

DOE/IG-0476

AUDIT
REPORT

BEST PRACTICES FOR
ENVIRONMENTAL MANAGEMENT
BASELINE DEVELOPMENT



JULY 2000

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

July 7, 2000

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman (Signed)
Inspector General

SUBJECT: INFORMATION: Report on "Best Practices for Environmental
Management Baseline Development"

BACKGROUND

In February 1999, you directed the Office of Environmental Management (EM) to implement controls to correct weaknesses in the environmental liability estimate identified during the Fiscal Year 1998 financial statement audit. You also requested the Office of Inspector General (OIG) to conduct an interim status review to ensure that these controls were sufficient to correct the weaknesses. In August 1999, the OIG reported that completed and planned corrective actions by EM and the Chief Financial Officer (CFO) should improve the liability estimate. These actions also had a positive impact on EM's project management through improvements in its baseline development processes.

Baseline development is the cornerstone of sound project management. A credible project baseline allows Headquarters and field project managers to track project cost, scope, and schedule; future project benefits; potential pitfalls; risks; and challenges. It can also be used to show stakeholders the relationship between the near-term budget limits and long-term project objective. The objective of this report is to share and promote, throughout the Department, the use of best practices employed by EM in its efforts to improve baselines.

RESULTS OF AUDIT

EM and CFO improved baseline development through the use of best practices developed while correcting weaknesses in the environmental liability estimate. These best practices were designed to ensure that baseline development guidance was followed and that the baselines developed were more accurate and supportable and periodically updated. EM and the CFO deserve credit for the timely execution of effective corrective actions, many of which could be implemented throughout the Department. The OIG is supportive of the Department's ongoing and planned efforts in this area. We believe that Department initiatives to improve baseline estimates are vital to successful project management at all sites.

While these improvements are important steps, recent OIG and other independent reviews indicated that problems with EM baselines still existed. The OIG found instances of baselines that were

incomplete, contained duplicate costs, were not being properly updated, or contained outyear costs estimates that were not supportable. In addition, two other independent reviews of EM projects reported problems in technical scope definition and cost estimating.

We recommended that the Department continue to use the corrective actions that resolved its material weakness in environmental liability reporting. EM should ensure that the best practices are in place, require periodic spot checks of baseline components, and share the results with EM management and CFO representatives. Because the best practices discussed in this report have broad applicability, we also recommended that they be included, as appropriate, in the Department's Project Management Manual.

MANAGEMENT REACTION

The Department concurred with the recommendations and agreed that sharing the "best practices" and the quality characteristics has the potential to improve the quality of project baselines. The Department plans to incorporate the recommendations of this report in the Project Management Manual.

Attachment

cc: Deputy Secretary
Under Secretary
Assistant Secretary for Environmental Management
Chief Financial Officer

Best Practices For Environmental Management Baseline Development

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Overview

INTRODUCTION AND OBJECTIVE

During the Cold War, the United States Government built a large industrial complex to design, test, and produce nuclear weapons. The activities of this complex resulted in extensive environmental contamination including unprecedented amounts of contaminated waste, water, and soil. The Department of Energy's (Department) Office of Environmental Management (EM) is responsible for managing the cleanup of the environmental contamination. EM estimated the total lifecycle cost of the cleanup effort to be \$168 billion over the next 70 years.

A major factor in the success or failure of the Department's environmental cleanup projects has been the extent to which projects have been defined. Well-defined projects are based on a sound technical foundation that lends itself to a realistic schedule and representative cost estimates. A baseline is the quantitative expression of technical requirements, schedule, and projected costs. As such, the baseline provides the definition of a project and becomes a major factor in its success or failure. Without credible project baselines, managers may have difficulty controlling cost, maintaining schedule, measuring performance, and demonstrating results to stakeholders.

The Office of Inspector General (OIG) identified material weaknesses in the Department's environmental liability reporting in the Fiscal Year (FY) 1997 and FY 1998 Consolidated Financial Statements. To correct the material weaknesses, EM, in conjunction with the Office of Chief Financial Officer (CFO), launched an initiative in FY 1999 to improve baselines for its cleanup projects. The objective of this report is to share and promote, throughout the Department, the use of best practices employed by EM in its efforts to improve baselines.

CONCLUSIONS AND OBSERVATIONS

EM, in conjunction with the CFO, has enhanced its baseline development process primarily through the use of best practices employed by some sites to correct the material weakness. During our review of selected project baselines, we identified best practices for ensuring that baseline development guidance was followed. These best practices led to additional best practices that helped ensure the baselines developed were accurate, supportable, and periodically updated.

While improvements were made, recent OIG and other independent reviews indicated that problems with EM baselines still existed. The OIG reported in an audit of the management of tank waste remediation at the Department's Hanford site (DOE/IG-0456) that the Department

did not have a fully integrated or complete baseline. The OIG also determined during the annual audit of the FY 1999 consolidated financial statements that certain lifecycle baselines omitted or duplicated costs, were not properly updated, or contained outyear cost estimates that were not supportable. In addition, two congressionally mandated independent assessments of EM projects released during FY 1999 identified problems in the related baselines technical scope definition and cost estimating.

EM and the CFO should ensure that the best practices identified in this report are applied on a consistent basis to all EM sites and project baselines as appropriate. In addition, the Office of Engineering and Construction Management should consider including them in the Project Management Manual.

(Signed)

Office of Inspector General

Best Practices For Environmental Management Baseline Development

Baseline development is the cornerstone of sound project management. A credible baseline allows Headquarters and field project managers to track project cost, scope, and schedule; future project benefits; potential pitfalls; risks; and challenges.

Past Weaknesses In Baseline Development

Although project baselines are important to successful project management, external and internal reviewers have identified weaknesses in the Department's project baseline practices. During recent years, the National Research Council (Council) and the OIG have identified needed enhancements in project baseline development.

The Council conducted a review of the Department's project management practices in FY 1998. The review identified a number of shortfalls in various areas affecting baseline development, including cost estimation, scheduling, and change control procedures. The Council also determined that the Department had difficulties establishing project definition and concluded that inadequate project definition accounted for 50 percent of cost increases in environmental remediation projects.

The OIG identified similar weaknesses in project baselines that supported the Department's environmental liability reporting in the FY 1997 and FY 1998 financial statement audits. The OIG found several weaknesses in environmental baselines, including inaccuracies and incomplete documentation of the estimates. Another identified weakness was inadequate updating of the baselines to reflect changes in scope, schedule, and cost of projects.

Baseline Development Initiatives

The Department has undertaken initiatives to address the baseline development weaknesses. For example, EM, in conjunction with the CFO, established internal control guidelines to strengthen the baseline development process for cleanup projects and included specific controls to ensure that the baselines were supportable and updated. The CFO issued additional guidance to ensure financial personnel were involved in the environmental cleanup project baseline development process. The Department has also established the Office of Engineering and Construction Management to develop project management policies, procedures, and practices to address concerns raised by the Council. This office is currently developing a Project Management Manual to address this management initiative.

Successful implementation of EM and CFO guidance contributed to correcting baseline weaknesses disclosed during previous reviews. The following discussion outlines best practices employed in improving project baselines that supported the environmental liability estimate. They should be considered by the Office of Engineering and Construction Management when addressing the Council concerns.

Best Practices

In the past, EM's guidance for baseline development included requirements for ensuring baselines were accurate, supportable, and updated, but did not include adequate controls for implementation. The best practices we identified during our review of selected project baselines in FY 1999 included activities that ensured that the baseline development guidance was implemented. The commitments made by certain field offices to implement the guidance resulted in additional best practices that ensured baselines were accurate and supportable and appropriately updated.

Guidance Implementation

Over the last 3 years, EM provided the field with baseline development guidance that included requirements for baselines to be accurate, supported, and up-to-date. However, not until EM and field managers effectively communicated and actually verified that the guidance was being faithfully executed did the baseline development process begin to improve.

Effective Communication

For projects of large magnitude and complexity, such as EM cleanup projects, efficient lines of communication between Department Headquarters, field offices, and contractors are imperative. The first step the Department took in improving communication was the issuance of a letter from the Secretary to EM that clearly stated the need to correct the weaknesses and required a written status of the corrective actions. In response to the Secretary's letter, EM developed the Internal Control Guidelines. In addition, the Acting Assistant Secretary for EM issued the guidelines with a clear message for corrective action and required written responses back from the field on whether the guidelines had been met. Finally, EM prepared a status report for the Secretary based on the responses from the field on implementing the guidelines.

Successive Verification of Baselines

Prior audit coverage showed it is essential that Department Headquarters and field offices periodically review and test site baselines. During FY 1999, EM and the CFO applied a process of successive verification to ensure that their guidance was followed. Both EM and the CFO required separate written confirmations that the guidance was met and performed internal validations on a sample of project baselines at selected field offices. Sites with EM baselines were subjected to internal validations either during the onsite visits by EM Headquarters personnel or via video conferencing. The objective of the validations was to ensure that project lifecycle baselines were adequately supported and that any major changes were incorporated. The field CFO personnel were also required to select a sample of baselines for verification and formally reported their results back to Headquarters. In addition, the guidance required review and approval of the baseline and lifecycle planning estimates by both Federal and contractor management.

Accurate and Supportable Baselines

The development of accurate and supportable baselines is a major undertaking. The Department's environmental cleanup projects are often very complex technically and involve many sub-activities. Further, many individuals with differing expertise can be involved in preparing the baselines. The development of baselines is complicated further by turnover of contractor and Departmental employees involved in the process. To respond to the commitment to implement EM guidance, a number of sites employed best practices involving jury reviews, external validation, professional cost estimation, and consistent contingency calculation. These practices increased baseline accuracy and support by increasing oversight of the baselines and ensuring consistency in skills and cost estimating.

Jury Review

To address the impact of project complexity on baseline accuracy and support, the Idaho National Environmental and Engineering Laboratory instituted a "jury review" process to provide greater oversight of baseline development. The staff was comprised of Federal and contractor program managers, technicians, budget representatives, and cost estimators. This multi-disciplinary team reviewed and criticized each baseline to ensure that work scope was covered, data was

consistent with site assumptions, and the cost estimates were defensible. Each step of the jury review process was documented, including initial results and final resolution of any problem identified.

External Validation

Periodic external validation was another best practice employed to help ensure baseline accuracy and supportability. In FY 1999, the management and integrating contractor at Oak Ridge hired a consultant to perform a limited validation of its baselines. This review identified several areas of needed improvement that the contractor promptly addressed. Oak Ridge EM and CFO personnel also took a proactive approach during the external validation to ensure the results of the review were valid and corrective actions were taken.

Cost Estimation

To improve accuracy and consistency in baseline development, the Idaho Operations Office hired professional cost estimators to replace or support individuals of other scientific or engineering disciplines. As an alternative, the creation of an in-house cost estimator training program could ensure greater accuracy and consistency in estimating skills.

Contingency Calculation

To ensure that risk is consistently captured in project baseline cost estimates, the Richland Operations Office required that contingency, the cost used to measure risk, be applied to its environmental restoration baselines as a separate item. Richland also required that cost estimates specifically identify the amount of contingency included and adopted a site-wide methodology for calculating contingency costs. Specifically identifying the amount of contingency in a baseline highlights the amount of risk in the project. In addition, using a consistent methodology to measure contingency will help make baselines more comparable.

Updating Baselines

Once developed, baselines should be periodically updated to reflect changes in scope, cost, and schedule. One barrier to keeping baselines updated included the large number of changes that can occur during a given year. For example, in FY 1999 the EM contractor at Oak Ridge Operations Office submitted approximately 600 proposed changes to

the baseline. When reviewing the field office responses to implement EM guidance, the EM contractor at Oak Ridge utilized a web-based change control system. Such a system raises the visibility of changes to baselines, highlights breakdowns in the change control process, and fosters more involvement by affected parties. In addition, when proposed changes are posted, including the last level of approval, those responsible for the delay are easily identified. We believe that a web-based system also allows easier access to proposed and completed baseline changes to Federal and contractor management.

Problems Still Exist

While the best practices discussed above led to improvements, recent reviews demonstrate that problems still exist in EM baselines. The OIG audit report "The Management of Tank Waste Remediation at the Hanford Site" (DOE/IG-0456) concluded that the project baseline was not fully integrated or complete and had not been validated in 7 years. The OIG also determined during the annual audit of the FY 1999 consolidated financial statements that certain lifecycle baselines excluded or duplicated decontaminating and decommissioning (D&D) costs, were not updated to reflect current cost estimates, or included estimates for outyear costs that were unsupported. In addition, two congressionally mandated independent project assessments completed in FY 1999 concluded for one EM project that the technical cost and schedule baseline was obsolete and another EM project baseline contained an inaccurate cost estimate.

RECOMMENDATIONS

Reforms in EM's baseline development process should improve the process for defining the nature and scope of the work to be performed, allow the Department to plan and implement a more cost-effective approach to cleanup, and correct the remaining problems in EM baselines. To further enhance and facilitate the Department's baseline development processes:

1. The Assistant Secretary for Environmental Management should:
 - a. Continue using EM Internal Control Guidelines, status reports, and onsite verification to ensure proper implementation;
 - b. Ensure that the "best practices" or quality characteristics mentioned above are in place for all projects as appropriate; and
 - c. Require periodic spot checks of baseline components and share the results with EM upper management and CFO representatives.

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2. The Chief Financial Officer should assist EM in assessing the adequacy of project baseline development at each site and continue to require routine spot checks of environmental baseline components.
 3. The Director, Office of Engineering and Construction Management, should consider the best practices discussed in this report when developing the Department's Project Management Manual.

**MANAGEMENT
REACTION**

The Department concurred with the recommendations. The Department agreed that sharing the "best practices" and the quality characteristics has the potential to improve the quality of project baselines and will incorporate the recommendations of this report in the Project Management Manual.

**AUDITOR
COMMENTS**

Management's planned actions are responsive to our recommendations.

Appendix 1

DEPARTMENTAL POLICIES AND PROCEDURES

The Department has established policies and procedures to aid in ensuring that project management activities are carried out in the most effective manner to allow for successful completion of a project.

DOE Order 5700.2D was issued in 1992 to establish policies and responsibilities for developing and reviewing project cost estimates, standardizing cost estimating procedures, and improving overall cost estimating techniques. The Order required that cost estimates be developed and maintained throughout the life of each project and noted that the project manager was responsible for the official baseline estimate. The Order also required that local cost guidance be developed, stating how an estimate will be developed, who will review the estimate, and how the estimate will be documented. In addition, the Order recommended that independent cost and estimate checks are performed to validate project lifecycle estimates. DOE Guide 430.1-1 was issued as a companion to DOE Order 5700.2 with the objectives of improving the quality of cost estimates and further strengthening the DOE program/project management system. DOE Guide 430.1-1 notes that accurate and timely cost estimates are integral to the effective and efficient management of Departmental projects and programs. The Guide provided uniform cost estimating methods and guidance for gathering preliminary information in order to prepare detailed cost estimates.

In FY 1999, EM established the "EM Internal Control Guidelines and Review Checklist" to ensure that sound internal controls existed over estimating the environmental liability. These guidelines included general process guidance, baseline guidance, and baseline change control guidance. The general process guidelines require that each field office identify an individual or organization to have lead responsibility for the overall management of the EM internal control system. In addition, the guidance requires that field offices update the lifecycle estimates for major changes occurring throughout the year. The guidance requires that each field office have a documented process for development, submission, review, and approval of project baselines. The guidance also requires that a documentation file be maintained for each project to support cost, scope, and schedule estimates. In addition, Departmental and contractor managers are required to review and approve each baseline and lifecycle planning estimate. The baseline change control guidelines require that each field office document responsibilities and procedures for the change control process, including procedures for documenting changes and determining their impact on the lifecycle baseline.

Field offices and related contractors also issued guidance for estimating project lifecycle costs at their respective sites. For example, the Management and Integration contractor at Oak Ridge Reservation issued baseline management and change control guidance to identify and define the technical, cost, and schedule baselines and the Baseline Change Proposal Process. This guidance was provided to project managers and cost estimators at the site for use in developing the lifecycle baselines for projects. Other field offices that we visited had issued similar guidance used to develop their lifecycle baselines.

Appendix 2

SCOPE

This audit was conducted during March 2000 at Headquarters. In addition, it combines the results from the audits of the Department's consolidated financial statements for FYs 1997, 1998, and 1999 conducted from April through December 1997 (IG-FS-98-01), from May 1998 through January 1999, (IG-FS-99-01), and from April 1999 through January 2000 (IG-FS-00-01), respectively. Specifically, this audit draws from the results of fieldwork on the Department's environmental liability reporting from the financial statement audits. Fieldwork for the environmental liability was conducted at Headquarters and at the Idaho, Oak Ridge, Richland, Savannah River, and Nevada Operations Offices, the Rocky Flats Field Office, and the Carlsbad Area Office.

METHODOLOGY

To accomplish the objective of this report, we:

- Reviewed Departmental guidance for maintaining project baselines, including corrective actions issued as a result of the FY 1998 financial statement audit;
- Reviewed OIG reports and National Research Council studies to identify problems with project management practices within the Department;
- Reviewed prior results of internal controls, compliance with laws and regulations, and completeness of the environmental liability; and
- Held discussions with key management responsible for developing, approving, recording, and reporting project lifecycle baselines.

The audit was made in accordance with generally accepted Government auditing standards for performance audits. The audit relied on tests of internal controls and compliance with laws and regulations made during the financial statement audits for FYs 1997, 1998, and 1999 to the extent necessary to satisfy the audit objectives. The financial statement audits were conducted in accordance with generally accepted Government auditing standards for financial audits. To a significant extent, our audit did not utilize computer-processed data and did not examine the reliability of that data. Since the financial statement audits included in the scope of this audit relied on computer-generated data, we, as part of those audits, evaluated the general and application control

environment of certain systems and evaluated the reliability of the data on a test basis. Because our reviews were limited, they would not have necessarily disclosed all internal control deficiencies that may have existed at the time of our audit.

The Office of Environmental Management and the Chief Financial Officer waived an exit conference.

Appendix 3

PAST AUDITS RELATING TO BASELINE DEVELOPMENT

Special Report on the Audit of the Management of DOE Construction Projects (DOE/IG-0398, November 21, 1996). In 1994 and 1995, the Office of Inspector General issued several reports on the Department's construction activities. In these reports, we expressed concern about the construction planning process and questioned whether planned construction was necessary to meet mission needs. The reports also pointed out that the Department did not ensure that originally identified needs were still valid several years after a project's conception. This report highlighted issues dealing with opportunities to improve the planning process to avoid construction of unneeded or oversized facilities.

Management of Tank Waste Remediation at the Hanford Site, (DOE/IG-0456, January 21, 2000). The last audit of the management of the tank waste program at Hanford was completed in 1993. This audit disclosed that the tank waste program was managed as a number of separate projects and lacked an integrated baseline. While the Department has made progress since our last audit, important elements of an integrated management approach are not in place.

Department of Energy: Opportunity to Improve Management of Major System Acquisitions (Chapter Report, 11/26/96, General Accounting Office (GAO) RCED-97-17). From 1980 through 1996, the Department of Energy (DOE) conducted 80 projects that it designated as major system acquisitions. DOE has completed 15 of these projects--most of them behind schedule and over budget. Three of the completed projects have yet to be used for their intended purpose. Thirty-one other projects were terminated before completion, after expenditures of more than \$10 billion. The remaining 34 projects are ongoing. Cost overruns and "schedule slippages" continue to plague many of these ongoing projects. GAO believes that four key factors underlie these problems: unclear or changing missions, incremental funding of projects, a flawed system of incentives for both DOE employees and contractors, and too few DOE staff with the appropriate skills to oversee contractors' operations. In recent years, DOE has undertaken several initiatives that are helping to improve the agency's overall management. Although not all of these efforts may improve the management of DOE's major system acquisitions, GAO believes that their implementation offers an excellent opportunity for DOE to address the key factors.

Nuclear Waste: Process to Remove Radioactive Waste From Savannah River Tanks Fails to Work (Letter Report, 04/30/99, GAO/RCED-99-69). GAO noted that a number of factors combined to cause DOE and Westinghouse Savannah River Corporation to spend almost a half billion dollars and to take about a decade to decide that the in-tank precipitation process would not work safely and efficiently as designed. The most serious factors were the ineffectiveness of the contractor's management and of the Department's oversight of the project. DOE and the contractor encountered delays in starting up the in-tank precipitation facility because they began construction before the design of the process was completed. Because DOE funded the project with operating funds, rather than with construction funds, the project was less visible to congressional oversight. There was also an inadequate understanding by DOE and the

contractor of the in-tank precipitation process and the cause of the benzene generation. The failure of the in-tank precipitation process to operate as originally planned will delay the cleanup of high-level waste at the Savannah River Site and increase costs. The facility was planned to begin operating in 1988, and now, DOE estimates that an alternative process may not be available until as late as 2007 and could cost from about \$2.3 billion to \$3.5 billion over its lifetime.

Nuclear Waste: Management Problems at the Department of Energy's Hanford Spent Fuel Storage Project (Testimony, 05/12/98, GAO/T-RCED-98-119). GAO noted several problems with the Hanford Spent fuel project including (but not limited to): as stored, most of the spent fuel at Hanford presents a risk of releasing nuclear materials to the environment and a consequent danger both to workers and the public; this fuel sits in two water basins that are well beyond their design life and are located just 1,400 feet from the Columbia River; never designed for long-term storage in water, some of the spent fuel has corroded, creating a radioactive sludge that has accumulated in the storage basins; because of leaks in the basins, workers risk exposure to radioactive materials if contaminated water is released to the soil, and the public risks exposure if this water moves through the soil to the river; it is likely that radioactive materials carried in water leaking from one of the basins have reached the river at least twice in the past; and these problems and unresolved technical questions will continue to affect DOE's ability to set reliable targets.

Nuclear Waste: Department of Energy's Hanford Tank Waste Project - Schedule, Cost and Management Issues, GAO/RCED-99-13, October 8, 1998. This audit was conducted in response to a request from the House of Representatives Chairman of the Committee on Commerce and the Chairman of the Subcommittee on Oversight and Investigations, Committee on Commerce, to review a revised Departmental approach to addressing the waste disposal problem at Hanford through a privatization contract. The report discussed (1) how the Department's current approach changed from its original privatization strategy; (2) how that change affected the project's schedule, cost, and estimated savings over conventional Departmental approaches; (3) what risks the Department was now assuming with this change in approach; and (4) what steps the Department was taking to carry out its project oversight responsibilities. Given the technical uncertainties stemming from the fact that the proposed waste treatment technology had yet to be tested at production levels on Hanford's complex and unique wastes, and management challenges such as obtaining needed contracting expertise, GAO concluded that the Department's financial risks were great.

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