol	4.73E-06
Polychlorinated aromatic hydrocarbons	0.00E+00	Polychlorinated aromatic hydrocarbons	0.00E+00
Polychlorinated biphenyls	0.00E+00	Polychlorinated biphenyls	0.00E+00
Polychlorinated dioxins/furans	0.00E+00	Polychlorinated dioxins/furans	0.00E+00
Pyrene	4.40E-08	Pyrene	1.89E-07

TABLE 7.6 Air Emissions from On-Site Open Detonation and Burning of Explosives and Explosives-Contaminated Wastes under the Regionalized 1 Alternative, by Treatment Site

Los Alamos National Laboratory			
Open Detonation		Open Burning	
Annual open detonation of 1.49E+00 t/yr explosives from LANL.		Annual open burning of 9.81E+01 t/yr explosives from LANL.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
1,1,3-Trimethyl-3-phenylindane	6.27E-11	1,3,5-Trinitrobenzene	4.17E-07
1,3,5-Trinitrobenzene	1.36E-11	2,4,6-Trinitrotoluene	5.03E-06
1- & 2-Methylnaphthalene	3.30E-09	2,4-Dinitrotoluene	1.26E-05
1-Nitropyrene	1.29E-10	2,6-Dinitrotoluene	1.10E-05
2,4,6-Trinitrotoluene	4.15E-10	2-Nitronaphthalene	6.52E-06
2,4-Dinitrotoluene	2.53E-10	Acetylene	1.84E-04
2,5-Diphenyloxazole	7.95E-03	Aluminum	1.76E-04
2,6-Dinitrotoluene	6.42E-11	Arsenic	0.00E+00
2-Nitrodiphenylamine	1.80E-11	Benz(a)anthracene	1.10E-05
2-Nitronaphthalene	9.03E-11	Benzo(a)pyrene	6.37E-06
2-Nitrophenol	2.85E-10	Beryllium	0.00E+00
Acetylene	2.00E-09	Butadiene	3.55E-08
Ammonia	3.21E-08	Cadmium	0.00E+00
Antimony	1.17E-10	Chromium	4.94E-02
Arsenic	0.00E+00	Cyanogen	1.29E-05
Barium	1.02E-07	Dibenzofuran	2.04E-05
Benz(a)anthracene	1.68E-11	Ethylene	5.06E-09
Benzene	2.75E-08	Formaldehyde	3.49E-07
Benzo(a)pyrene	3.52E-10	Formic acid	2.39E-07
Biphenyl	5.72E-12	Iron	1.51E-01
Cadmium	3.15E-10	Ketene	8.22E-09
Carbon dioxide	4.14E-04	Lead	4.10E-06
Carbon monoxide	1.34E-05	Mercury	0.00E+00
Chromium	3.87E-10	Methane	2.11E-07
Dibenz(a,h)anthracene	1.90E-10	Methyl cyanide	3.52E-09
Dibenzofuran	1.45E-04	Naphthalene	1.18E-04
Diphenylamine	4.35E-11	Nickel	3.22E-01
Hydrogen cyanide	0.00E+00	Phenol	6.29E-04
Lead	2.17E-09	Polychlorinated aromatic hydrocarbons	0.00E+00
Methane	3.66E-07	Polychlorinated biphenyls	0.00E+00
n-Nitrosodiphenylamine	1.46E-10		

TABLE 7.6 (Cont.)

Los Alamos National Laboratory			
Open Detonation		Open Burning	
Annual open detonation of 1.49E+00 t/yr explosives from LANL.		Annual open burning of 9.81E+01 t/yr explosives from LANL.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
Naphthalene	1.66E-08	Polychlorinated dioxins/furans	0.00E+00
Nickel	2.79E-10	Pyrene	2.52E-05
Nitrogen dioxide	5.83E-07		
Nitrogen oxide	1.89E-06		
Nonbenzene aromatic	3.29E-09		
Olefins	3.33E-09		
Paraffins	1.60E-08		
Phenanthrene	2.04E-11		
Phenol	2.77E-09		
Picric acid	5.50E-12		
Pyrene	8.93E-11		
RDX	2.31E-10		
Sulfur dioxide	2.45E-08		
Total nonmethane hydrocarbons	4.95E-07		

TABLE 7.7 Air Emissions from On-Site Open Detonation and Burning of Explosives and Explosives-Contaminated Wastes under the Regionalized 2 Alternative, by Treatment Site

Idaho National Engineering Laboratory			
Open Detonation		Open Burning	
Annual open detonation of 1.49E+00 t/yr explosives from LANL.		Annual open burning of 9.81E+01 t/yr explosives from LANL, SNL-NM, Pantex, and LLNL.	
Chemical	Air Release (t/yr)	Chemical	Air Release (t/yr)
1,1,3-Trimethyl-3-phenylindane	6.27E-11	1,3,5-Trinitrobenzene	4.17E-07
1,3,5-Trinitrobenzene	1.36E-11	2,4,6-Trinitrotoluene	5.03E-06
1- & 2-Methylnaphthalene	3.30E-09	2,4-Dinitrotoluene	1.26E-05
1-Nitropyrene	1.29E-10	2,6-Dinitrotoluene	1.10E-05
2,4,6-Trinitrotoluene	4.15E-10	2-Nitronaphthalene	6.52E-06
2,4-Dinitrotoluene	2.53E-10	Acetylene	1.84E-04
2,5-Diphenyloxazole	7.95E-03	Aluminum	1.76E-04
2,6-Dinitrotoluene	6.42E-11	Arsenic	0.00E+00
2-Nitrodiphenylamine	1.80E-11	Benz(a)anthracene	1.10E-05
2-Nitronaphthalene	9.03E-11	Benzo(a)pyrene	6.37E-06
2-Nitrophenol	2.85E-10	Beryllium	0.00E+00
Acetylene	2.00E-09	Butadiene	3.55E-08
Ammonia	3.21E-08	Cadmium	0.00E+00
Antimony	1.17E-10	Chromium	4.94E-02
Arsenic	0.00E+00	Cyanogen	1.29E-05
Barium	1.02E-07	Dibenzofuran	2.04E-05
Benz(a)anthracene	1.68E-11	Ethylene	5.06E-09
Benzene	2.75E-08	Formaldehyde	3.49E-07
Benzo(a)pyrene	3.52E-10	Formic acid	2.39E-07
Biphenyl	5.72E-12	Iron	1.51E-01
Cadmium	3.15E-10	Ketene	8.22E-09
Carbon dioxide	4.14E-04	Lead	4.10E-06
Carbon monoxide	1.34E-05	Mercury	0.00E+00
Chromium	3.87E-10	Methane	2.11E-07
Dibenz(a,h)anthracene	1.90E-10	Methyl cyanide	3.52E-09
Dibenzofuran	1.45E-04	Naphthalene	1.18E-04
Diphenylamine	4.35E-11	Nickel	3.22E-01
Hydrogen cyanide	0.00E+00	Phenol	6.29E-04
Lead	2.17E-09	Polychlorinated aromatic hydrocarbons	0.00E+00
Methane	3.66E-07	Polychlorinated biphenyls	0.00E+00
n-Nitrosodiphenylamine	1.46E-10		

TABLE 7.7 (Cont.)

Idaho National Engineering Laboratory			
Open Detonation		Open Burning	
Annual open detonation of 1.49E+00 t/yr explosives from LANL.		Annual open burning of 9.81E+01 t/yr explosives from LANL, SNL-NM, Pantex, and LLNL.	
Naphthalene	1.66E-08	Polychlorinated dioxins/furans	0.00E+00
Nickel	2.79E-10	Pyrene	2.52E-05
Nitrogen dioxide	5.83E-07		
Nitrogen oxide	1.89E-06		
Nonbenzene aromatic	3.29E-09		
Olefins	3.33E-09		
Paraffins	1.60E-08		
Phenanthrene	2.04E-11		
Phenol	2.77E-09		
Picric acid	5.50E-12		
Pyrene	8.93E-11		
RDX	2.31E-10		
Sulfur dioxide	2.45E-08		
Total nonmethane hydrocarbons	4.95E-07		

Airborne release source-terms: The uncertainties that exist in the hazardous chemical release source-term are primarily in the development of appropriate emission factors, but are also in the HW inventory data used to develop incinerator throughput. The stack emission rates were calculated as the product of the incinerator waste feed-rate and a source-category emission factor as follows:

$$Q (m/t) = CV \times FR \times EF_i$$

where:

- Q = source-term or chemical compound release rate (in mass units/time units),
- EF_i = chemical compound and waste composition group specific emission factors
- FR = hazardous waste feed rate
- CV = unit conversion factor

This relatively simple model incorporates empirically derived data (e.g., EF_i) and waste inventory compiled data (FR).

The empirical data were derived from RCRA-mandated HW trial burns. It is important to note that trial-burn derived, or any stack-, or field-test-derived emission factors usually represent an average value which relates the quantity of a pollutant released to the atmosphere with the activity associated with the release of the pollutant. In this case, the activity is high temperature combustion of hazardous waste. The incinerator emission factor is usually expressed as the weight of the pollutant divided by a unit weight or volume of the activity that emits the pollutant (i.e., grams of chemical compound per kilogram of waste throughput). Source-category emission factors are usually based on averages of all the source variables influencing emissions, such as combustion chamber temperature and residence time, waste chemicals present (and in what concentrations), waste feed rate, incinerator design and actual combustion efficiencies, control equipment and their capture efficiencies, etc. However, the data necessary for developing source operation parameter specific emission factor (EF) is often not available. Further, emission factors that are based upon a large number of observations, under different operating conditions, would reduce the uncertainty when applied to estimate general source category emission rates.

The incinerator EFs developed for the WM PEIS were based on available general waste descriptions from trial-burns that most closely match the types of HW generated in the DOE Complex. Also the trial-burn incinerator facility was chosen based upon its capability to burn HW with characteristics similar to the DOE Complex HW. In fact, the trial-burn facility selected had received HW for incineration from at least one DOE installation. Based on these considerations, estimates of airborne releases for the scenarios analyzed are probably within a factor of 2-4, depending upon the operating conditions, waste characteristics, and feed rate. This would be attributed to lack of sufficient data to specifically incorporate source operating parameters, such as combustion temperature, residence time, and chemical concentration into the emission factor equation. Even if these data were available, the lack of precise chemical concentrations of constituents in the DOE waste inventory (often not contained in DOE records) would limit its usefulness. The source-terms provided for the WM PEIS probably reflect a slight bias to the conservative estimates of release rates.

The waste inventory was compiled with considerable effort to obtain site-specific inventories that are indeed representative of the HW that may be found at each of the DOE sites. Hazardous waste shipping manifests were collected and supplemented with data from the sites on annual generation rates of hazardous waste. Uncertainties due to the completeness of the data base should be roughly a factor of 2. For the hazardous component of mixed and TRU waste, the chemical breakdown was more generic and was not available on a drum by drum basis as it was for HW, suggesting an order of magnitude uncertainty.

Recognizing that the uncertainties in the various source-term emission factors are often interdependent, the uncertainty in the routine treatment release source-term estimates covers several

orders of magnitude. Since reasonably conservative (but not always bounding) assumptions were generally used to account for the uncertainties in these factors, it is unlikely that the absolute values of the source terms were underestimated. The source term estimates provided will generally be heavily skewed towards the tails of the actual distribution of source-term values rather than reflect true "best estimates". Because of this, the uncertainty range cannot be generally applied to the final estimate of the source-term. Reasonable predictions of the distribution of source terms can not be quantitatively established without a much greater level of knowledge of the waste stream inventories, the future generation of wastes within each category, and the actual characterization of the operations, process parameters, facility configurations, and operating procedures. Developing this level of knowledge is beyond the scope of the WM PEIS.

Although the absolute values of the uncertainty in source-term estimates range to several orders of magnitude, the comparisons among the source-terms and the concomitant relative health effects and risks resulting from different alternatives are much less uncertain. Considerable effort was expended to assure that the routine release analysis approach and underlying assumptions were consistently applied for all waste streams, types of technologies considered, and operations, processes, and facilities evaluated. Thus, the relative health and risk impacts that are ultimately derived from and calculated for different facilities and alternatives are judged to provide useful information in allowing DOE discriminate among HW management alternatives evaluated in the WM PEIS.

8 WASTE MANAGEMENT PRACTICES — TODAY AND TOMORROW

Analysis of FY 1992 manifests covering shipments of HW from DOE facilities to off-site commercial treatment facilities has revealed important information about the types and volumes of HW that are currently being generated and managed. Over 2,000 manifests covering 11,000 wastes from 46 DOE locations were reviewed. Using information on the type of commercial facility receiving the waste and the description of the waste indicated on the manifest, a database was generated showing how much waste was directed to each treatment or disposal technology. This information has proved very useful for identifying the types of treatment systems that will be needed, as well as capacity and location requirements, for managing more of DOE's HW at on-site permitted facilities.

In addition to RCRA hazardous wastes, the manifests frequently include TSCA-regulated wastes (PCB and asbestos wastes) and non-RCRA or state-regulated wastes. Thus, the RCRA manifests comprise a comprehensive database for the handling of all three types of HW: RCRA, non-RCRA, and TSCA wastes. Wastes from ER operations sometimes appeared in the database, but they too were listed as either RCRA, non-RCRA, or PCB wastes. All manifested wastes were directed to: (1) RCRA- or TSCA-permitted treatment facilities for treatment and disposal, (2) to RCRA, TSCA, or non-RCRA landfills for stabilization and disposal or direct disposal, or (3) to waste brokers and vendors for consolidation and shipment to appropriate treatment, recycling, energy recovery, or disposal facilities.

RCRA wastes were identified by the HW codes on the manifests. PCB wastes were identified by the words "polychlorinated biphenyls" or "PCBs" in the waste description on the manifest. Non-RCRA wastes were identified as all other wastes (i.e., wastes not having a RCRA HW identification code or not identified as PCB wastes). In a few cases there was not enough information given to identify how the waste was to be managed; these wastes were grouped into a "treatment unknown" category. About 1.5% of the wastes fell into this category.

A double analysis of the 1992 manifests was conducted. In the first analysis, Argonne studied the actual distribution of shipments from each DOE facility for treatment at designated commercial facilities in 1992 (i.e., where was each waste sent and how was it most likely managed there). For example, wastes manifested to ENSCO, Inc. (El Dorado, Arkansas) or Rollins Environmental Services, Inc. (Deer Park, Texas, or Baton Rouge, Louisiana) are listed under "incineration" because that is the only HW operation available at these commercial facilities. However, wastes manifested to Rollins Oil Process Company facility in Los Angeles were either treated by aqueous methods or brokered/redistributed to other permitted facilities for treatment and disposal. Wastes manifested to USPCI, Inc. (Grassy Valley, California), Chemical Waste Management, Inc. (Kettleman Hills, California), or Enviro Safe of Idaho (Grandview, Idaho), which are all primarily landfills, were listed under either "stabilization" or "landfill," depending on the physical description of the waste (for example, liquids would be stabilized before they were

landfilled, whereas solids would be directly landfilled). Available information describing the types of treatment, blending, consolidation, recycling, recovery, or disposal operations available at each commercial facility was used to match the shipments with the most likely form of treatment or disposal applied by the commercial facilities receiving them in 1992.

To get some idea of how the future management of DOE wastes might change as improvements are made in the location of wastes for treatment, Argonne conducted a second analysis of the manifest data. The wastes were being allocated to various treatment technologies or to disposal based on current thinking, practices, judgment, rules, and waste management policy and guidance about the most effective and appropriate ways to manage hazardous and toxic wastes. A preliminary comparison of the results of the two analyses for RCRA, non-RCRA, and PCB wastes is shown in Table 8.1 (rounded to nearest hundred).

Given the same HW generation rates in 1995 as in 1992, the data above show that in the future, landfill demand will increase slightly to about 5,200 t/yr (~3,500 m³/yr [~4,600 yd³/yr]). Incineration demand will reduce to 2,200 t/yr (~1,500 m³/yr [~2,000 yd³/yr]) as more wastes are redirected toward other, more appropriate, treatment technologies. Organic removal/recovery will rise, as will most of the other choices. Mercury removal/recovery will not change.

The analysis also showed that the off-site treatment technologies used to treat just the RCRA-regulated portion of the HW, totaling 3,200-3,400 t/yr (~2,100-2,300 m³/yr

TABLE 8.1 Current and Future Use of Technologies for DOE HW Treatment

Commercial HW Treatment	Usage Today (1992)		Future Usage (1995)	
	t/yr	%	t/yr	%
Stabilization and disposal	4,900	50	5,200	53
Incineration	3,000	31	2,200	22
Organic removal/recovery	1,400	14	1,600	16
Deactivation/neutralization	200	2	200	2
Metal removal/recovery	100	1	100	1
Mercury removal/recovery	100	1	100	1
Aqueous treatment	100	1	200	2
Recycling	0	0	NE ^a	NE
Unknown	0	0	200	2
Total	9,800		9,800	

^a NE = not estimated.

[~2,700-3,000 yd³/yr]) in 1992, were appropriate for the most part and are not likely to change much in the future. This is a strong indication that the RCRA wastes are being properly and appropriately managed. If routine RCRA waste generation rates and profiles remain the same, 50% will still be appropriate for incineration and the remainder will go to organic removal/recovery (25%), stabilization and disposal (12%), mercury and metal recovery (7%), deactivation or neutralization (4%), aqueous treatment (1.5%), and recycling (0.5%).

For the non-RCRA wastes, 5,400 t/yr (3,600 m³/yr [~4,700 yd³/yr]) in 1992, even though they are not regulated by RCRA, they still can possess toxic and hazardous properties. In 1992, almost as much non-RCRA waste (1,454 t) as RCRA waste (1,595 t) was incinerated; however, much of it was not combustible. The wastes were either organically destroyed or reduced in volume, and part of them either escaped to the atmosphere with the stack gases or were disposed on the land with the ash and scrubber solids. With better management in the future, less non-RCRA waste should be incinerated, and more should be recycled, recovered, neutralized, or landfilled.

This study indicates that with more appropriate management, incineration of non-RCRA wastes could be reduced from about 1,500 t/yr (1,000 m³/yr [~1,300 yd³/yr]) to about 500 t/yr (333 m³/yr [~440 yd³/yr]). At the same time, organic recovery and recycling would increase to about 825 t/yr (550 m³/yr [~720 yd³/yr]), aqueous treatment and neutralization would grow to about 210 t/yr (140 m³/yr [~180 yd³/yr]), and landfill usage would rise to almost 4,000 t/yr (~2,000 m³/yr [~3,500 yd³/yr]).

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