

DOE/IG-0456

AUDIT  
REPORT

THE MANAGEMENT OF TANK WASTE  
REMEDICATION AT THE HANFORD SITE



JANUARY 2000

U.S. DEPARTMENT OF ENERGY  
OFFICE OF INSPECTOR GENERAL  
OFFICE OF AUDIT SERVICES

January 21, 2000

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman (Signed)  
Inspector General

SUBJECT: INFORMATION: Audit Report on "The Management of Tank Waste Remediation at the Hanford Site"

BACKGROUND

The production of nuclear weapons materials by the Department of Energy and its predecessor agencies generated a significant amount of highly radioactive and hazardous waste. Much of this waste, approximately 54 million gallons, is stored in 177 underground tanks at the Hanford Site in southeastern Washington State. Hanford has the largest number of underground storage tanks in the Department of Energy complex and many of these tanks have already leaked or are suspected to have leaked radioactive waste into the ground. Tank waste radionuclides have reached the groundwater that flows into the Columbia River.

For a number of years, the Department has operated a massive tank waste program at Hanford to address remediation issues relating to this waste. The Office of Inspector General conducted an audit of the management of the Hanford tank waste program in 1993. The audit found that the tank waste program was managed as a number of separate projects. As a consequence of not having an integrated baseline, the total cost and affordability of the overall project was unknown even though major commitments were planned for the construction of a processing plant. Construction of the plant never started; however, the Department undertook a privatization strategy to purchase waste processing services from best-in-class companies instead of building its own facilities.

In view of the estimated \$47 billion life-cycle cost of the tank remediation program at Hanford and the results of our prior review, we conducted the audit to determine whether the Department has a complete and integrated planning, budgeting, and management approach to achieve its project goals.

RESULTS OF AUDIT

At an estimated cost of nearly \$50 billion, the Hanford tank waste program is one of the largest, most technologically challenging environmental remediation efforts ever undertaken. In this context, the audit disclosed some progress since our 1993 review. However, we found that important elements of an integrated management approach were not in place:

- The project baseline has never been completed or validated.
- A critical path, with provisions for key decision evaluations, has not been defined and included in project planning.
- Regarding project planning, decisions relating to tank closure, use of retrieval technologies, plant processing and retrieval rates, and the availability of double-shell tank space are among those that could substantially impact the cost and duration of the project.
- The roles and responsibilities between project contractors have yet to be finalized.
- Working level interfaces between the Office of River Protection (ORP) and the Richland Operations Office have not been formally executed.
- A comprehensive project management plan for the project does not exist.

We could not obtain an explanation as to why the Department had not completed a management approach prior to the establishment of ORP. We identified several factors that have apparently hindered project planning and must be resolved for successful project completion. First, management believed that key dates in the Tri-Party Agreement for Hanford remediation between the Department, the State of Washington, and the U.S. Environmental Protection Agency (2018 for completion of single-shell tank retrieval and 2028 for completion of tank waste immobilization) were unrealistic. This led to a short-term focus on initiating waste processing at the expense of longer-term planning. In addition, frequent changes had been made to contracting and management approaches to the project. There was and had been a shortage of Federal personnel to manage the tank waste project. In mid-August 1999, there were 28 vacancies in ORP including key contract management positions. Finally, funding had been inadequate to address unresolved technical issues and required compliance work under the Tri-Party Agreement.

The Department has made progress since our last audit. Tank remediation is now managed as a single project. Certain cost and schedule elements of the project baseline have been established and actions were taken to implement interfacing relationships between the Department and its privatization contractor. Also, the congressionally mandated ORP was established in January 1999 and is developing a project management system including an integrated project baseline.

Without a complete and integrated planning, budgeting, and management approach to the tank waste remediation project, the Department may be unable to control, predict, explain, or defend future changes to cost and schedule. Changes have already occurred in this complex project significantly increasing life-cycle cost estimates. For example, the life-cycle cost estimate ranging from \$30 to \$38 billion included in the Fiscal Year 1996 Environmental Impact Statement has increased to \$47 billion. Other changes are likely as the baseline is further developed and refined. About \$3.8 billion has already been expended on this project. Meanwhile, Hanford remains the only Departmental site without tank waste treatment capabilities. Without a credible integrated baseline, the Department may not have convincing evidence that changes to milestone dates are warranted.

To address the issues discussed in this report, we recommended that the ORP develop and put into place an integrated project baseline to include all activities, a critical path, and provisions for key decision evaluations. In addition, we recommended that the ORP and Richland Operations Office negotiate realistic milestone dates with the State of Washington Department of Ecology and the Environmental Protection Agency.

#### MANAGEMENT REACTION

The Assistant Secretary for Environmental Management concurred with the report's finding and recommendations. The Assistant Secretary's comments and proposed corrective actions, which are an integral part of this report, are included verbatim in Appendix 3.

cc: Deputy Secretary  
Under Secretary

# The Management Of Tank Waste Remediation At The Hanford Site

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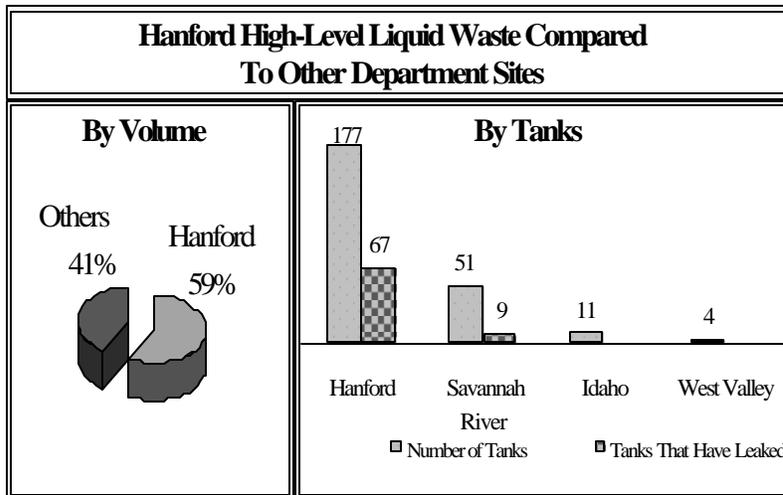
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# Overview

## INTRODUCTION AND OBJECTIVE

Approximately 54 million gallons of highly radioactive and hazardous waste are stored in 177 underground tanks at the Hanford Site in southeastern Washington State. This waste, comprised of liquids, slurries, sludges, saltcakes, and solids, was generated as a byproduct of the production of materials for nuclear weapons beginning in 1944. There are 149 single-shell and 28 double-shell tanks that range in capacity from 55,000 to 1.16 million gallons. Although Hanford has the largest number of tanks and amount of high-level waste in the Department of Energy complex, it is the only site without treatment capabilities.

At least 67 single-shell tanks at Hanford are known or suspected to have leaked in the past as the concrete and steel structures have deteriorated. About 1 million gallons of waste have seeped into the ground and radionuclides are moving faster than previously estimated. These radionuclides have reached the groundwater that flows under the Hanford Site and connects with the Columbia River.



In 1989, the Department of Energy, the U.S. Environmental Protection Agency, and the Washington Department of Ecology signed the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement). This agreement was intended to ensure compliance with the Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act. It established milestones and a schedule for cleanup and restoration of the Hanford Site over a 40-year period. Key tank waste provisions provided for the removal of waste from all single-shell tanks by September 30, 2018, and immobilization of all tank waste by December 31, 2028.

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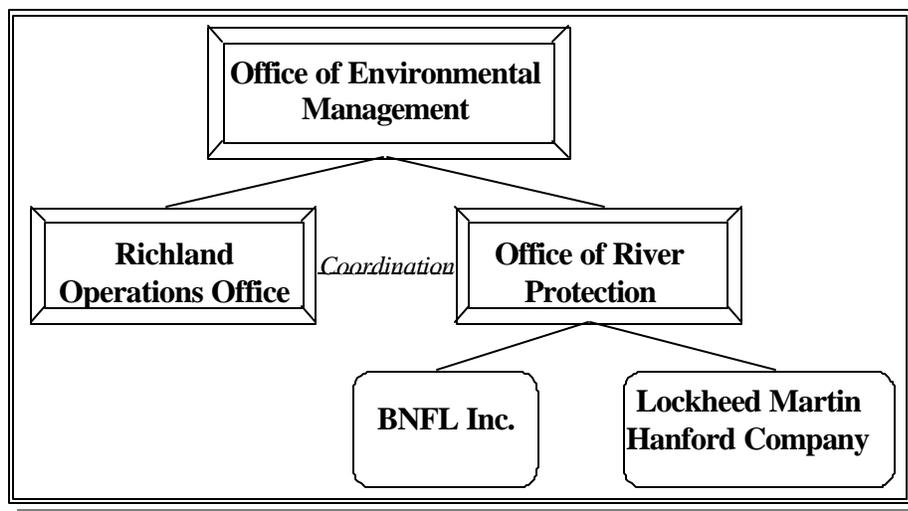
In response to the environmental concerns at Hanford, the Tank Waste Remediation System program was established in Fiscal Year 1992. The mission of the project was to store, treat, immobilize, and dispose of tank waste in an environmentally sound, safe, and cost-effective manner. The Department initially planned to start construction of a government-owned, contractor-operated plant to vitrify waste in March 1993. This plant would convert high-level waste into glass logs that would be sealed in canisters. Low-activity waste was to be treated through grouting.

The Office of Inspector General conducted its last comprehensive audit of the tank waste project in 1993. Our report, *Department of Energy's Management of High-Level Waste at the Hanford Site* (DOE/IG-0325), noted that the tank waste program was managed as a number of discrete projects without an integrated cost, schedule, and technical baseline. Also, the total cost and affordability of the overall project was unknown at that time even though major commitments were planned for the construction of a processing plant. However, construction of the plant never started and the Department embarked on a privatization strategy in 1994.

In September 1996, the Department entered into contracts with two contractor teams to build and operate demonstration facilities. Starting in 2002, these facilities would convert 6 percent of Hanford's tank waste into glass logs by 2007 and up to 13 percent of the waste by 2011. The Department estimated that it would cost \$3.2 billion for the two fixed-price contracts in constant Fiscal Year 1997 dollars. These contractors would then compete for a contract to process the remaining waste.

Based on a detailed review of the work of each contractor, the Department, in August 1998, decided to restructure the privatization contract and to authorize only BNFL (a subsidiary of British Nuclear Fuels, plc.) to proceed into the design phase. In August 2000, the Department is scheduled to decide whether to proceed with the construction and operations portion of the BNFL contract to process at least 10 percent of the tank waste. If BNFL is authorized to proceed, it will complete the design and construction of the waste treatment facilities and begin processing waste at fixed-unit prices. Cost estimates for the first phase of the treatment activities have more than doubled to \$6.9 billion (in Fiscal Year 1997 dollars), while the schedule has been extended from 2007 to 2017.

The Office of River Protection (ORP), established in January 1999, administers the BNFL privatization waste processing contract. ORP also administers a separate contract with Lockheed Martin Hanford Company (Lockheed Martin), which is responsible for tank stabilization and waste storage, retrieval of the tank waste, interim storage of the high-level vitrified immobilized waste, and onsite disposal of immobilized low-activity waste. The Department's official cost estimate for the tank waste project is



\$47 billion. In 1998, the project represented approximately 18 percent of the Department's total environmental liability. The official schedule indicates that waste from the single-shell tanks will be removed by September 30, 2018, and immobilization of all tank waste will occur by December 31, 2028, in accordance with the Tri-Party Agreement. In consideration of the project's importance, cost, significant changes in management and contracting approaches, and the results of our prior review, the objective of this audit was to determine whether the Department has a complete and integrated planning, budgeting, and management approach to achieve its project goals.

## CONCLUSIONS AND OBSERVATIONS

Although progress has been made, the Department does not have a complete and integrated planning, budgeting, and management approach to the tank waste remediation project. Management is working to develop such a system, but much more needs to be done to bring this project into conformance with Departmental project management guidelines. Without such an approach, the Department may not meet key milestones, costs could substantially escalate, and continued damage to the environment may occur.

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There have been a number of positive changes since our last audit. The tank waste cleanup effort, now called the River Protection Project (RPP), is being managed as one project. Many cost and schedule elements and roles and responsibilities between the Department and BNFL have been established. In addition, ORP has provided increased management attention to tank waste remediation and was developing a project management plan. Despite these accomplishments, key project management components have yet to be established and put into place to control the cost, schedule, and technical direction of the project.

The project baseline has undergone significant changes with the evolution of the privatization approach, but had not been completed nor validated. A complete project critical path had not been established nor had key decision points been defined. Also, design work for the vitrification facility was behind schedule. Finally, interfaces between Lockheed and BNFL and an overall project management plan have not been finalized.

We could not obtain an explanation as to why the Department had not completed a management approach prior to the establishment of ORP. In our discussions with project managers, a number of apparent contributing factors surfaced. First, management believed that key dates in the Tri-Party Agreement (2018 for completion of single-shell tank retrieval and 2028 for completion of tank waste immobilization) were unrealistic. This belief led to management's short-term focus on initiating waste processing at the expense of longer-term planning. In addition, frequent changes have been made to contracting and management approaches to the project. There had also been a shortage of Federal personnel to manage the tank waste project. In mid-August 1999, there were 28 vacancies in ORP including key contract management positions. Finally, funding has been inadequate to address unresolved technical issues and required compliance work under the Tri-Party Agreement.

The absence of an integrated project baseline, a critical path, interface agreements between project principles, and a comprehensive project management plan have put the tank waste project at risk. The history of the tank waste project demonstrates its susceptibility to cost increases and schedule delays. Sound project management tools are needed for controlling project cost and schedule growth, reducing environmental risk, preparing defensible budgets, and establishing meaningful performance measures. Such tools will also enhance the Department's credibility with its stakeholders. To

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facilitate the future success of the tank waste project, this report contains a series of recommendations to strengthen project management.

Management should consider the issues discussed in this report when preparing the yearend assurance memorandum on internal controls.

(Signed)

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Office of Inspector General

# The Management Of Tank Waste Remediation At The Hanford Site

## **Improvement In Project Management Is Needed**

The Department had not developed a complete and integrated management approach to achieve its goals for the \$47 billion RPP at Hanford. Key project management components have yet to be developed and implemented to control the cost, schedule, and technical direction of the project. Currently lacking are a complete and fully integrated project baseline, finalized interface agreements between contractors and other organizational elements involved in the project, and a comprehensive project management plan.

### Integrated Project Baseline

The project baseline is not fully integrated or complete. In addition, there has not been an independently validated baseline for this project in its 7 years. An integrated project baseline provides the foundation for a project from start to finish and is needed to manage changes in scope as well as monitor supporting contractors. The baseline should address three key elements of the project: technical, schedule, and cost. However, in the case of the RPP the technical and schedule elements had not been completed and integrated into the project baseline. To illustrate, a viable "end-state definition" – how much, if any, and what types of waste should remain in which tanks at project's end – had not been developed. Technical, schedule, and cost elements are each dependent on the end-state definition. In addition, facilities technical design work had not progressed as planned. Further, a critical path and decision points have not been established to address unresolved technical waste retrieval, processing, and storage issues in the schedule element.

A viable end state definition for tank closure was needed. The Tri-Party Agreement specified that 99 percent by volume should be retrieved, but the Department had not determined whether this was technically achievable or even desirable. New technologies are needed to retrieve waste from tanks in an environmentally sound manner. Furthermore, even if 99 percent retrieval is technically attainable, it may not be desirable considering cost, exposure to radiation, and technical practicability. Due to the differences in waste types, processing methods, and waste transformations over the last several decades, waste volume does not necessarily equate to environmental risk. A Departmental study showed, for example, that 90 percent of the long-term risk inventory was contained in approximately 68 tanks. The amount of waste that must be processed dictates the size and number of vitrification plants. Requirements for waste transfers, tank farm upgrades,

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and obtaining retrieval technologies are also dependent upon the end-state definition.

We also noted a likely shortfall in the design work that forms the foundation of the BNFL technical baseline. Under the BNFL contract, construction of the vitrification plant is to begin after the design work is approximately 30 percent complete (August 2000). At the 30 percent stage, all major processes and systems would have been designed. According to ORP personnel, it now appears that BNFL's design work will be, at most, 25 percent complete by August 2000. Shortfalls in design should be a matter of concern since simultaneous design, construction, and technology testing only increases the need for additional cost and schedule contingencies that can increase prices for treated waste. It also raises the likelihood of additional cost increases during the balance of the project.

Additionally, ORP had not established a critical path or defined decision points to address unresolved technical waste retrieval, processing, and storage issues in the schedule baseline. Unanswered technical questions exist and must be addressed at specific points in time to allow for proper planning and budgeting decisions and to avoid any potential negative impacts to project technical scope, cost, and schedule. The following illustrate the importance of some of these issues to project planning:

Retrieval Technologies for Single-Shell Tanks – For the 67 tanks that are known or suspected to have leaked in the past, the use of the current retrieval technology, hydraulic sluicing, may not be advisable due to the potential for further contamination of the surrounding environment.<sup>1</sup> Resolution of the retrieval issue should be reflected on a critical path because it could significantly change the technical scope, schedule, and cost of activities currently estimated at over \$6 billion.

Plant Processing and Retrieval Rates – To meet the present schedule, plants would need to process waste at an unprecedented rate of 120 metric tons of glass per day. At this rate, according to an in-house study, contracting for expanded processing capacity must begin in 2002 in order to meet the Tri-Party Agreement milestone date of December 31, 2028, for

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<sup>1</sup> With sluicing, high-velocity streams of water mix up the waste allowing it to be pumped from the tanks.

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complete tank waste immobilization. Questions exist as to whether this level of processing can be attained and whether facilities with such a large capacity would be efficient.<sup>2</sup> Furthermore, processing capacity is affected by the delivery rate of waste feed that is, in turn, constrained by the limited number of tanks that can be retrieved at any one time. Critical decision points for timely resolution of this issue have not been established and incorporated into the schedule baseline.

Adequacy of Available Tank Space – Similarly, decision points regarding potential storage issues have yet to be established and incorporated into the schedule baseline. ORP may not be able to adequately protect the groundwater unless it builds additional tanks. Presently, only the 28 double-shell tanks can be used to accept waste. However, space is limited in these tanks and is further constrained by requirements to store new waste from environmental cleanup and from single-shell tank stabilization. Compounding this problem are differences in waste compositions (what can be mixed with what) and the need to provide four specific waste feed formulas to the processing plant. Additional tanks may develop problems, such as the current problem with tank SY-101. Because of its rising crust, 100,000 gallons of waste must be transferred from SY-101 requiring the unplanned use of already limited serviceable tank space. Due to the long lead-time for budgeting, contracting, and constructing new tanks and the significant costs involved, planning for addressing this issue is crucial and decisions must be timely.<sup>3</sup>

A sound baseline and critical path are important for controlling the technical direction, cost, and schedule of this project. In their absence, management had begun development of a logic system which (1) graphically showed the sequencing of major project activities, and (2) was designed to generate technical, cost, and scheduling data for the

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<sup>2</sup> To put processing levels in perspective, the Department's Defense Waste Processing Facility at Savannah River began radioactive waste operations in March 1996. As of December 31, 1998, that facility had produced over 2 million pounds of high-level waste glass. This equates to a processing rate of about 330 metric tons per year.

<sup>3</sup> It takes 5–6 years after the decision is made to completely construct a double-shell tank with an estimated cost to build a new 1 million gallon tank ranging from \$60-\$172 million.

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initial baseline. As of August 1999, however, supporting details were still being developed and the logic system was incomplete. Until the logic system is complete and priced out, any life-cycle estimates will be uncertain.

#### Interface Agreements Between Project Principles

ORP had also not fully defined roles and responsibilities (interfaces) within and between the organizations responsible for the day-to-day execution of the project. Successful management of the project requires the establishment and management of interfaces within ORP and between the different participants: ORP, Richland Operations Office (Richland), Lockheed Martin, and BNFL.

An internal memorandum of agreement between ORP, Richland, and the Office of Environmental Management had been drafted regarding the organizational authorities, roles and responsibilities, and reporting structure for ORP. However, working level interfaces between ORP and Richland and within ORP need to be finalized. This is particularly important because Richland is responsible for the Hanford Site as a whole and all other site projects and integration. For example, ORP will have to work with Richland on permit applications for the BNFL processing facilities.

Interfaces between ORP and BNFL have been established, but corresponding agreements have not been finalized between ORP and Lockheed Martin. It will be important for Lockheed Martin to operate under a clearly defined set of roles and responsibilities. However, the plan defining Lockheed Martin's interfaces with ORP for carrying out their project responsibilities was under development during our review. Additionally, interfaces between Lockheed Martin and BNFL have not been established. Interfaces with clearly defined roles and responsibilities are crucial to ensure a systematic waste feed to BNFL by Lockheed Martin, and the acceptance of immobilized waste from BNFL for storage and disposal by Lockheed Martin.

#### Project Management Plan

In addition, ORP had not developed a comprehensive management plan defining the integrated project baseline with a fully developed critical path, management controls, and a framework for integration. Since its inception in Fiscal Year 1992, the tank waste program had functioned without a

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formalized project management plan. During our audit, we noted an ongoing effort by ORP to develop a comprehensive and integrated project management plan. This effort was referred to as the Strategic System Execution Plan. This plan is intended to be a blueprint for managing all aspects of the project. In developing this plan, ORP recognized that much remains to be done to put in place the organization, planning, staffing, and financial arrangements necessary to enter the next phase of the BNFL contract. An analysis performed internally by ORP personnel identified gaps in project management including the need to: develop a life-cycle critical path at the strategic level, institute additional performance measures, build a roadmap for project alternatives at the baseline management level, and establish integrating product teams at the work management level.

### **An Integrated Management Approach Is Necessary For A Project's Success**

Departmental guidance and industry standards prescribe the framework for project management. The Department's project-based management system defines and requires the development of integrated site baselines with site critical paths, and project management plans. Additional Departmental guidance also emphasizes the importance of planning, integrated baselines, a critical path, and effective interfaces to the success of a project. Industry standards prescribe the critical path method to schedule activities and logically link them in a network that focuses attention on those crucial to project completion. In addition, the Department has made commitments to the Congress regarding this project and its management.

A project baseline consists of the technical, cost, and schedule baselines. Sound integrated site baselines provide a basis for controlling scope and cost growth and support the preparation of defensible budgets. In addition to being the starting point for the Office of Environmental Management budget process, the project baseline is also used in the identification of critical project activities and the development of meaningful performance measures and contract incentives. A critical path identifies the longest sequence of connected activities necessary for project completion and should be included in schedule baseline. With such a path, management attention is focused on those activities and decisions crucial for project success. Clearly defined roles and responsibilities, in turn, are critical to the successful execution of projects on the path. Site critical paths, built from individual projects critical paths, are used by the Office of Environmental Management as a tool to focus project management efforts on achieving site cleanup and closure and to evaluate and take action to reduce programmatic risk.

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**Challenges To Project  
Management Integration  
Exist**

Departmental reports to the Congress acknowledged the need for project integration and outlined a management approach and plan. The project management approach set forth in a July 1998 report and in a January 1999 ORP Integrated Management Plan emphasized the need to ensure integration across all RPP and Hanford Site activities. Included in the ORP Integrated Management Plan was a commitment to prepare a project management plan that would define the project baseline, management controls, and how the project is integrated. The July 1998 report also stipulated that approximately 30 percent of the vitrification facilities design was to be completed prior to proceeding with the construction and operations phase of the BNFL contract.

Department officials were generally aware of these project management shortcomings. However, we could not obtain an explanation as to why the Department had not completed a management approach prior to the establishment of ORP. Based on discussions with project managers and other analysis, we identified several factors that apparently hindered project planning. First, management believed that certain milestones were unrealistic. This led to an environment in which management's attention was focused on the more definitive short-term activities. Additionally, frequent changes in contracting and management of the project, shortages in Federal staff, and funding constraints have also adversely affected project management and long-term planning. Essentially, management's main focus had been on the next 10 years and initiating waste processing, rather than on all activities required for successful completion of the project.

Unrealistic Milestone Dates

The 1989 Tri-Party Agreement contained an enforceable action plan and milestone dates for cleanup of the Hanford Site. Management believed that key dates in the Tri-Party Agreement -- 2018 for completion of single-shell tank retrieval and 2028 for completion of tank waste immobilization -- were unrealistic. This apparently led to a short-term focus on initiating waste processing at the expense of longer-term project planning. The milestone schedule was established before the technical scope -- the work to be done and how to do it -- was determined for this project. Representatives from the Washington State Department of Ecology and the U.S. Environmental Protection Agency also acknowledged that these milestones were unrealistic.

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However, the Department did not choose to place a discussion of these milestones on the agenda of the most recent Tri-Party Agreement renegotiations.

In January 1999, a team of representatives from the Department, Lockheed Martin, the Pacific Northwest National Laboratory, and BNFL studied six options for completing the tank waste project. The team concluded that the single-shell tank waste retrieval milestone of 2018 was not technically feasible under present safety and operational constraints and with current retrieval methods. The team recommended proceeding with the option that could complete waste processing by 2047 rather than 2028. Although two options had the potential for processing the waste by 2028, both had significant issues and constraints, including:

- steep increases in annual funding due to the shorter timeframe,
- waste retrieval rates that exceeded current capability,
- inefficient use of plant capacity, and
- lack of demonstrated ability to retrieve 99 percent of the waste by volume.

#### Project Approach

Frequent changes in contracting and management of this project also impeded long-term planning. These changes have required corresponding adjustments in the project management. The evolution of ORP as manager of the project and integrator of the activities of multiple contractors and a shortage of Federal staff to manage the project were additional complicating factors.

The contracting strategy for this project had been restructured twice in the last 6 years. The Department initially planned to start construction of a government-owned vitrification plant in March 1993 to convert tank high-level waste into glass logs. However, in 1994 a new privatization demonstration strategy was initiated. Fixed-price contracts were awarded to two contractor teams in September 1996 for development of preliminary facility designs and project plans. Upon completion of these activities, only one contractor (BNFL), was chosen to proceed into a 20-month conceptual design period.

In addition to the changes in contracting approach, the Department's

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management approach has also changed. Concerned about the Department's ability to manage the Tank Waste Remediation System program, the Congress directed that the Department establish the ORP at Hanford to manage all aspects of the project. The Department established ORP in January 1999. Additionally, rather than report directly to the Richland Operations Office, as was the case under the Tank Waste Remediation System program, the ORP Manager reports directly to the Department's Assistant Secretary for Environmental Management. This reorganization caused changes in planning and resulted in vacancies in critical positions.

Successful execution of the project requires effective management by the Department and ORP in particular. Sufficient staff with the required expertise to manage the privatization and prime contracts is key for project success. ORP was to evaluate and negotiate the business and financing agreement with BNFL to establish fixed unit prices for waste treatment and immobilization services as well as manage the Lockheed Martin contract. However, vacancies existed in the ORP group responsible for these functions as well as in other key activities.

At the time of its establishment, the Department analyzed ORP staffing needs and authorized a Federal staff of 104, including 5 in a contract administration group. Recruiting action was expected to have been completed by the spring of 1999. As of mid-August 1999, 28 vacancies existed including a Fixed Price Specialist, a Senior Contract Specialist, and two Junior Contract Specialists. Moreover, the need for an additional Contracting Officer to administer the Lockheed Martin contract arose as the result of an agreement with the Richland Operations Office giving ORP direct control over the contract.

#### Funding Shortfalls

Recent funding decisions have also precluded addressing unresolved technical issues. For instance, Fiscal Year 1999 funding for the Hanford Tanks Initiative to develop retrieval technologies was reprogrammed for use in other activities. Further, there was no provision in the Fiscal Year 2000 budget for demonstrating new retrieval technologies. Improved retrieval technologies are needed to accomplish the retrieval portion of the project. Moreover, current estimates indicate that funding shortfalls may continue to exist. For each of the last 5 years, there had been about \$50 million in

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unfunded Tri-Party Agreement and other compliance work alone. Current estimates indicate that the shortfall for compliance may widen to between \$200-\$400 million in each of the years 2003 through 2006. While a remedy for this problem obviously requires congressional action, we concluded that the Department could be more successful in its requests for additional funding if it had a validated baseline and the other analytical tools called for in this report.

**Improved Project Management Could Better Control Overall Cost And Reduce Risk**

The magnitude and complexity of this project make it unique among challenges facing the Department of Energy. In fact, this project dwarfs most others. As a consequence, some cost and schedule variances are probably unavoidable. However, without a complete and integrated planning, budgeting, and management approach to the tank waste remediation project, the Department may be unable to control, predict, explain, or defend future changes to cost and schedule. In our view, absence of a complete and integrated approach to the tank waste remediation project could cause further increased life-cycle cost estimates, increased contingency estimates, increased risks to the environment, loss of congressional support, and damage to the Department's credibility. Shortcomings in project management can also result in ineffective performance measures and contract incentives.

Changes have already occurred in this complex project significantly increasing life-cycle cost estimates. The life-cycle cost estimate ranging from \$30 to \$38 billion included in the Fiscal Year 1996 environmental impact statement has increased to \$47 billion. Until the baseline is complete and priced out, further increases in life-cycle cost estimates are likely.

One area of potential higher costs, for example, is contingency planning. Contingency is added to cover uncertainties such as incomplete project definition, design shortfall, and technical complexity. Planning estimates totaling approximately \$22 billion for three major components of this project indicated that contingencies totaled about \$4.9 billion. This contingency estimate reflected a 42 percent increase to operating costs for uncertainties associated with successful retrieval of waste in the tanks as well as the incomplete design data. It also reflected increases of approximately 39 percent to construction costs for the design uncertainties. Properly addressing the need for a viable end-state definition, additional design work, and critical path to address unresolved technical issues can reduce the need for cost

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contingencies.

Decisions based upon unrealistic assumptions can also lead to increased environmental risk. The groundwater under more than 85 square miles of the site is contaminated above current standards. The migration of such materials already presents a threat to the public health, welfare, and the environment. Approximately 70,000 people use groundwater and surface water obtained within 3 miles of the Hanford Site for drinking.

Programmatic decisions made based upon the use of unrealistic planning assumptions could further exacerbate the environmental risk. Extending the use of single-shell tanks already beyond design life as well as double-shell tanks near or beyond their design life would increase risk to workers, the public, and the environment.

Project management shortcomings may also affect funding. While privatization funding has been consistent with recent outlays, the Congress now has to address a privatization budget of \$606 million for starting construction of the vitrification facilities in Fiscal Year 2001. This is a significant increase over the Fiscal Year 2000 budget of \$106 million. Future privatization funding requirements will be even higher. Favorable congressional action on such funding requests could be impaired by continued project management shortcomings.

Poor project management damages the Department's credibility with its key stakeholders, such as the State of Washington and the Environmental Protection Agency. Beginning in 1989, for example, the Department agreed to certain milestones for tank waste cleanup as part of the Tri-Party Agreement. Officials in all three parties apparently now believe that some of those milestones are unrealistic. Without a credible integrated baseline and critical path, however, the Department cannot positively demonstrate what is achievable, what uncertainties remain to be resolved, and what possible effect resolution of those uncertainties may have on project cost and schedule. In our 1993 report, we pointed out that the State of Washington, in a related context, required that a request for delay be accompanied by clear and convincing evidence justifying the delay, as well as draft dates for alternative milestones. Without project management components in place, the Department may not have convincing evidence that changes to milestone dates are warranted.

Finally, the absence of an integrated baseline identifying a critical path

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eliminated the basis for establishing meaningful performance measures. Critical paths identify those activities that are crucial for completion of the project. Properly measuring progress and incentivizing the completion of these activities can help prevent negative impacts to the project cost and schedule.

The Assistant Secretary for Environmental Management should:

## RECOMMENDATIONS

1. Require the Manager, ORP to:
  - a. Complete development and implementation of the integrated project baseline to include all activities, a critical path, and provisions for key decision evaluations, and have Departmental Headquarters validate the end product.
  - b. Re-evaluate the risk of proceeding into construction of the vitrification facilities at Hanford in August 2000 when the design of these facilities is expected to be less than 30 percent complete.
  - c. Develop and implement interfaces between project principles.
  - d. Finalize development and implementation of an overall project management plan.
  - e. Fill critical contract administration vacancies.
2. After the development of a fully integrated baseline, have the Manager, ORP, and Manager, Richland Operations Office, negotiate new milestone dates, if required, for single-shell tank retrieval and completion of tank waste immobilization and re-evaluate the end-state definition for closing tanks with the State of Washington Department of Ecology and the Environmental Protection Agency.
3. Work with the Congress to fund the RPP sufficiently to meet all other Tri-Party Agreement requirements. If unsuccessful, have the Manager, ORP, and Manager, Richland Operations Office, expand negotiations with the State of Washington Department of Ecology and the Environmental Protection Agency to address any other milestone dates requiring revision because of funding shortfalls.

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**MANAGEMENT  
REACTION**

The Assistant Secretary for Environmental Management concurred with the report's finding and recommendations. The Assistant Secretary's comments and proposed corrective actions are included verbatim in Appendix 3.

**AUDITOR  
COMMENTS**

Management's proposed corrective actions are responsive to the report's recommendations. The report has also been revised to incorporate technical clarifications and corrections included in the comments provided by the Assistant Secretary for Environmental Management.

# Appendix 1

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## SCOPE

The audit was performed at Department Headquarters in Washington, DC and Germantown, MD; the Richland Operations Office and ORP in Richland, WA; and the GTS Duratek Pilot Melter Facility in Columbia, MD, from April to November 1999.

## METHODOLOGY

To accomplish the audit objective we:

- Reviewed Departmental and external assessments of the Tank Waste Remediation System program;
- Reviewed applicable laws and regulations including Departmental requirements and good practice guides related to program and project management;
- Reviewed the ORP Integrated Management Plan, provisions of the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement), and the privatization contract with BNFL;
- Held discussions with personnel from the Headquarters Office of the Deputy Assistant Secretary for Waste Management and Office of the Associate Deputy Secretary for Field Integration;
- Held discussions with field-level representatives from the Richland Operations Office, ORP, and its supporting contractors, the Environmental Protection Agency, and the Washington Department of Ecology;
- Evaluated the Tank Waste Remediation System Program Logic, Baseline Plan and Strategic Options, and related performance agreements;
- Examined program office documentation including the Fiscal Year 1999 Tank Waste Remediation System Multi-Year Work Plan, Fiscal Year 1999 Performance Expectation Plan, Fiscal Year 2000 Annual Performance Plan, and cost estimates for privatization functions;
- In accordance with the requirements of the Government Performance and Results Act reviewed the project performance measures; and
- Met with the Project and Operations Managers for the GTS Duratek

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Pilot Melter and toured their facility to obtain information on the current status and performance of the pilot melter.

The audit was performed in accordance with generally accepted government auditing standards for performance audits and included tests of internal controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed at the time of our audit. We did not conduct a reliability assessment of computer-processed data because such data was not relied upon during the audit.

The firm of KPMG LLP participated with the Department's Office of Inspector General in conducting the audit.

We discussed our findings with the Assistant Secretary for Environmental Management, the ORP Manager, and members of their respective staffs. Management waived an exit conference on this audit effort.

## Appendix 2

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### PAST AUDITS RELATING TO TANK WASTE ACTIVITIES AT THE HANFORD SITE

- *Department of Energy Management of High-Level Waste at the Hanford Site*, (DOE/IG-0325, April 14, 1993). The Department managed the Hanford tank remediation system as a number of separate projects not fully integrated into one major system acquisition. Total costs, therefore, were obscured and the Department had not clearly defined system requirements or developed overall cost and schedule baselines. Also noted were a vast array of uncertainties, including tank safety and inadequate information about the makeup of tank waste, that could significantly affect the program's cost and ultimate success. In response to the audit recommendations, the Under Secretary of the Department designated the Tank Waste Remediation System Program as one major system acquisition. Management also agreed to minimize funding commitments to the construction of a vitrification plant at Hanford to the extent practical while a rebaselining effort was being completed and project costs were identified.
- *Nuclear Waste: Department of Energy's Hanford Tank Waste Project - Schedule, Cost and Management Issues*, General Accounting Office (GAO) Report RCED-99-13, October 8, 1998. This audit was conducted in response to a request from the House of Representatives Chairman of the Committee on Commerce and the Chairman of the Subcommittee on Oversight and Investigations, Committee on Commerce, to review a revised Departmental approach to addressing the waste disposal problem at Hanford through a privatization contract. The report discussed (1) how the Department's current approach changed from its original privatization strategy; (2) how that change affected the project's schedule, cost, and estimated savings over conventional Departmental approaches; (3) what risks the Department was now assuming with this change in approach; and (4) what steps the Department was taking to carry out its project oversight responsibilities. Given the technical uncertainties stemming from the fact that the proposed waste treatment technology had yet to be tested at production levels on Hanford's complex and unique wastes, and management challenges such as obtaining needed contracting expertise, GAO concluded that the Department's financial risks were great.
- *Nuclear Waste: Understanding of Waste Migration at Hanford is Inadequate for Key Decisions*, GAO Report RCED-98-80, March 13, 1998. The audit report stated that the Department's understanding of how wastes move through the vadose zone to the groundwater was inadequate to make key technical decisions on how to clean up the wastes at the Hanford Site in an environmentally sound and cost-effective manner. The Department had no strategy in place for investigating the vadose zone. With the emerging evidence of waste migration from leaking tanks to the groundwater, the Department began to develop a strategy to investigate the vadose zone. While recognizing that the Department's management had made a strong commitment to dealing with vadose zone issues, GAO expressed the opinion that past actions had not been encouraging. GAO recommended that the Secretary of Energy develop a comprehensive vadose zone strategy for the Hanford Site that would address cleaning up the high-level waste tank farms and the cribs, ponds, trenches, and other waste sites. GAO also recommended that the Secretary of Energy reevaluate the Department's proposed strategy of removing additional wastes from single-shell tanks by injecting pressurized water into the tanks.
- *Nuclear Waste: Management and Technical Problems Continue to Delay Characterizing Hanford's*

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*Tank Waste*, GAO Report RCED-96-56, January 26, 1996. The audit report stated that continuing delays in characterizing Hanford's high-level waste led the Department to conclude in September 1995 that it could not comply with the agreed-upon deadlines contained in its Tri-Party Agreement with the State of Washington and the Environmental Protection Agency. Westinghouse Hanford Company, the Department's contractor, had been unable to characterize the contents of any of the tanks at Hanford sufficiently to declare them ready for remediation. GAO concluded that 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 developed treatment processes and facilities.

- *Department of Energy: National Priorities Needed for Meeting Environmental Agreements*, GAO Report RCED-95-1, March 3, 1995. The objective of the audit was to identify factors that hampered progress in the cleanup of DOE's nuclear weapons complex. Audit work was conducted at a number of the Department's field sites including the Hanford Site. GAO found that progress in cleaning up the weapons complex, as measured by the Department's completion of milestones set forth in agreements with regulators, had been slow because many agreements had turned out to be unrealistic and changes had proved difficult and time-consuming to negotiate. The report specifically referenced the Hanford Tri-Party Agreement signed in 1989 and noted that because the Department was unable to meet the milestones in it, the parties agreed to a re-negotiation of its provisions in January 1994. However, GAO concluded that even the revised milestones may not be realistic. GAO recommended that the Secretary of Energy (1) set national priorities for cleaning up the Department's contaminated sites using data gathered during an ongoing risk evaluation as a starting point, and (2) initiate discussions with regulators to renegotiate milestones that no longer reflect national priorities.
- *Nuclear Waste: Further Improvement Needed in the Hanford Tank Farm Maintenance Program*, GAO Report RCED-95-29, November 8, 1994. The audit was conducted to address concerns about the Hanford tank farm maintenance program expressed by the Senate Committee on Governmental Affairs. The audit concluded that some progress had been made in strengthening the tank farm maintenance program with the number of uncompleted maintenance projects reduced from 1,969 in January 1994 to 1,517 in October 1994. However the remaining backlog of projects was judged still too great to ensure that needed maintenance could be done in a timely manner. A new approach, called the "zone concept" was implemented at Hanford in October 1993 to improve the productivity of its tank farm maintenance. As implemented, however, the "zone concept" did not address the issues of reducing the time spent in preparing and closing out maintenance projects, developing benchmarks for measuring performance, and gathering and analyzing information about how much time and money are spent on individual work projects. GAO concluded that approaches at other Departmental sites offered opportunities for reducing the backlog.

## Appendix 3

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United States Government

Department of Energy

# memorandum

DATE: January 4, 2000

REPLY TO  
ATTN OF: EM-44

SUBJECT: Draft Report on "The Management of Tank Waste Remediation at the Hanford Site"

TO: Phillip L. Holbrook, Assistant Inspector General for Audit Services

We have reviewed the draft Office of Inspector General (IG) report on "The Management of Tank Waste Remediation at the Hanford Site." The IG report focuses on some critical aspects in the area of project management which need improvement in order to achieve success in the Tank Waste Remediation System (TWRS) Project. The recently established Office of River Protection, which manages TWRS, had self-identified several of the areas noted in this report and had corrective actions in progress prior to the start of the IG review. We concur with the recommendations, but we are providing some additional comments for your consideration.

The IG recommendations focused on three key areas: project management with associated systems and staffing requirements, the compliance agreement negotiated with the State of Washington and the Environmental Protection Agency, and critical funding needs. Considerable progress has been made in all of these areas since the establishment of the ORP to manage TWRS.

The Department concurs on the recommendation regarding the completion of the development and implementation of the integrated project baseline. The ORP has identified the need for a Project Integration Office (PIO) which is in the early stages of development and should be fully functional in the spring of 2000. This new office will manage all the project systems which support the project management structure including the integrated baseline, master schedule, and information systems. This will bring the focus of the management of the TWRS Project as a whole into one organization. As part of this, an integrated resource-loaded Level 0 schedule is being developed by ORP and scheduled to be complete in April 2000. The integrated schedule will include all BNFL and management and operating contractor TWRS activities, critical path, and provisions for key decision evaluations. The fully integrated Level 1 schedule will be published in August 2000 and will include: (1) a two-year detailed schedule, (2) an eight-year summary schedule, and (3) a life-cycle summary schedule. The Office of the Chief Financial Officer, Headquarters, is currently redefining the Department's project management processes. Validation of the baseline will be performed in accordance with the directives contained in these processes.

The report further recommends that ORP reevaluate the risk of proceeding into construction of the vitrification facilities at Hanford in August 2000 when the design of these facilities is expected to be less than 30 percent complete. ORP is planning to do a complete review of the risks of proceeding with the BNFL contract in the April through June 2000 time frame. Before authorizing BNFL to proceed, the Department will assure that all requirements listed

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in the contract with BNFL to achieve financial closure will be met. Construction is currently planned to begin in July 2001.

The report also recommends ORP develop and implement interfaces between project principles. Part of the mission of the newly established PIO is to identify all internal and external ORP interfaces and develop appropriate interface documentation to ensure the overall success in executing TWRS. Those interfaces will clarify requirements for all associated organizations, including contractor and DOE. This will be completed by September 2000.

We concur on the report recommendation for the development and implementation of an overall project management plan. The Project Management Plan for the TWRS Project is being developed. It is scheduled to be issued in May 2000.

Steps are being taken to fill critical contract administration vacancies as recommended in the report. The ORP has three contract administration positions. One is filled; and two, the Junior and Senior Contract Specialists, are still vacant. Work is underway for, these positions to be filled. The IG draft report indicated a need for an additional Contracting Officer to administer the management and operating contractor contract. That position has been filled.

Under the compliance agreement, the report recommends that EM require the Manager, ORP, and the Manager, Richland Operations Office, negotiate new milestone dates, if required, for single-shell tank (SST) retrieval and completion of tank waste immobilization. Near term Tri-Party Agreement (TPA) scopes for vadose zone are in place and discussions with Ecology have been initiated to redefine SST milestones consistent with the logics through 2008 as required by the treatment milestone negotiations. Outyear milestones for SST retrieval are closely linked to immobilization plant throughput and will be entertained with Ecology after suitable experience is gained from operation of the plant. The report also recommends they reevaluate the end-state definition for closing tanks with the State of Washington Department of Ecology and the Environmental Protection Agency. We concur with this recommendation. Consistent with the development of an integrated baseline, ORP has developed the initial scopes and schedules for defining the mission end-state based on cost and short-term and long-term risks consistent with Resource Conservation and Recovery Act (RCRA) and the TPA. Current logics define the scopes to collect the necessary data in these areas to support a National Environmental Policy Act closure Environmental Impact Statement on or about the 2009 timeframe. This will assist in defining the amount of waste to be retrieved from tanks and assist in sizing of the Phase 2 plant(s) in the 2012 timeframe.

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Finally the report recommends working with the Congress to fund the TWRS Project sufficiently to meet all other TPA requirements. If unsuccessful, it recommends negotiating changes to the TPA with the State and EPA to address any other milestone dates requiring revision because of funding shortfalls.

The Office of River Protection, along with the Assistant Secretary for Environmental Management, continues to work with the Congress in requesting sufficient funding to meet all other Tri-Party Agreements. Consistent with the Administration's deficit reduction agreement with the Congress, the Department has been required to prioritize its resources within constrained funding levels and is attempting to maximize its cleanup efforts through productivity improvements and the development of more efficient and less expensive technologies. ORP has also been working closely with the regulators and a lot of progress has been made to reduce this shortfall. If necessary, the Department will open discussions with the regulators on TPA milestones based on funding and baseline changes.

In addition to our comments on the IG report recommendations, there are a few facts in the report we would like to clarify or correct. In the introduction section on page 1, it is noted that more than 85 square miles of underground water has been contaminated at the Hanford site. We do not agree that all of this is as a consequence of the leaking tanks. Most of the plumes of contaminated groundwater resulted from past disposal and discharge practices. There are three identified waste management areas which may have been contaminated by waste from the tanks that leaked in the past or from surface discharges (spills) or ancillary equipment releases, e.g. pipes and headers. To date this contamination has been detected in 8 monitoring well samples that exceed drinking water standards. These three units are currently in RCRA assessment to determine the extent of existing impacts to groundwater.

Also on page 1, the statement that "risks to the environment and the people of the Northwest have been dramatically increased" may overstate the extent of the risks posed by contamination currently in the environment. A limited number of scenarios, that typically involve direct contact with contaminated soils or drinking water from groundwater resources near waste management areas, pose risks to future populations of on-site residents that exceed regulatory thresholds. However, no evidence exists that current or future off-site residents would be exposed to risks that exceed regulatory standards if cleanup plans are implemented as currently envisioned.

On page 6, in the discussion on retrieval technologies, the report states "for the 67 tanks already leaking . . ." There is no evidence that any single shell tanks are leaking at the present time. It would be more accurate to state that 67 of the tanks are known or suspected to have leaked in the past.

On the same page, in the discussion on tank space, there is a statement concerning a risk that more SSTs will begin leaking prior to being emptied. There is no evidence that tanks, once interim stabilization is complete, are at risk of beginning to leak prior to being emptied.

Interim stabilization will remove all pumpable liquids, and studies completed by ORP indicate that the tanks can be managed for a long duration without further threats to their integrity once the pumpable liquids have been removed.

On page 10, under funding shortfalls, it is noted that there is \$50 million of unfunded TPA work. However, the statement should be rewritten to more accurately reflect the shortfall to include other compliance work. We suggest the statement read “. . . \$50 million in unfunded Tri-Party Agreement and other compliance work alone.”

We appreciate the opportunity to review the draft IG report. Please include our comments as appropriate in your final report. If your staff has any questions regarding our comments, please contact Mark W. Frei, Deputy Assistant Secretary for Project Completion, at (202) 586-0370 or Ralph Lightner, Director, River Protection Office, at 301-903-7180.

  
Carolyn L. Huntoon  
Assistant Secretary for  
Environmental Management

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