U.S. Department of Energy

Office of Inspector General

Office of Audits and Inspections

AUDIT REPORT

Treatment of Salt Waste at the Savannah River Site

OAS-L-15-09

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Department of Energy
Washington, DC 20585

August 6, 2015

MEMORANDUM FOR THE ACTING ASSISTANT SECRETARY FOR ENVIRONMENTAL MANAGEMENT

FROM: Rickey R. Hass
Deputy Inspector General
for Audits and Inspections
Office of Inspector General

SUBJECT: INFORMATION: Audit Report: "Treatment of Salt Waste at the Savannah River Site"

BACKGROUND

The Savannah River Site (Savannah River), a Department of Energy (Department) site located near Aiken, South Carolina, was constructed during the 1950s to produce materials used in fabricating nuclear weapons in support of our nation's defense programs. The Department's Office of Environmental Management (EM) is responsible for the treatment and final disposal of the waste generated by these operations, including approximately 37 million gallons of high level radioactive waste stored in 45 aging underground tanks at the site. To maintain tank storage space at a safe level, evaporation is used to reduce the waste volume into crystallized salts (salt waste) that must then be disposed of. Considered to be the single largest environmental threat in the state, the Department manages its high level radioactive liquid waste inventory through legally enforceable agreements with the Environmental Protection Agency and the state of South Carolina. Substantial fines and penalties can be levied for missed milestones.

In 2002, to help meet its commitments, the Department contracted to build the high capacity Salt Waste Processing Facility (SWPF), the cornerstone of Savannah River's strategy for treating salt waste. The SWPF was to be built by 2008 at a total project cost of $900 million, with operations to begin in 2009. However, due to its inability to meet established milestones, the Department ultimately negotiated a conditional extension for SWPF to October 2015 and deployed an interim low capacity salt waste processing system, the Actinide Removal Process/Modular Caustic Side Solvent Extraction Unit (ARP/MCU). The Department also explored the potential to acquire supplemental treatment capacity through the deployment of a Small Column Ion Exchange (SCIX) system. Given the potential environmental impact and the importance of meeting enforceable milestones for treating high level waste, we initiated this audit to determine whether the Department had effectively managed the treatment of salt waste at Savannah River.

RESULTS OF AUDIT

We found that the Department's key salt waste processing facility, SWPF, was not operational and that the project experienced significant cost increases (about $1.4 billion to date) and

schedule delays, pushing the start date out to at least December 2018. As a result, the Department had treated only minimal amounts of salt waste at Savannah River. Further, the Department plans to decrease the amount of waste treated through its interim salt waste processing facility, ARP/MCU, to an average of 40 percent of its maximum capacity from fiscal years (FY) 2014 through 2018. Finally, the Department has suspended plans to deploy its supplemental salt waste processing capabilities, SCIX, that had the potential to provide significant additional treatment capacity.

Primary Salt Waste Treatment Facility

SWPF, the Department's key waste treatment facility designed to provide high volume treatment capacity for longer-term salt waste processing, is now 9 years behind schedule and nearly $1.4 billion over budget, with an estimated total project cost of $2.3 billion. Removing and treating the salt waste, which fills approximately 90 percent of the space in the site's 45 aging underground tanks, is an essential step to enable closing the site's liquid waste tanks that currently contain about 37 million gallons of waste. Salt waste removal and treatment is the central process within the site's Liquid Waste System and is instrumental for the successful completion of the liquid waste mission and overall environmental cleanup at Savannah River.

As such, the Department awarded a contract in 2002 for the design, construction, commissioning, and 1-year test operation of the high capacity SWPF. Construction was to be completed in 2008, with operations beginning in 2009. However, construction is currently only 84 percent complete and the remaining 16 percent of construction activity is significantly more complex. The estimated construction completion date has been pushed back to April 2016, and the Department recently announced that operations would not commence until the first quarter of FY 2019, at the earliest. Factors that likely affected some of the slippages and cost increases include:

- In 2004, the Defense Nuclear Facilities Safety Board requested that the Department redesign the SWPF to provide adequate natural phenomena hazard protection to confine radioactive materials during seismic events. In 2005, the Department adopted a local, safety-related performance category confinement barrier for SWPF. This led to significant initial delays in project construction.

- Faulty welds, discovered in early 2009, were found on piping used in floor drain lines for the SWPF. About one-third of the welds made by an equipment supplier had to be repaired due to poor quality work.

- The $437 million cost increase reflected in the March 2012 SWPF Estimate at Completion submittal is attributable to a number of factors and assumptions, including the impact of the late delivery of certain vessels. Delivery of the vessels slipped from the original planned date of June 2010 to June 2012. In response to further delivery delays, the project resequenced construction activities pursuant to an execution schedule that was never aligned with the approved performance measurement baseline schedule.

Therefore, the impacts of each construction work-around plan could not be determined for the entire project. This contributed to the misalignment of the Earned Value performance data, which masked performance issues and potential delays in the project.

- As noted in prior SWPF Construction Project Reviews, the project's risk management program is not being effectively used to manage the project or provide an early warning of potential cost and schedule impacts.

Creating greater uncertainty for the project, the Department had not reached agreement with the SWPF construction contractor for the cost of final construction closeout, facility commissioning, first year of test operations, and 6 months of facility support services. Furthermore, required modifications to existing facilities and support systems necessary for eventual SWPF operations have been delayed. The SWPF is closely tied to several interdependent operations. Given the large increase in salt waste volume that the SWPF is designed to process, modifications are required to existing transfer systems, utility services, and blend and feed equipment. In addition, significant technical requirements to implement nuclear facility safety standards for handling both radiological and chemical hazards must be completed. However, these necessary modifications and requirements are being postponed due to budget reductions, further jeopardizing the successful start-up of the SWPF when construction is complete.

Interim Salt Waste Processing

In 2008, the Department implemented an interim low capacity salt waste processing system, ARP/MCU, to bridge the gap in salt waste treatment until the SWPF became operational. ARP/MCU is designed to facilitate continued storage of liquid radioactive wastes within established safety margins and maintain routine Liquid Waste System operations. It was originally planned that this interim facility would terminate operations prior to start-up of the SWPF. However, after continued delays in completion of the SWPF construction project, it was necessary for the Department to extend the life of the ARP/MCU.

According to planning documents, the ARP/MCU can process 3 million gallons of salt waste per year. Additional equipment reconfiguration and filtration improvements could increase ARP/MCU capacity to 4.7 million gallons per year. Due to budget constraints, ARP/MCU was slated to process only about 1.3 million gallons of salt waste per year for FY 2014 through 2018, or an average of 40 percent of its current capacity. Furthermore, ARP/MCU processed only 551,000 gallons in 2014.

Supplemental Salt Waste Processing Plans

A planned third major component of the Department's salt waste processing strategy, SCIX, has been suspended. The Department's 2010 Liquid Waste System Plan established plans for SCIX to supplement salt waste processing operations and mitigate the impact on operations brought on by the SWPF construction delays, to include shortening the Liquid Waste System life cycle. SCIX is a modular capability and designed to process salt waste in parallel with ARP/MCU and the SWPF, when operational. This supplemental processing system was planned to process 3 million gallons of salt waste per year and, with additional enhancements, could process up to

4 million gallons per year. The Department estimated that it would cost approximately $100 million over 3 years to implement SCIX by FY 2018 and would cost about $50 million to operate annually or about one-half the estimated annual operating cost for the SWPF system.

The SCIX system was selected as a viable supplement to ongoing salt waste operations due to its unique advantages of near-term deployment and salt waste decontamination factors equivalent to SWPF. Specifically, the SCIX does not require construction of a new facility and has the potential for a second, simultaneous operation. Equipment modules are installed inside the tank risers of a double-shell waste storage tank, which provides both shielding and secondary containment for safety. A primary benefit of the SCIX system is that it introduces about 25 percent less water for each gallon of salt waste processed than the ARP/MCU and the SWPF. This capability presents an opportunity to shorten the Liquid Waste System life cycle and significantly reduce overall costs. The SCIX has also demonstrated the ability to remove radionuclide contaminants equivalent to the SWPF.

However, in September 2011, the Department suspended the SCIX program and redirected the remaining resources in response to a reduction of Savannah River operating funding. Instead of funding the SCIX, the Department chose to develop and test a solvent known as the Next Generation Solvent to enhance ARP/MCU and SWPF operations. The solvent would allow both the ARP/MCU and SWPF to significantly increase the amount of radionuclide contaminant removal.

External Technical Reviews

Due to significant cost and schedule overruns associated with the SWPF construction project, a senior EM official requested that an External Technical Review be conducted for the entire Liquid Waste System. The purpose of the review was to identify salt waste processing alternatives that could provide cost savings, schedule acceleration, and risk reduction, while achieving the Liquid Waste mission. The August 2013 review *Savannah River Site Salt Waste Processing Alternatives External Technical Review Report* contained multiple conclusions and recommendations regarding alternatives that could potentially provide a positive impact on the Savannah River Liquid Waste program costs and schedule**.**

Subsequent to the completion of this review, further construction and operations delays associated with the SWPF, coupled with projected near-term budget constraints, led the Department's Senior Management to request an update to the assumptions presented in the initial report to determine if technically and economically viable alternatives were still available. The updated evaluation, dated August 2014, reported that viable alternatives to the current treatment strategy appear to exist that offer significant life cycle cost savings and accelerated schedules within the current baseline. In fact, the updated External Technical Review concluded, in part, that there appeared to be options to accomplishing the Liquid Waste mission that do not require completion of the SWPF. The review examined, in depth, three scenarios using various operational combinations of the SWPF, ARP/MCU, and SCIX technologies. Two of the scenarios examined salt waste processing without the SWPF capability. An estimate for the total life cycle cost of each scenario was developed using data provided by the Department's Office of Program Planning and Budget. According to the analyses, the greatest potential cost avoidance,

up to $920 million, could be achieved by using a combination of ARP/MCU and two SCIX units without the SWPF. These approaches yielded a projected completion date 2½ years ahead of the projected completion date using SWPF.

Additionally, as part of the updated evaluation, the review team performed a sensitivity analysis that considered a scenario in which the SWPF project cost is increased and operations would continue another 6 years beyond the completion of bulk waste treatment to support residual waste removal from the storage tanks. In this scenario, the current strategy using the SWPF could be $920 million higher than the two-SCIX alternative. The initial review further concluded that a delay of 3 to 5 years beyond FY 2019 for the start-up of the SWPF would diminish its cost effectiveness and usefulness. Subsequent to the completion of the updated review, the baseline for the SWPF was increased by nearly $1 billion. This development would likely exacerbate the concerns raised by the review team related to the project's cost effectiveness. Regarding the SCIX, the initial review noted that past interest by the public sector to fund a SCIX system through commercialization should be investigated.

Path Forward

The Department recently determined that the completion of the SWPF is the best path forward. Senior EM officials told us that this decision considered the information reported in the external reviews. EM further concluded, however, that the reviews had not fully evaluated the risks associated with the various alternative scenarios. In particular, a senior EM official directly involved with the decision told us that the Department wanted to minimize risk by using existing technology. They added that economics alone was not the basis for their decision and indicated that they would examine other options like SCIX if SWPF project delays continue. Specifically, EM has been directed to:

- Address the FY 2016 funding shortfall to keep the ARP/MCU operating;

- Consider, in 2 to 3 years, maintaining the ARP/MCU as a standby facility after FY 2019 to provide a salt waste processing option if the SWPF encounters operating challenges in processing 9 to 12 million gallons of waste per year; and

- Consider, in FY 2021, completing development of SCIX to provide optionality if SWPF has operating issues.

SUGGESTED ACTIONS

In light of its recent decision that the SWPF will be the primary method to treat salt waste at Savannah River and given its history of schedule delays and cost increases, the Department should maintain a rigorous, intensive project management oversight regime to closely monitor construction progress. Should this process identify even potential additional delays or cost overruns, a fresh look at the viabilities of the SWPF should be undertaken.

Attachments

cc: Secretary
Deputy Secretary
Chief of Staff

OBJECTIVE, SCOPE, AND METHODOLOGY

OBJECTIVE

The objective of the audit was to determine whether the Department of Energy (Department) had effectively managed the treatment of its salt waste at the Savannah River Site.

SCOPE

The audit was performed from August 2013 through August 2015. It included a review of the Savannah River Site's (Savannah River) High Level Waste System operational plans for accomplishing salt waste treatment beginning in fiscal year 2013. We conducted work at Savannah River near Aiken, South Carolina, and obtained information from the Department's Office of Tank Waste and Nuclear Material in Washington, DC. The audit was conducted under Office of Inspector General project number A13SR033.

METHODOLOGY

To accomplish the audit objective, we:

- Reviewed applicable Federal regulations and requirements;
- Reviewed the Savannah River Site Liquid Waste System Plan;
- Reviewed current and planned operational budgets for the Liquid Waste System;
- Reviewed the Federal Facility Agreement and Site Treatment Plan for Savannah River;
- Reviewed prior reports related to planning, development, and implementation of strategies for the treatment of salt waste at Savannah River;
- Held discussions with departmental and contractor personnel regarding the treatment of salt waste; and
- Assessed departmental decisions regarding salt waste treatment alternatives.

We conducted this performance audit in accordance with generally accepted Government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objective. We believe the evidence obtained provides a reasonable basis for our observations based on our audit objective. Accordingly, we assessed significant internal controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. In particular, we assessed the Department's implementation of the *GPRA Modernization Act of 2010.* We determined that the Department had established performance measures related to treatment and disposal of salt waste at Savannah River. 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 rely on computerized data to accomplish the audit objective. Therefore, an assessment of the reliability of computer processed data was not performed. An exit conference was waived by the Office of Environmental Management.

FEEDBACK

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