

U.S. Department of Energy Office of Inspector General Office of Audit Services

Audit Report

Status of the Mixed Oxide Fuel Fabrication Facility

DOE/IG-0713

December 2005



Department of Energy

Washington, DC 20585

December 21, 2005

MEMORANDUM FOR THE SECRETARY

FROM:

Gregory H. Friedman

Inspector General

SUBJECT:

INFORMATION: Audit Report on "The Status of the Mixed

Oxide Fuel Fabrication Facility"

BACKGROUND

In September 2000, the United States and the Russian Federation signed the Plutonium Management and Disposition Agreement which committed each country to dispose of 34 metric tons of surplus plutonium. To meet this goal, the National Nuclear Security Administration (NNSA) planned to construct a Mixed Oxide Fuel Fabrication (MOX) Facility at the Savannah River Site. As a component of the national program to dispose of surplus nuclear weapons materials, the MOX Facility and associated processes will combine plutonium oxide from weapons with uranium oxide to produce a mixed oxide and fabricate it into nuclear fuel. In March 1999, based on processes and facilities successfully operated by COGEMA Inc. in France, a contract was awarded to a private consortium (Duke Engineering Services, COGEMA Inc., and Stone and Webster) to design the MOX Facility.

Under the National Defense Authorization Act of Fiscal Year 2002, the Department of Energy (Department) was directed to provide a plan outlining a schedule and cost for the plutonium disposition activities. In February 2002, NNSA reported, that the construction of the MOX Facility would start in FY 2004, begin operations in FY 2007, and cost nearly \$1 billion to design and construct. Through 2005, Congress appropriated \$950 million for these activities. However, disagreements regarding liability protection for U.S. companies performing work in Russia arose, which delayed construction of the U.S. facility. In accordance with U.S. policy, the U.S. and Russian disposition programs were to proceed in parallel. In July 2005, the parties agreed on provisions governing liability protection. With the resolution of this issue, NNSA currently plans to start construction in May 2006.

The objective of this audit was to determine if the MOX Facility is within budget as established in its 2002 report to Congress.

RESULTS OF AUDIT

The cost of the MOX Facility will significantly exceed the amounts reported to Congress in 2002. As of July 2005, NNSA's unvalidated estimate for the design and construction of the MOX Facility was about \$3.5 billion, which is \$2.5 billion more than it had

previously estimated. NNSA originally reported that it had a high degree of confidence in its 2002 estimate because the MOX technology was well-established and based on proven processes used in Europe since the 1960s, and that it expected modifications to the technology to be relatively minor. NNSA also reported that the design was approximately 60 percent complete. However, as of July 2005, NNSA had spent \$453 million – nearly half of the \$1 billion design and construction budget - on just design activities, and had only completed 70 percent of the design work. NNSA currently estimates that it will spend a total of \$744 million on base facilities and equipment design activities.

Although the Russian liability issue and additions to project scope had a significant impact on the cost and schedule of the project, we found that weaknesses in project management and limited administration of the contract contributed to the cost growth. Specifically, NNSA utilized a cost-plus-fixed fee contract to procure design services, despite the fact that this type of contract had inherent limitations in controlling costs. Also, adequate attention was not given to establishing an appropriate performance baseline or ensuring that reporting mechanisms to monitor progress and track costs were in place. Further, officials did not provide adequate oversight of the project to ensure that contractor performance problems were identified in a timely manner, or that the problems were corrected before providing additional funds. As a result, of the nearly \$1 billion appropriated for the MOX Facility construction project, only about \$206 million remains available to actually support construction activities based on current estimates.

To its credit, NNSA has recently taken steps to improve its management of the MOX Facility project. In its Project Management Improvement Plan, NNSA identified weaknesses in its staffing, project management and contract administration. NNSA also identified problematic areas related to baselining the project to meet the current construction schedule. To address these weaknesses, NNSA initiated actions to improve performance, established appropriate timelines, and tracked corrective actions taken. Although these recent initiatives were positive steps, additional enhancements to the project are needed. As such, we made specific recommendations to facilitate the successful completion of the project.

MANAGEMENT RACTION

Management agreed with the audit recommendations; but noted that while project cost has risen, comparing the current MOX cost estimate to that which appeared in a 2002 report to Congress overstates the cost difference. In addition, management stated that the cost growth associated with the project cannot be fairly attributed to failures in project management. Management views, along with our rebuttal comments, are summarized beginning on page 6 and included in their entirety as Appendix 3.

Attachment

cc: Deputy Secretary

Under Secretary for Energy, Science and Environment Administrator, National Nuclear Security Administration Chief of Staff

Director, Policy and Internal Controls Management, NA-66

STATUS OF THE MIXED OXIDE FUEL FABRICATION FACILITY

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Design and Construction Budget

The audit disclosed that the cost of the Mixed Oxide Fuel Facility (MOX) will significantly exceed the amounts reported to Congress. As of July 2005, the National Nuclear Security Administration's (NNSA's) unvalidated estimate for the design and construction of the MOX Facility was about \$3.5 billion, which is \$2.5 billion more than reported to Congress in 2002. NNSA's previous estimate of \$1 billion for the facility's design and construction was reported in the February 2002 plutonium disposition plan presented to Congress. NNSA reported that it had a high degree of confidence in the estimate because the MOX technology was well-established and based on proven processes used in Europe since the 1960s, and it expected modifications to the technology to be relatively minor. NNSA also stated that the facility's design was about 60 percent complete at the time of the 2002 report.

However, by July 2005, NNSA had already spent \$453 million - nearly half of the \$1 billion design and construction budget - on just design activities, and had only completed 70 percent of the design work. NNSA estimated that it would spend a total of \$744 million just for the facility's base and equipment design activities.

NNSA attributed part of the design cost increases to a change in work scope including design work intended to reduce construction costs in the long-run. Specifically, NNSA had incurred costs of \$144 million for process equipment and software designs, and estimated that it would spend a total of \$324 million for these design activities. These design activities were originally intended to be performed in the construction phase, but NNSA added it to the base design contract in 2003.

NNSA stated that spending additional funds up front to complete 100 percent of the detailed design work prior to the construction phase should reduce construction costs, minimize the number of costly changes later on in the project, and increase the confidence in the cost and schedule estimates. However, we noted that the cost estimate for construction has increased, rather than decreased. NNSA estimated in July 2005 that construction will cost approximately \$2.8 billion in addition to the estimated \$744 million to be spent on design activities.

Project Management and Oversight

Although schedule delays associated with the Russian liability issue and added scope have resulted in cost impacts, we determined that NNSA's project management weaknesses and limited oversight significantly contributed to the project's cost increases.

Project Management Weaknesses

Key project management practices necessary to control costs and quickly identify and report performance concerns were not employed by NNSA. NNSA's project management practices did not mitigate the risk of cost growth associated with the cost-plus-fixed fee contract used for the MOX Facility project. Specifically, NNSA did not incentivize the contractor to control costs, nor did it establish an effective performance baseline. Further, NNSA did not ensure that monthly reports and cost ceilings were meaningful and relevant.

Cost Control Incentives

The Department awarded a cost-plus-fixed-fee contract despite the contract's inherent high risk of cost growth. Cost growth is not unusual in these contracts because the contractor is reimbursed for the costs it incurs under the contract with minimal responsibility for the cost of work performed. In 1999, an independent team reviewing the MOX Facility contract warned of the potential for escalating costs because the contractor had no incentives to minimize costs nor penalties for overruns or poor performance. The team reported that the Department had very little, if any, leverage in negotiations with the contractor in setting the performance baseline, nor were there any contractual means short of management persuasion to ensure cost control. Through June 2005, the contract was modified for more than \$100 million due to cost overruns and variances.

Performance Baseline

Contributing to the contract's susceptibility for cost growth was NNSA's failure to establish a performance baseline, or Critical Decision-2. Critical Decision-2 is a project management step which establishes the scope, cost, and schedule baseline, and provides a basis to measure and track performance. When a project reaches Critical Decision-2, the Department's Office of Engineering and Construction Management monitors and reviews the project, and formally tracks performance.

If a project experiences significant variances in its cost and schedule, it is placed on the "watch list" and is closely monitored until corrective actions have taken place.

In July 2004, an independent research team determined that the MOX project should have been baselined "some years ago" so that it would have the visibility and attention of all parties. The team recommended that projects such as MOX have a baseline established at the 30 to 40 percent design point. The team further recommended that if all requirements of Critical Decision-2 could not be met at that point, a shortened list of requirements should be developed so that a formal baseline for some portion of the work could be developed and approved. In contrast, NNSA had delayed submission of Critical Decision-2 for several years even though NNSA determined that the project was well enough established to begin construction in 2003. As the start of construction was deferred, so was the formal baselining process. Consequently, the design contract has continued for 6 years without the benefit of a performance baseline. As of July 2005, NNSA still did not have a baseline for the project.

Progress and Cost Reporting

In lieu of a full performance baseline, NNSA relied on information detailed in the monthly project reports to monitor progress and track costs. However, the reports were so confusing and misleading that the contractor deemed them as "useless for evaluating performance or managing the project." NNSA recognized problems with the information in 2003 and acknowledged that it needed to work with the contractor to develop a more effective means to measure performance. Nonetheless, problems reported in 2003 were still evident in Fiscal Year (FY) 2005. For example, performance of some design processes was being measured against an outdated cost plan. The contractor reported unfavorable cost and schedule variances for months, but explained that the variances were inaccurate and meaningless because performance was being compared against a two year old plan. Rather than discuss corrective actions it would take to reduce unfavorable variances, the contractor explained that variances would be eliminated when contract modifications added more funds to the contract.

Further, cost ceilings and budgets were often established too late to be useful for controlling costs. For example, in January 2002, NNSA directed the contractor to make design changes which would allow the MOX Facility to process an additional feedstock.

Page 3 Details of Finding

In April 2002, the contractor submitted a change proposal and began incurring costs for the design change. The contractor completed the design for the alternate feedstock in December 2003 at a cost of approximately \$47 million. Despite this, in March 2005, NNSA provided interim funding to the contractor for the still unapproved change proposal. NNSA imposed a \$39 million cost ceiling, stating that the contractor was not authorized to "make expenditures or incur obligations exceeding \$39 million" even though the contractor had already completed the work 15 months earlier at a cost of \$47 million.

Limited Contract Administration

NNSA did not provide adequate administration of the project to ensure that contractor performance problems were identified in a timely manner, nor that the problems were corrected before providing additional funds. For example, despite NNSA giving a positive review of the contractor's project management system in 2000, a subsequent review of the same system in 2003 noted significant problems. Among the concerns noted were that performance reporting was based on outdated information and that variance analyses were non-specific. NNSA found that the contractor's performance reporting was so problem-ridden that it initiated 18 requests for corrective actions toward improving performance tracking so that it provided meaningful information.

Further, after significant problems were identified, NNSA continued to increase contract funding without ensuring that problems were corrected. For example, in August 2003, the Defense Contract Audit Agency (DCAA) reported on its attempts to audit two contract change proposals totaling \$300 million. DCAA found that the change proposals were so poorly supported that it suspended its audit. DCAA reported that it would not audit other change proposals until the contractor had implemented corrective actions. The contracting officer was so concerned about these estimating system deficiencies that he warned the contractor that failure to immediately implement corrective actions would negatively impact negotiations of future change proposals. Nonetheless, in the 20 months since the DCAA audit, NNSA increased the value of the contract by more than \$340 million, even though a follow-up review of the estimating procedures had not been completed.

To some extent, these problems were due to the fact that NNSA's staffing levels and skill sets were not sufficient to oversee a project of the size and complexity of the MOX Facility. Concerns

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regarding staffing were reported soon after the contract was awarded in 1999, when an independent team reviewed the MOX Facility contract. The team reported its concern that NNSA did not have enough technical staff to oversee the project, and noted that NNSA had only one person, the technical manager, assigned exclusively to the MOX project. Given the complexity of the contractor's organization, the array of work to be performed, and the absence of contractor penalties for cost overruns or poor performance, the team warned NNSA to exercise close control of contract costs. The team recommended that, at a minimum, NNSA should place at least one Federal employee at the contractor's site to facilitate monitoring. NNSA did not place a Federal representative at the site until FY 2003, 4 years after the report was issued, because it believed that its "virtual" oversight office was sufficient to manage the project.

However, in a 2004 programmatic review, NNSA reported that the program was at risk because only a "handful" of Federal employees were overseeing the MOX project. NNSA planned to increase its staffing levels, but is awaiting resolution of issues which had stalled the project's progress.

Impact on Project Funds

Ultimately, of the nearly \$1 billion appropriated for the MOX Facility construction project, only about \$206 million may be available to actually support construction activities. As of July 2005, NNSA had already incurred costs of \$453 million for design activities, and estimated that it needed another \$291 million to complete the design. In addition, NNSA was accruing \$13 million each month to support the contractor's design contract.

RECOMMENDATIONS

We recommend that the Administrator for NNSA:

- 1. Incorporate performance incentives in future contract negotiations;
- 2. Develop formal baselines for major projects as soon as practicable, tailoring Critical Decision-2 requirements to accommodate early development;
- 3. Ensure that information contained in monthly project reports is timely, relevant, and accurate in its portrayal of project status;
- 4. Include, and adhere to, contract cost ceilings to control spending;

Page 5 Details of Finding

- 5. Perform thorough, recurring, and timely reviews of contract performance, and verify that problems are corrected, including cost estimation problems identified in DCAA audits; and,
- 6. Ensure that the number and skill set of the Federal staff assigned to the MOX project is sufficient to oversee a project of its size and complexity.

MANAGEMENT REACTION AND AUDITOR COMMENTS

Management agreed with our recommendations for improving project oversight and initiated corrective actions. For example, management identified deficiencies in contract management and directed the contractor to develop a corrective action plan. Additionally, management is reorganizing the program to streamline reporting and strengthen project management. We consider management's actions to improve project management responsive to our recommendations. While management agreed with our conclusion that the cost of the facility will significantly exceed the amount reported to Congress in 2002, it believed the statement may be misleading unless placed in proper context. To ensure a more credible cost comparison, management believed several factors should be considered in our report. Management's specific comments on these cost factors, followed by our responses are detailed below.

Management Comment

Management stated that comparing the current cost estimate, which reflects future year dollars, to that which appeared in the 2002 report to Congress, which was expressed in 2001 dollars, overstates the cost difference. Using FY 2005 dollars, management estimated that the escalation of FY 2006 through FY 2013 costs (the end of the facility's cold startup) accounted for approximately \$360 million of the total project estimate.

<u>Auditor Response</u>

We recognize that comparing management's unescalated 2002 estimate to its escalated 2005 estimate would affect the cost difference reported. However, cost escalation only represents approximately 14 percent of the increase in total project costs noted in this report. Further, we noted that since 2002, management had not updated any of its reports to Congress to include the cost of escalation for the project.

Page 6 Comments

Management Comment

Management also stated that our inclusion of sunk costs--all project costs incurred to date--was misleading.

<u>Auditor Response</u>

In calculating the cost of the facility, we included all costs incurred under the design contract. We believe it was appropriate to include all costs incurred on the project to date since excluding these costs would understate the total project cost.

Management Comment

Management stated that the cost increase discussed in the report reflected the 2.5 year delay resulting from the Russian liability impasse.

<u>Auditor Response</u>

We agree, and acknowledged in the report, that the 2.5 year delay contributed to the cost increase because it stalled construction and prolonged the design phase. Nonetheless, a substantial amount of design work remains to be completed. Recent reports show the design is only 70 percent complete after six years. The fact that management has another 30 percent of design work to perform is one example of why costs have increased significantly.

Management Comment

In addition, management stated that the cost increase resulted in large part from circumstances that cannot be fairly attributed to project management. Management reported that cost increases were caused by the enhanced aqueous polishing capability. Management stated that the enhanced capability was added to handle impure plutonium as a result of the cancellation of the immobilization project. Management stated that, although this design change increased the cost of the MOX program, it represents considerable cost savings over the original plan to cover both a MOX and an immobilization program.

<u>Auditor Response</u>

We disagree with management's assertion that the enhanced aqueous polishing capability was a large contributor to the cost increase. According to the contractor's estimates, this added scope

Page 7 Comments

increased design costs by about \$50 million, or approximately 2 percent of the cost increase discussed in this report. Further, it should be noted, that NNSA had already decided to incorporate this enhancement when it reported to Congress in 2002.

Management Comment

Management stated that the cost increase also resulted from significant increases in the cost of construction materials and labor.

Auditor Response

The cost escalation, as noted above, incorporates increases in construction labor and materials, and would only account for a small portion of the cost increase.

Management Comment

Management stated that shifting the glove box and equipment design-build work from the construction phase to the design phase of the project resulted in increased costs, but allowed the MOX design team to be maintained during delays caused by the Russian liability issue. Management added that this would benefit the project by completing more of the overall design work prior to construction.

<u>Auditor Response</u>

As we acknowledged in our report, shifting the work from the construction phase to the design phase resulted in an increase in design costs. However, the overall project cost should not have been affected. Rather, we would expect that shifting the work from one phase of the project to another would result in an increase in design costs with a proportionate decrease in construction costs. Yet, both estimates have increased dramatically.

Page 8 Comments

OBJECTIVE

The objective of this audit was to determine if the MOX Facility is within budget as established in its 2002 report to Congress.

SCOPE

We conducted the audit from September 2004 to December 2005, at NNSA's Office of Fissile Materials Disposition in Washington, D.C., and the contractor's headquarters in Charlotte, North Carolina. The scope of the audit included MOX Facility design activities and costs from March 1999 through July 2005.

METHODOLOGY

To accomplish the audit objective, we:

- Obtained and reviewed documentation for the MOX project, including studies and cost estimates;
- Reviewed the agreement between the United States and Russia related to the disposition of weapons-grade plutonium;
- Assessed annual reports to Congress on project status;
- Reviewed the base contract including all modifications to the contract through May 2005;
- Evaluated performance tracking and reporting mechanisms used in the MOX project;
- Researched Federal and Departmental regulations;
- Analyzed external, independent project reviews;
- Assessed internal controls and performance measures established by the Government Performance and Results Act of 1993; and,
- Interviewed key NNSA and contractor personnel.

The audit was conducted 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.

Appendix 1 (continued)

We assessed compliance with the Government Performance and Results Act of 1993 related to the MOX Facility and found that the Department had established and reported on performance measures associated with the project. 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 we did not rely on any computer processed information to achieve our audit objective.

Management waived an exit conference on December 7, 2005.

PRIOR AUDIT REPORTS

- NNSA's Pit Disassembly and Conversion Facility (IG-0688, May 2005). The construction of the Pit Disassembly and Conversion Facility (Conversion Facility) has been delayed, primarily due to foreign policy issues that are beyond the National Nuclear Security Administration's (NNSA) immediate control. The review confirmed that the schedule and cost parameters outlined in the Department's February 2002 report to Congress will not be met despite the importance of the project and the high priority that it has been assigned. NNSA's estimate was that the Conversion Facility would not be completed until 2013 a four year delay provided that the remaining foreign policy issues are resolved in the near term. In addition, NNSA's costs for the Conversion Facility will likely increase substantially beyond the life-cycle cost of \$1.7 billion reported to Congress in 2002.
- Savannah River Site's Waste Solidification Building (IG-0618, September 2003). The Department's plan for the Plutonium Disposition Program was incomplete in that NNSA plans to transfer the waste treated at the Waste Solidification Building (WSB) to Environmental Management, but Environmental Management has no corresponding plans to receive, process, and dispose of the waste. In addition, neither NNSA nor Environmental Management has developed a cost or schedule baseline for the disposal of WSB-treated waste. A path forward does not exist because the Department has not established a policy for disposal of newly generated nuclear wastes from NNSA activities. Without an integrated and coordinated plan, the Department's accelerated cleanup goals may not be achieved and life-cycle costs for the Plutonium Disposition Program are likely to exceed initial estimates.
- The Department of Energy's Strategy for Disposal of Plutonium (ER-L-02-01, February 2002). The Department's original approach for the disposal of plutonium immobilizing 8.4 metric tons of plutonium and converting 25.6 metric tons to fuel was estimated to cost about \$6.3 billion. In contrast, the Office of Inspector General estimated that converting all 34 metric tons to reactor fuel would cost about \$4.6 billion and immobilizing all the material would cost about \$4.3 billion. Department officials originally believed that converting all of the plutonium into fuel was not technically feasible and the Russian Federation would reject a proposal to immobilize the entire amount. However, the Department had since resolved the technical feasibility issues surrounding conversion. The audit disclosed that the Department could save at least \$1.7 billion by converting all of the surplus plutonium into fuel and avoiding the cost of plutonium immobilization.



Department of Energy National Nuclear Security Administration Washington, DC 20585



NOV 1 4 2005

MEMORANDUM FOR

George W. Collard

Assistant Inspector General

for Performance Audits

FROM:

Michael C. Kane

Associate Administrator

for Management and Administration

SUBJECT:

Comments to MOX Facility Draft Report;

A04ET001/2004-17925

The National Nuclear Security Administration (NNSA) appreciated the opportunity to have reviewed the Inspector General's (IG) draft report, "The Status of the Mixed Oxide Fuel Fabrication Facility." We provide the following comments:

The report concluded that the cost of the facility will significantly exceed the amount that was reported to Congress in 2002. This conclusion is accurate on its face, but unless it is placed in proper context, may be misleading.

While project costs have risen, comparing the current MOX cost estimate to that which appeared in a 2002 report to Congress overstates the cost difference. To ensure a more credible comparison, we would point out that the costs related to the various disposition options outlined in the report are in 2001 dollars but the current estimate (1) is in future year dollars; (2) reflects sunk costs incurred to date; and (3) includes a 2.5 year delay caused by the liability impasse due to the requirement to maintain parallel progress with Russia.

Moreover, it must be recognized that the cost increases result in large part from circumstances that cannot be fairly attributed to project management such as: (1) addition of an Enhanced Aqueous Polishing capability in the current project to handle impure plutonium as a result of the cancellation of the immobilization project. Although this design added to the cost of the MOX program, it represents considerable cost savings over the original plan to cover both a MOX and an immobilization program; (2) significant increases in the cost of construction materials and labor; and (3) shifting of glove box and equipment design-build work that was originally planned for the construction phase to the design phase of the project. This advancement of work was necessary to maintain the MOX



design team due to the delay in starting construction caused by liability. The advancement will benefit the project by completing more of the overall design work prior to construction.

The report acknowledges that NNSA has acted to improve project management for the MOX program. In August 2004, the MOX project Contracting Officer identified a number of deficiencies in contract management and directed the contractor to develop a corrective action plan. Additionally, NNSA is implementing a reorganization in the Fissile Materials program to establish a streamlined reporting relationship that will strengthen project management and efficiency for MOX construction. We believe we have made significant progress. The Report is helpful by identifying some key areas for continued focus. We agree with the recommendations contained within the report to further improve project oversight.

We have attached our specific comments to the recommendations. Should you have any questions related to this response, please contact Richard Speidel, Director, Policy and Internal Controls Management.

Attachment

cc: Deputy Administrator for Defense Nuclear Nonproliferation

Senior Procurement Executive Director, Service Center

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