THE INTEGRATED DATA BASE PROGRAM:

AN EXECUTIVE-LEVEL DATA BASE OF SPENT FUEL AND RADIOACTIVE WASTE

INVENTORIES, PROJECTIONS, AND CHARACTERISTICS

J. A. Klein
Oak Ridge National Laboratory*
Oak Ridge, Tennessee 37831

ABSTRACT

The Integrated Data Base (IDB) is the official U.S. Department of Energy (DOE) data base for spent fuel and radioactive waste inventories and projections. As such, it should be as convenient to utilize as is practical. Examples of summary-level tables and figures are presented, as well as more-detailed graphics describing waste-form distribution by site and line charts illustrating historical and projected volume (or mass) changes. This information is readily accessible through the annual IDB publication. Other presentation formats are also available to the DOE community through a simple request to the IDB Program.

INTRODUCTION

The Integrated Data Base (IDB), a U.S. Department of Energy (DOE) program jointly sponsored by the Office of the Assistant Secretary for Nuclear Energy, the Office of the Assistant Secretary for Defense Programs, and the Office of Civilian Radioactive Waste Management, maintains the official data base for spent fuel and radioactive waste inventories and projections through the year 2020.

The purpose of the IDB Program is to create and maintain a reliable baseline of quality data and information to be used for national program planning, decision making, and other management activities. As the official data base for DOE, the IDB is readily available to the DOE community and to DOE-sponsored contractors.

The IDB Program provides access to information on spent fuel and radioactive waste inventories and characteristics, including volume and/or mass, age, radioactivity, heat generation, chemical and physical properties, location, packaging, and nuclide composition. Utilizing a modular system of computer codes, the IDB also provides projections based on anticipated growth rates, schedules for new facilities, waste-generation factors, and treatment assumptions. Projections for commercial waste are based on official Energy Information Administration (EIA) electrical growth projections.

The program's annual report, "Integrated Data Base for 1986: Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics," DOE/RW-0006, Rev. 2, presents summary-level tables and figures that compare volumes and radioactivity of all forms of spent fuel and radioactive waste [high-level waste (HLW), transuranic (TRU) waste, and low-level waste (LLW)]. These materials are generated by commercial fuel cycles [including decontamination and decommissioning (D&D) activities], defense programs, remedial action programs, and institutional and industrial operations.

Figure 1 illustrates the primary sources of data that are included in the IDB. A major program function is to translate various inputs from the numerous sources into a common and internally consistent data base. Data are collated and integrated to ensure that all forms are counted only once.

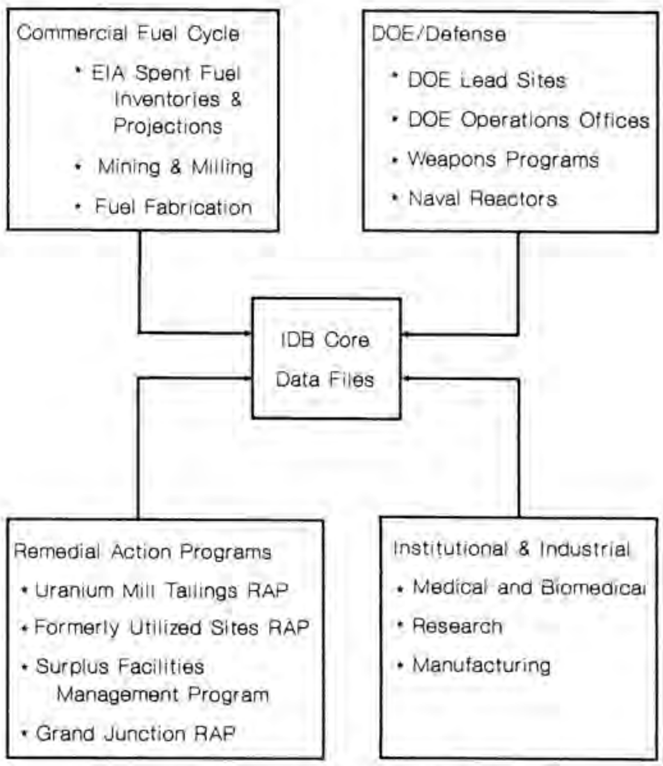

Fig. 1. Sources of IDB Data.

*Operated by Martin Marietta Energy Systems, Inc. for the U.S. Department of Energy, under contract DE-AC05-84OR21400.

The IDB Program encompasses three major technical areas: data collection and processing, calculation of isotope generation and depletion, and data base development and user access. The steps involved in the flow of data from input to output, including data processing, is shown in Fig. 2.

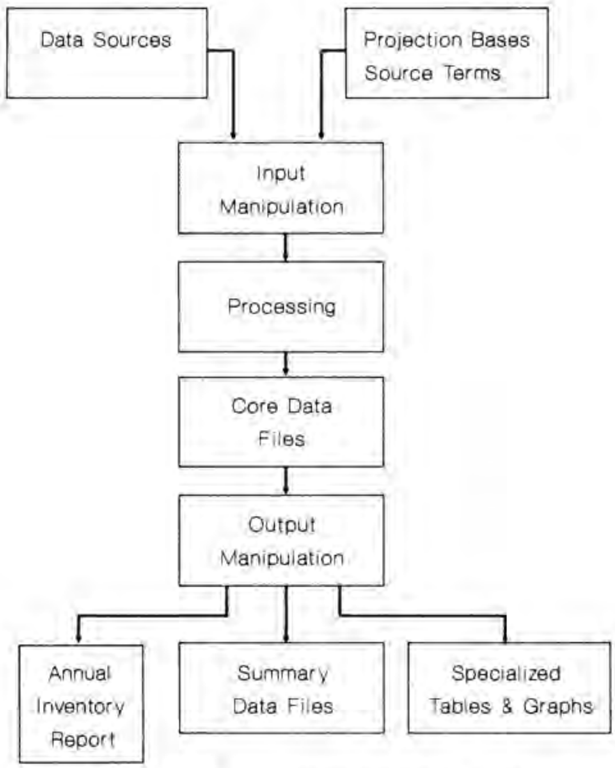

Fig. 2. Data Manipulation in the IDB Program.

SUMMARY DATA TABLES AND FIGURES

The usefulness of the IDB is inherent in its summation tables and figures, in which data for all waste forms are listed and displayed in a self-consistent manner. For example, Table I shows the summary of spent fuel and waste inventories through December 31, 1985, and Table II includes projections to 1990, 2000, 2010, and 2020. These tables were generated from the core data files through the use of Statistical Analysis System (SAS) programming.

Figure 3 presents the volumes of commercial and DOE/defense wastes and spent fuel accumulated through 1985 in a pie chart that provides a clear pictorial overview of the relative amounts of this country's radioactive wastes. It is apparent that, on a volume basis, LLW dominates the total, with DOE/defense LLW comprising over half this country's total waste. In Fig. 4, the radioactivities of the same wastes are presented in a similar fashion. On this basis, spent fuel comprises more than 90% of the radioactivity to be disposed of. It is obvious from these two figures why spent fuel and LLW are the major areas of concern in recent discussions on the storage and disposal of radioactive waste.

WASTE-SPECIFIC DATA

The IDB maintains the capability of producing numerous figures, maps, and charts based on the data within its core data files. Figure 5 presents the projected mass of annual commercial spent fuel discharges. From this projection, it can be seen that even though the number of new reactors coming on line has been steadily decreasing, the trend for annual spent fuel discharges is toward an increase in discharges through the year 2020. Figure 6 also addresses spent fuel discharges, plotting the cumulative mass of the discharged fuel versus time and introducing the fuel age as a parameter. In 1985

TABLE I

Spent Fuel and Radwaste Inventories as of December 31, 1985

Spent Fuel	Mass, MTU	Activity, MCi	Thermal Power, kW
BWRs (28,033 assemblies)	5,095	4,329	15,600
PWRs (18,319 assemblies)	7,762	9,940	37,300
High-Level Waste	Volume, m^3	Activity, MCi	Thermal Power, kW
Savannah River (DOE)	122,700	841	2,538
Idaho (DOE)	10,100	69	210
Hanford (DOE)	222,000	517	1,573
West Valley (commercial)	2,310	32	96
Transuranic Waste	Volume, m^3	Activity, MCi	TRU Elements, kg
DOE, Buried	194,000	0.34	1,480
DOE, Stored	92,100	1.58	1,755
Low-Level Waste	Volume, m^3	Activity, MCi	Land Used, ha
DOE Sites	2,180,600	11.91	128
West Valley (Closed 1975)	75,310	0.47	4
Maxey Flats (Closed 1977)	135,280	0.93	10
Sheffield (Closed 1978)	88,334	0.02	4
Barnwell, SC	501,717	1.87	22
Beatty, NV	98,639	0.22	12
Richland, WA	260,668	0.99	21
Commercial Uranium Mill Tailings	Volume, m^3	Activity, MCi	Thermal Power, kW
At Mill Sites	99,958,000	0.87	19
Remedial Action Programs (DOE)	Volume, m^3	Activity, MCi	No. of Sites
UMTRAP (Uranium Mill Tailings)			25
FUSRAP (Formerly Utilized Sites)	118,920		29
SFMP (Surplus Facilities)	24,910		320
GJRAP (Grand Junction)	52,070		598

TABLE II

Current and Projected Volume of Spent Fuel and Radioactive Waste

Source of Material and Type	End of CY 1985 Volume (10^3 m^3)	End of CY 1985 Radioactivity (10^6 Ci)	End of CY 2000 Volume (10^3 m^3)	End of CY 2000 Radioactivity (10^6 Ci)	End of CY 2010 Volume (10^3 m^3)	End of CY 2010 Radioactivity (10^6 Ci)	End of CY 2020 Volume (10^3 m^3)	End of CY 2020 Radioactivity (10^6 Ci)
DOE/Defense								
HLW								
Interim Storage	355	1,427	343	1,605	366	1,404	374	1,434
Glass	0	0	2.8	284	3.9	429	4.6	486
TRU								
Buried	194	0.3	194	0.3	194	0.3	194	0.3
Stored	92	1.8	182	3.5	243	4.7	303	5.9
LLW	2,181	11.9	4,043	18.3	5,159	20.9	6,256	22.9
UMTRAP & GJRAP								
Mill Tailings	52		15,110		15,110		15,110	
Other Waste	0		8,241		8,241		8,241	
FUSRAP	119		870		870		870	
SFMP								
TRU Waste	1.3		3.3		3.4		3.4	
LLW	24		791		800		800	
Mill Tailings	0		1,617		1,617		1,617	
Commercial								
Spent Fuel (10^3 MTIHM)	12.9	14,269	42.5	31,624	67.9	47,612	107.8	72,020
Commercial HLW Glass (WVDP)			0.2	22.5	0.2	17.8	0.2	14.1
LLW	1,160	4.6	2,441	8.5	3,545	11.3	4,972	14.8
D&D (LLW)			0.6		91.3		795.9	
Mill Tailings	99,958	0.9	146,480	1.3	197,303	1.7	265,865	2.3

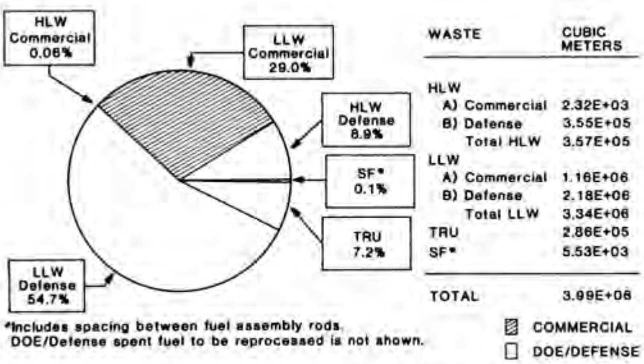

Fig. 3. Volumes of Commercial and DOE/Defense Wastes and Spent Fuel Accumulated Through 1985.

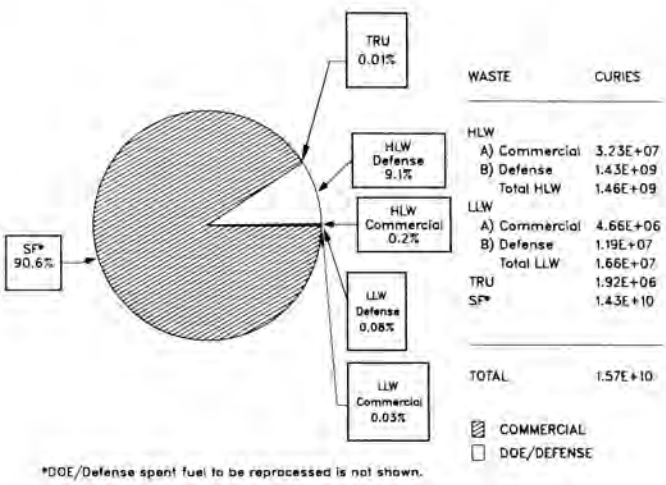

Fig. 4. Radioactivities of Commercial and DOE/Defense Wastes and Spent Fuel Accumulated Through 1985.

very little fuel was more than 10 years old; by the year 2000, about 40% will be more than 10 years of age, and by 2020, this fraction will have increased to some 60%.

The distribution of HLW volume and radioactivity is illustated in Fig. 7. This bar chart indicates that, although Hanford has the majority of the HLW volume, the largest amount of radioactivity is located at Savannah River. This discrepancy is due partially to Hanford being an older facility, which would allow for additional decay time for some of its HLW, and partially to Hanford having used, in its early history, a bismuth phosphate reprocessing scheme, which produced large quantities of dilute HLW. It is interesting to note that Savannah River will be the first DOE/defense site to vitrify its HLW into glass logs suitable for disposal in the spent fuel and HLW geologic repository.

Figure 8 gives a breakdown of the total volume of the retrievably stored TRU waste by site. This material will be sent to the Waste Isolation Pilot

Fig. 5. Projected Mass (MTIHM) of Annual Commercial Spent Fuel Discharges for the DOE/EIA Upper Reference Case.

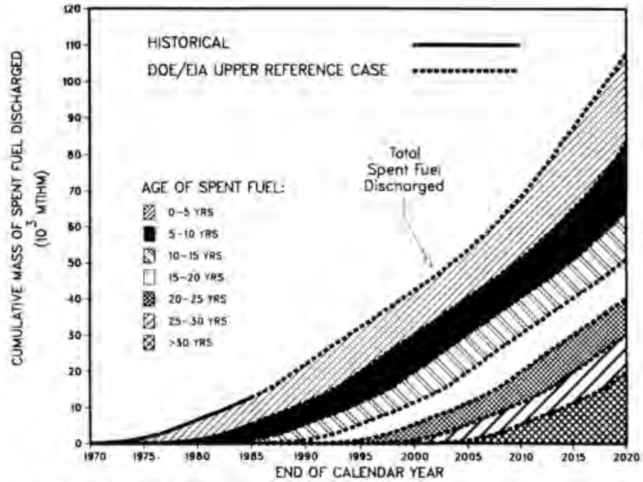

Fig. 6. Projected Cumulative Mass (MTIHM) of Commercial Spent Fuel Discharges for the DOE/EIA Upper Reference Case.

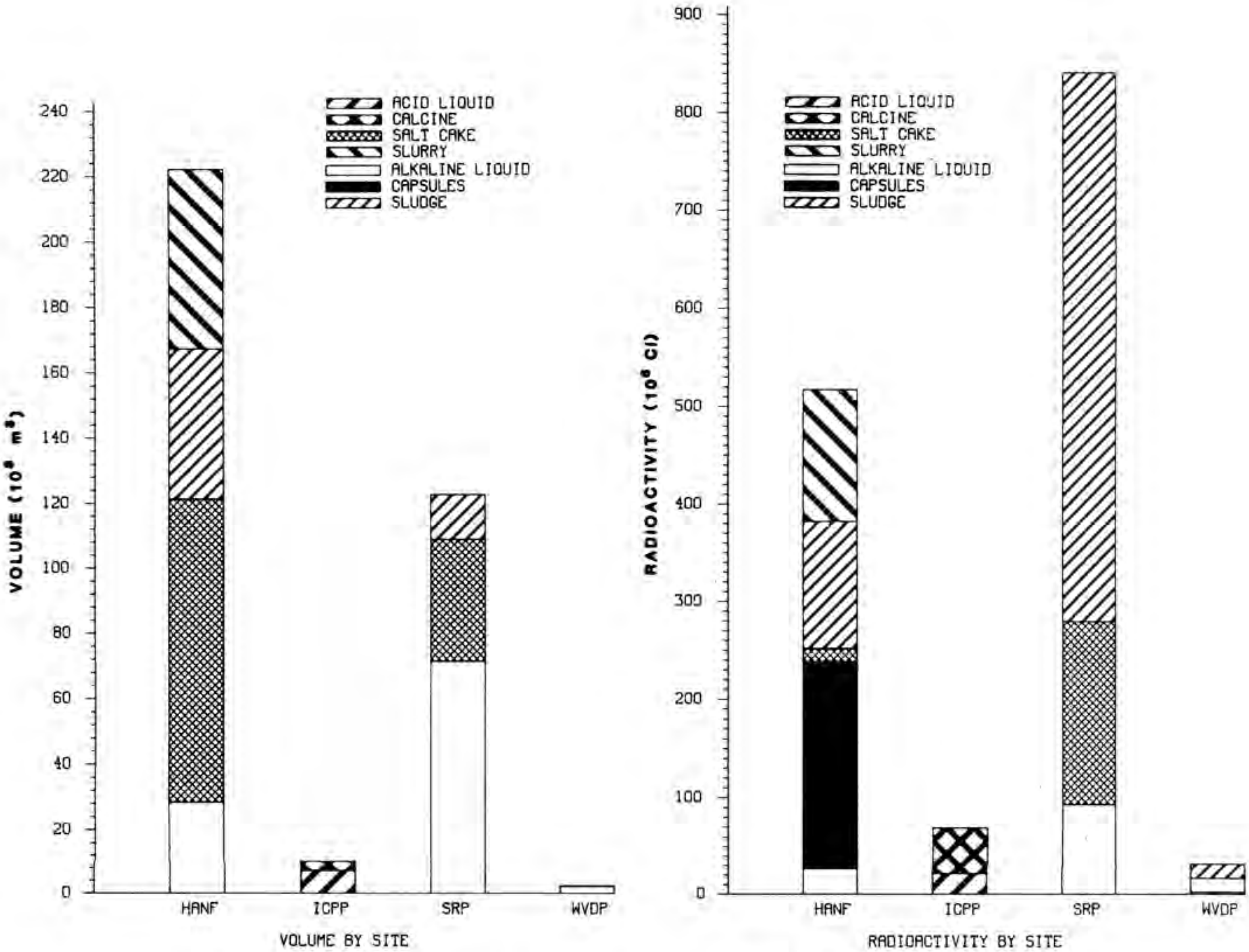

Fig. 7. Distribution of Volume and Radioactivity of HLW by Site and Type Through 1985.

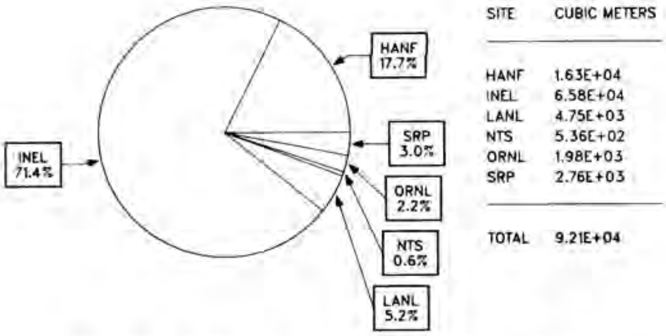

Fig. 8. Total Volume of Retrievably Stored DOE/Defense TRU Waste Through 1985.

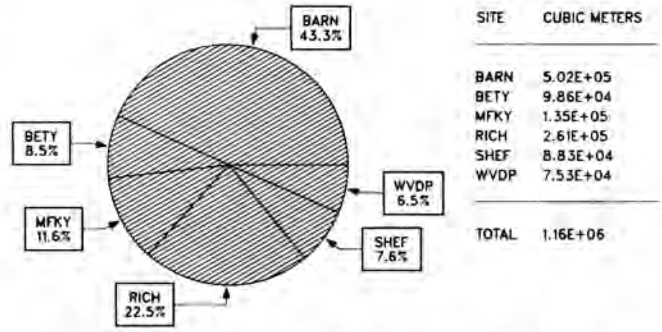

Fig. 10. Total Volume of Buried Commercial LLW Through 1985.

Plant (WIPP) and includes both the contact and remote handled TRU waste categories. Idaho National Engineering Laboratory (INEL) is the major storage site for TRU material, because it receives the bulk of the Rocky Flats weapons-related TRU waste.

A breakdown of the volume of DOE/defense LLW that is buried at the various DOE sites is described in Fig. 9. This material is normally produced and

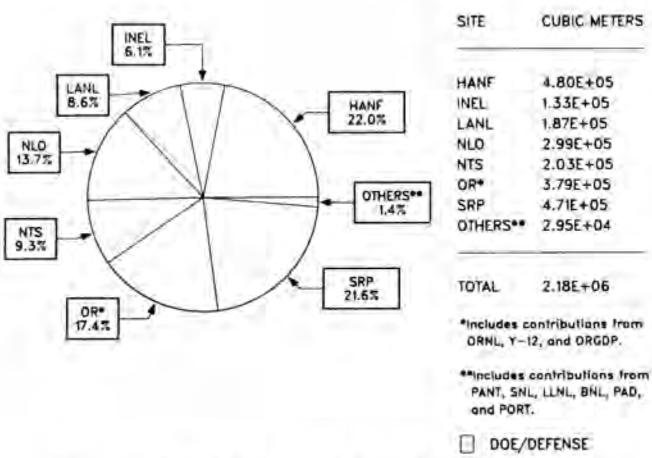

Fig. 9. Total Volume of Buried DOE/Defense LLW Through 1985.

buried on-site without shipment to a remote site. The DOE sites exhibiting the largest volumes of buried DOE/defense LLW are Hanford, Savannah River, and Oak Ridge. A similar breakdown for the buried commercial LLW is depicted in Fig. 10. West Valley, Maxey Flats, and Sheffield are all closed to additional waste, which leaves only Beatty, Richland, and Barnwell to receive commercial LLW until the various regional compacts can implement the selection of their individual disposal sites. Figure 11 illustrates the volume of LLW shipped to the commercial sites, by state, and Fig. 12 projects the cumulative volume of both DOE/defense and commercial LLW until the year 2020. The DOE/defense share of the total LLW inventory is expected to drop slowly from approximately 65% in 1985 to around 55% in 2020.

SPECIAL STUDIES AND REQUESTS

Special requests for information and special studies can be divided into three general categories:

1) ad hoc inquiries that can be responded to directly from existing IDB publicatons or prior data searches,
2) requests that require a special search of existing data bases or a new integration of existing data, and
3) queries that involve requests for special runs to generate new information.

Requests that can be responded to directly include historical annual storage rates, site-by-site volumes, and reconciliation of any apparent omissions or duplications. Responses resulting from requested searches might include isotopic details of spent fuel discharges or the amount of heavy metal present in the TRU waste. Questions in these first two categories can usually be handled over the telephone. Queries in the third category, which require special runs, are normally handled through DOE requests. Depending on the nature of the request, queries in this category might require a reimbursement of costs.

In summary, the Integrated Data Base provides, in a wide variety of formats, technical information on spent fuel and radioactive waste in terms of inventories, projections, and characteristics. This information is useful in various program planning exercises and in response to requests for data by DOE, state and local governments, and interested third parties.

As the IDB is the official DOE data base, it would behoove those within the DOE community to utilize the IDB as much as is practical. This is especially true for those doing waste disposal analysis in the present critical time frame. Frequently, more complex data bases than the IDB are needed, but in those cases, it would also be practical to ensure that, at least, consistency is maintained between data bases. Even for those outside the official DOE community, it would seem reasonable that any analysis or independent assessment should be undertaken from the same initial starting point. This can easily be accomplished by referencing the IDB.

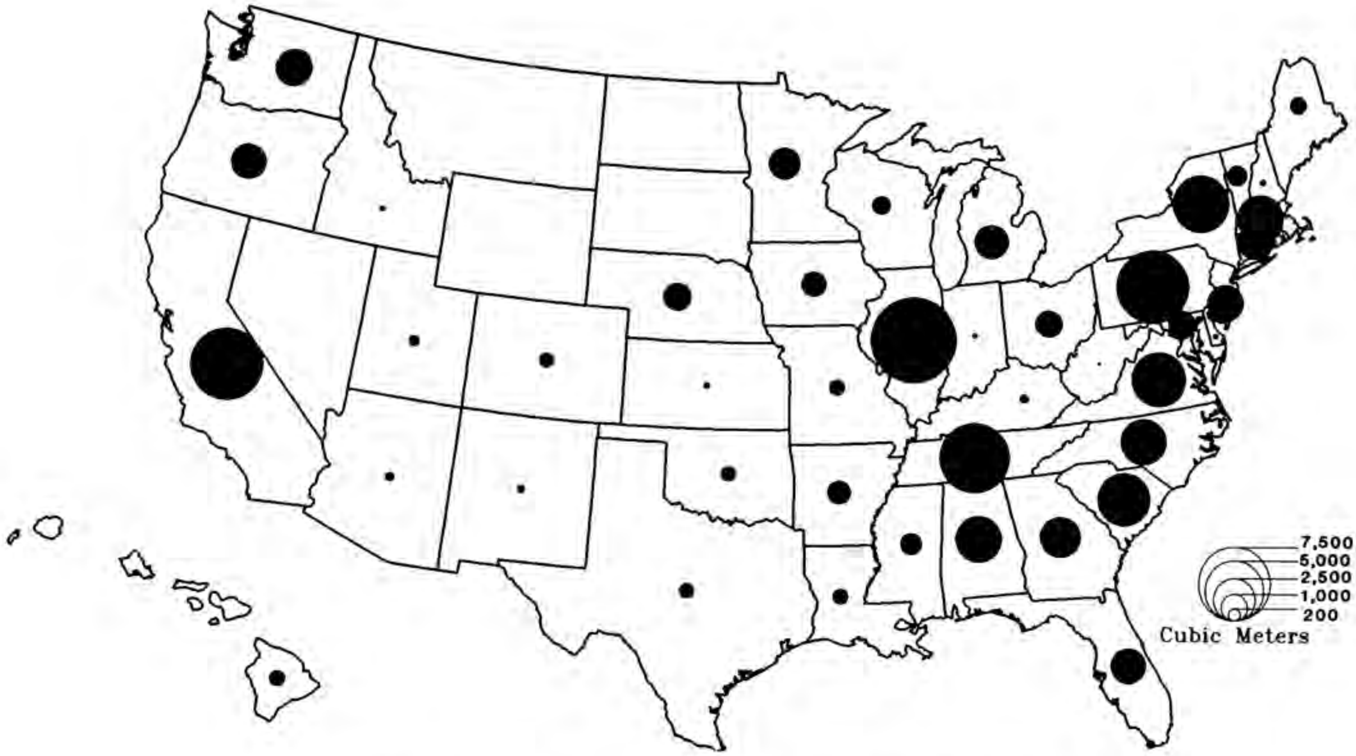

Fig. 11. Volume of LLW Shipped to Commercial Burial Sites, by State, in 1985.

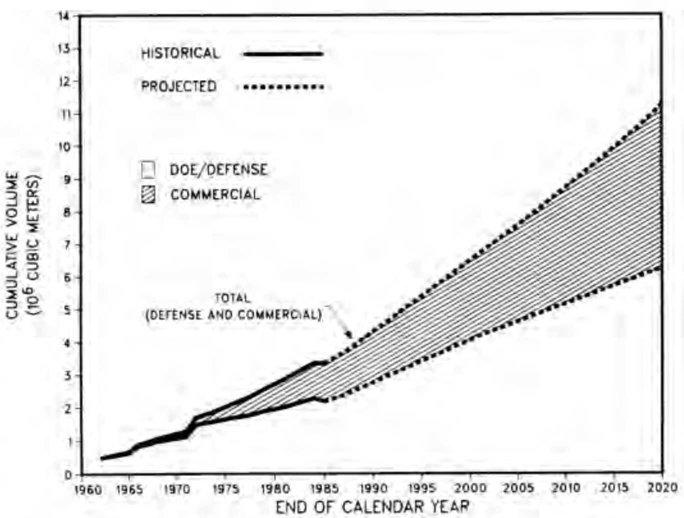

Fig. 12. Historical and Projected Cumulative Volume of LLW.

Additional information can be obtained by contacting any of the following:

U.S. Department of Energy

M. L. Payton
Office of Civilian Radioactive Waste Management
Washington, DC 20585
202 252-9007
FTS 896-9007

E. F. Mastal
Office of Nuclear Energy
Washington, DC 20545
301 353-4553
FTS 233-4553

E. A. Jordan
Office of Defense Programs
Washington, DC 20545
301 353-5429
FTS 233-5429

S. S. Perkins
Oak Ridge Operations
P. O. Box E
Oak Ridge, TN 37831
615 576-8862
FTS 626-8862

Oak Ridge National Laboratory

J. A. Klein
Oak Ridge National Laboratory
Bldg. 4500-N
P. O. Box X
Oak Ridge, TN 37831-6234
615 574-6823
FTS 624-6823