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NUCLEAR WASTE

Management and Technical Problems Continue to Delay Characterizing Hanford's Tank Waste





United States
General Accounting Office
Washington, D.C. 20548

**Resources, Community, and
Economic Development Division**

B-270726

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The Honorable Hazel R. O'Leary
The Secretary of Energy

Dear Madam Secretary:

The Department of Energy (DOE) has about 55 million gallons of highly radioactive waste currently stored in 177 underground tanks at its Hanford site in Washington State. Some of these tanks have leaked, and others contain potentially flammable waste. DOE's program for developing a safe, permanent way to dispose of the waste in these tanks is one of its highest priorities. This cleanup effort is also one of DOE's most expensive projects; its estimated life-cycle cost is \$36 billion.

Characterization, the first major step in cleaning up tank wastes, involves determining the specific contents of the tanks through sampling and other means. At Hanford, the characterization program has experienced a series of delays, leading to numerous revisions in the schedule for completing the work.¹

The last formal schedule revision took place in January 1994, when DOE negotiated an agreement with Washington State and the U.S. Environmental Protection Agency (EPA) to finish characterization by September 1999. Also in January 1994, DOE agreed to implement a recommendation by the Defense Nuclear Facilities Safety Board to characterize wastes in the 54 tanks with known or suspected safety problems by October 1995. Because of characterization's importance to the cleanup and safe storage of the wastes, our objectives were to (1) review DOE's progress in meeting the deadlines, (2) identify any impediments to making progress, and (3) determine what impact continued delays could have.

Results in Brief

Continuing delays in characterizing Hanford's high-level waste led DOE to conclude in September 1995 that it could not comply with the current agreed-upon deadlines. Westinghouse Hanford Company, DOE's contractor, has been unable to characterize any of the 177 tanks sufficiently to declare them ready for remediation. In addition, DOE did not meet its commitment

¹For descriptions of these problems, see Nuclear Waste: Problems and Delays With Characterizing Hanford's Single-Shell Tank Waste (GAO/RCED-91-118, Apr. 23, 1991) and Nuclear Waste: Hanford Tank Waste Program Needs Cost, Schedule, and Management Changes (GAO/RCED-93-99, Mar. 8, 1993).

to the Defense Nuclear Facilities Safety Board to characterize the 54 tanks with known safety problems by October 1995. Although DOE and Westinghouse believe tank wastes are stored safely, they are unable to predict when any of the tanks will be characterized.

Although many factors have contributed to the continued delays, two stand out. First, despite more than 10 years of effort, DOE and Westinghouse have had difficulty resolving such fundamental questions as how to take reliable top-to-bottom samples from the tanks, what types of and how much sampling data to gather, and how to reconcile conflicting information about a tank's contents. It is unclear whether the current characterization effort will produce enough information to support moving to the next steps of the cleanup effort. Second, DOE and Westinghouse have not had effective management systems for detecting and addressing problems with the characterization program. In some cases, managers were unaware of technical and safety problems; in others, they knew about problems for lengthy periods before addressing them. Since February 1995, Westinghouse has taken some steps to address these sampling and management problems.

The limited progress in characterizing the high-level radioactive wastes may have substantial and far-reaching effects on the \$36 billion cleanup program for the tanks. Delays or inadequacies in characterization could drive up the cost of other parts of the program and increase the risk that designers could rely on incomplete or inadequate information as they develop treatment processes and facilities.

Background

The wastes in Hanford's 177 underground tanks are a by-product of more than 50 years of nuclear weapons production. (Fig. 1 shows a typical tank farm under construction.) Storing, managing, and cleaning up these wastes pose many challenges. Some tanks, for example, contain flammable gas or potentially combustible organic compounds. Injected into the tanks as liquids, the wastes have assumed a variety of forms as they have settled and recombined over the years. These forms include sludge and a hard "saltcake" that may have to be pulverized before it can be removed from the tanks. Wastes in at least 67 single-shell² tanks have leaked or are assumed to have leaked into the ground as the concrete-and-steel structures have deteriorated.

²Hanford has 149 single-shell tanks, built between 1943 and 1964, which have one layer of steel inside the concrete outer wall. The remaining 28 double-shell tanks, built between 1968 and 1986, have two layers of steel.

Figure 1: Typical Hanford Tank Farm Under Construction



DOE's program for addressing these wastes, called the Tank Waste Remediation System, calls for a series of actions to chemically characterize the waste in the tanks, remove it from the tanks, and prepare it for permanent disposal during the several hundred thousand years in which some of it will remain dangerously radioactive. This program is expected to cost \$36 billion over its life-cycle.

Waste characterization is the first major action. Since fiscal year 1989, the first year for which reliable cost data exist, DOE has spent about \$260 million on characterization. The purpose of characterization is to provide sufficient information for safe storage of the waste in the tanks while awaiting the development of processes for remediating it, as well as for designing the steps of the remediation process itself. These steps include removing the wastes (retrieval), separating them into low-level

and high-level portions (pretreatment), treating them (vitrification),³ and preparing them for permanent disposal.

DOE began characterizing the waste in Hanford's tanks in 1985. Since then, its efforts have repeatedly fallen behind schedule. DOE's March 1994 schedule resulted from the renegotiation of an agreement originally signed in 1989. This Tri-Party Agreement with Washington State's Department of Ecology (Ecology) and EPA initially called for completing the characterization of single-shell tanks by 1998. DOE subsequently found itself unable to comply with the characterization deadline and renegotiated the agreement. The revised Tri-Party Agreement calls for characterizing all 177 tanks for retrieval, pretreatment, treatment, and disposal by September 1999.⁴

In a separate agreement to address concerns raised by the Defense Nuclear Facilities Safety Board, an independent executive-branch oversight body, DOE agreed to another set of characterization requirements related primarily to the safe storage of the waste. Under this agreement, DOE was to characterize the 54 "watchlist" tanks—those with known or suspected safety problems, such as potential flammability—by October 1995 and to sample and assess safety conditions associated with all 177 tanks by October 1996.

Characterization Has Fallen Behind Schedule

DOE and Westinghouse have made limited progress in meeting the agreed-upon deadlines for characterization. Despite some recent improvements in sampling capability, Westinghouse remains behind schedule in taking samples from the tanks. Its responses to reporting requirements have consisted mainly of summarizing previously known information about the tanks' contents. In September 1995, DOE acknowledged that the Tri-Party Agreement and Safety Board characterization deadlines could not be met and proposed a two-phased approach for characterizing tank wastes that would extend characterization activities well beyond 1999. As of the time we completed our work, however, DOE had not formally notified Ecology that it could not meet the Tri-Party Agreement deadlines.

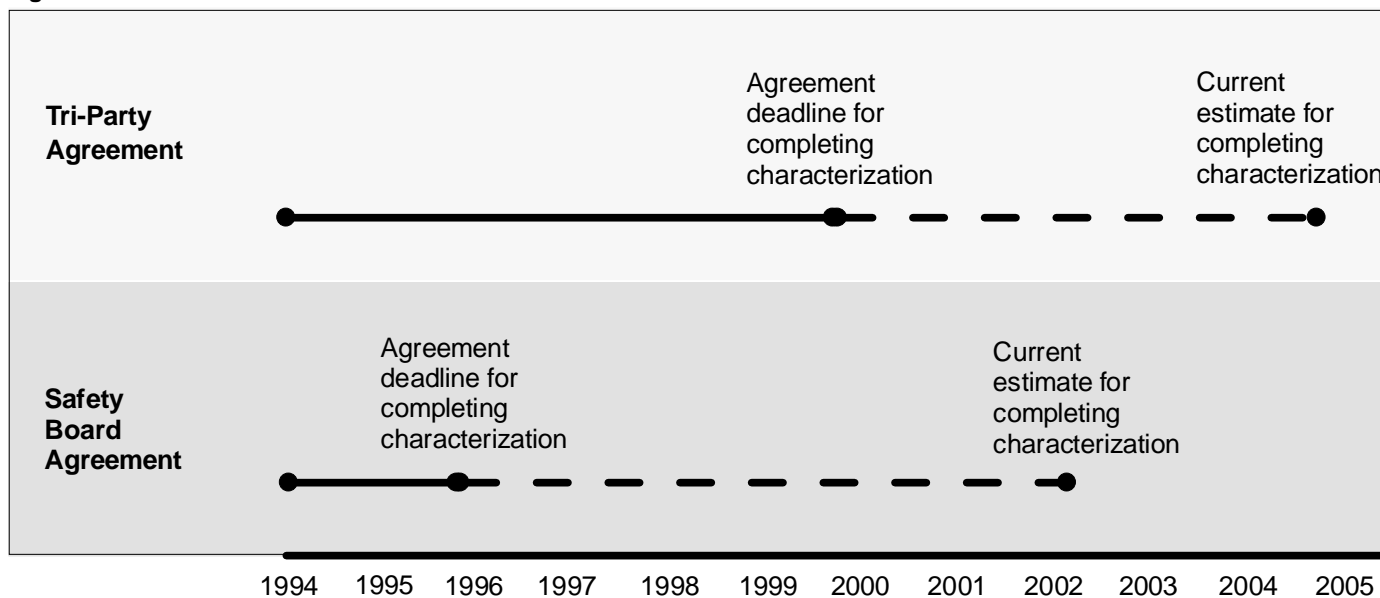
³Vitrification, DOE's proposed approach for dealing with both the high-level and low-level radioactive waste, involves converting the waste into a glasslike product that will hold the waste in place until its radioactive components deteriorate.

⁴The Tri-Party Agreement also recognizes that additional characterization will occur after the wastes are removed from the tanks and enter pretreatment and treatment processes.

Sampling Schedules Have Not Been Met

DOE and Westinghouse have made limited progress in meeting the Safety Board and Tri-Party agreement deadlines (see fig. 2). The Safety Board agreement called for taking and analyzing about 216 of 408 core samples⁵ by September 30, 1995. As of that date, Westinghouse had completed 42. The Safety Board agreement also called for taking core samples from all 54 watchlist tanks by October 1995; by that date, Westinghouse had obtained core samples from 10 watchlist tanks. At Westinghouse's current estimated sampling pace, all 408 core samples will not be done until 2002—more than 5 years after the agreement's October 1996 deadline. Similarly, while the revised Tri-Party Agreement calls for full characterization of tank wastes by September 1999, DOE's recent planning documents show that at the current sampling pace, DOE does not expect to meet this requirement until September 2004.

Figure 2: Deadlines and Current Estimates for Characterization Work at Hanford



Westinghouse has shown some improvement in its ability to take core samples. In fiscal year 1994, Westinghouse completed only 3 of 13 planned core samples, but in fiscal year 1995, it completed 39—the same number it had estimated it would be able to take. However, the 39 were concentrated

⁵A core sample is a top-to-bottom sample of the tank waste using a hollow-core drill bit about 1 inch in diameter.

in fewer tanks than Westinghouse had planned.⁶ Westinghouse currently estimates that it will be able to take about four core samples per month through March 1996 and five per month thereafter.

During fiscal years 1994 through 1995, Westinghouse also used other types of samples besides core samples to augment its understanding of tank wastes, completing 177 of 210 planned samples.⁷ These other methods yield results that are generally considered less comprehensive than core samples, because they usually do not involve a top-to-bottom sampling of the waste. However, the results of these samples can supplement what is learned from core samples because they can provide information on tank vapors and liquids that core samples may not provide. Even with these other efforts, to date no tank has yet been sufficiently characterized either to meet the Safety Board's sampling requirements or to support any of the subsequent steps in the waste treatment process. The Director of DOE's characterization division said that he was unable to estimate when the characterization of any tank would be completed.

DOE and Westinghouse officials believe that characterization difficulties are not affecting the safe storage of tank wastes. According to the assistant manager of DOE's tank waste remediation program, Westinghouse has placed controls on tank farm operations to reduce the risk of an unintentional release. The controls include using sparkless equipment and avoiding certain types of drilling procedures. However, these controls have made it more difficult for DOE to maintain its desired sampling rate.

DOE and Westinghouse characterization managers have acknowledged that they will not meet the Safety Board or Tri-Party Agreement deadlines. They have prepared a draft revision of the original implementation plan agreed to with the Safety Board. This draft, which does not specify a completion date, is discussed in more detail in the next section. DOE and Westinghouse also acknowledged the need to propose changes to the Tri-Party Agreement, but at the time we completed our work, they had not yet submitted a formal proposal to Ecology or EPA. However, Ecology has informed DOE and Westinghouse that in the state's view, the inability to obtain adequate samples does not provide sufficient grounds for

⁶Westinghouse planned to take core samples from 30 tanks in fiscal year 1995. However, it took the samples from only 16 of the 30 tanks because it needed to obtain more complete information from the tanks sampled.

⁷These other types of samples are vapor, auger, and grab samples. Vapor samples involve extracting gases from the space at the top of the tanks. Auger samples, considered a cost-effective method of obtaining samples from tanks with less than 23 inches of waste, are obtained using a large, steel, hand-turned drill bit to sample 15 inches of the waste. Grab samples are taken using a bottle attached to a cable that is lowered into the surface of soft or liquid waste.

renegotiating the characterization milestones of the Tri-Party Agreement. Ecology expects DOE to formulate a plan to compensate for past inadequacies and to meet commitments under the current Tri-Party Agreement schedule.

**Characterization Reports
Mainly Summarize
Information Already
Known**

The revised Tri-Party Agreement requires DOE to submit, for Ecology's approval, characterization reports on a certain number of tanks each year through 1999.⁸ All 23 of the reports submitted through fiscal year 1994 were based mostly on existing "historical" data about the wastes, supplemented with limited sampling results. The 30 reports submitted on September 30, 1995, were also based primarily on historical information, although they contained some results of samples taken since May 1989.

Reaction to the value of these reports is mixed. DOE accepted the reports, but Ecology, the body that must approve the reports, has criticized their contents, including Westinghouse's extensive reliance on historical information.⁹ Rather than approve the 23 reports submitted in fiscal years 1993 and 1994, Ecology received them on the condition that Westinghouse develop additional characterization data and resubmit the reports for approval within 2 years. In connection with the fiscal year 1995 reports, Ecology's characterization team leader said that 25 of the 30 reports were inadequate because they contained mainly historical information, modeling results that had not been verified, and limited analytical results. He considered the results of the analyses of the most recent samples insufficient because they were limited to determining whether tank wastes were being maintained in a safe condition and did not contribute to any remediation step.

⁸The agreement calls for reports on 3 tanks for fiscal year 1993, 20 in fiscal year 1994, 30 in 1995, 40 in 1996 and 1997, 30 in 1998, and 14 in 1999.

⁹Because the reports were submitted as required, the director of DOE's characterization division told us that he authorized an incentive payment to Westinghouse. For fiscal year 1995, DOE provided Westinghouse with a payment of \$843,333 for submitting the required 30 reports by September 30, 1995. Under the terms of DOE's draft performance criteria, Westinghouse can earn \$2 million for submitting the required 40 reports in fiscal year 1996 if the reports meet DOE's requirements.

Characterization Progress Has Been Impeded by Technical Difficulties and Lack of Effective Management Controls

While many factors have contributed to the slow pace of the characterization effort, the primary reasons for slow progress are that (1) DOE and Westinghouse have not yet determined how to successfully draw reliable samples and characterize the waste and (2) managerial weaknesses with the characterization program and other aspects of the tank farms have exacerbated delays and contributed to operational inefficiencies.

Characterization Approach Continues to Change

DOE and Westinghouse have been unable to develop and implement a characterization approach that has been successful in meeting the requirements of the Tri-Party Agreement or their commitments to the Safety Board. Three different approaches have been attempted since the Tri-Party Agreement was signed in 1989, and in each case, the approach has not been successfully implemented. As a result, DOE and Westinghouse are still having difficulty answering fundamental methodological questions that have existed since the characterization program began: how to take reliable samples, what types of and how much sampling data to gather, and how to reliably predict the waste constituents on the basis of sampling and other data.

Limited progress in taking samples has led DOE and Westinghouse to search for another characterization approach that would satisfy the requirements of the Tri-Party Agreement as well as their commitments to the Safety Board. The latest approach, proposed in September 1995, aims to evaluate the program on a continuing basis while taking samples and collecting data, rather than following a fixed schedule. DOE now views sampling as an iterative process in which the total number of samples needed depends on the results of the initial samples taken. This viewpoint is in contrast to DOE's earlier strategy that required a fixed number of samples.

DOE's latest characterization strategy has two phases: Phase one concentrates primarily on ensuring safe storage while demonstrating the approach's overall validity. More specifically, phase one includes

- reducing the number of core samples from 408 to 109, which would be done by grouping tanks believed to contain similar wastes and taking core samples from the 25 to 30 tanks considered representative of the various groups;

- supplementing data obtained from the reduced number of core samples with historical data, temperature and moisture measurements, and data obtained from other types of samples (such as vapor and auger samples); and
- using computer models to analyze the various data in order to predict the tanks' contents and evaluate the risk of potential combustion.

Westinghouse characterization project officials acknowledged that if assumptions about the validity of this approach are not successfully demonstrated during fiscal years 1996 and 1997, more core samples and other types of samples may be needed in phase one.

Phase two of Westinghouse's approach would focus primarily on the characterization of tank wastes to support the treatment and disposal steps. The time frames, funding requirements, and sampling strategies for phase two are currently undefined. After evaluating the results of phase one, Westinghouse plans to formulate and implement phase two beginning in fiscal year 1997.

Adequacy of Proposed Approach Is Uncertain

The September 1995 characterization proposal, while more in line with what DOE can realistically expect to accomplish in the next several years, has generated concerns about whether it will provide sufficient characterization information to proceed with remediation efforts. These concerns have been expressed by regulators, advisory bodies, and other persons involved with the remediation effort. Among the main concerns about the adequacy of the proposed approach are whether historical and sampling data can be reconciled, whether the computer models will reliably predict actual quantities of specific tank wastes, and whether the information being developed will be thorough and accurate enough to proceed with the various steps in retrieving and treating the wastes.

Disparities Exist Between Historical Data and Sampling Information

Having accurate knowledge of the amounts of waste components is important in choosing pretreatment and treatment technologies and designing facilities. Westinghouse's new approach would rely to a significant extent on historical data for purposes of characterization. However, as far back as October 1991, DOE recognized that its historical data were incomplete and unreliable. The Safety Board has expressed concern that historical data are not complete, reliable, or representative because inadequate operational controls have resulted in limited information about (1) the specific types of waste placed in tanks and (2) the chemical processes occurring in the tanks. DOE and Westinghouse

Reliability of Computer Models Is Untested

have acknowledged that such disparities exist and plan to determine how to resolve them in phase one of their proposed approach.

Computer models are key components in Westinghouse's approach to predict tank waste constituents and evaluate potential safety problems. However, their reliability is largely untested. Westinghouse plans to test the models' reliability during a "demonstration" period in fiscal years 1996 and 1997, when some tank wastes will be characterized and compared to the models' predictions. The Safety Board, among others, has raised concerns about reliability. The Board's technical staff concluded that "Significant portions of the new strategy are based on simplified models and simulants that may not adequately represent tank wastes."

The limited information available to date shows examples of substantial differences between the models' projections and the data obtained through core samples. In September 1995, Westinghouse reported the results of 144 possible comparisons between the models' projections and the core sample results in 12 tanks. These comparisons included waste constituents, such as chromium and phosphate, that are important in determining the volume of glass needed for the vitrification process. The core sample results were at least three times higher or lower than the models' projections in about 25 percent of the comparisons. In addition, for another 20 percent of the comparisons, the sample results showed the presence of such constituents as cesium 137, phosphate, and total organic carbons, while the models' projections indicated that these constituents did not exist in the tanks.¹⁰

Sufficiency of Characterization Information Is Uncertain

Considerable uncertainty exists about the characterization information needed to design methods and facilities for cleanup. Westinghouse is currently developing criteria known as data quality objectives; these criteria specify what information will be needed for each step in remediating tank wastes. Although Westinghouse's approach is based on obtaining sufficient data from a reduced number of core samples, in 1992 Westinghouse told us that between 2 and 14 core samples may be needed to adequately characterize a single tank.

We asked an independent nuclear engineering consultant to review Westinghouse's approach to determine if it will produce sufficient

¹⁰The remaining comparisons differed from the models' results by a factor of less than three.

information about the waste to meet DOE's objectives.¹¹ His review raised concerns about the reliability of the information that will be developed for most of the tanks under Westinghouse's proposed approach. The consultant concluded that the proposed approach involving limited sampling may yield adequate characterization information for about 31 single-shell tanks and several double-shell tanks believed to contain waste that is relatively homogenous, but he concluded that the approach may be considerably less reliable for approximately 135 other tanks. For those tanks, the consultant concluded that more core samples than originally planned, rather than fewer, may be needed to reconcile disparities between the tanks' waste contents as derived from sample analyses and the tanks' waste contents as deduced from historical data.

Managerial Weaknesses Have Contributed to Operational Inefficiencies

The technical complexities associated with characterizing tank wastes highlight the need for an effective management system for detecting and addressing problems. However, such a system has been lacking in the characterization program. Instead, technical and safety problems have gone uncorrected for considerable periods, either because managers were unaware of the problems or because they were slow to take action on problems they knew about. In an April 1995 letter to the Safety Board, the Secretary of Energy acknowledged that numerous problems affecting the characterization program have been caused by ineffective management.

Lack of Awareness Limited Timely Action

We found instances involving operational and safety-related problems in which Westinghouse or DOE managers were initially unaware of circumstances that caused delays or increased safety risks. For example:

- Before being placed into service, a new rotary-mode sampling truck was inspected in July 1994, 3 months later than planned. Westinghouse inspectors reported that welds on the truck did not meet design code requirements. Consequently, the truck was inoperable for an additional 3 months; its unavailability contributed to Westinghouse's obtaining considerably fewer rotary-core samples in 1994 than originally planned. The report's authors stated that Westinghouse management lacked commitment in identifying and tracking such deficiencies.
- Westinghouse managers were not aware that workers were operating the push-mode core sampler without an operable instrument called a bottom detector to prevent damaging or drilling through the bottom of a tank.

¹¹For specific technical assistance in performing our review, we used the services of Dr. George W. Hinman, an independent nuclear engineering consultant, who is currently Director, Office of Applied Energy Studies, Washington State University. Dr. Hinman has worked for about 40 years in the nuclear energy field in industry, government, and academia.

When this practice was reported in February 1995, the report stated that the workers involved did not have adequate knowledge of safe sampling procedures. As a result, push-mode sampling was halted for more than 2 weeks while safety procedures were reevaluated and workers received additional training, according to Westinghouse's deputy operations manager for characterization.

Actions Were Often Slow Even When Management Was Aware of Problems

We also found instances in which management was aware of problems with characterization—or with tank farm maintenance activities affecting characterization—but was slow to address them. For example:

- In 1993, virtually all sampling activity was suspended for more than 6 months following a safety violation in which a maintenance worker contaminated himself and others while using unapproved procedures to unclog a blocked drain. This incident, referred to as the “rock-on-a-rope” occurrence because of the extremely primitive methods used, was the culmination of a series of incidents that indicated deficiencies in operations at the Hanford site, including inadequate procedures and personnel's lack of awareness of important technical procedures. DOE took limited actions on these incidents until this substantial event occurred.
- If wind speeds exceed 15 miles per hour—a common occurrence at Hanford—core samples cannot be taken unless sampling equipment and operations are protected from the wind. Although sampling delays associated with Hanford's windy conditions have been apparent for years, no solutions were advanced until January 1995, after the Safety Board had suggested many times for more than a year that a wind barrier be fabricated.

These examples of management's ineffectiveness are supported in several broader studies. In October 1990, for example, the Safety Board issued a statement concluding that management's attention to the characterization effort was inadequate. More than 2 years later, an internal DOE review found that there were “significant weaknesses in the safe control, adequate management, and technical implementation of field, laboratory, and supporting project activities.” In January 1995, about 2 years later, DOE acknowledged to the Safety Board that confusion still existed over who, at the management level, was responsible for managing and coordinating various characterization activities.

In a 1995 letter to the Secretary of Energy, the Safety Board placed the management issue at the center of the lack of progress. It said the principal source of difficulty was

“the loose and ineffective structure of the technical and administrative organizations assigned to characterization of the waste tanks. That has caused numerous delays for relatively trivial reasons that could have been readily overcome by a strong and determined manager with sufficient authority. . . .”

Characterization Delays Could Increase Costs and Add to Cleanup Uncertainty

DOE’s problems in keeping characterization on schedule affect more than just compliance with various agreements. Other problems include potential cost increases for the characterization effort, inefficient use of a laboratory, and uncertainty about carrying out other aspects of the remediation program.

Final Cost of Characterization Is Unknown

Delays in characterizing tank wastes raise the likelihood that DOE’s most recent estimates of total characterization costs are understated. Since fiscal year 1989, the earliest date that reliable cost data were available, DOE has spent about \$260 million on characterization, and in August 1995, it estimated that it would need to spend at least \$569 million more through fiscal year 1999 to meet the Safety Board and Tri-Party agreements.

Characterization work beyond fiscal year 1999 will most likely include sampling the majority of the 177 tanks to obtain information to support retrieval, pretreatment, treatment, and disposal of the wastes. The amount of additional program funds needed after fiscal year 1999 to support these characterization activities has not been estimated. The director of DOE’s characterization division said that DOE will not know for several years what these program costs are likely to be.

Analytical Laboratory Was Not Efficiently Used

Delays in sampling the wastes affected utilization of the 222-S analytical laboratory, a facility Westinghouse operates at Hanford. This laboratory, which was recently expanded to deal with the expected volume of incoming samples, has a staff of more than 143 full-time-equivalent positions and a budget of nearly \$12 million.¹² Westinghouse anticipated that about two-thirds of the laboratory’s capacity would be needed to analyze the samples. However, during fiscal year 1995, the lower-than-expected volume of samples required only 25 percent of the total capacity available. Laboratory personnel used an additional 20 percent of capacity during the year in various activities, such as developing internal procedures and process controls. Consequently, more than half of the laboratory’s capacity went unutilized. According to the

¹²We previously reported on the need for additional laboratory space in *Nuclear Waste: Hanford Tank Waste Program Needs Cost, Schedule, and Management Changes* (GAO/RCED-93-99, Mar. 8, 1993).

analytical laboratory's performance documents, sample analysis has increased to 53 percent of total capacity in the first 2 months of fiscal year 1996 because more samples had recently been obtained.

Remaining Remediation Steps May Be Delayed and Cost More

The most significant effect of the delays may be on the rest of the steps in the remediation process—retrieval, pretreatment, treatment, and disposal. These other steps of the process depend on the adequacy and quality of characterization information. In particular, data on the quantities and chemical properties of such waste components as chromium, phosphate, cesium 137, zirconium, and plutonium are important for determining the most efficient pretreatment technologies and the design of treatment facilities. Insufficient and untimely characterization information could either delay the construction of those facilities or cause the construction to proceed without sufficient information, increasing the risk of costly errors.

DOE and Westinghouse do not share the view that limited characterization information could jeopardize the success of subsequent steps in the remediation process. Despite slower-than-expected progress on characterization, DOE plans to begin testing equipment for retrieving tank wastes in fiscal year 1996 and to begin designing treatment facilities the following year. According to the assistant manager of DOE's tank waste remediation program, DOE believes that (1) current knowledge is sufficient to proceed with the initial facility design and retrieval of selected wastes and (2) additional characterization information will be available before the design reaches a critical phase. Ecology's position is that sufficient data to begin designing treatment facilities currently exist, but if DOE is unable to characterize tank wastes at its expected rate, the lack of characterization information could ultimately jeopardize the success of the remediation program.

Rather than constructing and operating its own facilities to treat the tank waste, DOE is considering privatization as an alternative approach. Under such an approach, a company or a consortium of companies from the private sector would finance, design, build, and operate pretreatment and treatment facilities and deliver the finished product—in this case, vitrified waste encased in stainless steel containers—to DOE for a fee. DOE expects this approach to save billions of dollars because the potential for innovation in the private marketplace could lead to greater efficiencies and improved performance. Authorization to pursue this approach was obtained from the Secretary of Energy in late September 1995. In

November 1995, DOE drafted a request for proposals to be reviewed by interested parties and expects to issue this request in February 1996.

Whether or not DOE moves ahead with privatization, it will be responsible for providing the characterization information necessary to proceed with remediating the tank wastes. DOE's current strategy of proceeding with limited characterization information could increase the risk that facilities may not perform as needed and/or may need costly modifications to perform safely and efficiently. For example, DOE has conflicting data on the quantities of key waste constituents, such as chromium and phosphate, that affect the quality and durability of the vitrified glass product in which the waste will be immobilized. The independent nuclear engineering consultant we asked to review the program believes that without more reliable information on these and other elements, proceeding to construct the facilities is risky because they (1) may be built with insufficient capacity to process wastes containing greater-than-expected quantities of certain components or (2) may be built with excess capacity, resulting in needless expense. In our previous work on DOE's waste-processing facilities, we found that DOE had experienced major start-up problems, cost increases, and schedule delays caused in part by a "fast track" approach where construction began before major technical uncertainties were resolved.¹³

DOE and Westinghouse Have Taken Some Actions to Improve Characterization

In its performance evaluation of Westinghouse for the period from October 1994 through March 1995, DOE pointed out substantial problems with Westinghouse's management of the characterization effort. The evaluation stated as follows:

"[Westinghouse] has been unsuccessful in demonstrating tangible results on waste characterization; total program performance is considered a significant deficiency for the evaluation period. Limited progress has been demonstrated on field sampling improvements, technical basis development, or program optimization through process and productivity improvements. Adverse cost and schedule performance during the evaluation period indicate a strong probability to exceed available program funds without corrective action."

DOE and Westinghouse have begun some efforts to bring greater management control to the characterization effort, which had four different DOE managers between August 1994 and July 1995. In

¹³For more information on this issue, see *Nuclear Waste: Defense Waste Processing Facility—Cost, Schedule, and Technical Issues* (GAO/RCED-92-183, June 17, 1992).

February 1995, DOE changed the effort from a “program” to a “project” with a single manager. The Westinghouse project manager reports directly to the Westinghouse vice president for tank waste remediation. DOE and Westinghouse also clarified the lines of reporting accountability within the program and increased the amount of time that managers spend in the field observing characterization activities.

Other accomplishments that DOE and Westinghouse reported over the past 8 months include the completion of a variety of technical documents outlining DOE’s new characterization strategy; characterization criteria, called data quality objectives, describing tank waste safety, disposal, and historical data requirements; historical tank content estimate reports for all tanks; and 42 vapor tank sampling and characterization reports to address noxious vapor concerns. To enhance their capability to sample tank wastes, DOE and Westinghouse deployed three rotary-mode core sampling trucks and placed into operation an X-ray imaging device to provide real-time data on the recovery of core samples. These changes hold some promise for improvement, but it is too early to tell if they fully address the operational deficiencies and management weaknesses that have plagued the characterization program to date.

For the period during which many of these improvements were made (April 1995 through September 1995), DOE gave Westinghouse a “satisfactory” performance rating for its characterization project achievements. DOE’s evaluation praised Westinghouse for increasing management’s attention to program issues and developing and issuing “sound technical basis” documents to the Defense Nuclear Facilities Safety Board. However, the evaluation also stated:

“Information provided by the contractor through the Data Quality Objective (DQO) process has been insufficient to determine when a tank is fully characterized and [when] the need for further sampling is no longer required. . . . The root of this problem is a lack of adequate discipline in the definition of characterization needs and objectives, and the subsequent operations executed to accomplish those needs/objectives. The result has been excessive cost due to inefficient sampling and an inadequacy of data required to meet DQOs.”

Conclusions

After more than 10 years and about \$260 million invested in trying to characterize the tank wastes at Hanford, little definitive progress has occurred. Disagreement still exists over how much and what kind of characterization data are needed to reliably predict actual quantities of waste constituents and build appropriate treatment facilities. Inadequate

management attention has impeded solutions to these problems. DOE's current proposal raises questions about whether enough characterization information will be available to build effective facilities for retrieving the wastes and preparing them for permanent disposal. If the information proves to be inadequate, further technical problems and cost overruns are likely, jeopardizing the success of the overall program and increasing the potential that funds may be used unwisely.

All parties, including DOE, Westinghouse, potential private contractors, and the Congress, need further assurance that the characterization program has a sound technical foundation. Answers are needed to such questions as how much sampling and what kinds of sampling methods are sufficient to reliably characterize a tank's contents; how to reconcile disparities between existing data on tank contents and actual waste sample data; and how much characterization information is needed before the design and construction of pretreatment and treatment facilities should begin. Without this information, it will be difficult to reliably predict when the overall program will be done or how much it will cost. Furthermore, these uncertainties could undermine the savings DOE expects to realize by privatizing the tank waste remediation program.

Recommendations

To ensure that Hanford's tank waste characterization program will provide a sound foundation for designing and building waste treatment facilities, we recommend that the Secretary of Energy commission an independent review of the characterization program, using an organization such as the National Academy of Sciences, to resolve questions about the technical adequacy of Hanford's characterization strategy. The review should focus on determining (1) how much and what kind of information is sufficient to reliably characterize the tank wastes and predict the quantities and conditions of the waste constituents and (2) the amount and quality of characterization information needed for DOE to proceed with the design and construction of waste treatment facilities.

To ensure that funds for the overall tank waste remediation program are spent as wisely as possible, we recommend that the Secretary of Energy defer funding the construction of pretreatment and treatment facilities until (1) the technical adequacy of the characterization program has been confirmed or established and (2) sufficient waste characterization information is available to reliably define the requirements of those facilities.

Agency Comments and Our Evaluation

We provided a draft of this report to DOE, the Westinghouse Hanford Company, and the Washington State Department of Ecology for their review and comment. We discussed the report with officials from DOE, Westinghouse, and Ecology, including the assistant manager for DOE's Tank Waste Remediation System, the director of DOE's characterization division, and the director of DOE's safety division; the director of Westinghouse's tank waste characterization project and the ecology coordinator for Westinghouse's Tank Waste Remediation System. Overall, the officials agreed that the report was accurate and factual; however, DOE, Westinghouse, and Ecology disagreed with several aspects of the report, including the tone and substance of our conclusions and recommendations. In addition, DOE, Westinghouse, and Ecology provided annotated comments on technical aspects of the draft. We have incorporated those comments where appropriate.

DOE said that while the report accurately describes past difficulties with the characterization program, the report does not adequately recognize the performance improvements accomplished since February 1995. DOE provided a list of accomplishments that included developing program strategy documents, completing tank safety analyses and tank characterization reports, performing laboratory testing of wastes, acquiring new drilling equipment, and increasing the number of samples taken. In determining DOE's progress, we used the criteria in the agreements DOE has signed with Washington State, EPA, and the Safety Board. We also developed and compared data on waste samples planned and accomplished, since sample data are essential for completing characterization. In addition, we documented other activities DOE accomplished that could help in meeting characterization objectives and included many of them in our report. We believe that we have adequately emphasized that DOE recently has made more progress in taking and analyzing samples and in completing other characterization activities.

DOE and Westinghouse were concerned that our report could be interpreted to mean that because of problems with the characterization program, DOE could not ensure that the tanks are safe. DOE and Westinghouse officials believe that the tanks are safe because of the controls they have put in place over tank farm operations, including sampling activities. These controls are designed to prevent harmful releases due to such conditions as high temperature and/or flammability risks. We did not evaluate the level of safety associated with the tank wastes and did not intend to imply that the tanks are unsafe because of deficiencies in the characterization program. We revised our report to

clarify that DOE believes the tank wastes are being safely stored. However, our report does explain that the Safety Board has directed DOE to conduct additional characterization of tank wastes to ensure that they are safely stored. Until those characterization activities are complete and the waste constituents are better understood, DOE has placed controls over the tanks to provide an added level of assurance.

While DOE officials agreed with the value of having an outside technical review of the characterization program, they noted that DOE had recently begun such an effort with one of its contractors, Pacific Northwest National Laboratory. Specifically, DOE is planning to fund a study team to help resolve critical uncertainties related to the safety of the tank wastes. The team will also develop an approach to integrate data needs to support all aspects of the tank waste program, from current operations to treatment and disposal of the wastes. This proposal was drafted in December 1995, after we completed our field work. On the basis of the initial documentation DOE provided, it appears the study team will focus on resolving uncertainties related to tank safety rather than evaluate the viability of the characterization program. We continue to believe that a group, independent of ongoing tank waste and related DOE activities, needs to address the technical feasibility of the characterization strategy.

DOE and Westinghouse disagreed with our view that difficulties in characterizing the wastes could affect the remaining steps in the disposal program, including the design and construction of facilities to treat the wastes. DOE said that at sampling rates achieved since March 1995, it expects characterization of the wastes to be complete by 2004, which DOE believes is adequate to support the disposal program. In addition, DOE said that enough information exists now to proceed with the design and construction of treatment facilities. DOE expressed concern that any deferral of funding for remediation could make it difficult to keep the project moving forward to accomplish waste treatment and disposal. Ecology officials shared similar concerns.

We believe our report accurately describes the potential effect that characterization difficulties could have on the remaining steps in the remediation program. For example, even DOE's latest schedule for completing characterization could be in jeopardy. First, DOE is unsure if Westinghouse can maintain a core sampling rate of four to five samples per month. Recent additional controls placed on the tanks and other sampling problems may make this sampling rate difficult to achieve. Second, DOE's projected completion of characterization by 2004 is based

on a characterization approach that has not been validated. Third, quantities of certain waste constituents need to be determined to minimize uncertainties that affect the construction of treatment facilities. On the basis of our discussions with DOE and Ecology, we agree that facility design activities could proceed as characterization work continues, and we have modified our report accordingly. However, on the basis of this report and our previous work, we continue to believe that construction of treatment facilities should not be funded until the technical adequacy of DOE's characterization strategy is confirmed or established by independent sources and sufficient waste characterization information is available to reliably define the requirements of those facilities.

Scope and Methodology

Most of our work was performed at DOE's Hanford site in Washington State. To determine DOE's progress in meeting the tank waste characterization commitments, we reviewed tank waste characterization milestones that DOE committed to with the Washington State Department of Ecology and the Environmental Protection Agency in the Tri-Party Agreement and with the Defense Nuclear Facilities Safety Board. We compared these commitments with DOE's actual sampling results through September 1995, the latest month for which data were available.

To identify impediments to progress and determine what impact these impediments could have, we reviewed tank characterization reports, engineering studies, characterization technical basis documents, characterization project strategy documents, and other materials. We reviewed Ecology and Safety Board reports and correspondence with DOE on concerns associated with the characterization program, and we reviewed program documents detailing program improvements in the management of the characterization project and in Westinghouse's sampling capability. We also reviewed DOE's and Westinghouse's cost estimates of the characterization program and the Tank Waste Remediation System.

We supplemented our reviews of reports and other documentation by interviewing DOE and Westinghouse officials, including the assistant manager for DOE's Tank Waste Remediation System, the director of DOE's characterization division, Westinghouse's vice president for tank waste remediation, and various others with program responsibilities. We also interviewed officials from oversight agencies, including Ecology's Tank Waste Remediation System coordinator and characterization team leader, and Defense Nuclear Facilities Safety Board members and their staff.

We conducted our work from May 1995 through January 1996 in accordance with generally accepted government auditing standards.

As you know, 31 U.S.C. 720 requires the head of a federal agency to submit a written statement of the actions taken on our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Reform and Oversight not later than 60 days after the date of this letter and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of this letter.

We are sending copies of this report to appropriate congressional committees and other interested parties. We will also make copies available to others on request.

Please call me at (202) 512-3841 if you or your staff have any questions. Major contributors to this report are listed in appendix I.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Victor S. Rezendes". The signature is fluid and cursive, with the first name "Victor" and last name "Rezendes" clearly distinguishable.

Victor S. Rezendes
Director, Energy, Resources, and
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