

## **Chapter 1**

# **Introduction**

# CONTENTS

	<i>Page</i>
GENERAL .....	15
THE WEAPONS COMPLEX .....	15
Functions and Management .....	17
Size and Location .....	18
Relationships With Regulators and With the Public .....	19
THE OFFICE OF TECHNOLOGY ASSESSMENT STUDY .....	20

## *Figure*

<i>Figure</i>	<i>Page</i>
1-1. Department of Energy Weapons Complex .....	16

## *Table*

<i>Table</i>	<i>Page</i>
1-1. The Weapons Complex .....	17

### GENERAL

The Department of Energy (DOE) Nuclear Weapons Complex consists of 14 facilities in 13 States,<sup>1</sup> on military reservations covering 3,350 square miles and employing more than 100,000 people (see figure 1-1 and table 1-1).<sup>2</sup> Since the middle of this century, these facilities have been producing uranium materials and irradiating them in nuclear reactors, reprocessing these materials to separate weapons constituents, manufacturing and finishing weapons components, producing special parts, assembling and testing weapons, conducting research and designing new weapons, and recycling parts when weapons are retired. In the 1990s, the legacy of producing tens of thousands of warheads over the past five decades is widespread environmental contamination from the waste products of this process, accompanied by a pervasive concern among local communities and others over possible public health threats, and an uncertain fate for waste generated in the future.

Poorly contained hazardous and radioactive wastes from weapons production have contaminated groundwater, soil, sediments, and surface water and have also been released into the air surrounding weapons plants. Factors contributing to contamination include manufacturing processes that are inherently waste producing; a history of emphasizing the urgency of weapons production for national security, to the neglect of health and environmental considerations; ignorance of, and lack of attention to, the consequences of environmental contamination; and decades of self-regulation, without independent oversight or meaningful public scrutiny. In late 1989, commenting on the serious problems he faces in managing DOE defense programs, Secretary of Energy James D. Watkins said that "the [waste management and environmental] problems have resulted from a 40-year culture cloaked in secrecy and imbued with a dedication to the production of

nuclear weapons without a real sensitivity for protecting the environment."<sup>3</sup>

### THE WEAPONS COMPLEX

Work performed at the DOE Weapons Complex has traditionally been divided into four categories:

1. weapons research and development at three national laboratories, Los Alamos and Sandia in New Mexico and Lawrence Livermore in California;
2. nuclear materials (plutonium and tritium) production and processing at the Hanford Plant in Washington State and the Savannah River Site in South Carolina, along with uranium processing at the Feed Materials Production Center in Ohio and the Idaho National Engineering Laboratory;
3. warhead component production at the Rocky Flats Plant in Colorado, the Y-12 Plant in Tennessee, the Mound Plant in Ohio, the Pinellas Plant in Florida, the Kansas City Plant in Missouri, and the Pantex Plant (final assembly) in Texas; and
4. warhead testing at the Nevada Test Site.

Although the Weapons Complex was developed in World War II as part of the Manhattan Project, a major expansion occurred in the early 1950s. Today, most operating facilities are more than 30 years old. Operations are in various stages of transition because of safety and environmental problems that have diverted attention from production and because of the uncertain future of the entire enterprise.

Environmental and health problems resulting from nuclear weapons production at these facilities have been discussed and debated over the past few years. DOE has now directed its attention to these problems, has acknowledged their seriousness and

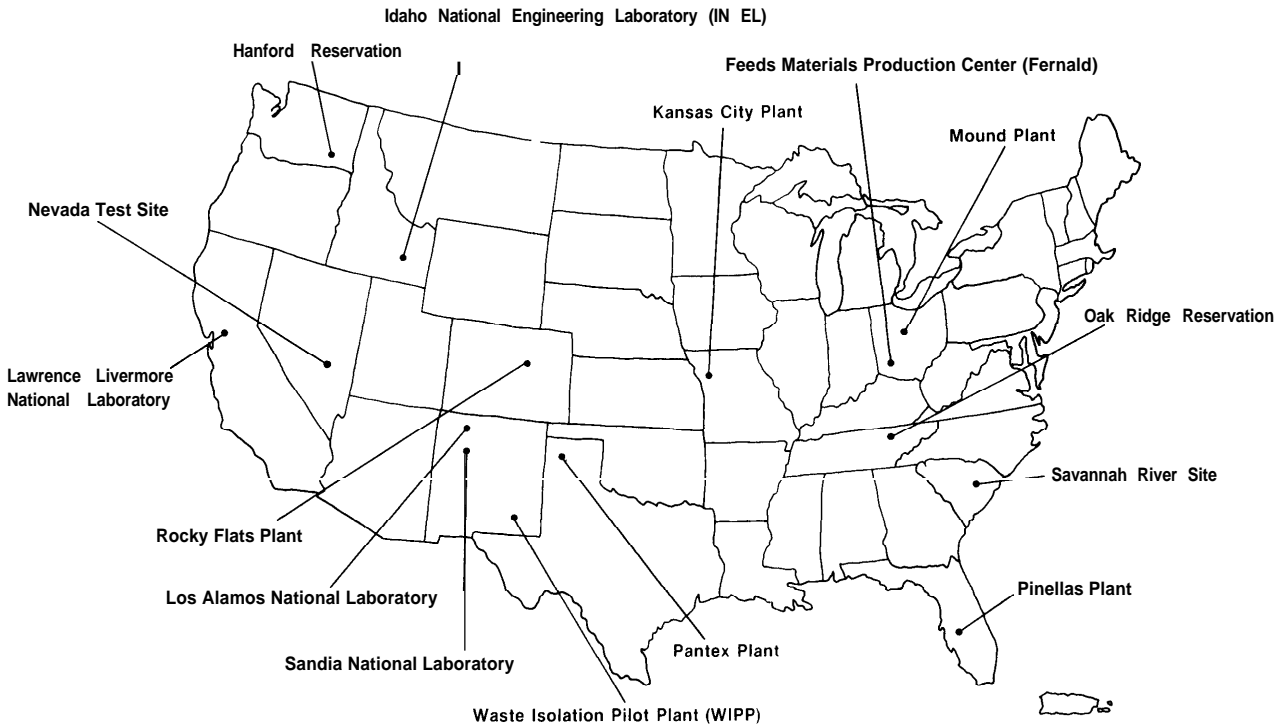
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<sup>1</sup>This definition of 14 facilities in the Nuclear Weapons Complex generally agrees with DOE's definition of major facilities grouped under defense programs but excludes some smaller operations as well as those under other DOE programs. Other reviews have included additional facilities, such as the Portsmouth and Paducah Gaseous Diffusion Plants, or have counted some facilities in one reservation separately, and thus have resulted in a larger number. In addition, 15 locations are identified in figure 1-1 and table 1-1 because of inclusion of the Waste Isolation Pilot Plant.

<sup>2</sup>To obtain some idea of the size of the Weapons Complex, it may be helpful to realize that the Nevada Test Site covers an area larger than the State of Rhode Island and that the Oak Ridge Reservation Sandia National Laboratory, and Los Alamos National Laboratory each occupy an area approximately the size of Washington DC.

<sup>3</sup>Statement of Admiral James D. Watkins, Secretary of Energy, before the Senate Committee on Energy and Natural Resources, Oct. 5, 1989.

Figure I-1—Department of Energy Weapons Complex



SOURCE: Office of Technology Assessment, 1991.

extent, and stated its intention to expend vast resources to remediate past contamination and to establish sound waste management practices for the future. DOE has responded to these environmental and waste management problems with a Five-Year Plan for environmental restoration and waste management, and a new organization to direct these efforts.<sup>4</sup>

DOE operates the weapons production facilities through its headquarters organization known as Defense Programs, which manages weapons production to meet the needs of the Department of Defense. Although owned by the Federal Government, the weapons facilities are operated by private companies under management and operations contracts with the Department of Energy. A new DOE headquarters organization known as Environmental

Restoration and Waste Management has been established recently to direct waste management and environmental restoration efforts. Actual work at the sites is still carried on by the private companies that operate each facility under the direction of DOE field operations offices.

Although facilities in the DOE complex have much in common, there is no “typical” facility.<sup>5</sup> Each site has a unique combination of characteristics that shapes its particular waste and contamination problems and affects the way those problems are addressed. Relevant facility characteristics include its functions and management; its size, location, and proximity to populated areas; and its relationships with Federal and State regulators, neighboring communities, and the general public. These distinguishing features are discussed below.

<sup>4</sup>4-1-h, 5-year planning process that DOE has instituted resulted in a series of documents that now constitute the most comprehensive, published discussion of environmental restoration and waste management throughout the Weapons Complex. Ch. 2 contains specific references to these publications.

<sup>5</sup>The following discussion of facilities within the DOE Weapons Complex is summarized from data gathered by Office of Technology Assessment staff during visits, briefings, meetings, and inspections at each of the major sites.

Table I-I—The Weapons Complex (Principal Facilities List)

Type of facility	Facility	Location (State)	Size (square miles)	Management and operations contractor	Approximate current employment
Weapons research and design	Los Alamos National Laboratory	NM	75	University of California	7,400
	Sandia National Laboratory	NM	62	AT&T	8,500
	Lawrence-Livermore National Laboratory	CA	12	University of California	8,500
Materials production	Hanford Plant	WA	570	Westinghouse	13,500
	Savannah River Site	SC	300	Westinghouse	20,000
	Fernald	OH	0.2	Westinghouse	1,000
	Idaho National Engineering Laboratory	ID	893	EG&G/ Westinghouse	10,500
Weapons manufacturing	Rooky Flats Plant	CO	14	EG&G	6,000
	Oak Ridge Reservation	TN	58	Martin-Marietta	16,500
	Mound Plant	OH	0.3	EG&G	2,400
	Pinellas Plant	FL	0.2	General Electric	2,000
	Kansas City Plant	MO	0.5	Allied Signal Corp.	7,800
	Pantex Plant	TX	14	Mason & Hanger-Silas Mason	2,800
Warhead testing	Nevada Test Site	NV	1,350	Reynolds Electric	8,400
Waste disposal	Waste Isolation Pilot Plant	NM	16	Westinghouse	650

SOURCE: U.S. Department of Energy.

### *Functions and Management*

When they are operating, five facilities produce materials for nuclear weapons. The Feed Materials Production Center in Fernald, OH, is not currently operating but, in the past, it produced uranium metal ingots; the Hanford Plant, which is also shut down, handled the production of weapons-grade plutonium; the Y-12 Plant in Oak Ridge, TN, produces uranium metal and light elements; and the Savannah River Site (when operating) produces tritium and has in the past produced plutonium. Highly enriched uranium is recovered at the chemical processing plant in Idaho and at Y-12. Weapons components are produced at several facilities--ceramic and uranium components at Y-12, plutonium and beryllium components at Rocky Flats, and other components at the Kansas City, Mound, and Pinellas plants. Weapons assembly is completed at the Pantex Plant.

At this time, many material processing and weapons production operations at the facilities are

shut down. DOE intends to evaluate the possibility of reopening and operating some of them safely, in compliance with applicable laws and regulations. Others, such as Fernald, will cease producing nuclear materials and will focus primarily on cleanup activities. A general review of modernization needs for the entire Weapons Complex is underway.

During the past 6 years, many of the weapons facilities have undergone changes in the contractors that operate them for DOE, and a fewer number of firms now operate these plants. Specifically, Westinghouse Hanford Co. replaced Rockwell Hanford Co. at Hanford in 1987; Westinghouse Materials Co. of Ohio replaced National Lead of Ohio at Fernald in 1985; Westinghouse Savannah River Co. replaced E.I. du Pont de Nemours & Co. at Savannah River in 1989; Martin Marietta Energy Systems replaced Union Carbide Corp. at Y-12 in 1984; Westinghouse Idaho Nuclear replaced Exxon Nuclear Idaho Co. at the Idaho Chemical Processing Plant (ICPP) in 1984 (EG&G Idaho is general contractor for the site); and,



*Photo credit: U.S. Department of Energy*

Hanford Reservation 300 area adjacent to the Columbia River.

in a highly publicized change apparently related to alleged violations of environmental laws and regulations, EG&G Rocky Flats Corp. replaced Rockwell International at Rocky Flats in 1989. Westinghouse is also the contractor for the Waste Isolation Pilot Plant in New Mexico.

### *Size and Location*

DOE Weapons Complex facilities are spread across the Nation, from South Carolina to Washington State; they vary greatly in both size and proximity to populated regions. Fernald, which has produced uranium metal, and Rocky Flats, which produces plutonium “triggers,” are relatively small facilities located near populated areas. The 1,450-acre Fernald site is 20 miles northwest of Cincinnati, OH, in a farming area. Although Rocky Flats covers about 6,550 acres, all major structures are concentrated in fewer than 400 acres. The plant is within 16 miles of downtown Denver, Boulder, and Golden,

CO. About 80,000 people live within 3 miles of the facility.

Other sites are much larger. Hanford encompasses approximately 360,000 acres in southeastern Washington State: Richland, Pasco, and Kennewick (the Tri-Cities area, with a population of 140,000) are nearby, downstream on the Columbia River. Portland, OR (population 360,000), is about 230 miles downstream. Hanford’s primary mission has been the production of weapons-grade plutonium. The Savannah River Site, which produces tritium and plutonium, consists of 192,000 acres on the north bank of the Savannah River. Built in the early 1950s, the site is approximately 13 miles south of Aiken, SC (population 15,000), and 20 miles southeast of Augusta, GA (population 50,000). The average population density in counties surrounding the site ranges from 23 to 560 people per square mile, with the largest population (more than 250,000) in the Augusta, GA, metropolitan area. Savannah River,

which employs more than 20,000 people, is the largest plant (in terms of employment) in the Weapons Complex.

The Oak Ridge Reservation covers approximately 58,000 acres in Tennessee. Oak Ridge, among other activities, produces uranium and ceramic weapons components. The City of Oak Ridge (population 28,000) is adjacent to the Y-12 Plant;<sup>6</sup> Knoxville, TN (population 350,000), is about 20 miles to the east of Oak Ridge. The Idaho National Engineering Laboratory (INEL), which reprocesses naval reactor fuel to recover uranium-235 for reuse as fuel in the Savannah River production reactors, is the largest weapons site in terms of area, covering 570,000 acres in southeastern Idaho and overlapping five counties.

### *Relationships With Regulators and With the Public*

Nine of the Weapons Complex facilities are proposed or listed on the National Priorities List (NPL) for cleanup action under the Superfund law (CERCLA);<sup>7</sup> these and the remaining sites are also subject to the Resource Conservation and Recovery Act (RCRA).<sup>8</sup> Thus, waste management and environmental restoration programs at the facilities may come under different regulatory authorities, depending on whether the U.S. Environmental Protection Agency (EPA) or the State has primary jurisdiction, and on what State laws, regulations, or standards apply. The facilities are also at different stages with respect to formulating agreements with EPA or the States. Relationships among the parties range from the fairly adversarial mode that appears to exist in Ohio and EPA Region V (Fernald); through the relatively cooperative mode in Tennessee (Oak Ridge) or South Carolina (Savannah River) and EPA Region IV in Atlanta, which covers both facilities; to the negotiated accommodation developed through tri-party agreements in the State of Washington (Hanford) and in Colorado (Rocky Flats).

Other factors important to understanding the situation at each facility are the attitudes and concerns of the affected and interested public. Almost all of the sites, but especially Fernald, Rocky

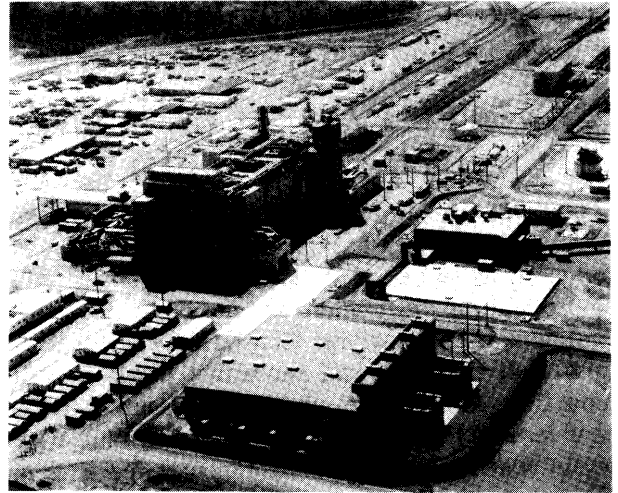


Photo credit: U.S. Department of Energy

Defense Waste Processing Facility at Savannah River.

Flats, Hanford, Savannah River, and Oak Ridge, have experienced strongly articulated public concern and adversarial activity. More cooperative working relationships appear to have developed at those sites with programs formulated to obtain public input and consider public concerns. For example, the Oak Ridge facility has taken some positive steps to work with the public over the past several years (including an aggressive policy of openness and an advisory committee with local representatives). Hanford has made similar efforts, and other sites have programs or plans to improve public communications in the future.

Only in the last few years have significant efforts been initiated to understand the nature and extent of environmental contamination at the DOE Weapons Complex and to develop more effective approaches for managing waste and reducing future contamination. These efforts are just beginning, and the results are not yet evident except at a few locations. At most sites, characterization must continue for 5 years or more before the extent and concentration of contaminants in the environment can be known and the available remediation technologies can begin to be considered. Technical, institutional, and regulatory factors will all contribute to the complexity of DOE

<sup>6</sup>The term Y-12 originated during the wartime Manhattan Project. Y-12 is one of three distinct areas on the Oak Ridge Reservation. The others are K-25, which was the location of the large gaseous diffusion plant for separating uranium isotopes, and X-10, which is now the location of the Oak Ridge National Laboratory.

<sup>7</sup>Comprehensive Environmental Response, Compensation and Liability Act of 1980, 42 U.S.C.A. §9605-9657 (Pub. L. No. 96-51 O).

<sup>8</sup>Resource Conservation and Recovery Act of 1976, 42 U.S.C.A. §6901-6981 (Pub. L. No. 94-580).

environmental restoration and waste management programs for many years to come.

## **THE OFFICE OF TECHNOLOGY ASSESSMENT STUDY**

Over the past year the Office of Technology Assessment (OTA) has studied both current and proposed approaches to waste management and environmental restoration at the DOE Weapons Complex. OTA's analyses focused on: 1) evaluating immediate problems and needs that would benefit most from additional emphasis and resources in the near term, 2) assessing technologies available for waste management or environmental restoration, and 3) investigating ways to determine priorities and allocate resources. Related institutional, management, and regulatory issues have also been evaluated. This report incorporates the results of those evaluations and attempts to assess the prospects for the future and the means of enhancing these prospects.

The body of this report contains four chapters:

1. introductory material,
2. description and evaluation of DOE cleanup programs,
3. description and evaluation of efforts to protect public health, and
4. discussion of policy initiatives to improve cleanup prospects.

The following subjects are summarized in appendix material:

- site contamination,
- example of groundwater contamination and cleanup,
- status of cleanup cost estimation, and
- ecological issues.

In addition, OTA intends to publish separate background papers on waste management, the regulatory framework for the cleanup process, and analyses of cleanup worker health issues.