U.S. Department of Energy

Office of Inspector General

Office of Audits and Inspections

AUDIT REPORT

Management of the Startup of the Sodium-Bearing Waste Treatment Facility

DOE-OIG-16-09

March 2016

Department of Energy
Washington, DC 20585

March 30, 2016

MEMORANDUM FOR THE SECRETARY

FROM: Rickey R. Hass
Acting Inspector General

SUBJECT: INFORMATION: Audit Report on "Management of the Startup of the Sodium-Bearing Waste Treatment Facility"

BACKGROUND

Under its contract for the Idaho Cleanup Project, CH2M-WG Idaho LLC was to design, construct, and operate the Sodium-Bearing Waste Treatment Facility (SBWTF) to treat 900,000 gallons of radioactive liquid waste that is currently stored in underground waste tanks at the Idaho National Laboratory. The 1995 Settlement Agreement required the Department to complete processing of the sodium-bearing waste by December 31, 2012. Following treatment, as required by the *Resource Conservation and Recovery Act*, the waste tanks were to be removed from service by December 2014. However, the project had cost and schedule issues, leading the Department of Energy's Idaho Operations Office to delay the planned start of operations a number of times. In December 2010, to address cost overruns, the Department implemented a contract modification where it placed a cost cap of $571 million for the construction of the facility. Any construction costs above that amount were to be borne by the contractor. Operating costs are fully reimbursable, are not subject to the cost cap, and begin after construction is complete.

In April 2012, the Department declared construction complete, beginning the project's operation phase, and in June 2012, CH2M-WG Idaho LLC initiated comprehensive performance testing, which involved operating the plant at high temperature with a nonradioactive simulant to prove full performance of the facility. On June 16, 2012, during testing, the facility experienced a "system pressure event" which led to the shutdown of the facility. The Department's investigation into the event revealed both operational and design deficiencies and the facility has been shut down since the event for modifications and repairs to the facility and process. We initiated this audit to determine whether the Department effectively managed the startup of the SBWTF.

RESULTS OF AUDIT

Our audit revealed significant problems with the Department's management of the startup of the SBWTF. In particular, we found that the Department moved the work associated with the comprehensive performance test, which demonstrates that the facility would perform its mission

as designed, from the construction phase of the project to the operations phase of the project. This project modification resulted in the Department not performing a rigorous test of the functionality of the facility before construction was declared complete. In lieu of the rigorous testing, the Department applied a lesser standard to validate that the facility was capable of operating as intended, a method that permitted the project to be transitioned to the operations stage while meeting the revised cost goal and shortly after the revised schedule goals. Such action deprived the Department of the opportunity to demonstrate with a high level of certainty that the plant would operate as intended, a fundamental expectation of the originally approved project scope. In fact, the comprehensive performance test was identified as a key performance parameter in the original project scope.

Changing, removing, or not performing key parameters during construction, while permissible, is inconsistent with one of the key tenets of the Department's project management procedures, as defined by Department Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*. Specifically, performance testing meets the definition of a "characteristic, function, requirement, or design basis that, if changed, would have a major impact on the system or facility performance, schedule, cost and/or risk for the project." Had the Department continued with its original project parameters and completed the comprehensive performance test during the construction phase, it may have identified the flaws in the original design and corrected those issues with construction funding and project management discipline.

Subsequent to the event, we noted that the Department concluded that the movement of comprehensive performance testing from the construction phase to the operations phase was based on questionable information provided to senior executive management. Specifically, executive management relied on test data and operating experience at other facilities to demonstrate mission readiness of the SBWTF. This approach was adopted even though there were significant differences between the facilities and that such differences rendered the test data insufficient to demonstrate readiness. In addition, we learned during the course of our audit that multiple project personnel told us there was pressure to declare the facility construction complete without exceeding the Congressionally approved line item construction project amount of $571 million, also the contractual cost cap for construction. Specifically, we were told that the original comprehensive performance test approach was deemed to be too time-consuming and would jeopardize the schedule and cost limitations for the construction project.

Additionally, we identified a weakness in Department Order 413.3B, which does not specifically require that comprehensive performance testing occur during the construction phase. The Order instead defines the point where construction is declared complete and operations are ready to begin as Critical Decision 4. Had the Order specified that comprehensive performance testing occur prior to Critical Decision 4, it would have been impermissible to postpone the test until the operations phase of the project.

Finally, the Department based its declaration of project completeness on Operational Readiness Reviews without the benefit of robust design reviews and thorough acceptance and startup testing using materials that simulate, to the greatest extent possible, the waste or other materials to be processed in the actual facility prior to the readiness reviews. According to Department officials, an Operational Readiness Review ensures that there is sufficient provision for off-

normal events in the current design and that people are adequately trained to operate the plant as the hazards are introduced. While the Department's Office of Health, Safety, and Security initially concluded that these reviews were appropriately executed, it subsequently performed a lessons learned review following the system pressure event and concluded that the reviews were not sufficiently robust for this first-of-a-kind facility and operations personnel were not prepared for startup.[1]

In light of the issues we identified, we concluded that the Department's cost cap did not successfully limit the construction costs borne by the taxpayers, and the total actual construction cost for this facility is likely understated by about $181 million thus far. Based on expenditures of $4 million per month, the future costs could exceed $40 million by the planned startup date of September 2016. Recasting these "operation costs" as construction costs would breach the approved limit of $571 million.

Department officials told us that other cleanup work at the Idaho site that might otherwise have been accelerated was not, because the funding for that work is being used to repair and reconstruct the SBWTF. In addition, in January 2015, the Idaho Department of Environmental Quality issued a Notice of Violation to the Department for failing to meet its commitment in the Resource Conservation and Recovery Act Notice of Noncompliance Consent Order related to the closure of the sodium-bearing waste tanks. Idaho levied a penalty on the Department of $648,000 with the potential for additional penalties if new milestones are not met. Also, a planned spent nuclear fuel shipment to the Idaho National Laboratory for research purposes has been suspended due to its failure to meet its cleanup commitment.

Improving cost and project management for large construction projects such as the SBWTF is essential if the Department is to resolve long-standing management weaknesses in this area. To address these important issues going forward, we made several recommendations designed to help others understand and avoid similar issues during major construction projects.

MANAGEMENT RESPONSE

Management partially concurred with the recommendations. Management agreed with our first recommendation but did not concur with Recommendations 2 and 3. Management's comments and our response are included in the body of the report. Management's verbatim comments are included in Appendix 3.

Attachments

cc: Deputy Secretary
Chief of Staff
Assistant Secretary, Office of Environmental Management

[1] In May 2014, the Office of Health, Safety, and Security was split into the Office of Enterprise Assessments, responsible for Independent Oversight Review Reports, and the Office of Environment, Health, Safety, and Security, responsible for developing Operating Experience Summaries.

MANAGEMENT OF THE STARTUP OF THE SODIUM-BEARING WASTE TREATMENT FACILITY

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MANAGEMENT OF THE STARTUP OF THE SODIUM-BEARING WASTE TREATMENT FACILITY

DETAILS OF FINDING

As defined in Department of Energy Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, Critical Decision 4 (CD-4) is the achievement of the project completion criteria defined in the Project Execution Plan, the approval of transition to operations, and the mark of the completion of the construction phase. The approval of CD-4 is predicated on the readiness to operate and/or maintain the system, facility, or capability. Prior to attaining CD-4, certain requirements must be met, including:

- Verifying that the Key Performance Parameters and Project Completion Criteria have been met;
- Ensuring that mission requirements have been satisfied; and
- Conducting an Operational Readiness Review (ORR).

A Key Performance Parameter is a characteristic, function, requirement, or design basis of a project that, if changed, would have a major impact on the system or facility performance, schedule, cost, and/or risk. Additionally, Department Order 413.3B specifies that the minimum Key Performance Parameters must stay intact for the duration of the project because they represent a foundational element within the original performance baseline. While changes should be avoided to the maximum extent possible, they were permissible under the Order.

The Department also recognizes that certain basic, project management principles are essential components of its framework for successful project execution. These principles include:

- Well-defined and documented project requirements;
- Well-managed project scope and risk-based performance baselines and stable funding profiles that support original cost baseline execution; and
- Development of reliable and accurate cost estimates using appropriate cost methodologies and databases.

Department Order 413.3B also states that successful project and contract execution is highly dependent on well-defined requirements that serve as the foundation upon which performance milestones are developed, achieved, and evaluated.

Startup of the Sodium-Bearing Waste Treatment Facility

The Department did not effectively manage the startup of the Sodium-Bearing Waste Treatment Facility (SBWTF). Specifically, we found that the Department postponed rigorous, comprehensive performance testing; an activity intended to demonstrate the facility's capability to function as intended and meet mission need, until after construction was declared complete. As originally envisioned, once the testing is successful, the project is moved from the

construction phase to the operations phase. However, by postponing the comprehensive performance test, the Department failed to perform a rigorous test of the functionality of the facility before construction was declared complete. The Department relied instead on other data to validate the operation of the facility and declare it complete within the cost cap established for the project and just beyond the revised estimated completion date. Had the testing been performed prior to declaring the project complete, the Department may have identified the flaws in the original design and corrected them under the discipline of its project management process. Instead, the design and construction rework that was performed to correct the deficiencies was conducted without the benefit and rigor of project management tools to, among other things, measure cost and schedule performance. In addition, the construction work was performed after construction was declared complete and used operating funds to pay for project costs.

Comprehensive Performance Testing

The Department's decision to postpone comprehensive performance testing from the construction phase to the operations phase proved to be detrimental to the project because, by doing so, management had little assurance that the facility would perform as intended when construction was declared to be complete and the operations phase began. In particular, in August 2010 the Department eliminated a key performance parameter that required comprehensive performance testing with a simulant similar in composition to the actual sodium-bearing waste and at temperatures approximating actual operating temperatures. Originally, this high temperature comprehensive testing was to be completed prior to CD-4, which began the operations phase of the project. However, the Department changed construction requirements to allow testing with heated nitrogen gas, rather than a liquid simulant, at a much lower temperature. The nitrogen gas did not test the functionality of the SBWTF in the same manner as would the liquid simulant testing, as it did not achieve the higher temperatures required for operations. When subjected to the lower expectations, the facility performed sufficiently well that management declared the project construction complete, and in April 2012, the operations phase commenced.

The more rigorous testing that included the higher temperatures and realistic liquid simulant was not eliminated, because it was fundamental to demonstrating operability of the facility. Instead, it was postponed until the operations phase of the project. During the more rigorous testing the facility experienced a system pressure event, which ultimately demonstrated several major weaknesses in design and construction of the facility, leading to the redesign of a number of systems, as well as additional construction work on certain components. We concluded, and a Department official confirmed, had the comprehensive performance test not been postponed, the costs for the redesign and reconstruction work would have been incurred during the construction phase of the project.

Project Management Rigor

Furthermore, all of the redesign and construction work to correct the weaknesses was performed without the benefit and rigor of the Department's project management process, as identified in Department Order 413.3B. Specifically, the redesign and construction work has not been managed with detailed project cost and schedule estimates, and the project baseline has not been

updated to reflect all modifications to the facility that have been identified since CD-4. Absent detailed cost and schedule estimates, measuring performance is difficult and less precise. Further, one Idaho official told us that they are not tracking CH2M-WG Idaho LLC's progress with performance milestones. The Office of Environmental Management (Environmental Management) Operations Activities Protocol for activities performed in the operations phase requires measurement of cost and schedule performance, as well as risk analysis. While Management asserted that a certified Earned Value Management System and risk management plan were in place, the redesign and construction should have been managed through definable scopes of work, cost, schedule plans, milestones, and performance metrics.

According to the Director of Project Management with the Office of Acquisition and Project Management, project management rigor should be applied to any type of construction work. He said that for construction-type work, cost and schedule (baseline) management should occur, and a work plan with milestones should be in place. Further, he stated that a detailed project cost accumulation by activity should be measured, as accurate project cost accumulation is necessary to improve the basis of future independent cost estimates.

Project Costs

We also found that capital costs of the SBWTF may be significantly understated. The Department established a cost cap for the SBWTF, a new management tool that was deemed a major success by Department officials because it held the contractor accountable for "construction completion" at the agreed upon price of $571 million, as this was the Congressionally approved line item construction project amount. However, the additional construction work to bring the facility back to operational status has cost the Department an estimated additional $181 million so far. Based upon prior year expenditures of $4 million per month, the future costs could exceed $40 million by the planned startup date of September 2016. Accordingly, the total actual construction cost of the facility is significantly understated, and the approved construction cost of $571 million has been exceeded, assuming the costs incurred after CD-4 for redesign and construction were recast to the construction project.

According to the Department's Financial Management Handbook, all costs of construction, which in general includes final testing and inspection, should be accumulated until the plant is beneficially occupied or placed into service. The Handbook requires that "the cost of components that are constructed for a project but that fail to perform as expected and are abandoned, as well as post-crystallization-of-design engineering work, should be included in the cost of construction…" However, we found that none of the redesign and rework that occurred after CD-4, costs which, in our view, clearly meet this test, was capitalized as construction costs for the facility. For example:

- Rework occurred on four filters used for capturing gases produced by the waste treatment process. The original design had each filter held in place solely by its own weight. The system pressure event revealed that they needed to be securely tied down to prevent solids from passing through. The redesign has the filters bolted down to prevent lifting under high pressure.

- Rework occurred on feed nozzles used for transferring waste for treatment. This design change was needed due to the nozzles experiencing erosion during testing. The first redesign was to use a ceramic insert in the nozzle, but the insert cracked as a result of differential heating. The second redesign was to plate the outside of the nozzle with an extremely hard and durable metal to withstand the erosive conditions.

These are just two examples from an extensive list of fixes made to the facility that have occurred, and additional rework is still underway. Further, although beneficial occupancy was declared in April 2012, this declaration was premature. Beneficial occupancy is the "stage of construction of a building or facility, before final completion, at which its user can occupy it for the purpose it was constructed." As of March 2015, project management informed us that they do not anticipate starting the treatment of waste in the operating SBWTF until 2016, because rework of the process equipment is still ongoing. Management informed us that this date has been negotiated with the Idaho Department of Environmental Quality as a compliance milestone.

Project Management

We attributed the problems we observed to weaknesses in certain project management practices. In particular, we found the basis the Department used for postponing the comprehensive testing was, in hindsight, not reasonable. We also found weaknesses in Department Order 413.3B related to project commissioning. Officials involved with the project also told us there was significant pressure to declare the facility complete without exceeding the line item construction project amount. In addition, the ORR process that was used to declare readiness to operate the facility was, according to Department reviewers, potentially flawed.

Basis for Decreased Testing

We noted that the basis for decreasing the performance testing that was to be conducted during the construction phase was, in the final analysis, not reasonable. Specifically, in a memorandum to the Deputy Secretary of Energy in 2010, the Assistant Secretary for Environmental Management asserted that the lower temperature heated nitrogen testing, together with extensive experience at non-Federal testing and waste treatment facilities, would be sufficient to confirm the functionality of the SBWTF. The memorandum also stated that Thor Treatment Technologies, the treatment process designer, asserted that the heated nitrogen testing would adequately demonstrate the facility mission readiness with a high degree of confidence. However, after analysis of the system pressure event, management officials concluded that there were deficiencies with these assertions as follows:

- The hot nitrogen test involved pumping heated nitrogen through the components of the facility to test the majority of the treatment process systems. However, the heated nitrogen could not produce sufficient heat to properly test the operability of the facility and did not use waste simulant. Multiple project officials have stated that the hot nitrogen testing was not sufficient to test the facility and that the more rigorous testing that was previously planned should have been performed prior to CD-4 being declared.

- The testing at Hazen Research Inc., which was used to help form the basis for the testing at the SBWTF, was only a one-tenth scale prototype facility, and the testing consisted of only two test runs, one of which was unsuccessful. In addition, there were significant differences between the two facilities. For example, the primary system that transforms the waste at Hazen did not have the same internal components due to scale limitations. Also, the safety standards used during the pilot plant testing were much less stringent than those used at the SBWTF during operations, primarily because Hazen is a nonradiological, nonnuclear facility. While these differences were not considered significant during testing, Idaho officials told us they subsequently realized that the differences were significant enough that full scale or even half-scale pilot testing should have been conducted prior to startup.

- The Erwin, Tennessee, facility, whose operating experience was relied upon to help form the opinion of the functionality of the SBWTF, is less complex and is used to treat wastes that are primarily organic and resin based. The Erwin facility uses a single vessel in the primary system that transforms the waste for storage, while the SBWTF uses a second vessel to reduce nitrogen oxide, as well as a different system to capture gases that result from treatment. In addition, the Erwin facility is much more hands-on; the maintenance of the facility is performed by personnel in contact with components. In contrast, at the SBWTF maintenance will be performed remotely, which requires a number of additional components to be installed in the facility.

Project Commissioning

We found that management did not perform a commissioning phase prior to construction completion. Although Department Order 413.3B defines CD-4 as operability of the facility, it does not specifically require a commissioning phase prior to CD-4 to determine operability. Commissioning is used to ensure that all facility and process systems have been constructed, are operational, and are verified to perform according to the design intent and the user's operational needs. According to industry standards, the main objective of commissioning is to confirm that the design intent of the components, systems, and the plant as a whole are achieved.

While the Department has taken steps to better understand project commissioning, it has yet to add this phase to its project management guidance. In particular, the Department created a Facilities Commissioning Working Group to advance a more transparent and predictable commissioning activity within the Department's capital facilities, and has completed the Environmental Management *Commissioning Experience Report*. The report is a review of the experience concerning the commissioning of 10 Environmental Management facilities, including the SBWTF. We noted, however, that it does not address whether commissioning was adequate for these facilities and does not offer corrective actions or a path forward in regard to changes to the commissioning process.

Pressure to Start Operations

Multiple project personnel have stated there was pressure to declare the facility complete, and this may have led to the lesser testing requirements and the rush to start up the facility.

Specifically, it was determined the original testing approach was too time-consuming, and continuing with the original comprehensive testing would have introduced significant schedule and cost risks to the project. In addition, according to one project official, it would have affected the cost cap negotiations. However, the decision to revise the testing approach had an unforeseen adverse consequence, as it shifted the risk and any additional costs of construction to the Department. Finally, we were told that the Department did not want to exceed the total project cost of $571 million, as this was the approved construction amount, and exceeding it would require the Department to request additional funds from Congress.

Operational Readiness Review

The Department based its declaration of project completeness in part on an ORR process that may have been ineffective. ORRs are based on records review, observations, and interviews of relevant personnel. According to Department officials, a properly completed ORR ensures there is sufficient provision for off-normal events in the current design and that people are adequately trained to operate the plant once hazards are introduced. Following CH2M-WG Idaho LLC's ORR, the Department conducted its own ORR independently of the contractor and, based on the review, declared the project complete and ready to transition to operations. Shortly after these reviews were conducted, the Department's Office of Health, Safety, and Security (HSS) determined that the degree of rigor applied during the ORR process was appropriate.[2] However, in fiscal year 2014, 2 years after the system pressure event, HSS conducted a lessons learned review and concluded that despite the ORRs meeting Department requirements, the ORR process was not sufficiently robust for commissioning this first-of-a-kind facility based on experience obtained from the smaller-scale demonstrations. HSS noted that the SBWTF differed not only in scale from the demonstration facilities but also in specific process features. With an assumed, but unproven, confidence in the facility design such that the equipment response to abnormal conditions would be recognizable, operations personnel were not prepared for startup.

Costs

As a result, the Department's cost cap did not successfully limit the construction costs borne by the taxpayers, and the total actual construction cost for this facility has been understated by about $181 million so far. Based upon prior year expenditures of $4 million per month, the future costs could exceed $40 million by the planned startup date of September 2016. Recasting these "operation costs" as construction costs would breach the Congressionally approved construction limit of $571 million. Department officials also told us that certain out-year work, such as waste exhumation and sludge treatment at the Subsurface Disposal Area, that might have otherwise been accelerated, cannot be performed because the funding that would be applied to that work has been used to repair and reconstruct the SBWTF.

In addition, in January 2015, the Idaho Department of Environmental Quality issued a Notice of Violation to the Department for failing to meet its commitment in the Resource Conservation and Recovery Act Notice of Noncompliance Consent Order. Idaho Department of Environmental

[2] In May 2014, the Office of Health, Safety, and Security was split into the Office of Enterprise Assessments, responsible for Independent Oversight Review Reports, and the Office of Environment, Health, Safety, and Security, responsible for developing Operating Experience Summaries.

Quality levied a $648,000 penalty on the Department, with the potential for additional fines and penalties if new milestones are not met. Idaho officials recently told us they now estimate that waste treatment operations could start by September 2016, barring unforeseen issues that could materialize as additional testing is performed. Also, a planned shipment of spent nuclear fuel to be used for research purposes was canceled by the Department when the SBWTF failed to meet its commitment to the State, in accordance with terms of the Idaho Settlement Agreement.

RECOMMENDATIONS

To address the weaknesses discussed in this report, we recommend that the Assistant Secretary for Environmental Management, in consultation with the Director, Office of Acquisition and Project Management:

1. Develop a lessons learned regarding reliance on scale testing and prior operating experience at other facilities to demonstrate facility readiness to operate at a first-of-a-kind facility, in order to ensure that the scale testing and operating experience is comparable to the first-of-a-kind facility; and

2. Ensure that first-of-a-kind, major projects within Environmental Management receive robust design reviews and undergo thorough acceptance and startup testing using materials that simulate, to the greatest extent possible, the waste or other materials to be processed in the actual facility prior to conducting ORRs.

In addition, we recommend that the Director, Office of Acquisition and Project Management:

3. Evaluate Department Order 413.3B regarding commissioning first-of-a-kind Environmental Management facilities and consider incorporating a commissioning phase before CD-4.

MANAGEMENT RESPONSE

Environmental Management partially agreed with the findings and recommendations. Management concurred with the first recommendation and stated that Environmental Management has already formed the Commissioning Group to provide an increased focus on plant commissioning to support upcoming project completions and to disseminate lessons learned from ongoing or completed projects. The group will also develop the *Commissioning Guide* that will include strategies and guidance for successful startup and commissioning approaches, including best practices for facility readiness in addition to the safety requirements for operational readiness.

Management did not concur with the second recommendation and stated that the ORR process did not need to be revised, asserting that the current ORR process meets its intended objective to ensure safe facility operations and protection of the environment. However, management also stated that the Department based its declaration of project completeness on ORRs that were not intended to accomplish that function. Management added that, "in attempting to utilize the ORR as a substitute for robust design review and final acceptance testing [Environmental Management] missed an opportunity to identify the design problems at an earlier stage and contributed to the overall cost increase of the project."

The Office of Acquisition and Project Management (OAPM) did not concur with the third recommendation. Management did, however, agree that commissioning the SBWTF should have been done prior to declaring the project complete. OAPM asserted that this recommended course of action had been considered in the past when the current Department Order 413.3B was being developed but that the program offices and Office of the Chief Financial Officer determined that the prudent course of action was for the program offices to make the final determination regarding a commissioning phase in their projects.

Management's comments are included in Appendix 3.

AUDITOR COMMENTS

Management's comment to Recommendation 1 was responsive.

In recognition of management's acknowledgement that ORRs are not intended to be a substitute for robust design review and final acceptance testing, we modified our recommendation to ensure that Environmental Management conduct robust design reviews and thorough acceptance and startup testing using materials that simulate, to the greatest extent possible, the waste or other materials to be processed in the actual facility prior to conducting the ORRs.

With respect to Recommendation 3, given that OAPM agreed that commissioning should have been performed prior to project completion, we believe Department Order 413.3B needs to be revised to encourage the use of a commissioning phase prior to CD-4 to ensure that all systems have been constructed, are operational, and are verified to perform according to the design intent and the operational needs. The Order should include a discussion of the project execution risks of proceeding to operations when commissioning is not adequately performed prior to CD-4.

Should management decide to retain its prior decision to allow the program offices to make the final determination regarding a commissioning phase, this decision can be made part of the Order. However, our audit demonstrated that the flexibility given to Environmental Management, in this case, allowed it to make a poor determination as to the extent of commissioning necessary. Given the Department's long history of ever-increasing project costs and schedules and related project management deficiencies, we believe it was unwise for any program office to act contrary to Office of Project Management Oversight and Assessments (formerly known as OAPM) advice.

OBJECTIVE, SCOPE, AND METHODOLOGY

Objective

The audit objective was to determine whether the Department effectively managed the startup of the Sodium-Bearing Waste Treatment Facility (SBWTF).

Scope

The audit was performed between June 2014 and March 2016 at Department Headquarters in Washington, DC, and the Idaho National Laboratory in Idaho Falls, Idaho. The scope of the audit included a review of the startup activities associated with the SBWTF. The audit was conducted under Office of Inspector General project number A14ID048.

Methodology

To accomplish the audit objective we:

- Reviewed applicable laws, regulations, orders, guidance, policies, and procedures;
- Reviewed related reports issued by the Office of Inspector General and Government Accountability Office;
- Held discussions with Department and contractor personnel;
- Analyzed industry standards pertaining to commissioning of facilities; and
- Analyzed project management requirements.

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 objectives. We believe that the evidence obtained provides a reasonable basis for our conclusions based on our audit objective. The audit included tests of controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. Additionally, we assessed the implementation of the *GPRA Modernization Act of 2010* and found that the Department had established performance measures related to project management of construction and operational activities. 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 computer-processed data to satisfy the audit objective and therefore did not conduct a data reliability assessment.

An exit conference was held with the Office of Environmental Management and the Office of Acquisition and Project Management on March 15, 2016.

PRIOR REPORTS

- Audit Report on *Cost Transfers at the Department's Sodium-Bearing Waste Treatment Facility Construction Project* (OAS-M-13-03, August 2013). The Sodium-Bearing Waste Treatment Facility (SBWTF) Construction Project experienced significant cost and schedule escalation. In 2010, the contractor transferred $13.1 million from the construction project to nonconstruction accounts. Because the facility was subject to a cost cap, this reduced the contractor's liability for the construction of the facility. Auditors examined the cost transfers and determined that three of the seven transfers totaling $7.9 million represented direct costs and should not have been transferred.

- Audit Report on *Processing of Sodium-Bearing Waste at the Idaho National Laboratory* (OAS-L-10-03, February 2010). The audit found that the Department had not always effectively managed the construction of the SBWTF. The Department did not ensure the project was managed under a sufficiently developed baseline and, as a result, costs were greater than anticipated and there may not have been sufficient schedule contingency. In December 2006, the Department approved the baseline with a cost of $461 million and start of operations in July 2010. However, the Department expanded the mission of the SBWTF without including all the necessary cost and schedule increases in the baseline. In January 2009, the Department increased the baseline by approximately $109 million. The Department acknowledged that contractor performance and Department directed changes contributed to increased cost and schedule of the project.

- Audit Report on *Management Controls over Changes to the Idaho Cleanup Project Contract Baseline* (OAS-M-08-10, July 2008). The audit found that more than 9 months passed between when the Department of Energy issued the Request for Proposal and the CH2M-WG Idaho LLC (CWI) contract became effective. During that time, changes to the work scope, and thus the contract baseline, were required. The auditors found that two of the changes removed work scope but not the associated costs. First, the processing of two waste streams was removed from scope; however, the $6.2 million of associated cost was not removed. Second, another change reduced the amount of work necessary to construct a containment facility but did not reduce the cost by the associated $5.9 million. The Department acknowledged that the costs were not appropriately reduced and they had not performed required cost/price or technical analyses of CWI's proposals. As a result, the baseline was overstated by $12.1 million, which could increase CWI's fee by as much as $4.3 million.

MANAGEMENT COMMENTS

Department of Energy
Washington, DC 20585

DEC 16 2015

MEMORANDUM FOR RICKEY R. HASS
DEPUTY INSPECTOR GENERAL
FOR AUDITS AND INSPECTIONS
OFFICE OF INSPECTOR GENERAL

FROM: MONICA C. REGALBUTO
ASSISTANT SECRETARY
FOR ENVIRONMENTAL MANAGEMENT

SUBJECT: Management Response to the Office of Inspector General Draft Audit Report, *Management of Start-up of the Sodium-Bearing Waste Treatment Facility* (IG-A14ID048)

The Office of Environmental Management (EM) appreciates the opportunity to review the Office of Inspector General (OIG) Draft Audit Report, *Management of Start-up of the Sodium-Bearing Waste Treatment Facility* (IG-A14ID048) that was issued September 29, 2015. EM would like to offer reaction to the recommendations, as well as provide comments on specific sections of the draft report (Attachment 1).

The report stated that the Department of Energy (DOE) did not effectively manage the start-up of the Sodium-Bearing Waste Treatment Facility (SBWTF). Specifically, the DOE-IG concluded that the Department postponed rigorous, comprehensive performance testing that would demonstrate the facility's capability to function as intended until after construction was declared complete (i.e., Critical Decision (CD)-4. The report also states that if the Department had completed comprehensive performance testing during the construction phase as per the original project baseline key performance parameters (KPPs) and not advocated for and obtained a waiver from those KPPs, it may have identified the flaws in the original design and corrected those issues with construction funding and the work would be subject to project management discipline. Furthermore, the report notes that, because of the varied nature of commissioning the capital asset projects across all DOE programs, establishing the technical requirements for performing plant commissioning is incumbent upon the respective program as approved by the appropriate Project Management Executive (PME) at CD-2. (Reference DOE Order (O) 413.3B, *Program and Project Management for the Acquisition of Capital Assets*). As such, the report recommends a more formal, mandatory commissioning phase be established in DOE O 413.3B. Furthermore, the draft report stated that the Department based its declaration of project completeness in part on an Operational Readiness Review (ORR) process that may have been ineffective.

The DOE-IG made three recommendations in the draft audit report. They are restated as follows (in italics):

To address the weaknesses discussed in this report, we recommend that the Assistant Secretary for Environmental Management, in consultation with the Director, Office of Acquisition and Project Management:

1. *Develop a lessons learned regarding reliance on scale testing and prior operating experience at other facilities to demonstrate facility readiness to operate at a first-of-a-kind facility, in order to ensure that the scale testing and operating experience is comparable to the first-of-a-kind facility; and*

2. *Perform a formal review of the program's Operational Readiness Review planning process and modify it, as necessary, to ensure its suitability for first-of-its-kind facilities.*

In addition, we recommend that the Director, Office of Acquisition and Project Management:

3. *Evaluate Department Order 413.3B regarding commissioning first-of-its-kind Environmental Management facilities and consider incorporating a commissioning phase before CD-4.*

With regard to the OIG recommendations, EM provides the following responses:

Reply to Recommendation 1.

DOE-EM concurs with the DOE-IG recommendation to develop and disseminate lessons learned from the start-up and commissioning of the SBWTF, particularly those lessons related to facility scale-up from pilot plant testing and appropriate tests and diagnostic capabilities during plant commissioning. DOE-EM has already formed an EM Commissioning Group to provide an increased focus on plant commissioning to support upcoming project completions (e.g., Salt Waste Processing Facility and the Low-Activity Waste Facility of the Waste Treatment and Immobilization Plant) and to disseminate lessons learned from ongoing or completed projects (e.g., SBWTF). The group will also develop an EM Commissioning Guide that will include strategies and guidance for successful startup and commissioning approaches, including best practices for facility readiness in addition to the safety requirements for operational readiness.

Reply to Recommendation 2.

DOE-EM non-concurs with the second recommendation to revise the ORR process. DOE-EM does not concur that the ORR process needs to be revised. As noted below, the ORR process has a very specific objective, i.e., to ensure operation of the facility or activity being evaluated, will be able to be done safely and protect the environment. Currently, the DOE directive governing ORRs is DOE Order 425.1D. This directive has

been revised several times, including most recently in 2010. A need for revisions to the ORR process, including the Order or companion DOE Standard, DOE-STD-3006, *Planning and Conducting Readiness Reviews*, are identified based upon lessons learned that the Order requires each ORR Team Leader to prepare at the end of each ORR, as well as input from the Defense Nuclear Facilities Safety Board.

General Comments

1. An ORR is not intended as a substitute for a design review or to validate an existing design. DOE O 425.1D identifies the expectations for an ORR. From Attachment 1, Page 7, the following is what an ORR is expected to accomplish: *(8) 4. In the opinion of the ORR team, adequate protection of the public health and safety, worker safety, and the environment has been maintained.*

2. The inadequacies of the design were uncovered by testing directed by, or authorized by, completion of the ORR, and prior to the introduction of radioactive materials. The ORR report identified a concern with the lack of process testing. From the ORR report: *"ENG.1-OBS-2: The limited amount of process testing prior to ORR and prior to Hot Operations may result in operational difficulties."*

   The recommendation by the ORR team was to allow the commencement of a specific plan that actually directed the testing that uncovered the flawed design.

   ".....The DOE ORR team recommends that the pre and post-start findings be closed by the DOE-ID in accordance with their existing procedures and processes. Upon closure of all pre-start findings and acceptance of corrective action plans for the post-start findings it is recommended that the IWTU facility be granted authorization for startup in accordance with PLN-3350, IWTU – Startup Plan..."

   It was the testing required in the startup plan that uncovered the flaw and it was clearly required by the ORR recommendation prior to any introduction of radioactive materials.

Attachment #1 contains additional comments regarding specific sections of the report that DOE-EM does not agree with.

Reply to Recommendation 3.

DOE-EM is not the programmatic office that is responsible for DOE Directive DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets.* Attachment 2 is a memorandum dated October 14, 2015, from Paul Bosco, Director, Office of Project Management Oversight and Assessments (PM), (the office responsible for DOE O 413.3B) to Rickey R. Hass, Deputy Inspector General for Audits and Inspections, Office of Inspector General (DOE-IG) that addresses Recommendation 3. The memorandum from PM to DOE-IG stated that PM strongly advised the Chief

Executive for Project Management (CE) against changing the Comprehensive Performance Testing until after CD-4 and altering the KPPs due to the additional project execution risks this change may introduce.

As discussed below, PM continues to support the authority of the CE and PME to establish the technical conditions (also known as KPPs) of successful completions of their capital asset projects. Accordingly, PM non-concurred with the recommendation to evaluate DOE O 413.3B regarding commissioning first-of-its-kind EM facilities and incorporating a commissioning phase before CD-4, project completion, as it believes it provides this necessary authority and leeway to DOE PMEs. That said, based on informal communication, they would be receptive to revisit this topic with the Programs with the next update of the Order.

PM noted that this recommendation was previously considered in the development of the current version of DOE O 413.3B. Based on dialogue with EM, the National Nuclear Security Administration, the Office of Science, and the Office of the Chief Financial Officer, it was determined that the prudent course of action was for Program Offices to make a determination regarding the extent of the commissioning process for projects involving nuclear/chemical processes when establishing project completion criteria. (Reference Appendix A, paragraph 5.d in DOE O 413.3B). Given the diverse portfolio of projects within the Department, DOE O 413.3B enables the applicable PME to make risk informed decisions about KPPs and CD-4 project completion criteria when establishing the Performance Baseline at CD-2, or during a Baseline Change Proposal.

DOE-EM appreciates the opportunity to submit this response for inclusion in the final audit report. If you have any questions, please contact me or Mr. Kenneth G. Picha, Jr., Deputy Assistant Secretary for Tank Waste and Nuclear Material, at (202) 586-2003.

Attachments:

1. Comments on specific sections of the draft DOE IG Audit Report
2. Memorandum dated October 14, 2015, from Paul Bosco, Director, Office PM, to Rickey R. Hass, Deputy IG for Audits and Inspections, DOE-IG

cc: Mark Whitney, EM-2
Kenneth G. Picha, Jr., EM-20 DAS
Steve Schneider, EM-20 Acting ADAS

Attachment 2

Memorandum dated October 14, 2015, from Paul Bosco, Director, Office PMOA, to Rickey R. Hass, Deputy IG for Audits and Inspections, DOE-IG pursuant to draft DOE IG report, *Management of Start-up of the Sodium Bearing Waste Treatment Facility* (IG-A14ID048)

Department of Energy
Washington, DC 20585

October 14, 2015

MEMORANDUM FOR RICKEY R. HASS
DEPUTY INSPECTOR GENERAL FOR
AUDITS AND INSPECTIONS
OFFICE OF INSPECTOR GENERAL

FROM: PAUL BOSCO
DIRECTOR
OFFICE OF PROJECT MANAGEMENT
OVERSIGHT AND ASSESSMENTS

SUBJECT: Inspection Report on "Management of the Start-up of the Sodium-Bearing Waste Treatment Facility"

The Office of Project Management Oversight and Assessments (PMOA), formerly the Office of Acquisition and Project Management, provides the following comments on the draft report.

General Comment

PMOA notes that the draft report does not fully document the multiple "deep dives" with the Chief Executive for Project Management (CE) which were conducted for SBWTF with the program office, project team and PMOA (then known as the Office of Engineering and Construction Management or OECM) to explore a variety of project related topics including the change of the key performance parameters (KPP) to move the Comprehensive Performance Test (CPT) to a post Critical Decision 4 (CD-4) activity, rather than maintain it as a CD-4 required KPP. The project team and program office position based on the advice of their technical subject matter experts, was that the CPT was only necessary to meet a State of Idaho requirement for air emission testing, and that the hot nitrogen simulant testing was sufficient to demonstrate functionality and operability of the system as constructed in order to turn it over for further operational testing and final hot commissioning activities. While PMOA strongly advised the CE against this change in plans and KPPs due to the additional project execution risks this change may introduce, the CE, as is their prerogative, decided after extensive dialogue that the benefits of moving into the operational phase sooner outweighed the possible potential risks.

Attachment 2

Memorandum dated October 14, 2015, from Paul Bosco, Director, Office PMOA, to Rickey R. Hass, Deputy IG for Audits and Inspections, DOE-IG pursuant to draft DOE IG report, *Management of Start-up of the Sodium Bearing Waste Treatment Facility* (IG-A14ID048)

Non-Concur with Recommendation 3

PMOA non-concurs with Recommendation 3 that the Director of PMOA "Evaluate Department Order 413.3B regarding commissioning first-of-its-kind Environmental Management facilities and consider incorporating a commissioning phase before CD-4."

PMOA notes that this recommendation was previously considered in the development of current DOE O 413.3B. Based on dialogue with the Office of Environmental Management, the National Nuclear Security Association, the Office of Science, and the Office of the Chief Financial Officer, it was determined that the prudent course of action was for Program Offices to make a determination as to the extent of the commissioning process for projects involving nuclear/chemical processes when establishing project completion criteria. Please reference Appendix A, paragraph 5.d in DOE O 413.3B. Given the diverse portfolio of projects within the Department, DOE O 413.3B enables the applicable Project Management Executive (PME) to make risk informed decisions about KPPs and CD-4 project completion criteria when establishing the Performance Baseline at CD-2, or during a Baseline Change Proposal.

Thank you for the opportunity to review the draft report. If you should have any questions, please contact Melvin Frank at (202)586-5519.

FEEDBACK

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Washington, DC 20585

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