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Report to Congressional Requesters

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NUCLEAR WASTE

Unresolved Issues Concerning Hanford's Waste Management Practices

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Resources, Community, and
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November 4, 1986

The Honorable Mike Synar
Chairman, Subcommittee on Environment,
Energy, and Natural Resources
Committee on Government Operations
House of Representatives

The Honorable John Glenn, Ranking Minority
Member, Subcommittee on Energy, Nuclear
Proliferation, and Government Processes
Committee on Governmental Affairs
United States Senate

On October 24, 1985, you asked us to review the Department of Energy's management and disposal of defense waste at its Hanford, Washington, facility and to determine how the Department complies with the Resource Conservation and Recovery Act of 1976 and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 in conducting these activities. This report provides the information you requested.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of its issuance. At that time, we will send copies to appropriate congressional committees; the Secretary of Energy; and the Director, Office of Management and Budget. We will also make copies available to others upon request.

J. Dexter Peach
Assistant Comptroller General

Executive Summary

Purpose

The Department of Energy's (DOE) Hanford, Washington, facility has produced plutonium for nuclear weapons for more than 40 years, and conducts energy research and development activities. As a result, Hanford generates radioactive, hazardous, and mixed (contains both radioactive and hazardous substances) waste; most has been stored or disposed of on-site. The Chairman, House Subcommittee on Environment, Energy, and Natural Resources, and Ranking Minority Member, Senate Subcommittee on Energy, Nuclear Proliferation, and Government Processes, asked GAO to determine how Hanford complies with the Resource Conservation and Recovery Act of 1976 (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) in managing and disposing of its waste. (See p. 8.)

Background

The methods Hanford uses to store or dispose of waste have changed over the last 43 years. Between 1943 and 1980, Hanford used 149 single-shell tanks to store high-level liquid radioactive waste. Leaks from these tanks prompted Hanford to use double-shell tanks; it expects to have 28 by October 1986. Also, until 1970 Hanford disposed of liquid low-level and transuranic (man-made radioactive elements with atomic numbers greater than uranium) radioactive waste directly to the soil and buried the solid form of these wastes in shallow pits. Hanford continues to use soil disposal and burial for low-level waste, but since 1970 it has packaged and stored solid transuranic waste pending geologic disposal. Also, since 1973 Hanford has put liquid transuranic waste in double-shell tanks. Hanford has 39 active and at least 337 inactive low-level waste disposal sites and 35 transuranic waste sites.

RCRA and CERCLA are multi-faceted, complex waste management statutes. RCRA regulates hazardous waste from generation through its ultimate disposal, and CERCLA regulates the cleanup of inactive waste sites. DOE must comply with both statutes but is exempt from RCRA when compliance would be inconsistent with the Atomic Energy Act; RCRA also excludes source, byproduct, and special nuclear material (GAO refers to these as RCRA's Atomic Energy Act exclusions). CERCLA has no exclusions, and one provision of RCRA's 1984 amendments (underground storage tanks) includes all radioactive material. Effective January 1986, the Environmental Protection Agency (EPA) authorized Washington State to implement RCRA under EPA's direction; EPA manages CERCLA.

Results in Brief

GAO found that Hanford has been slow to implement both waste management statutes—it has not identified all units that should be regulated

under RCRA nor has it identified all potential CERCLA sites that may require corrective actions. As a result, Hanford does not know—nor can it ensure the regulatory agencies—that it is appropriately managing and/or disposing of its radioactive, hazardous, and mixed waste.

In addition, Hanford disposes of liquid low-level waste directly to the soil—including byproduct waste that is exempt from RCRA and other waste that is not exempt. State and EPA officials oppose both practices primarily to prevent groundwater contamination. Hanford officials believe that RCRA's Atomic Energy Act exclusions allow them to dispose of byproduct waste in this manner without a permit, while at the same time Hanford has begun to apply for permits to dispose of similar, nonbyproduct waste.

Further, Hanford does not meet RCRA's groundwater monitoring requirements at four hazardous or mixed waste units; other units also may not comply.

Principal Findings

Inadequate Identification

Although Hanford submitted RCRA permit applications for 13 units when required, it continues to identify disposal units that should be permitted—12 more as of September 1986. Hanford is likely to identify others after DOE and EPA resolve several regulatory issues and one of Hanford's contractors completes analyzing options to shallow land burial for lead and other radioactively contaminated, hazardous waste. (See p. 24.)

Also, Hanford has not identified the magnitude of its CERCLA problems. In July 1986 Hanford sent DOE a draft report that identified 337 sites. Although the draft report could change, GAO found that Hanford (1) limited the scope of the report—it excluded at least 43 sites where it did not dispose of waste directly to the soil, (2) did not comply with DOE's policy—it excluded at least 200 unplanned release sites, (3) counted at least 56 multiple units as 25 sites, and (4) excluded 149 high-level waste tanks. Therefore, the total number of CERCLA sites at Hanford could be significantly higher than 337—750 or more. (See p. 44.)

Liquid Waste Disposal

Hanford officials believe that they can use soil disposal for liquid low-level waste containing chemical substances, including waste considered to be byproduct—and continue without a RCRA permit and/or EPA or state oversight. Hanford did not include any such units in its November 1985 RCRA applications. State and EPA officials told GAO they would not allow private entities to dispose of waste in this manner without protective liners and proper monitoring. In September 1986—almost a year after required—Hanford submitted an application for seven mixed waste units that dispose of waste to the soil; none are byproduct units. Although Hanford now acknowledges that some low-level liquid waste disposal units come under RCRA, it continues to dispose of other, similar waste outside of RCRA because Hanford considers the waste to be byproduct. (See p. 27.)

Groundwater Monitoring

At 4 sites with 17 disposal units, Hanford does not have an effective groundwater monitoring system to detect hazardous waste releases and ensure that its disposal practices do not contaminate the environment. RCRA regulations require at least four wells appropriately located around each hazardous waste disposal site to detect leaks; Hanford does not meet this requirement. In February 1986, EPA and the state issued an enforcement order; Hanford agreed to drill up to 77 wells at the four sites by November 1987. State officials told GAO they will assess the data from the wells before determining whether Hanford needs to take additional actions.

Hanford may also not meet RCRA's groundwater monitoring requirements at other waste sites. Hanford officials continue to work with EPA and the state on this issue, but they believe that the need for and location of groundwater monitoring wells should be considered on a technical basis for all of Hanford rather than on a site-by-site basis and/or strict adherence with RCRA requirements. (See pp. 34 and 51.)

Other Issues

Since November 1984 compliance with RCRA and CERCLA has become more complex because RCRA requires that corrective actions be taken for CERCLA sites as a prerequisite for receiving a RCRA permit. Also, a 1984 RCRA amendment provides that petroleum and hazardous substances in underground storage tanks are subject to RCRA; Hanford's 177 high-level waste tanks must now comply with this provision. However, EPA has until November 1988 to issue underground storage tank regulations; EPA officials could not estimate when corrective actions regulations would be issued. Further, on October 17, 1986, the President signed CERCLA

amendments that introduce additional uncertainties not only concerning Hanford's plans and timing for corrective actions under CERCLA but also the corrective actions required to receive a RCRA permit. (See p. 64.)

Matters for Congressional Consideration

Hanford uses RCRA's Atomic Energy Act exclusions to dispose of low-level byproduct waste in a manner different from what RCRA would otherwise allow. In view of the potential environmental problems that could result from this difference and a recent legislative change that reduced the applicability of the exclusions, GAO believes the Congress should consider whether RCRA's Atomic Energy Act exclusions are still appropriate.

Recommendations

The Secretary of Energy should require Hanford to report to EPA and Washington State

- all sites and units previously and currently used to treat, store, and dispose of waste, including those considered to be byproduct and those contaminated by unplanned releases and
- the regulatory authority (RCRA, CERCLA, or the Atomic Energy Act) that controls the management, disposal, and/or corrective actions for all sites and units identified.

GAO believes that DOE's implementation of this recommendation would not only assist Hanford to comply with RCRA, CERCLA, and the Atomic Energy Act but would also help DOE to address recommendations made in Nuclear Energy: Environmental Issues at DOE's Nuclear Defense Facilities (GAO/RCED-86-192, Sept. 8, 1986).

Agency Comments

GAO discussed the facts presented with DOE, EPA, and state officials and incorporated their clarifications where appropriate. As requested, GAO did not ask these agencies to review and comment officially on this report.

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Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DEIS	draft environmental impact statement
DOE	Department of Energy
EPA	Environmental Protection Agency
GAO	General Accounting Office
PUREX	Plutonium and Uranium Extraction plant
RCRA	Resource Conservation and Recovery Act of 1976
TRU	transuranic waste

Introduction

The Department of Energy (DOE) owns the Hanford facility, which occupies 570 square miles in southeastern Washington State. Hanford was established in 1943 as part of the Manhattan Project to produce plutonium for nuclear weapons. Although Hanford continues to produce plutonium, it also conducts various other functions such as fuel fabrication, fuel reprocessing, and energy research and development activities. As a result of these activities, Hanford generates high-level, transuranic, and low-level radioactive waste; hazardous waste; and waste containing both radioactive and hazardous substances (mixed waste). In managing and disposing of its various wastes, Hanford must comply with numerous environmental laws, such as the Clean Air Act, the Clean Water Act, the Toxic Substances Control Act of 1976, the Resource Conservation and Recovery Act of 1976 (RCRA), and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

The Congress enacted RCRA and CERCLA to recognize the major environmental problems caused by inadequate management of hazardous waste from generation through disposal (RCRA) and to establish a mechanism for the cleanup of inactive hazardous waste disposal sites (CERCLA). Under certain circumstances, RCRA exempts DOE facilities from compliance; CERCLA has no such exemption.

Overview of the Hanford Site

Hanford is located on a desert plain, averaging about 6.3 inches of rainfall annually. The plain rises gradually to an altitude of about 400 feet above sea level in the southeastern part of the site and 700 feet in the northwestern part. The Columbia River flows through the northern part of the site and forms part of its eastern boundary. The Yakima River flows along a portion of the southern boundary. The cities of Richland, Pasco, and Kennewick, known as the Tri-Cities, situated on the Columbia River downstream of Hanford, have a combined population of about 144,000. Groundwater aquifers—both unconfined and confined (contained in impermeable material to prevent the movement of water)—underlie the site.

The four primary contractors that assist DOE in conducting the various activities at Hanford are (1) Rockwell Hanford Operations, responsible for fuel reprocessing, waste management, and site support services such as security and fire protection, (2) Battelle Memorial Institute, responsible for operating the Pacific Northwest Laboratory and conducting environmental monitoring, (3) UNC Nuclear Industries, responsible for fuel fabrication and an on-site reactor, and (4) Westinghouse Hanford Company, responsible for a research laboratory and the fast flux test

facility, a research reactor. Four other contractors provide construction and support services. By October 1, 1987, DOE expects to consolidate the activities performed by the eight contractors under four contractors to more effectively and efficiently manage the facility.

Four major operating areas exist at Hanford: the 100 area contains one active and eight deactivated plutonium production reactors; the 200 area includes the fuel reprocessing plant and waste management facilities, including the high-level waste storage tanks and low-level waste liquid and solid disposal sites; the 300 area contains fuel fabrication and research facilities; and the 400 area contains the fast flux test facility. In addition, the 600 area encompasses the remainder of the site, including a hazardous waste landfill.

Description of Various Waste Types at Hanford

Hanford generates high-level, transuranic, and low-level radioactive waste; hazardous waste; and mixed waste. DOE regulates itself in all areas of radioactive waste management and must comply with RCRA in managing and disposing of its solely hazardous waste. Regulation of mixed waste has been—and continues to be—a jurisdictional issue among DOE, the Environmental Protection Agency (EPA), and states.

High-Level Radioactive Waste

High-level waste, generated from reprocessing spent or used nuclear reactor fuel, remains dangerous for hundreds of years and must be handled behind protective shielding. Between 1943 and 1980, Hanford used 149 single-shell carbon steel tanks (capacity ranged from about 55,000 to 1 million gallons) to store high-level liquid waste. In 1956 Hanford suspected that one single-shell tank leaked radioactivity into the ground. Subsequently, Hanford identified 28 additional leaking tanks and 31 others that may have leaked because of tank liner corrosion and deterioration. Hanford officials told us it is unlikely that they will find additional leaking tanks because they no longer put liquid waste in single-shell tanks.

As a result of the leaks detected, in 1968 Hanford began constructing, and in 1970 began using, double-shell carbon steel tanks to store high-level waste. It currently has 20 active double-shell tanks and expects to put 8 more into service in October 1986; these tanks have a capacity of 1 million gallons each. DOE documentation shows that Hanford has about 61.4 million gallons, or 232,000 cubic meters, of high-level waste in various forms in the single- and double-shell tanks.

In March 1986 DOE released a draft environmental impact statement (DEIS) that evaluates alternatives for the permanent disposal of Hanford's high-level waste in the single- and double-shell tanks. Although Hanford expects to finalize the environmental impact statement in the spring of 1987, Hanford officials told us that it could be 7 years before a decision is made on the permanent disposal of the single-shell tank waste. In the interim Hanford would conduct further research on the most viable permanent disposal alternative. However, beginning in 1996, Hanford plans to vitrify (convert into glass) the high-level waste in the double-shell tanks, store it in stainless steel canisters on site, and eventually send it to a geologic repository when one is available (about 1998).

However, not all of Hanford's high-level waste is stored in tanks. Between 1972 and 1985, Hanford removed two high heat emitting radioactive elements—cesium and strontium—from the single-shell tank waste. Hanford wanted to eliminate a potential heat problem when it removed water from the waste before transferring it to other single-shell tanks. Hanford processed the cesium and strontium and put them in double-walled capsules. The 2,179 capsules are stored in stainless steel-lined concrete water basins. The 1,579 cesium capsules have commercial value as irradiation sources in food processing and medical equipment sterilization. According to Hanford officials, DOE has leased all the cesium capsules either to private firms or loaned them to other DOE facilities such as the Oak Ridge National Laboratory. At the end of their estimated 20 to 40 year useful life, the capsules will be returned to Hanford before their permanent disposal. Currently, the 600 strontium capsules have no demonstrated commercial demand, according to Hanford officials.

Transuranic Radioactive Waste

Transuranic (TRU) waste generally refers to discarded material such as machinery, tools, filters, rubber gloves, paper, rags, sheet metal, glassware, and dried or cemented sludge from fuel reprocessing. TRU waste is contaminated with man-made radioactive elements having atomic numbers greater than uranium (plutonium, neptunium, americium, and curium). TRU waste contains medium radioactivity that decays slowly. Most TRU waste can be handled without protective shielding, but it is toxic and remains that way for thousands of years.

Hanford has four types of TRU waste: solid waste buried before 1970, solid waste stored since 1970, liquid waste stored since 1973, and soil contaminated from pre-1973 waste disposal practices when liquid waste containing TRU radioactive elements was drained directly to the soil. Hanford no longer buries solid TRU waste or disposes of such liquid waste directly to the ground. Since 1970 Hanford has packaged and stored solid TRU waste primarily in 55-gallon drums, and since 1973 has stored liquid TRU waste in double-shell tanks. As of December 1985, DOE documentation estimated that the combined volume of buried waste, contaminated soil, and stored TRU waste is about 175,000 cubic meters. Because liquid TRU waste is commingled with other waste in the high-level tanks, DOE's documentation does not show a separate estimate for it. Hanford plans to process, package, and send stored and future-generated solid TRU waste to a DOE repository in New Mexico beginning in October 1988 and to process the liquid along with high-level waste beginning in 1996. Hanford does not expect to decide until 1994 on the actions needed to better ensure the environmental integrity of the contaminated soil and solid TRU waste sites.

Low-Level Radioactive Waste

Hanford generates both solid and liquid low-level waste. Solid low-level waste consists of trash—tools, paper, rags, and glassware—and liquid low-level waste consists primarily of water circulated through various facilities to reduce or absorb heat (cooling water). Low-level waste typically contains small levels of radioactivity in large volumes and most can be handled without protective shielding.

Between 1943 and January 1986 Hanford generated about 210 billion gallons of liquid (excludes cooling water used for the nine plutonium production reactors) and about 11 million cubic feet of solid low-level waste. Hanford officials pointed out that they have some uncertainty about the contaminated water estimate but believe that about 29 billion gallons of the liquid was contaminated with low-level radioactivity; the remainder was uncontaminated water used in various plant operations. During 1986 officials estimate that Hanford could generate about 9.8 billion gallons of liquid and about 850,000 cubic feet of solid low-level waste. According to Hanford officials, about 1.4 billion gallons of the liquid is radioactively contaminated and the remaining 8.4 billion gallons is uncontaminated cooling water and steam condensates.

The contaminated water has been disposed of directly to the soil through subsurface facilities (cribs, ponds, trenches, ditches, and french

drains). Hanford has 28 active and an estimated 275 inactive liquid disposal facilities at the site. Solid waste is buried in shallow pits or trenches, 4 to 25 feet below the ground. Hanford has 11 active and an estimated 62 inactive solid waste disposal sites.

Hazardous Waste

Hazardous waste contains substances that are highly toxic, corrosive, reactive, or ignitable or are listed in 40 CFR Part 261. The specific substances—over 400—include cadmium, chromium, lead, and solvents used in degreasing such as tetrachloroethylene.

Hanford generates various solely hazardous wastes, but the amount is small compared with the amount of radioactive waste generated. As of January 1986, for example, Hanford had about 41,000 gallons of liquid and about 14,100 pounds of solid hazardous waste. Liquids are now sent to an approved off-site facility for treatment, recycle, or disposal; solids are stored pending the state's review of Hanford's RCRA permit applications.

Mixed Waste

Mixed waste contains both radioactive and hazardous substances. Hanford officials could not estimate how much solid and liquid low-level mixed waste was generated between 1943 and January 1986; they will evaluate this as part of their CERCLA activities. These officials believe, however, that most of Hanford's old liquid and solid low-level waste sites contain some mixed waste.

In 1986 Hanford officials estimate that about 10,000 cubic feet of solid mixed waste would be generated as well as some low-level liquid mixed waste. They could not estimate how much. These officials explained that Hanford currently has two low-level waste streams with hazardous characteristics, but these streams contain byproduct material, and in July 1986 Hanford completed in-plant modifications to manually reduce or eliminate the hazardous characteristics of both streams. In addition, Hanford continues to characterize the substances in other liquid low-level waste to determine if they contain hazardous substances that would make them subject to RCRA.

RCRA Addresses Today's Problems

In 1976 the Congress enacted RCRA to, among other things, regulate the management and disposal of current and future generated hazardous waste from "cradle to grave." RCRA requires that any person or company owning or operating a facility where hazardous waste is treated, stored,

or disposed of must obtain a permit and comply with performance, recordkeeping, reporting, and facility operation standards. The act also provides that facilities in operation on or before November 19, 1980, may continue operating under "interim status" until a final hazardous waste permit is received. Interim status is Part A of the RCRA process and the final operating permit application is Part B. Until final disposition of the permit application, facilities must comply with interim status regulations, such as groundwater monitoring and financial responsibility requirements.

EPA is responsible for implementing RCRA but may authorize a state hazardous waste program if the state's program is at least equivalent to EPA's. On August 2, 1983, EPA granted interim authorization to Washington State for hazardous waste management; effective January 31, 1986, EPA granted the state final authorization except for requirements related to RCRA's 1984 amendments, which EPA retains until it authorizes this program. Hanford submitted Part A and Part B applications to EPA and the Washington Department of Ecology, EPA's counterpart in the state, on November 7, 1985. State and EPA officials estimate that it could take until 1990 to process Hanford's Part B application. However, they expect to complete permit action on Hanford's on-site hazardous waste landfill by 1988 and are considering granting permits by grouping processes or units identified in the Part B application rather than issuing only one site-wide permit.

For many years after RCRA was enacted, DOE contended it was exempt from the act's regulation. DOE took this position because RCRA specifically excludes from its jurisdiction activities or substances subject to the Atomic Energy Act to the extent that the application of RCRA would be inconsistent with Atomic Energy Act requirements (section 1006(a)). Also, RCRA's definition of a hazardous waste excludes source, byproduct, and special nuclear material as defined in the Atomic Energy Act.[1] As defined in that act, source material refers to uranium or thorium; special nuclear material refers to plutonium and enriched uranium; and byproduct material refers to "any radioactive material yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material."

In 1983 two environmental public interest groups and the state of Tennessee sued DOE for RCRA noncompliance at one facility in Tennessee. In

[1]As used in this report, RCRA's Atomic Energy Act exclusions include both RCRA Section 1006(a) and the hazardous waste definitional exclusion.

April 1984 the United States District Court for the Eastern District of Tennessee ruled that (1) RCRA's exemption for Atomic Energy Act activities or substances did not apply to waste that was not radioactive and (2) such hazardous waste is subject to RCRA. The case involved only one facility, but DOE extended the ruling to all facilities operated under authority of the Atomic Energy Act. Although the ruling and DOE's acceptance of it (DOE did not appeal) established RCRA jurisdiction over hazardous waste at DOE facilities, it did not address questions concerning regulatory jurisdiction over mixed waste or the definition of byproduct material. These issues are discussed in more detail in chapter 2.

RCRA's 1984 Amendments Could Significantly Affect DOE

On November 8, 1984, the Congress amended RCRA. Two provisions of these amendments could significantly affect DOE's waste management practices. First, the amendments include a new provision applicable to underground tanks used to store petroleum or hazardous substances (subtitle I). Subtitle I does not include RCRA's Atomic Energy Act exclusions; therefore, DOE's high-level waste tanks are subject to this statutory provision. Second, the 1984 amendments require corrective actions for inactive waste sites as a condition for receiving a RCRA Part B permit for active sites (section 3004(u)). DOE is required to take corrective actions for solely hazardous and mixed waste sites under section 3004(u) to the same extent as private entities.

Concerning subtitle I, the 1984 amendments required federal agencies to notify the state of the existence of such tanks by May 1986; Hanford provided the required notification on May 8, 1986. EPA has until November 1988 to issue regulations governing other underground storage tank activities, such as monitoring and reporting releases (spills, leaks, discharges, and emissions), taking corrective actions if a release occurs, and preparing closure plans to prevent future environmental contamination from the tanks.

In addition, EPA has not issued regulations for federal agencies' compliance with section 3004(u). On July 15, 1985, EPA issued a rule to implement RCRA's 1984 amendments. Prior to the rule, however, several federal agencies (including DOE) raised concerns about the implication of section 3004(u) for their activities. The agencies' primary concern was that an earlier proposed definition of "facility"—a facility includes the entire site under control of the hazardous waste owner—was too broad. In the preamble to the rule, EPA recognized that this issue was open and had expected to resolve it by September 1985.

On March 5, 1986, EPA published in the Federal Register a statutory interpretation of the applicability of section 3004(u) to federal agencies. EPA concluded that (1) federal agencies must operate under the July 15, 1985, definition of a facility, (2) federal agencies are required to take corrective actions for releases from hazardous waste sites to the same extent as private entities, and (3) the scope of federal ownership refers to individual departments, agencies, and instrumentalities. At the same time, EPA issued a notice of intent to propose rules concerning other issues related to federal agencies' compliance with section 3004(u). EPA stated that its proposed rules would, in part, specify limits for federal agencies' responsibility for activities operated by private parties and establish a system to prioritize—with state participation—the cleanup of hazardous releases at federal facilities. An EPA official told us that the targeted date for issuing a draft rule is April 1987 but could not estimate when a final rule would be forthcoming.

CERCLA Addresses Past Problems

The Congress enacted CERCLA in 1980 to clean up abandoned or uncontrolled waste sites that release or have the potential to release hazardous substances. A waste site is any area where substances (including hazardous waste), as defined under CERCLA section 101(14), have been deposited, stored, disposed of, placed, or located without adequate measures for controlling the release of such waste or substances into the environment. Under CERCLA, EPA considers radioactive materials to be hazardous substances. CERCLA does not have RCRA's source, byproduct, and special nuclear material exclusion.

Federal agencies must comply with CERCLA to the same extent as private entities. This includes identifying abandoned or uncontrolled sites, conducting preliminary assessments and site investigations, and initiating appropriate remedial or removal actions. Federal agencies are not eligible for CERCLA funds but must fund remedial and removal actions through the budget process. Remedial actions can include transferring the hazardous materials to landfills, treating or isolating the material on-site or at an approved treatment facility, or a combination of these.

DOE Order 5480.14, "CERCLA Program," dated April 26, 1985, provides guidance and instructions to DOE field offices and contractors for identifying and evaluating inactive hazardous waste disposal sites and instituting remedial actions to control the migration of hazardous substances at each site. DOE's order sets out a five-phase program and establishes estimated completion dates for each phase. DOE expects to complete all five phases by 1995; phase I was scheduled to be completed in April

1986. Hanford's efforts to comply with CERCLA are discussed in chapter 3.

Objectives, Scope, and Methodology

On October 24, 1985, the Chairman, Subcommittee on Environment, Energy, and Natural Resources, House Committee on Government Operations, and the Ranking Minority Member, Subcommittee on Energy, Nuclear Proliferation, and Government Processes, Senate Committee on Governmental Affairs, requested that we review DOE's management and disposal of defense waste at Hanford and determine how DOE complies with environmental laws at that location. On the basis of subsequent discussions, we agreed to (1) determine how DOE manages and disposes of low-level mixed waste at Hanford and how DOE complies with RCRA and CERCLA in conducting these activities and (2) determine, for high-level and TRU waste that will not go to a geologic repository, DOE's plans for the permanent disposal of these wastes and its efforts to comply with RCRA and CERCLA in conducting these disposal activities.

To obtain a perspective on the scope of environmental and waste activities at Hanford, we reviewed numerous site-specific reports concerning the management and disposal of radioactive, hazardous, and mixed waste, including Radioactive Liquid Waste Discharged to the Ground in the 200 Areas During 1984, Rockwell/Hanford Operations Effluents and Solid Waste Burial During Calendar Year 1984, Environmental Monitoring at Hanford for 1984, Groundwater Monitoring at the Hanford Site, a December 1975 final environmental impact statement on Hanford's waste management practices, an April 1980 final environmental impact statement dealing with double-shell tanks for defense high-level radioactive waste storage, and a March 1986 DEIS on the disposal of Hanford's defense high-level and TRU waste. We obtained inventory estimates for high-level, TRU, low-level, and mixed waste from DOE's December 1985 Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics publication, Radioactive Liquid Wastes Discharged to the Ground in the 200 Areas, and Hanford officials. We did not, however, verify data in these documents or data provided by DOE officials. We also toured Hanford's liquid and solid waste disposal areas, hazardous waste landfill, and several operations buildings.

We then reviewed the Resource Conservation and Recovery Act of 1976 and 1984 amendments to that act and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and proposed reauthorization amendments to the act to determine requirements applicable to DOE. We also reviewed DOE's November 1985 proposed

rulemaking on byproduct material and comments received on it and obtained information on DOE's policy review efforts related to the proposed rulemaking. We met with DOE's Assistant General Counsel for Environment concerning the potential impacts of the proposed rule on DOE's waste management activities.

To obtain additional information needed, we interviewed DOE headquarters officials in the Offices of Defense Waste and Transportation Management; Environmental Guidance; and Environmental Audits and Compliance; Richland Operations Office (Hanford) officials in the Waste Management Division and Environment, Safety, Health, and Quality Assurance Division; Rockwell officials responsible for waste management activities; and Battelle Memorial Institute officials responsible for environmental monitoring. We also interviewed Washington State Department of Ecology, EPA Region X (region responsible for Hanford), and EPA headquarters officials to obtain their views and perspectives on Hanford's RCRA and CERCLA activities. We obtained pertinent documentation from these officials to determine applicable policies and procedures and to identify potential RCRA and CERCLA issues, corrective actions needed, and timing of activities planned or in process.

To assess Hanford's compliance with RCRA, we obtained and reviewed (1) DOE Order 5820.2, Radioactive Waste Management, and DOE Order 5480.2, Hazardous and Radioactive Mixed Waste Management, (2) Hanford's November 1985 RCRA Part A and Part B applications, November 1984 RCRA-candidate waste stream document and a January 1986 contractor revision, and (3) EPA and state RCRA inspection reports and a February 1986 enforcement order against DOE for RCRA noncompliance at Hanford. We also reviewed minutes of a meeting held among EPA, state, and Hanford officials concerning DOE's appeal to the enforcement order and options for its resolution. We could not verify that Hanford had included all RCRA-candidate waste streams in its November 1984 document or all known hazardous waste treatment, storage, and disposal facilities in its RCRA applications.

We did select 2 of Hanford's 28 liquid waste streams for detailed review. Because the state has primary enforcement and monitoring responsibilities at Hanford, we relied on state officials to identify those waste streams that illustrate the controversy over mixed waste and other jurisdictional issues. State officials identified two waste streams: Plutonium and Uranium Recovery Extraction plant (PUREX) process condensate and PUREX chemical sewer.

To address Hanford's efforts to comply with CERCLA, we obtained DOE Order 5480.14, CERCLA Program; EPA's draft federal facilities program manual for implementing CERCLA responsibilities of federal agencies; internal DOE instructions concerning CERCLA assessments; historic information on CERCLA sites identified by Hanford; Hanford's December 1985 list of potential CERCLA sites; and its July 1986 draft CERCLA phase I report. We compared the inactive waste sites shown in the December 1985 list with the sites shown in the phase I draft report. We did not, however, compare EPA's system for ranking phase I sites with the ranking system developed by DOE. Although we recognize that Hanford's phase I draft report could change as a result of DOE's review, the report is the most current information available.

We discussed the facts presented in this report with DOE and EPA headquarters, Hanford, EPA Region X, and Washington State Department of Ecology officials and incorporated their clarifications where appropriate. However, as requested by the Chairman's and Ranking Minority Member's offices, we did not ask DOE, EPA, or Washington State to review and comment officially on this report.

Our work was conducted between November 1985 and September 1986 and was performed in accordance with generally accepted government auditing standards.

Hanford Does Not Meet RCRA Requirements

Although Hanford has taken some actions to meet RCRA's requirements, conflicts exist between Hanford and EPA and state officials over Hanford's disposal of liquid low-level radioactive and mixed waste—including that considered to be byproduct—directly to the soil. State and EPA officials pointed out that they would not allow private entities to dispose of waste in this manner because their regulations prohibit hazardous waste disposal without protective liners and proper monitoring, primarily to prevent groundwater contamination.

However, Hanford officials believe that RCRA's Atomic Energy Act exclusions allow them to continue disposing of low-level liquid waste, including that considered to be byproduct, in this manner—and continue without a RCRA permit or EPA or state oversight. Therefore, Hanford did not include any soil disposal units in its November 1985 RCRA applications. However, in July 1986, EPA determined that hazardous waste subject to RCRA that is mixed with radioactive waste subject to the Atomic Energy Act can be regulated under RCRA and/or an authorized state hazardous waste program. Authorized states, such as Washington, must certify to EPA by July 3, 1987, that their programs include regulatory authority for mixed waste.

Subsequent to EPA's determination, Hanford submitted a RCRA application for seven mixed waste units that dispose waste directly to the soil—none are byproduct units. As a result, Hanford continues to dispose of liquid low-level byproduct waste directly to the soil without EPA or state oversight while at the same time acknowledging that disposal of low-level liquid mixed waste not considered to be byproduct must comply with RCRA. Although Hanford officials believe they have appropriately identified byproduct waste that should not be regulated under RCRA, it has not provided state and EPA officials information necessary for them to assess the validity of this determination. Hanford expects to provide this information by the end of fiscal year 1987.

Further, concerned about Hanford's lack of the appropriate number and location of groundwater monitoring wells to detect hazardous waste releases, the state and EPA in February 1986 issued an enforcement order against DOE for Hanford's noncompliance with RCRA's groundwater monitoring requirements at 4 sites that include 17 disposal units. Hanford and the state resolved the enforcement order on October 1, 1986; Hanford has tentatively agreed to drill up to 77 wells at the 4 sites by November 1987. However, state officials told us that they will assess the groundwater monitoring data from the wells before determining whether Hanford needs to take additional actions.

DOE's Implementation of RCRA

RCRA, enacted in 1976, provides for the safe management and control of current and future generated hazardous waste. Federal agencies must comply with RCRA's requirements to the same extent as private entities and are responsible not only for all hazardous waste activities conducted on their lands but also, as owners, those activities conducted by their contractors or lessees. Under RCRA, as implemented by EPA, hazardous waste handlers were required to notify EPA or authorized states of their hazardous waste activities by August 18, 1980, including the location of hazardous waste activities, types of activities producing the waste, and specific hazardous wastes handled. On August 14, 1980, DOE notified EPA that Hanford was a generator, transporter, owner, and operator of a hazardous waste treatment, storage, and disposal facility.

Although DOE made this notification, DOE contended that its facilities were not subject to RCRA. As explained in chapter 1, DOE took this position because of RCRA's Atomic Energy Act exclusions. Following a 1984 court decision that DOE's hazardous waste is not exempt, DOE acted to comply with RCRA. Although the court clearly established RCRA jurisdiction over solely hazardous waste at DOE facilities, it did not address jurisdictional questions concerning mixed waste at DOE facilities or the definition of byproduct material.

In an attempt to resolve these questions, DOE on November 1, 1985, published in the Federal Register a proposed rulemaking to clarify the definition of byproduct material and those mixed wastes that would be subject to RCRA. In the proposed rulemaking, DOE pointed out that the Atomic Energy Act's definition of byproduct material is keyed to the process of producing and utilizing special nuclear material; therefore, the process itself would appear to determine whether radioactive materials are considered byproduct.

In essence, DOE introduced two concepts not previously associated with the definition of byproduct material: direct and indirect process waste. As a result, radioactive waste, defined as byproduct material, would be excluded from RCRA regulation if it is (1) directly yielded in the process of producing or utilizing special nuclear material or (2) made radioactive as a direct and necessary consequence of that process. Only radioactive waste—with hazardous characteristics—that DOE determines comes from an indirect process would be subject to RCRA. For example, cutting oil used to machine plutonium to a usable configuration would be considered a direct process waste, exempt from RCRA, because the radioactive contamination is a direct and necessary consequence of producing plutonium, according to the proposed rulemaking. However, waste from

the preparation of radioactive material for commercial use would be indirect process waste, subject to RCRA.

DOE received 28 comments on the proposed redefinition: 10 related to extending the time for comments or increasing the number of locations for public hearings and 19 (including 1 of the 10) related to the contents of the proposed rule. Of the 19 comments specific to the contents, 18 opposed DOE's position and 1, from EPA, questioned the need for the redefinition. In addition, nine specifically highlighted the confusion caused by the direct and indirect process distinction DOE introduced to the byproduct definition.

On March 27, 1986, DOE's Assistant Secretary for Environment, Safety, and Health initiated a policy review on the status and future direction of the proposed rulemaking. DOE expects the policy review to specifically assess (1) the consequences of proceeding with the proposed rule, (2) the consequences of not proceeding, and (3) other options to it. The policy review is a joint DOE effort involving its environment, safety, and health; defense and nuclear programs; and field office staffs. According to DOE environment, safety, and health officials, no action will be taken on the proposed rulemaking until the policy review is complete, but they could not estimate when this would occur.

Prior to the proposed rulemaking, DOE prepared reports for each of its facilities identifying waste streams that would be "candidates" for RCRA regulation—Hanford's was dated November 1984. DOE designated them as candidate mixed waste streams because it did not know if all such streams contained hazardous substances. These reports—called waste stream documents—were referenced in the November 1985 proposed rule and were available for public review at DOE headquarters and eight locations across the nation.

During the process of preparing the waste stream documents, EPA headquarters officials told us they met several times with DOE to discuss the RCRA-candidate waste streams identified. As a result of the information exchanged (EPA neither made site visits nor obtained independent information), EPA headquarters concluded that the waste stream documents provided a reasonable split between waste streams that are hazardous primarily due to their radioactivity and excluded from RCRA regulation and those that are primarily a chemical hazard and subject to RCRA.

EPA Region X and state officials told us that Hanford did not consult with them while preparing its November 1984 waste stream document

but did brief them after it was complete. A state official responsible for hazardous waste permitting and compliance activities at Hanford does not believe the November 1984 document adequately characterized all potential RCRA waste streams. As a result, the official asked Hanford for detailed radioactive and hazardous substance data on its low-level liquid waste streams and groundwater quality around them.

In response to this request, Hanford in May 1986 provided state and EPA officials results of a single sample for each of 23 waste streams. Hanford plans to provide them details on a broader, multi-random sampling effort in fiscal year 1987. According to officials, Hanford plans to sample 35 waste streams and substreams by April 1987 and complete its analyses by September 30, 1987. State and EPA officials told us that the additional information is needed to allow them to make informed RCRA enforcement decisions at Hanford. EPA officials also pointed out that Hanford's operations vary; therefore, a sample taken one day may be different from a sample taken another day or even at different times on the same day. As a result, Hanford needs to take multi-random samples to determine the various substances in its waste streams.

In the November 1984 waste stream document, Hanford estimated that 37 of its 66 waste streams would be candidates for RCRA. We found that in January 1986 Hanford's waste management contractor—in conjunction with Hanford officials—revised the waste stream document and proposed reducing the number of candidate RCRA waste streams from 37 to 13—the 13 are solid waste streams. According to Hanford contractor officials, all liquid low-level streams were considered to be unregulated either because they were sampled and found not to contain hazardous constituents or considered byproduct material under DOE's proposed rulemaking.

The document shows that the contractor proposed reclassifying 27 waste streams rather than the 24 streams (37 less 13) eliminated from RCRA-candidate status. This occurred because the January 1986 document added, deleted, and/or combined waste streams shown in the November 1984 report. Of the 27 waste streams, the contractor proposed reclassifying 9 from RCRA candidate mixed waste to byproduct, 16 from RCRA candidate mixed waste to radioactive only, 1 from byproduct to radioactive only, and 1 from hazardous only to nonhazardous. Site documentation showed that the contractor sampled about 23 waste streams but did not change the classification of all waste streams sampled.

Hanford officials told us that the contractor prematurely or erroneously reclassified some waste streams on the basis of preliminary waste stream sampling and misinterpreting DOE's proposed byproduct definition. These officials stated that neither they nor DOE headquarters accepted the January 1986 revision, and the November 1984 waste stream document will not be officially revised until DOE resolves the proposed byproduct rulemaking. Therefore, Hanford continues to operate under the waste stream classifications set out in the November 1984 document. DOE's Richland Operations Office Environment, Safety, Health, and Quality Assurance Division Director also told us that Hanford plans to consult with EPA Region X and state officials when the document is revised.

RCRA Part A and Part B Applications Incomplete

Hanford included 13 hazardous waste treatment, storage, and disposal units in its November 1985 RCRA Part A and Part B applications. As of September 19, 1986, Hanford identified 12 others that will require a permit. In sending the applications to EPA and the state, DOE's Richland Operations Office Assistant Manager pointed out that additional permit applications could be needed after DOE resolves the proposed byproduct rulemaking and EPA resolves RCRA Section 3004(u) issues. The additional units identified as of September 1986 do not account for other permit applications that may be needed when these regulatory issues are resolved.

EPA's May 1980 RCRA regulations required all handlers of hazardous waste to submit a Part A application to EPA by November 19, 1980. Hanford submitted a RCRA Part A application for one unit—its hazardous waste landfill. EPA did not act on this application because of the uncertainties concerning RCRA's applicability to DOE facilities, according to an EPA official. Subsequent to the 1984 United States district court decision regarding DOE's Tennessee facility, Washington State officials requested Hanford to submit a Part A application by November 1984. After reviewing the application submitted, on April 30, 1985, the state called for a revised Part A because Hanford had not included mixed waste and other units as the state requested. Hanford submitted a revised Part A on September 30, 1985, that included some mixed waste units. Table 2.1 shows the units Hanford included in the application.

Table 2.1: Units Shown in Hanford's September 30, 1985, RCRA Part A Application

Description	Hazardous waste	Mixed waste
Hazardous waste landfill	X	
Hazardous waste storage facility	X	
Proposed hazardous waste storage facility	X	
Explosive demolition sites	X	
Containment systems test facility	X	
Sodium fire facility	X	
Alkali metal treatment and storage facility	X	
Process trenches (2)	X	
Maintenance and storage facility		X
Sodium removal pilot plant		X
Low-level burial grounds (10)		X
Transportable grout facility		X
Solar evaporation basin (4)		X
Waste storage tanks (8)		X
Solvent evaporation unit		X

Of the seven mixed waste units, none dispose of waste directly to the soil. On November 7, 1985, Hanford submitted a revised Part A that excluded two of the mixed waste units shown in table 2.1. According to Hanford officials, the transportable grout facility was dropped because it will not begin operating until 1988 and will initially treat only low-level radioactive material, and the waste storage tanks were dropped because the waste is classified as byproduct and would be stored for less than 90 days (RCRA requires permitting of storage units that hold waste for more than 90 days). As a result of submitting the Part A application, Hanford can operate under interim status until final disposition of its Part B application, which Hanford submitted on November 7, 1985. The Part B application provided detailed information on the units Hanford identified in the Part A application.

State and EPA officials estimate that it could take until 1990 to process Hanford's Part B application, although they expect to issue the hazardous waste landfill permit by 1988. They are considering grouping processes or units identified in the application rather than issuing only one site-wide permit. For example, one permit would be issued for all land disposal sites, one would include all treatment units, and another, all storage units.

Hanford did not include information related to RCRA Section 3004(u) in its permit applications. As a condition for receiving a permit, RCRA Section 3004(u) requires corrective actions for all releases of hazardous waste or constituents from any solid waste management unit regardless of when waste was put into the unit. In sending its Part A and Part B applications to EPA and the state, Hanford noted that EPA needed to resolve policy and legal issues related to section 3004(u) and indicated that further permit applications could be needed when EPA resolved these issues.

In March 1986 EPA issued a notice on the applicability of section 3004(u to federal agencies; and on September 18, 1986, sent Hanford a letter, which served as a partial Notice of Deficiency because Hanford did not provide section 3004(u) information in its permit applications. Within 45 days of receipt of the letter, EPA requested Hanford to provide information on (1) land disposal units used after November 19, 1980, that have been retired or are still in use, (2) units covered under other DOE programs, such as CERCLA, (3) treatment units, storage areas, and other past and present waste handling areas, and (4) units that handle or hav handled byproduct waste. EPA pointed out that it needs this information to assess past and continuing releases from all solid waste management units at Hanford as section 3004(u) requires.

Additional Units Identified

Since Hanford submitted its RCRA applications, it has identified additional units that should have been included. In April 1986 DOE's Richlan Operations Office Manager directed Hanford officials to review the Par A and Part B RCRA applications to ensure that all hazardous waste units were included and requested DOE's Office of the Inspector General to investigate and determine if one contractor intentionally omitted any units from the applications.

According to a special agent in the Office of the Inspector General, the manager became concerned about the completeness of the applications after learning that waste characterization data for the N-reactor water demineralization plant may have been available before Hanford submitted its Part B application. Until May 1986 the demineralization plan discharged about 600 gallons of corrosive chemicals and 56,000 gallons of rinse water to an unlined pond about every 2 days. In May 1986 the contractor began using a new, double-lined pond to neutralize the waste before releasing it to the unlined pond. On October 3, 1986, a DOE headquarters official told us that DOE is reviewing the report on the N-reactc

contractor but could not estimate when the report would be sent to Hanford officials.

As a result of the Manager's April 1986 directive, Hanford identified 12 units that will require RCRA permit applications, including 2 ditches, 5 ponds, 2 cribs, 2 treatment units, and the N-reactor demineralizer double-lined pond—9 are mixed waste units. Of the nine, seven dispose waste to the soil—one is no longer used and six will continue to be used but not for hazardous waste disposal. None of the nine are byproduct units. In addition, one contractor identified potential difficulties with Hanford's continued disposal of lead and other radioactively contaminated, hazardous waste in low-level burial sites. The contractor is evaluating alternatives to shallow land burial for this waste but could not estimate when the evaluation would be complete. The contractor has advised DOE's Richland Operations Office Manager that the alternative selected could result in the need for additional treatment or storage permits.

On September 19, 1986, Hanford sent EPA and the state Part A permit applications for 11 of the units already identified and stated it would submit either a Part B application or a closure plan by February 1987. In addition, Hanford submitted a Part A application on June 13, 1986, to continue operating the N-reactor demineralizer pond and expects to submit a Part B application by November 28, 1986. Further, on October 1, 1986, Hanford withdrew its permit application for two of the low-level burial units shown in its November 1985 RCRA Part A and Part B applications.

Other Unresolved RCRA Issues

State, EPA, and Hanford officials told us that a number of other unresolved issues exist concerning the applicability of RCRA and state hazardous waste regulations at Hanford. Two key issues identified include (1) the state's regulatory jurisdiction and/or control over liquid low-level waste, including that considered to be byproduct and the point at which a waste stream is subject to state control and (2) the adequacy of Hanford's groundwater monitoring systems at several hazardous waste units.

Concerning the first issue, Hanford officials believe that RCRA's Atomic Energy Act exclusions allow them to dispose of liquid low-level mixed and byproduct waste without a RCRA permit or EPA or state oversight. State officials believe that all waste with hazardous constituents—

including that considered to be byproduct—is within the state's jurisdictional purview. State and EPA officials told us that the regulatory agencies would not allow similar discharges by private entities because RCRA regulations do not allow the disposal of waste in this manner without protective liners and proper monitoring, primarily to prevent groundwater contamination. The second issue focuses on Hanford's compliance with RCRA regulations for the number and location of groundwater monitoring wells.

On July 3, 1986, EPA published a Federal Register notice concerning state authority to regulate the hazardous components of radioactive mixed waste under RCRA. EPA concluded that hazardous waste subject to RCRA that is mixed with radioactive waste subject to the Atomic Energy Act can be regulated under RCRA and/or an authorized state hazardous waste program. States with authorized programs must seek authority to regulate mixed waste and provide a written certification to EPA by July 3, 1987, that their programs are broad enough to include such waste or by July 5, 1988, if a state statutory amendment is needed. The notice did not resolve RCRA's byproduct exclusion but recommended that, until DOE resolves the byproduct rulemaking, states work directly with DOE facilities to determine the waste streams that should be regulated. Washington State officials told us that they would decide by the end of October 1986 whether to seek this authorization.

Exclusions Allow Hanford to Dispose of Waste Differently

In developing its RCRA applications, Hanford excluded numerous low-level waste streams and disposal units it believes are exempt from RCRA and state regulation. Hanford excluded at least 26 low-level waste streams—5 of which Hanford classifies as byproduct, including 2 that exhibit hazardous characteristics. Hanford believes the remaining 21 waste streams are nonhazardous under the state's hazardous waste program. Hanford officials reached this conclusion on the basis of their knowledge of plant processes and operations, review of engineering plans, and a single sample taken from the streams. State and EPA officials told us that they would wait until Hanford completes a broader, multirandom sampling effort in fiscal year 1987 before determining whether Hanford correctly characterized the 26 waste streams.

EPA and state officials expressed concern about a number of liquid waste streams that Hanford excluded; they identified the PUREX process condensate and PUREX chemical sewer as two of particular concern. These two waste streams also illustrate the confusion caused by RCRA's Atomic Energy Act exclusions.

Hanford disposes of waste from the process condensate to a crib and waste from the chemical sewer to an unlined pond—about 404 million gallons of waste during 1985. State and EPA officials told us that the two waste streams have caused groundwater contamination at Hanford. In September 1986 Hanford submitted a RCRA application for the pond that receives liquid waste from the PUREX chemical sewer (as well as several other operations) but not for the sewer itself. Hanford has not submitted an application for the crib that receives the PUREX process condensate waste because Hanford classifies it as a byproduct unit.

Process Condensate Waste Stream

The PUREX process condensate waste stream results from the condensation of acid vapors generated during the chemical extraction of plutonium and uranium from irradiated nuclear fuel elements. The process condensate waste has RCRA hazardous characteristics (corrosivity) but is classified as a byproduct stream by Hanford. In 1985 this waste stream discharged about 27 million gallons of contaminated water to a crib, according to a contractor official.

Groundwater monitoring results from two wells near the crib showed that in 1984 the process condensate discharged radioactive substances such as tritium, strontium, uranium, and cesium. In addition, between July 1985 and July 1986, Hanford found weekly pH levels ranging from 0.90 to 5.3 in this waste stream. Under RCRA, pH levels below 2.0 are considered hazardous. Hanford found pH levels below 2.0 in 15 of the samples taken.

In addition, in August 1985 Hanford took one sample from the process condensate stream to determine the specific substances in it and whether the concentration of chemicals would be hazardous under RCRA and the state's hazardous waste program. Appendix I lists the substances and concentrations found in this waste stream. Neither Hanford, the state, nor EPA have completed analyzing the sample data to determine whether the concentrations of various chemicals in the process condensate should be regulated under RCRA. State and EPA officials told us they would make this determination after receiving the results of Hanford's broader sampling effort in fiscal year 1987. Hanford officials believe the concentrations of the various substances are within RCRA's limits.

To raise the pH levels in the process condensate waste stream and thus eliminate its hazardous characteristics, Hanford officials told us that in July 1986 they completed in-plant equipment modifications to manually

neutralize the waste before it is discharged to the crib. For the week ending July 26, 1986, Hanford found a pH level of 5.3, which is within the 4.0 to 7.0 pH range the contractor would like to maintain and outside hazardous levels. However, a Hanford contractor official told us that the manual neutralization process could still result in some hazardous pH discharges to the crib because a delay occurs between the time samples are taken and analyzed and process adjustments are made. In addition, once the waste stream leaves PUREX it cannot be diverted for treatment before entering the crib. Because of this, the contractor plans to submit a proposal to Hanford officials in December 1986 to install an automated neutralization system. The contractor estimates the system could cost about $650,000 and be operational in late 1989.

Chemical Sewer

In 1985 Hanford disposed of over 377 million gallons of contaminated water to the chemical sewer and ultimately to an unlined pond via a ditch. Historically, the PUREX chemical sewer received low-level radioactive liquid waste, cooling water, steam condensate, acids, and chemicals from aqueous makeup tanks. According to a Hanford contractor official, PUREX has about 50 of these tanks and each day can distribute over 200,000 gallons of chemicals to the PUREX process through them. The aqueous makeup tanks have been a major contributor to chemicals released to the sewer; in 1985 about 17,000 gallons of chemicals discarded to the sewer resulted from accidental spills from these tanks. The chemicals released are both toxic and corrosive under the state's hazardous waste regulations and include sodium hydroxide, hydrazine, and nitric and sulfuric acids.

Groundwater monitoring results from two wells near the pond that receives liquid effluents from the chemical sewer and several other facilites show radioactive substances such as uranium, strontium, and cesium. In August 1985 Hanford sampled waste from the sewer; appendix I shows the substances and concentrations found in it. State and EPA officials have not determined whether the concentrations of the various substances in the sewer should be regulated under RCRA.

Nevertheless, in September 1986 Hanford submitted a RCRA application to continue using the pond that receives the sewer's waste but not for the sewer itself. Hanford's reason for not doing so centers around another RCRA regulatory issue, that is, the point at which a waste stream is subject to state control. Hanford officials believe that the chemical sewer complies with RCRA because at the point where effluents leave the

sewer and enter the ditch, samples taken show that all chemical substances had been diluted to the extent that they are no longer hazardous under RCRA or the state's hazardous waste regulations.

EPA and state officials believe that regulation begins where Hanford first discards hazardous chemicals into the sewer. The issue is significant, according to an EPA official, because any unit that received hazardous waste after the effective date of RCRA regulations (November 19, 1980) should have been included in the RCRA applications. Site documents show that the chemical sewer received hazardous waste on several occasions since that date. However, Hanford did not include the sewer in its RCRA applications because at the point where effluents leave the sewer and enter the ditch the concentrations were below the state's hazardous limits.

Related to this issue is another RCRA issue, that is, whether the chemical sewer qualifies as a totally enclosed treatment facility and can operate without a RCRA permit. RCRA regulations define a totally enclosed treatment facility as one that is directly connected to an industrial production process and prevents the release of any hazardous waste or constituents to the environment during treatment. RCRA does not apply to facilities meeting this definition. Similarly, Washington State does not require owners of such facilities to obtain a permit if certain conditions are met. The conditions specify that the facility must—to the maximum extent practical given the limits of technology—be operated to prevent groundwater degradation and other environmental damage.

Hanford officials told us they believe that the chemical sewer qualifies as a totally enclosed treatment facility and effluents from it can be diverted to a concrete retention basin for further treatment before being released to the environment. Hanford began using the basin in 1983; it diverted from the sewer radioactive material that exceeded certain limits. According to Hanford officials, some radioactive effluents discharged to the basin may also have contained hazardous substances. Beginning in February 1986, Hanford also used the retention basin to neutralize corrosive effluents rather than discharge them directly to the environment without treatment. Prior to that time, about every 2 days Hanford discharged between 12,000 and 15,000 gallons of effluents to the environment without treatment, according to contractor officials. Hanford's contractor plans to stop using the basin and install equipment to neutralize effluents before they enter the chemical sewer. Hanford officials expect to begin equipment installation in fiscal year 1988 at an estimated cost of $400,000.

State and EPA officials told us that the chemical sewer does not qualify as a totally enclosed treatment facility because the primary function of the sewer is to convey waste from one place to another, not to treat the waste. Since EPA and the state have made this determination, then the point at which regulation of a waste stream begins becomes critical to the state's determining whether the chemical sewer should be regulated under its hazardous waste program. Hanford officials pointed out that its planned in-plant modifications are expected to eliminate chemical discharges to the sewer; therefore, this matter will no longer be an issue. A state official told us the state plans to assess the adequacy of Hanford's actions before determining whether it needs to take additional actions.

However, on October 1, 1985, the state cited Hanford for noncompliance with state water pollution statutes. The state pointed out that during 1985 Hanford had discharged chemicals to the sewer on six occasions that exceeded state limits. Site records show that at least four of the six discharges (both accidental and intentional) exceeded the state's hazardous waste limits at the point the waste entered the ditch. Through mathematical calculations Hanford determined that, by the time the chemicals reached the groundwater, the concentrations were either neutralized or diluted well below the state's standards and, therefore, did not pollute the groundwater.

In response to the state's notice, Hanford in November 1985 instituted certain actions to prevent the discharge of chemicals to the sewer and from the sewer to the environment. The actions included (1) installing an alarm system to detect chemical releases, (2) continuous monitoring of tanks during material transfers, and (3) conducting a study of engineering options to preclude the release of chemicals into the sewer. Hanford completed this study in March 1986. Among other things, the study recommended that Hanford install tanks to collect aqueous makeup overflows and discarded chemical solutions. Hanford is implementing this recommendation and expects to have the tanks in place by February 1987 at an estimated cost of $600,000. According to a state official, Hanford needed to take this action to prevent further groundwater contamination and to comply with the state's notice of violation.

Studies Underway to Change Disposal Practices

Hanford continues to study ways to reduce, eliminate, or recycle low-level liquid waste streams rather than discharge them to the soil. A Hanford contractor is preparing one study (initially started to comply with DOE Order 5820.2); Hanford must complete the study by February 1987.

In a July 1986 report, the House Committee on Appropriations expressed concern about Hanford's continued disposal of low-level liquid waste to the ground. The report indicated that Hanford should analyze options to this disposal method and provide a schedule for compliance with all applicable environmental laws and regulations within 120 days of enactment of DOE's fiscal year 1987 appropriations bill. The continuing resolution for fiscal year 1987 was signed on October 18, 1986, and include these same requirements. Hanford officials said they would meet the requirements by expanding the work conducted to comply with DOE Order 5820.2.

In an April 1986 draft, the contractor evaluated 28 liquid waste streams and identified an alternative disposal method for all 28 streams that would result in the least volume of waste discharged. The alternatives include (1) a closed loop recycling system for cooling water and steam condensate waste streams and (2) treatment facilities (filtration and ion exchange columns to remove radioactive materials) for process condensate, laboratory, and chemical sewer wastes. The draft report estimated that it could cost up to $500 million if Hanford adopted the alternative disposal methods by the year 2000.

After assessing the 28 streams, Hanford's contractor further analyzed the four worst streams—N-reactor effluents, waste fractionization and encapsulation facility process condensate, PUREX process condensate, and PUREX ammonia scrubber. These four streams account for more than 98 percent of the radioactive contaminants discharged to the ground, with the exception of tritium. The draft report concluded that alternative treatment and disposal systems for the first three streams could cost between $154 million and $176 million. Hanford expects to eliminate the fourth stream as part of a PUREX facility modification project, expected to be completed by 1995.

The draft report also concluded that, because of the time needed to design and construct the alternatives proposed, Hanford must continue disposing of low-level liquid waste to the ground. Officials pointed out that Hanford will continue using ponds and cribs to dispose of the large volumes of water generated. For example, when low-level liquid disposal sites are no longer effective in retarding radioactive migration to the groundwater and need to be replaced, Hanford intends to replace them with similar structures, that is, a crib would be replaced with a crib. In fact Hanford is constructing a new crib to receive the PUREX process condensate waste and expects to begin using it by October 1986. A

contractor official estimates the crib will cost about $900,000 to construct.

State and EPA Question the Adequacy of Hanford's Groundwater Monitoring

Hanford does not have adequate groundwater monitoring around several hazardous waste disposal units. Among other things, RCRA regulations require operators of hazardous waste units to have at least one upgradient and three downgradient monitoring wells at the edge of each unit to detect for hazardous substance contamination. Although it has more than 900 groundwater monitoring wells, Hanford drilled most of these to assess the movement of radioactive contamination in the groundwater rather than to detect releases from specific disposal units. State and EPA officials told us that Hanford lacks the appropriate number of groundwater monitoring wells, the wells at units under their jurisdiction are not properly located to detect hazardous chemical releases, and Hanford has not defined the extent of groundwater contamination at units known to have leaked.

On the basis of June 1985 RCRA compliance inspection and other information, on February 5, 1986, the state and EPA issued an enforcement order against DOE for Hanford's noncompliance with RCRA's groundwater monitoring requirements at three disposal units: (1) a hazardous waste landfill, (2) two process trenches, and (3) four solar evaporation basins. The enforcement order included a $49,000 civil penalty imposed by the state for alleged infractions, such as Hanford's discharging chemicals to the solar evaporation basins without approval or a permit and failing to (1) install an adequate groundwater monitoring system around these basins and the on-site hazardous waste landfill and (2) satisfy RCRA's groundwater monitoring interim status regulations. Although not specifically mentioned, EPA and state officials told us that the enforcement order also covered the 10 solid low-level waste units included in Hanford's Part B application.

Hanford's Part B application included closure plans for the process trenches and solar evaporation basins and groundwater monitoring waivers for the landfill and low-level waste units. RCRA regulations include provisions for seeking such waivers. The state and EPA denied the landfill groundwater monitoring waiver because Hanford did not demonstrate that there was no potential for hazardous waste to migrate from the landfill to the groundwater and the Columbia River. According to state and EPA officials, it is likely the state will also deny the groundwater monitoring waiver for the low-level waste units because Hanford

has contaminated the groundwater, and the contaminants are migrating (moving).

Although Hanford officials believe the waiver requests were technically valid, between March and June 1986 they tentatively agreed to install (1) 17 wells at the process trenches and 16 at the solar evaporation basins by December 1986, (2) 9 wells by December 1986 at the landfill, and (3) up to 35 wells by November 1987 near the low-level waste units. Hanford officials estimate that the wells will cost between $80,000 and $100,000 each to install and take initial samples. Hanford also agreed to conduct RCRA required waste site and groundwater analyses at the process trenches and solar evaporation basins to determine the extent of contamination from these facilities. Although Hanford and the state resolved the enforcement action on October 1, 1986 (the $49,000 civil penalty is under appeal), state officials told us that they will assess the data from the wells and the analyses performed before determining whether Hanford needs to take additional actions. As a result, this regulatory issue may not be fully resolved for several years.

A Hanford official told us that the denial of the landfill groundwater monitoring waiver could raise questions about the adequacy of Hanford's groundwater monitoring at other waste disposal sites. He pointed out that other sites are located under similar climatic, hydrologic, and geologic conditions as the landfill, and it could cost millions of dollars to comply with RCRA at the other low-level waste sites. This issue, however, relates to federal agencies' implementation of RCRA Section 3004(u). Until EPA issues regulations, Hanford officials could not speculate on what additional actions they may have to take.

In addition, in its Part B application, Hanford requested a double liner/leachate collection system (leak prevention system) waiver for the low-level burial sites. As a result of the landfill waiver denial, Hanford officials believe it is possible that the state and EPA will not grant this waiver, and in April 1986 Hanford requested $4 million of additional environmental compliance funding from DOE headquarters.

Although many RCRA issues remain open, Hanford has been working with EPA and state officials to negotiate a memorandum of agreement regarding compliance with federal and state environmental rules, regulations, and goals. Although not legally binding, the memorandum would set out how each of the agencies would interact with each other. On October 1, 1986, Hanford and DOE officials told us that they do not know if Hanford would continue with these negotiations. They explained that

Hanford may seek other mechanisms to develop a reasonable working relationship with EPA and state officials.

Conclusions

RCRA is a complex, multi-faceted hazardous waste statute. To fully and effectively comply with RCRA and its 1984 amendments, Hanford may have to change its operations and waste disposal practices. Hanford's compliance with RCRA is compounded by (a) regulatory problems when radioactive and hazardous substances are mixed in a particular waste and (b) uncertainties over what actions it may have to take to comply with RCRA Section 3004(u). Resolution of these issues will not be easy, may take years, and could cost millions of dollars.

Although EPA's July 1986 notice was intended to clarify the mixed waste regulatory issue, it did not resolve the byproduct exclusion issue. Until EPA authorizes Washington State (if the state decides to seek authorization) to regulate mixed waste and DOE determines how it will proceed on the proposed byproduct rulemaking, Hanford will continue to dispose of liquid waste to the soil—in some cases conforming with RCRA and in other cases without conforming because Hanford classifies the waste as byproduct. In addition, Hanford has agreed to drill wells to meet RCRA's groundwater monitoring requirements, but until it completes drilling the wells and analyzing samples from them and the state reviews and assesses the information, the adequacy of Hanford's groundwater monitoring will also remain open.

Hanford Is Experiencing Delays in Conducting CERCLA Activities

Hanford has initiated activities to comply with DOE's five-phase CERCLA program, but it has been slow in conducting these activities and has not identified all potential CERCLA-sites that may require corrective actions. For example, Hanford did not meet the targeted completion date of April 1986 for phase I activities—inactive waste site identification—and has notified DOE that it will not meet the targeted April 1987 date for completion of phase II activities—characterization of substances in the waste. In July 1986 Hanford submitted a draft report to DOE showing the results of its phase I activities. The draft report could change as a result of DOE's review; therefore, Hanford's phase I activities will not be complete until a final report is sent to EPA.

We found that, although Hanford identified 337 inactive waste sites in its phase I analysis, it

- did not include at least 43 sites that did not dispose waste directly to the soil;
- excluded at least 200 unplanned release sites to limit the scope of phase I; and
- counted at least 56 multiple disposal units as 25 sites because, according to officials, they received waste from the same source at the same time.

Although we identified these omissions, Hanford may have excluded other waste sites. For example, the estimate for unplanned release sites is for only one area at Hanford; officials could not estimate how many additional unplanned release sites exist in other areas. In addition, Hanford did not include its 149 high-level waste single-shell tanks and 3 TRU waste sites in the phase I analysis; these issues are discussed in chapter 4. At a minimum, if Hanford had included the above sites, the total number evaluated during phase I would have been 750 or more rather than 337.

Hanford not only underestimated the number of inactive waste sites in the phase I report, but it also reached no definitive conclusion about the potential hazards of 47 percent (158) of the 337 sites. As a result, the phase I report recommended that about 52 of the 158 sites and 62 other sites be investigated further during phase II. Since Hanford (1) missed DOE-established milestones, (2) may have to assess significantly more sites than the 337 identified, and (3) may have to determine the actual substances in at least 114 sites, Hanford may find it difficult to meet DOE's April 1993 date for implementing corrective actions on waste sites that present a potential environmental or public health hazard and/or complete CERCLA activities by 1995, as DOE currently requires.

Two other issues could also affect Hanford's CERCLA plans. One is the corrective actions it may be required to take before receiving a RCRA permit (section 3004(u)); the other is the actions that it will have to take to comply with CERCLA amendments signed by the President on October 17, 1986. These amendments set specific activities and time frames for federal agencies' compliance with CERCLA.

Overview of CERCLA

CERCLA, enacted in 1980, provides for cleanup of releases of hazardous substances from abandoned or uncontrolled hazardous waste sites that present or have the potential to present a substantial danger to public health, welfare, or the environment. CERCLA defines a site as any area where hazardous waste or substances have been deposited, stored, disposed of, placed, or located without adequate measures for controlling the release of such wastes or substances to the environment. As used in CERCLA, a hazardous waste or substance includes both chemical and radioactive materials.

EPA has lead agency responsibility for CERCLA; unlike RCRA, EPA cannot authorize a state CERCLA program. CERCLA required that persons (person, corporation, federal agency, or other entity) notify EPA of the existence of hazardous waste treatment, storage, and disposal facilities by June 9, 1981, except those that had a RCRA permit. Federal agencies must comply with CERCLA to the same extent as private entities and are expected to fund cleanup actions through the budget process. EPA has compiled a National Priorities List, designating and ranking the nation's worst known sites contaminated with hazardous waste. EPA uses a Hazard Ranking System to identify National Priorities List sites; currently sites with a ranking of 28.5 or more are included on the list. Effective February 18, 1986, federal agencies' hazardous waste sites can be included on the list.

Once a person identifies an abandoned or uncontrolled hazardous waste site, EPA believes that certain activities should be performed to determine whether a problem exists and, if so, what corrective measures are needed to address the problem. EPA uses a three-phase approach to determine what actions are needed. The phases are as follows:

- Preliminary assessment of readily available information to determine if no further action, emergency action, or additional investigation is needed. Information obtained during this phase includes identifying the types of hazardous substances present, groundwater pathways, and facility management practices.

- Site investigation builds on the preliminary assessment phase. It may include site inspections, monitoring, testing, and other information needed to determine if there is any immediate danger to persons living or working near the facility. Information that may be addressed during this phase includes determining the need for immediate removal action; the amounts, types, and location of hazardous substances stored; and the potential for substances to migrate from areas where they are located.
- Removal and/or remedial actions occur. Removal actions are intended to provide prompt response to prevent immediate and significant harm to the public or the environment. Removal actions—not necessarily the final solution—include such things as averting fires or explosions, installing fences or other barriers to limit access, or moving hazardous substances off-site. Remedial actions are intended to achieve a permanent, cost-effective remedy or cleanup of hazardous waste sites and include such things as containment of wastes on-site, a mix of cleanup and containment, and total site cleanup.

On October 17, 1986, the President signed CERCLA amendments. These amendments require EPA to (1) ensure that federal agencies conduct a preliminary assessment for each site submitted in response to RCRA Section 3016 (Section 3016 required each federal agency to submit to EPA by January 31, 1986, an inventory of each site at which hazardous waste is or has been stored, treated, or disposed) within 18 months of enactment and (2) identify sites to be included on the National Priorities List not later than 30 months after enactment.

The amendments also require federal agencies to

- start remedial investigation and feasibility studies for National Priorities List sites within 6 months of their being placed on the list;
- enter into an interagency agreement with EPA for the remedial actions required within 180 days of completing the feasibility studies (if EPA and the agency cannot agree on the remedial action required, EPA will make the selection); and
- begin remedial actions no later than 15 months after completion of the remedial investigations and feasibility studies.

The 1980 CERCLA legislation did not include similar requirements. DOE will have to change its CERCLA program to comply with these amendments.

DOE's CERCLA Program

According to DOE environment, safety, and health officials, DOE began its CERCLA program in 1983 after EPA issued CERCLA implementing regulations, but DOE did attempt to meet the statutorily mandated June 1981 notification requirement. On May 14, 1981, DOE headquarters asked its field offices to provide the CERCLA information required. However, DOE received only a limited response to this request.

EPA has encouraged federal agencies to utilize the same three-phase approach to CERCLA that EPA uses to ensure that requirements for documenting a go or no go decision for continued activity on a site will be met. According to an EPA official, DOE opted to pattern its CERCLA program after the Department of Defense's five-phase program. DOE had expected to finalize an order implementing CERCLA by September 30, 1984; it did not do so until April 26, 1985.

DOE Order 5480.14, "CERCLA Program," provides guidance and instructions to its field offices and contractors for implementing its five-phase CERCLA program. The five phases are as follows: (I) installation assessment to locate and identify inactive hazardous waste disposal sites that may pose an undue risk to public health and the environment, (II) confirmation, through sampling or computer modeling, to quantify the presence of hazardous substances, (III) engineering assessment to develop, evaluate, and recommend a plan for controlling hazardous substance migration, (IV) remedial actions to implement site-specific recommendations made in phase III, and (V) compliance and verification to prepare remedial action documentation and establish appropriate monitoring. Hanford's CERCLA phase I report showed that DOE's phase I is generally comparable to EPA's preliminary assessment phase; phases II and III, to EPA's site investigation phase; and phases IV and V, to EPA's remedial/removal action phase. Table 3.1 shows the five phases and the estimated completion dates for all DOE facilities.

Table 3.1: Estimated Completion Dates for CERCLA Activities at DOE Facilities

Phase	Description	Estimated completion date
I	Installation assessment	April 1986
II	Confirmation	April 1987
III	Engineering assessment	April 1989
IV	Remedial actions	April 1993
V	Compliance and verification	April 1995

DOE's Director of Environmental Audit and Compliance and Director of Environmental Guidance told us that DOE's estimated completion dates

would be ahead of the time limits set out in the CERCLA amendments. These officials also told us that their offices will review the phase I reports submitted by DOE's field offices and suggest revisions, if warranted. These officials estimated that the phase I report review process for some DOE facilities could be completed by the end of October 1986.

As set out in the order and implementation guidance DOE provided its field offices, CERCLA phase I activities involved (1) identifying all inactive waste sites as well as sites contaminated from spills or unplanned releases of hazardous substances, (2) ranking the sites identified, and (3) prioritizing the sites for phase II waste characterization activities. Once its field offices identified their inactive waste sites, DOE's CERCLA order directed them to rank the nonradioactive, hazardous waste sites using EPA's Hazard Ranking System and radioactive and mixed waste sites using a Modified Hazard Ranking System developed by DOE. DOE's implementation guidance and headquarters environment, safety, and health officials stated that field offices should rank sites using both EPA's and DOE's systems.

DOE developed its modified ranking system to compensate for the manner in which EPA's system scores toxicity, persistence, and the amount of hazardous waste present. Under EPA's system, DOE concluded that radioactive waste sites would receive the highest possible toxicity score because all radioactive elements have the potential to cause severe toxic effects, such as cancer. Further, because many radioactive elements have relatively long half-lives, most would receive the maximum persistence score. DOE concluded that EPA's system tends to overestimate the potential hazard of radioactive and mixed waste sites relative to solely hazardous sites. Therefore, DOE's system splits the waste characteristics section of EPA's system into two subsections: one for radioactive waste and one for chemical waste. Under DOE's system a mixed waste disposal site would have two scores—one for the chemical waste and one for the radioactive waste, and the higher of the two scores would be used to rank the site. For solely hazardous waste sites, DOE's system yields a score identical to EPA's, according to DOE documentation.

EPA has not endorsed or authorized DOE to use its modified system to rank sites. EPA officials told us that DOE should rank its sites using EPA's system for consistent decisionmaking on the need for continued CERCLA activities at inactive waste sites. Further, although others, such as private industry, have expressed concerns about EPA's system, EPA will not allow them to modify the hazard ranking system because under current CERCLA regulations EPA is required to use this system. EPA officials also

stated that, in order to identify National Priorities List sites, they would rank DOE's sites using EPA's hazard ranking system.

After ranking the sites, DOE's implementation guidance recommended that its field offices prioritize the sites that should be investigated first under phase II activities. This prioritization would be made using a Remedial Action Priority System developed by DOE. According to the guidance, DOE developed the priority system to bridge the gap between site evaluation and site characterization, assessment, and remedial action efforts. DOE believes the priority system will allow it to investigate and make scientifically based recommendations first at those sites that show the highest potential risk. To do this, field offices would predict potential contamination migration from four pathways—groundwater, surface water, air, and land—and estimate exposures from the contamination projected. DOE concluded that, although the Remedial Action Priority System uses more information than EPA's or DOE's ranking systems, it is based on readily available information and should not require any data collection efforts.

Hanford's CERCLA Activities

Hanford submitted no inactive waste sites to DOE headquarters to meet CERCLA's June 1981 notification requirement. Hanford officials concluded that their sites were exempt because the CERCLA reporting requirement dealt with RCRA hazardous waste. At that time Hanford officials believed that Hanford was exempt from RCRA; therefore, they did not submit any potential CERCLA sites to DOE headquarters.

Since DOE found that the response to its May 1981 request was limited, in January 1983 DOE again requested a listing of inactive waste sites from its field offices. DOE headquarters wanted this information to establish its own inactive waste site inventory. Hanford did not submit any sites pursuant to this request. However, in the spring of 1985 Hanford undertook activities to comply with DOE Order 5480.14 and in December 1985 provided DOE headquarters an inactive waste site list that showed about 378 sites (if multiple units are counted). Hanford submitted these sites to comply with RCRA Section 3016. Subsequently, Hanford found that seven sites included on the December 1985 list were operated after 1980 and, therefore, were RCRA sites. Hanford did not include them on its RCRA applications because they are liquid disposal sites that contain byproduct material, according to a Hanford contractor official.

In July 1986 Hanford submitted its draft CERCLA phase I report to DOE headquarters, EPA, and the state. According to a Hanford contractor official, Hanford did not meet the April 1986 date because of funding reductions and some ad hoc projects, such as answering GAO, DOE headquarters, EPA, and state questions and preparing the RCRA Part B application, which took precedence over phase I activities. Further, in transmitting the report to DOE, Hanford stated that it will not meet the targeted April 1987 date for completion of phase II activities because of the large number of sites that must be evaluated and limited resources available. Although we recognize that information presented in Hanford's phase I report could change as a result of DOE's review, the draft report is the most current information available.

Hanford's Phase I Report Is Not Complete

Hanford identified 337 inactive waste sites in its phase I report. Of the 337 sites, Hanford recommended phase II characterization for 62 and no further action for 117. It also placed 158 sites in what it termed a further-action-pending category. Hanford officials told us that further-action-pending sites are those for which the scores received and available documentation differ. For example, 139 of the 158 sites received a low score even though site documentation indicated that Hanford had disposed of significant quantities of radioactive and chemical waste to them, and 19 received a high score even though documentation indicated that Hanford disposed of small quantities of radioactive and chemical waste. Hanford and DOE officials explained that Hanford's approach elevated 139 sites for possible phase II characterization that would have fallen out on the basis of the scores they received and lowered only 19 sites that would have required characterization on the basis of the scores they received. As explained later, the phase I report recommended that Hanford should consider characterizing the waste in about 52 of the 158 sites. Whether Hanford does this, however, depends on funding priorities.

DOE's CERCLA order did not include the further-pending-action category. According to a DOE headquarters environment, safety, and health official, DOE subsequently developed this category so that the field offices could meet the projected time frames set out in DOE's order and to limit the number of sites that would be characterized during phase II. DOE did not want the field offices to characterize further-action-pending sites if they could draw conclusions about these sites from the waste characterizations conducted for phase II sites. A Hanford contractor official estimates it will cost about $100,000 to fully characterize each site. However, Hanford officials told us—and a DOE environment, safety, and

health official substantiated the fact—that Hanford was the only DOE facility to include the further-action-pending category in its phase I analysis and report.

Although it recommended waste characterization for 62 sites, Hanford gave 81 sites a ranking of 28.5 or higher—all were liquid waste sites (as noted earlier, EPA uses scores of 28.5 or more to identify National Priorities List sites). Of the 19 sites (81 less 62) with rankings above 28.5 but not recommended for phase II, Hanford concluded that, on the basis of additional technical analyses, the rankings for the 19 sites were too high and placed them in the further-action-pending category. As a result, only 62 of the 81 were recommended for phase II. Hanford officials told us that these 62 sites could be potential National Priorities List sites. They did not include this information in the phase I report because they have "no personal experience on how the National Priorities List process may be applied to Hanford."

Hanford did not include all inactive sites in its phase I assessment and in some cases did not count all disposal units at one site. We found that Hanford

- did not include at least 43 sites it believed were beyond the scope of the phase I analysis; that is, sites that did not dispose waste directly to the soil;
- excluded at least 200 unplanned release sites; and
- counted at least 56 multiple waste units as 25 sites because, according to officials, they received waste from the same source at the same time.

If Hanford had included these sites, the total number evaluated in the phase I report would have been at least 600 rather than 337. However, we believe the number could be even higher. For example, the 43 sites included 5 outfall structures (cooling water pipes from the old 100 area reactors that went to the Columbia River), about 30 tanks, at least 8 retention basins in the 100 area—officials could not estimate how many other similar facilities were excluded from other areas at Hanford. In addition, Hanford did not include its 149 high-level waste single-shell tanks and 3 TRU waste sites (these issues are discussed in ch. 4). If these were included, the total number evaluated in the phase I report would have been 750 or more.

DOE Order 5480.14 required field offices to include unplanned release sites in the phase I analysis. Hanford did not do so and did not indicate how many such sites were excluded. Although Hanford officials could

not provide a definitive number for the unplanned release sites excluded, a contractor official believed there could be as many as 200 unplanned release sites in the 200 area alone—about 100 of which were virgin sites until contaminated by the unplanned releases and the other 100 occurred in or near existing waste sites. This official could not estimate how many additional unplanned release sites existed in other area at Hanford.

According to Hanford officials, they did not include the unplanned release sites because they decided to limit the scope of the phase I repor to meet the April 1986 deadline. As a result, Hanford decided to address unplanned release sites in fiscal year 1987. They also told us that not all unplanned releases were documented over the last 43 years, especially those that occurred in the 1940's and 1950's and/or those that involved nonradioactive releases; some unplanned releases were investigated as part of normal operations to determine whether cleanup was required. For these reasons, Hanford officials concluded that including these sites would make the phase I evaluation more difficult and time-consuming.

Concerning Hanford's counting multiple units as one site, the phase I report recognizes that the number of waste sites depends on how they are counted, for example, one site that has five cribs was counted as one. Hanford officials told us that dual waste units were counted as one when they received waste from the same source at the same time. However, Hanford's phase I report does not clearly show that all the sites contained identical amounts, types, and concentrations of radioactive and/or chemical substances and for 6 sites (containing about 14 disposal units) the type of waste disposed changed over the operating life of the site. For example, one site with three cribs received process condensate from uranium recovery operations from 1952 to 1957, process condensate from a waste fractionization plant from 1967 to 1973, and construction waste for a 6-month period in 1967. Further, for 10 of the 25 multidisposal sites, Hanford's phase I report did not provide radioactive and/or chemical inventory data.

Hanford and DOE officials stated that grouping units is immaterial and misses the point. They explained that the important issue is whether Hanford identified all sites and the extent to which Hanford will characterize the waste in these sites. These officials also said that adequate characterization of the multiple unit sites represents a technical issue that is not unique to these sites but applies to all CERCLA sites; and before proceeding with characterization activities, Hanford expects to prepare sampling plans. These officials could not estimate when these

plans would be available. For the 25 multiple unit sites, we noted that Hanford's phase I report recommended 10 for phase II characterization and 5 for no further action and placed 10 in the further-action-pending category including 3 with scores higher than 28.5. Therefore, Hanford's plans as set out in the phase I report do not indicate how well it will characterize the multiple unit sites.

Hanford's Phase I Report Recommendations

For the 337 sites analyzed, Hanford's phase I report showed only one ranking score. Hanford officials told us they followed DOE's order and ranked 21 chemical-only sites using EPA's system, ranked 33 radioactive-only sites using DOE's system, and ranked 283 mixed waste sites using both EPA's and DOE's systems and using the higher of the two scores. According to a Hanford official, it would require a 1-month effort, cost $20,000, and be a departure from the requirements of DOE Order 5480.14 to provide both sets of scores for the mixed waste sites. A Hanford contractor official pointed out that comparing both sets of scores would be meaningless because of the flaws in EPA's system, which in part considers volume but not concentrations of hazardous substances in that volume. For example, cooling water that contains small amounts of radioactive substances would rank high because of the large volumes discharged.

After ranking its sites, Hanford prioritized those that should be assessed first under phase II. Hanford did not use DOE's Remedial Action Priority System to set the priorities but recommended that this system be employed early in the phase II process. According to a DOE environment, safety, and health official, Hanford could not use the Remedial Action Priority System because it was not—and still is not—available for use. Hanford set priorities for the sites on the basis of their proximity to population centers, the distance of the sites from groundwater and surface water, and the potential impact on other DOE program schedules (such as 100 area reactor decommissioning program). For the 62 sites, Hanford recommended that phase II activities be conducted in the following order:

- two ponds and one trench located in the 300 area that received scores of 79.28;
- six trenches, three cribs, three reverse wells, and three french drains located in the 100 area that received scores ranging from 44.55 to 28.96;
- seven liquid TRU waste sites located in the 200 area including four cribs and three reverse wells that received scores ranging from 65.44 to 32.72; and

- 37 low-level waste sites located in the 200 area including 29 cribs, 4 french drains, 3 reverse wells, and 1 ditch that received scores ranging from 65.44 to 30.20.

Although the seven liquid TRU waste sites had higher scores than the 100 area sites, Hanford officials told us they "had more time to act" on these sites because the TRU sites are further away from surface water and groundwater than the 100 area sites. In addition, Hanford is considering entombing the 100 area reactors, including a few inactive waste sites that takes priority over the TRU waste sites. Hanford officials told us they plan to follow the priority scheme for the 62 sites as outlined above unless DOE headquarters directs them to do otherwise.

In addition to recommending sites for phase II analyses, Hanford's phase I report included other recommendations. For example, the report recommended that Hanford (1) establish a centralized CERCLA library, (2) evaluate pre-1980 unplanned release sites in phase II that were excluded in phase I, (3) establish a comprehensive monitoring and sampling plan as required by DOE Order 5480.14 before proceeding with phase II activities, and (4) consider including about 52 of the 158 further-action-pending sites in phase II since these sites are adjacent or similar to sites recommended for phase II. According to Hanford officials, these 52 sites will "probably not be as fully characterized as a regulatory agency would like"; therefore, they hesitate to imply that a full characterization effort is planned at this time. Hanford officials told us that funding priorities would determine whether they implement these additional recommendations.

Conclusions

More than 5 years after the Congress enacted CERCLA, Hanford has not disclosed the magnitude of its potential CERCLA problems as required. Hanford made a conscious decision to exclude certain waste sites, thereby limiting the scope of its CERCLA phase I assessment. As a result, the total number of CERCLA sites could be 750 or more rather than the 337 Hanford reported. In addition, Hanford did not determine the potential hazards associated with 158 further-action-pending sites but recommended that limited analyses be conducted for 52 of these sites during phase II in conjunction with conducting waste characterization activities for 62 other sites. Also, Hanford did not meet the April 1986 date for completion of phase I activities and has notified DOE headquarters that it will not meet the targeted completion date for phase II activities. For these reasons, we believe that Hanford may find it difficult to initiate

remedial actions by April 1993 and complete all CERCLA activities by April 1995, as DOE currently requires.

However, two other issues could impact Hanford's planning for and timing of CERCLA activities. One concerns the corrective actions Hanford may have to take for CERCLA sites in order to receive a RCRA permit (section 3004(u)). As discussed in chapter 2, EPA has not yet issued these regulations but has asked Hanford for detailed information on retired and active waste treatment, storage, and disposal units—including those considered to be byproduct.

The other uncertainty is the actions that Hanford will have to take to comply with the recently signed CERCLA amendments. The amendments first require EPA to ensure that federal agencies conduct a preliminary assessment of all inactive waste sites identified. To meet this requirement, Hanford must first identify all sites and units previously used to dispose of waste as well as unplanned release sites. By doing so, Hanford would not only comply with DOE's CERCLA order but will also be in a better position to (1) meet the legislatively mandated requirements of CERCLA's amendments, (2) identify sites that require corrective actions in order to receive a RCRA permit, and (3) assist DOE to implement previous recommendations we made (Nuclear Energy: Environmental Issues at DOE's Nuclear Defense Facilities (GAO/RCED-86-192, Sept. 8, 1986)).

Additional Unresolved RCRA and CERCLA Issues at Hanford

Hanford's compliance with RCRA and CERCLA for its 149 high-level waste single-shell tanks and 35 TRU waste disposal sites is fraught with uncertainties and will remain unresolved for some time. For example, until November 1984 Hanford's high-level waste tanks were exempt from RCRA; Subtitle I of RCRA's 1984 amendments changed the situation. EPA has until November 1988 to issue regulations implementing this statutory provision. In addition, Hanford did not include the single-shell tanks in its CERCLA phase I assessment because they were not empty—EPA headquarters officials told us that Hanford should have included the tanks because some have, or were suspected of having, leaked, which qualifies them as CERCLA sites.

Further, for various reasons Hanford excluded seven TRU waste sites from its CERCLA phase I assessment; four were used after November 1980, but Hanford officials consider them to be byproduct sites. Therefore, Hanford did not include them on its RCRA applications. Further, corrective actions for the remaining 28 TRU waste sites could be required under RCRA Section 3004(u). An EPA official estimated the agency would issue draft regulations in April 1987 but could not estimate when it would issue final regulations.

Meanwhile, Hanford continues to take actions to manage its single-shell tank and TRU waste. For example, in March 1986 DOE released a DEIS setting out permanent disposal options for Hanford's single-shell tank and TRU waste. Although they expect to complete the DEIS in the spring of 1987, Hanford officials stated they would conduct between 5 and 7 years of additional research before deciding on a permanent disposal option for these wastes. By the time Hanford decides, EPA should have issued subtitle I and section 3004(u) regulations, thereby allowing Hanford to base its decision on the most currently available environmental requirements.

Single-Shell Tanks

At least 60 of Hanford's 149 single-shell tanks have leaked or are suspected of having leaked high-level waste and other contaminants to the soil. Site documentation and Hanford officials state that the contamination stayed in the soil underlying the tanks and did not contaminate the groundwater. However, Hanford does not have groundwater monitoring wells around these tanks. In addition, Hanford continues to evaluate permanent disposal options for the single-shell tank waste; its plans could be affected by the actions it may have to take to comply with RCRA Subtitle I.

Between 1943 and 1964 Hanford constructed 149 single-shell tanks to store high-level liquid waste generated from plutonium separation and recovery operations. The capacity of these tanks ranged from about 55,000 gallons to 1 million gallons. Hanford built these tanks in clusters or "tank farms"; it has 12 farms with 4 to 18 tanks per farm. Hanford officials and site documentation state that all 149 tanks had been deactivated (no new high-level waste added) as of November 21, 1980. Most of the liquid has been removed from these tanks, but they do contain about 37 million gallons of salt cake and sludge and about 8 million gallons of liquid high-level waste. Salt cake is mostly crystallized nitrate salt that results from the evaporation of the liquid, and sludge is a mud-like material that remains in the bottom of the tank after the liquid is pumped out.

Hanford has a system of 758 "dry wells" (used to detect radioactive contamination in the soil) around the single-shell tanks but no groundwater monitoring wells near them. Fifteen of the tanks have lateral radiation monitoring devices 10 feet underneath the tanks, and four others have a drainage grid beneath them that connects to a leak detection sump. Because of Hanford's dry climate, the distance from the tanks to the underlying groundwater, and the limited amount of liquids in the tanks, Hanford officials believe dry wells are a more sensitive method for tracking contamination from the tanks than groundwater monitoring wells.

State and EPA officials disagree. They pointed out that (1) it took a number of years for Hanford to confirm leaks through dry well measurements, (2) the tanks contain hazardous substances and dry wells do not detect these substances, and (3) dry wells do not indicate whether radioactive or hazardous substances have migrated to the groundwater. Hanford and DOE headquarters officials stated that they will continue to work with EPA and the state to resolve this issue, but they believe that the need for and location of groundwater monitoring wells should be considered on a technical basis for the entire Hanford facility rather than on a site-by-site basis and/or strict adherence with RCRA requirements.

Problems With Single-Shell Tanks

In 1956 Hanford suspected that one single-shell tank leaked radioactivity into the ground; Hanford confirmed this in 1961 through its dry well monitoring. Subsequently, Hanford identified 28 additional leaking tanks and 31 others that may have leaked. The last confirmation of leaks from two single-shell tanks occurred in 1984; Hanford suspected

these tanks of leaking in 1976 and 1977. Since all single-shell tanks were deactivated in 1980, Hanford officials told us it is less likely that any other leaking tanks will be found.

Site documentation shows that the tanks leaked about 492,000 gallons of high-level waste and other contaminants to the soil; the largest single leak was 115,000 gallons over a 2-month period in 1973. However, Hanford could have kept the leak at about 35,000 gallons or less if its contractor had adhered to the procedures established for reviewing dry well monitoring results, according to a report prepared to assess the impacts of the leak. Hanford officials pointed out that the waste from the largest leak is contained in the soil under the tanks and has not contaminated the groundwater.

When Hanford suspected that a tank leaked, officials told us that they immediately transferred the liquid from the leaking tank to other single-shell tanks. Because of this action, it often took several years to confirm that a tank leaked and for five tanks it took 11 to 12 years because the leaks were small. Four tanks leaked between 1,200 and 10,000 gallons and one, 20,000 gallons. According to officials, once the liquid was removed from the tanks Hanford had to rely on dry well monitoring to confirm a leak, but it took time for the radioactive elements to migrate through the soil to the wells. In addition, once Hanford suspected that a tank leaked, it conducted engineering evaluations of the tank's structural integrity. If information obtained during the evaluation differed from dry well monitoring data, Hanford formed a review committee to assess the information. In at least four cases, a suspected leaking tank was determined to be sound.

Characterization of Waste in the Single-Shell Tanks

Although Hanford officials know that the single-shell tanks also contain hazardous substances, they have only general knowledge of the specific substances or amounts involved because various wastes had been added to and pumped from the tanks over the last 43 years. In October 1984 Hanford formed a team of contractor officials to develop a methodology and computer model to characterize the types of substances remaining in the single-shell tank waste. The team identified six radionuclides and three chemicals (chromium, nitrate, and cadmium) for analysis. Hanford officials continue to assess the adequacy of analyzing for these nine substances as a basis for selecting a permanent disposal option for the single-shell tank waste.

As part of the waste characterization effort, Hanford plans to take at least two samples from the contents of 14 single-shell tanks. Six tanks selected are part of a single-shell tank disposal test (discussed later); Hanford selected the other eight tanks on the basis of the estimated inventory of insoluable radioactive material in them. By September 30, 1986, Hanford expects to complete analyzing samples taken from these tanks and complete its initial assessment of the reliability of the waste characterization computer model; by September 30, 1987, it expects to determine whether additional sampling is needed or whether it can rely on the model to project the radioactive and chemical substances in the tanks. Hanford officials estimate it will cost about $24 million to conduct these activities.

DEIS Options for Single-Shell Tank Waste

In March 1986 DOE released a DEIS setting out four permanent disposal options for Hanford's single-shell tank waste but not the tanks themselves. In the DEIS, Hanford did not select a preferred disposal option but pointed out that further research would be needed to verify some features of each option considered. Hanford officials told us it could be 1993 before they select a specific option for the single-shell tank waste. Table 4.1 lists the permanent disposal options set out in the DEIS and associated costs estimated by Hanford officials.

Table 4.1: Options Hanford Considered for the Permanent Disposal of Waste Contained in the Single-Shell Tanks

	Dollars in Millions
Option	**Cost[a]**
In-place stabilization and disposal	$491
Geologic disposal	6,490
Combination of in-place and geologic disposal	491
No action/continued storage[b]	638

[a]1987 dollars

[b]For first 100 years

If Hanford were to send the single-shell tank waste to an off-site geologic repository, the estimated disposal costs would be about $500 million more than the costs shown in table 4.1 for on-site geologic disposal.

State officials raised several issues about the DEIS and the options presented. For example, they do not believe that Hanford's in-place stabilization and disposal option would meet RCRA requirements if implemented as proposed. These officials pointed out that Hanford does not plan to install a double liner/leachate collection system under these

tanks or to drill groundwater monitoring wells adjacent to them. They also pointed out that (1) the DEIS provides only limited data on the chemical substances in the tanks, particularly organics and heavy metals that can carry radioactive material through the soil faster than radionuclides alone and (2) Hanford could have considered other disposal options for the waste. State officials suggested that Hanford could consider sluicing (adding water) the waste from the tanks. Although these officials recognize that Hanford does not want to add water to the tanks because of the potential for additional leaks, they explained that techniques are available that inject only small amounts of water to help remove the waste, thereby minimizing the potential for leaks.

EPA supports the state's contention that the permanent disposal options set out in the DEIS may not meet RCRA's requirements. In a September 1986 letter commenting on the DEIS, EPA's Acting Director, Office of Federal Activities, noted, among other things, that (1) RCRA requires tanks to have secondary containment systems—the single-shell tanks do not have this—and (2) RCRA does not allow for disposal of waste in tanks. The letter also stated that information presented in the DEIS was insufficient concerning regulatory compliance and groundwater protection issues. EPA recommended that Hanford analyze the chemical and radioactive substances in all single-shell tanks to help determine what environmental regulations apply and what remedial actions are necessary.

Hanford officials pointed out that there can be various combinations of the alternatives presented in the DEIS and that Hanford would conduct additional research and environmental analyses prior to implementing an option. They also explained that the DEIS states that, if appropriate, the waste will be treated, stored, and disposed of in accordance with applicable environmental requirements, including RCRA.

Single-Shell Tank Disposal Test

The DEIS presents options only for the permanent disposal of single-shell tank waste and not the tanks themselves. Hanford officials told us that under these options they would have to fill the tanks to prevent subsidence and cover them to prevent intrusion of water, animals, and people (except for the no action alternative). Because of this, in 1983 DOE headquarters directed Hanford to develop a single-shell tank disposal test to confirm the construction methodology and environmental safety and verify cost and schedule estimates to fill and cover the tanks. To effectively conduct the test, Hanford set various tank selection criteria, such as low TRU waste content, low heat content, and low volume of high-level waste.

The tanks in only one farm met the criteria established, according to site documentation. The farm includes six tanks that contain about 638,000 gallons of waste. On the basis of preliminary analyses, Hanford officials believe that three of the tanks contain TRU waste. Hanford plans to sample the contents of these six tanks as part of its waste characterization efforts to determine the amount and types of radioactive and hazardous substances in them. By the first quarter of fiscal year 1988, it expects to complete filling the tanks with gravel (leaving the waste in them) and by the fourth quarter of fiscal year 1989, complete installing a protective barrier over the six tanks. Hanford officials estimate the disposal test could cost about $8.2 million.

Applicability of RCRA and CERCLA

Until November 1984, DOE's high-level waste tanks were exempt from RCRA because they contained substances that were excluded from the act's definition of hazardous waste. However, RCRA's 1984 amendments included subtitle I applicable to underground tanks used to store petroleum or hazardous substances. Subtitle I does not exclude Atomic Energy Act substances because this subtitle applies to all CERCLA substances (except those already regulated under RCRA). Under CERCLA, EPA considers radioactive materials to be hazardous substances; therefore, the material in Hanford's high-level waste tanks are now subject to RCRA regulation under subtitle I.

DOE environment, safety, and health officials told us that DOE plans to comply with subtitle I, but they are discussing options for compliance with EPA headquarters officials. DOE has suggested that EPA could exempt DOE from complying or could issue regulations applicable only to DOE. According to these officials, DOE made these suggestions because they believe that safety and environmental inconsistencies exist between subtitle I and the Atomic Energy Act. For example, if EPA required interior inspection of high-level waste tanks, worker exposures or environmental degradation could occur.

Subtitle I provides that federal agencies with underground storage tanks notify the states of the existence of these tanks by May 1986. Hanford reported the single-shell tanks along with other underground storage tanks to the state on May 8, 1986. EPA has until November 1988 to issue regulations governing other subtitle I requirements, such as monitoring and reporting releases from the tanks, taking corrective actions if a release occurs, and preparing closure plans to prevent future contamination. Until EPA issues regulations governing these activities, the additional actions Hanford may have to take to comply with RCRA will

remain open. We noted that Hanford's scheduled time frames for the single-shell tank disposal test coincide with RCRA's statutorily mandated November 1988 date for subtitle I regulations. An EPA official told us that DOE is assuming a certain amount of risk of noncompliance with future RCRA regulations by continuing with the test before EPA issues subtitle I rules.

In addition, Hanford did not include the 149 single-shell tanks in its CERCLA phase I assessment. According to Hanford officials, the tanks contain salt cake, sludge, and liquid waste; therefore, they do not consider them to be CERCLA sites. EPA headquarters officials pointed out that CERCLA is concerned with inactive waste sites that release or have the potential to release hazardous substances. Sixty of the tanks have—or are suspected of having—leaked, which indicates a potential that others may leak and qualifies them as CERCLA sites. EPA officials concluded that Hanford should have included the 149 single-shell tanks in the CERCLA phase I assessment.

TRU Liquid and Solid Waste Disposal Issues

Site documentation and Hanford officials state that the TRUwaste sites have not contaminated, or adversely affected, the public or the environment. However, the DEIS notes that Hanford lacks some data necessary to reach this conclusion. In addition, Hanford has removed some soil from one TRU liquid waste site and plans to exhume three TRU solid waste sites because of environmental and safety concerns. Although Hanford included 28 TRU sites in its CERCLA phase I assessment, it excluded 7 others, including 4 that had been used after November 1980. However, Hanford did not include the four sites in its RCRA Part B application because officials believe they contain byproduct material, thereby making them exempt from RCRA.

Until 1970 DOE had no waste classification for TRU waste. As a result, Hanford buried solid low-level waste contaminated with TRU radioactive elements in shallow pits, 4 to 25 feet below the ground—Hanford has 11 of these sites. In addition, prior to 1973 Hanford disposed of liquid waste containing TRU radioactive elements from several operations directly to the soil through cribs, ponds, ditches, trenches, and french drains—Hanford has 24 of these sites. In the 1970's Hanford changed its waste disposal methods. In 1970 it began packaging and storing solid TRU waste until DOE decided on a safe, permanent disposal method for it and in 1973 began storing liquid TRU waste in double-shell tanks. Since the liquid TRU waste will be processed and disposed of with high-level

waste, we limited our discussion to the 35 liquid and solid waste sites contaminated with TRU radioactive elements.

Hanford has estimated the amount and types of TRU radioactive substances disposed in these sites and plans to determine if they contain hazardous substances as part of CERCLA phase II activities. Hanford's phase I CERCLA report shows that it plans to characterize the waste in seven liquid—but no solid—waste sites.

Hanford's Monitoring for TRU waste Contamination

Hanford has about 100 dry wells and 13 groundwater monitoring wells to detect contamination from 19 TRU liquid waste disposal sites; for 5 sites Hanford has neither dry nor groundwater monitoring wells. Of the 19 sites, Hanford monitors 8 with both dry and groundwater monitoring wells, 7 with dry wells only, 2 with groundwater monitoring wells only, and 2 sites are monitored from dry and/or groundwater monitoring wells located near other sites.

However, Hanford's groundwater monitoring wells do not meet RCRA's requirements for location or numbers applicable to nonradioactive, hazardous waste sites. With the exception of one pond where Hanford has three groundwater monitoring wells ranging from 100 to 500 feet from the pond and one crib where two groundwater monitoring wells are inside the crib, at the other locations it has only one groundwater monitoring well inside the disposal site and/or up to a distance of 120 feet away. Site documentation shows that Hanford takes monthly or quarterly samples from the groundwater monitoring wells and analyzes the samples for nitrates and radioactive elements such as cesium, strontium, uranium, and ruthenium.

In addition, Hanford has no dry wells or groundwater monitoring wells specifically associated with 8 of its 11 TRUsolid waste sites. Site documentation shows that the groundwater varies from 30 to 230 feet under these disposal sites, and three sites are within 30 to 40 feet of the groundwater. For these three sites, Hanford has one well to monitor two sites and two wells for one site. The other eight sites are 125 to 230 feet above the groundwater—Hanford has no groundwater monitoring wells for them.

Hanford officials told us that TRU radioactive elements have not been detected in any of the hundreds of groundwater monitoring wells around the facility and dry wells are a more sensitive method for tracking contaminants because of the dry climate and distance between

the disposal sites and the underlying groundwater. Therefore, they believe the existing system of dry wells and groundwater monitoring wells is adequate to detect for radioactive contamination from the TRU liquid disposal sites. They also stated that there is an extremely low potential for waste from the TRU solid sites to contaminate the groundwater because of the waste form (a solid), the dry soil and small amount of rain the area receives, and the distance to the groundwater. These officials acknowledged that Hanford has not conducted a monitoring program for hazardous substances that complies with RCRA and reiterated their earlier position that the groundwater monitoring issue should be resolved on a technical basis looking at the entire Hanford facility rather than on a site-by-site, RCRA requirement basis.

We noted that Hanford's rationale for not needing groundwater monitoring wells at these sites is similar to the rationale it used to request groundwater monitoring waivers for the landfill and solid low-level waste sites included in its RCRA applications (see ch. 2). The TRU solid waste sites are located under similar climatic, hydrologic, and geologic conditions as the landfill and low-level burial sites. In addition, state and EPA officials believe that Hanford should not only have groundwater monitoring wells around the TRU waste sites but that this monitoring should also be consistent with RCRA's requirements.

Problems Encountered With TRU waste Disposal Sites

In 1971 Hanford became concerned that one TRU waste disposal trench contained plutonium in quantities sufficient to cause a criticality concern (under certain conditions fissionable material can develop a self-sustaining nuclear chain reaction and subsequently release radioactivity to the environment). Hanford used the trench from July 1955 until April 1962 and discharged about 1.1 million gallons of waste from plutonium processing operations to it during the 7-year period. The waste contained plutonium, acids with a 2.5 pH rating, solvents such as tributyl phosphate and carbon tetrachloride, and undissolved solids such as aluminium, magnesium, and calcium.

As early as 1959, Hanford's nuclear material accountability records indicated that the trench had quantities of plutonium near the 15 kilogram criticality level. When Hanford stopped using the trench in 1962, it contained 27.4 kilograms. Hanford monitored the trench and in 1973 found that plutonium levels ranged from 25 to 70 kilograms but that the top 12 inches of soil in the trench (several thousand cubic feet) contained 40 kilograms of plutonium.

Hanford decided to remove the top 12 inches of soil to reduce the risk of environmental contamination from the plutonium. Hanford conducted the removal operations from 1976 until July 1978. During these operations, Hanford sampled and analyzed soil sediment below the trench. The samples showed at least two types of plutonium contamination in the soil. Hanford did not sample for chemical substance contamination at that time.

Hanford put the soil into canisters and then placed the canisters in 55-gallon drums (about 700); it has been storing the drums pending their disposal in a geologic repository in New Mexico. According to Hanford officials, the removal was conducted with minimal environmental exposure and worker radiation exposures were low because the removal operations were conducted using remotely operated equipment. Hanford officials estimated that it cost about $1.5 million for the removal, packaging, and disposal activities.

In addition, Hanford's DEIS shows that another liquid TRU disposal site—a reverse well—contaminated the groundwater. Hanford used the well from April 1945 until September 1947 to receive overflows of alkaline and radioactive waste from settling tanks. Hanford stopped using the site when a nearby groundwater monitoring well showed radioactive contamination. According to Hanford officials, the contamination did not include TRU radioactive elements. The DEIS states that, within 2 days of finding the contamination, Hanford discontinued using the well and rerouted the waste to other disposal facilities.

The DEIS also shows that Hanford is considering exhuming the contents of three TRU solid waste sites. These sites are close to the Columbia River and population areas. The DEIS concluded that the waste in these sites could present an environmental and public health risk because they are located at a lower elevation than other waste sites and could be subject to flooding from the Columbia River. Except for the DEIS, Hanford officials told us they have conducted no other analyses of the potential long-term dangers and hazards associated with these three sites. Rather Hanford is considering exhuming the sites as a precautionary measure on the basis of a "prudent man's approach."

DEIS Options for TRU waste

Although DOE considers the TRU buried waste and contaminated soil sites as disposed, the DEIS evaluated permanent disposal options for this waste. The four options are: geologic disposal, in-place stabilization and

disposal, a "reference" alternative that combines features of both geologic and in-place stabilization and disposal, and no action/continued storage. The reference alternative for these waste sites is to conduct characterization studies (both soil and waste), improve subsidence control, cover some sites with a protective barrier, and mark the sites to prevent human intrusion.

In the DEIS Hanford did not select a preferred disposal option; Hanford pointed out that it would conduct further research to verify disposal methods and prepare additional environmental analyses before proceeding with a specific option. Hanford has been conducting research on the use of grout for liquid and solid waste sites and in-situ vitrification for liquid waste sites. Grout involves injecting a cement mixture into the ground that fills openings in the soil, hardens, and keeps the waste from migrating. In-situ vitrification is an in-ground melting process that converts the waste into a glass form.

Grout, under development since 1980, would reduce void spaces in disposal sites, thereby reducing the potential for subsidence and waste migration. Hanford has tested the technology using a simulated crib. During fiscal year 1988 Hanford expects to complete testing the technology, evaluate the data from these tests, and document the results. Although it is developing this technology primarily for low-level waste sites, Hanford officials recognize its potential for both liquid and solid TRU disposal sites. Hanford's contractor has also conducted laboratory, pilot, and large-scale in-situ vitrification experiments. In July 1987 Hanford's contractor expects to conduct the final large-scale test using one TRU waste crib. Hanford expects to have the results of these research efforts by the end of 1988 and then determine their applicability to TRU waste sites. Hanford officials estimate that it could be 1994 before they make a decision.

Applicability of CERCLA and RCRA

Hanford included 28 of the 35 sites contaminated with TRUradioactive elements in its CERCLA phase I assessment. Hanford excluded (1) two liquid and two solid waste sites because it used them subsequent to November 1980 to dispose of low-level radioactive waste, (2) two settling tanks that it does not consider as CERCLA sites because they contain sludge, and (3) a site contaminated by an unplanned release. Although it used four TRU sites after November 1980, Hanford did not include them on its RCRA applications because, according to officials, they are considered to be byproduct. Hanford's rationale for excluding the two settling tanks is the same as that used for the 149 single-shell tanks. Since the

settling tanks contain sludge, Hanford considers them to be active sites. As explained in chapter 3, Hanford did not assess any unplanned release site as part of its CERCLA phase I activities but plans to do so in fiscal year 1987.

EPA and state environmental officials pointed out that corrective actions for the TRU solid waste sites could be required under RCRA Section 3004(u) if they release hazardous waste or hazardous constituents. EPA officials could not estimate when section 3004(u) regulations would be issued, but in September 1986 EPA asked Hanford for information concerning past and current solid waste management units so that EPA can assess their status under section 3004(u). Until EPA issues regulations implementing this provision, Hanford officials would not speculate on what, if any, additional actions they may have to take.

Environmental Monitoring Data Lacking

In the DEIS Hanford states that TRU waste disposal sites have not adversely affected the environment but also points out numerous instances where Hanford lacks certain environmental information. The DEIS notes that the reliability of predicting the release of radioactive material from subsurface facilities depends on the type of storage facility, the waste form in the facility, and the physical processes that affect the waste.

Although Hanford knows the type of subsurface facilities used to dispose of TRU waste, the DEIS indicates that information is either lacking or limited concerning specifics on the waste form and physical processes that affect the waste. For example, the DEIS notes that

- data are incomplete for individual radioactive elements disposed of prior to 1970,
- no data exist on the relationship between travel time of individual radioactive elements and thickness of soil deposits,
- site-specific data on soil composition in the waste disposal areas are limited,
- precise data on soil/water/radioactive material interaction in the soil between the ground and the water table are lacking,
- quantitative data on the effect of microbiological degradation of waste and how radionuclide migration could be influenced by a microbial presence are limited,
- data on solubility and concentrations of radioactive elements and chemicals are limited, and

- data on the movement of groundwater in the unconfined aquifer underlying the site need to be developed further.

In a September 1986 letter, EPA also noted some of these same deficiencies and stated that resolution of these issues must be provided prior to Hanford's proceeding with a permanent disposal option and to determine compliance with RCRA, CERCLA, or other applicable environmental requirements. The letter stated that Hanford should either address these issues in the final environmental impact statement or through a comprehensive Hanford/EPA/state agreement. EPA also noted that data confirming actual discharges by the unconfined aquifer to the Columbia River have not been presented in the DEIS and suggested that Hanford make this determination.

Hanford officials told us they used conservative assumptions to project the potential environmental impacts of the options set out in the DEIS. For example, Hanford double-counted the amount of radioactivity in the single- and double-shell tank waste because it does not know for certain the amount or location of radioactive material in them. In addition, Hanford based the DEIS on thousands of soil samples and projected environmental impacts assuming sandy soil rather than silt even though silt has better absorption properties (the soil at Hanford is composed of sand, silt, and gravel). Hanford officials did agree that for specific site operations they would prefer to have more detailed environmental monitoring data. Nevertheless, they are confident the DEIS presents a conservative assessment of the environmental impacts of the permanent disposal options considered.

Conclusions

Although DOE has issued a DEIS for the permanent disposal of Hanford's single-shell tank and TRU waste, its long-term decisions could be affected by actions it may have to take to comply with RCRA, particularly subtitle I and section 3004(u). For example, Hanford may have to take corrective actions for 28 TRU waste sites as a condition for receiving a RCRA permit. Until EPA issues regulations implementing these statutory provisions, neither EPA, DOE headquarters, nor Hanford officials would speculate on what, if any, additional actions Hanford may have to take to effectively manage and dispose of these wastes.

In addition, Hanford did not include the 149 single-shell tanks in its CERCLA phase I assessment. EPA officials believe the tanks should have been included because some have leaked, which qualifies them as CERCLA

sites. Further, as a result of RCRA's Atomic Energy Act exclusions, Hanford has not submitted RCRA permit applications for four TRU-contaminated waste sites used after November 1980—Hanford classifies them as byproduct.

Summary and Recommendation

Until an April 1984 court ruling, DOE believed it was exempt from RCRA because of that act's Atomic Energy Act exclusions. Even today, Hanford officials believe that these exclusions allow them to continue disposing of some waste without meeting RCRA's requirements. Although Hanford now acknowledges—almost a year after RCRA required—that some of its disposal units should comply with RCRA, officials continue to believe that other, similar units do not because they are byproduct units. Further exacerbating the issue of what RCRA includes or excludes concerning Atomic Energy Act activities or substances is DOE's proposal to clarify what should be classified as byproduct and exempt from RCRA. This proposal engendered a great deal of federal, state, and public opposition; it would not resolve the regulatory debate concerning RCRA's Atomic Energy Act exclusions.

In addition, Hanford (1) has not identified all units that should be regulated under RCRA, (2) has not provided the state and EPA data to verify that it correctly classified waste that would not be regulated under RCRA, and (3) did not include information in its RCRA applications concerning corrective actions for inactive waste sites. Until November 1984, the regulatory distinction between RCRA and CERCLA was fairly straightforward. CERCLA required the cleanup of inactive waste sites used prior to November 19, 1980, that released or had the potential to release hazardous substances. After that date and in the future, RCRA regulated hazardous waste from generation through disposal.

However, RCRA's November 1984 amendments complicated waste management and disposal issues by making RCRA permits conditional on federal agencies' taking corrective actions for inactive waste sites now covered by CERCLA. This means that facilities, such as Hanford, must not only obtain a permit for all waste units used since November 19, 1980, but must also identify and notify EPA of the existence of all treatment, storage, and disposal units—whether retired or still in use. Hanford did not include this information in its November 1985 RCRA applications and in September 1986 EPA issued a partial Notice of Deficiency because of this omission.

RCRA's 1984 amendments also addressed the regulatory gaps created by that act's Atomic Energy Act exclusions. The amendments included a new provision applicable to underground tanks used to store petroleum and hazardous substances (subtitle I). Subtitle I broadened the types of hazardous waste to be regulated by including all CERCLA substances (except those already regulated by RCRA). Since CERCLA includes both

chemicals and radioactive materials as a hazardous substance, the material in Hanford's 177 high-level waste tanks are now subject to RCRA under subtitle I.

Further compounding RCRA's and CERCLA's overlapping requirements could be the CERCLA amendments that the President signed on October 17, 1986. These amendments establish specific activities and time frames for federal agencies' compliance with CERCLA and will not only affect Hanford's CERCLA plans but could also affect the corrective actions Hanford will have to take to obtain a RCRA permit. Since these amendments have recently been signed, we did not consider their impacts in this report.

However, the statutory and regulatory complexities of RCRA and CERCLA do not excuse Hanford from complying with both laws as well as the Atomic Energy Act. Before Hanford can do this, it must identify all waste treatment, storage, and disposal sites and units regardless of the type of waste disposed of in them or when they were used, as well as sites contaminated from spills or unplanned releases. Hanford has taken some actions to address these issues, but much more needs to be done. Until Hanford makes full disclosure of its waste treatment, storage, and disposal sites and units, its actions to comply with RCRA and CERCLA will be open to question, fraught with uncertainties, and reactive rather than proactive.

Matters for the Congress' Consideration

In view of (1) RCRA's Atomic Energy Act exclusions that allow Hanford to dispose of some liquid low-level waste in a manner different from what RCRA would otherwise allow, (2) the confusing and overlapping regulatory relationships among RCRA, CERCLA, and the Atomic Energy Act, (3) the Congress' broadening the definition of hazardous substances to include all radioactive materials under subtitle I, (4) the recently enacted CERCLA amendments, and (5) the potentially serious environmental problems that may result from inconsistent waste disposal practices, we believe that the Congress should consider whether RCRA's Atomic Energy Act exclusions are as appropriate today as they were 10 years ago when RCRA was enacted.

Recommendation to the Secretary of Energy

We recommend that the Secretary of Energy require Hanford to report to EPA and Washington State

- all sites and units previously and currently used to treat, store, and dispose of waste, including those considered to be byproduct and those contaminated by unplanned releases, and
- the regulatory authority (RCRA, CERCLA, or the Atomic Energy Act) that controls the management, disposal, and/or corrective actions required for each site and unit identified.

We believe that DOE's implementation of this recommendation would not only assist Hanford to comply with RCRA, CERCLA, and the Atomic Energy Act but would also help DOE to address the recommendations made in our report Nuclear Energy: Environmental Issues at DOE's Nuclear Defense Facilities (GAO/RCED-86-192, Sept. 8, 1986). In that report, we made recommendations aimed at enhancing environmental protection around DOE defense facilities nationwide.

Substances and Concentrations Found in the PUREX Process Condensate and Chemical Sewer Wastes

Substances	PUREX process condensate	PURE chemic sew
Metals[a]		
Aluminium	<150	<15
Silver	< 10	<
Barium	< 6	<
Beryllium	< 5	<
Calcium	76	18,96
Cadmium	9	
Chromium	< 10	
Copper	13	8
Iron	< 50	< 5
Mercury	20	<0
Potassium	<100	6
Magnesium	19	3,45
Manganese	< 5	
Sodium	441	3,14
Nickel	< 10	1
Osmium	<300	<30
Lead	< 30	< 3
Antimony	<100	<10
Tin	<300	<30
Strontium	<300	<30
Uranium	32	4
Vanadium	< 5	<
Zinc	32	4
Anions[b]		
Chloride	<0 5	1
Fluoride	<0 5	2
Nitrate	175 3	8
Sulfate	0 5	10 2
Phosphate	<1 0	<1
Volatile organics[a]		
Acetone	•	6
Butanal	12	
1-Butanol	50	
3-Buten-2-one	22	
Nitromethane	8	
Tetrahydrofuran	13	

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