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Office of Audit Services

Audit Report

Development and Implementation of the Department's Enterprise Architecture

DOE/IG-0686

April 2005

Department of Energy

Washington, DC 20585

April 21, 2005

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman
Inspector General

SUBJECT: INFORMATION: Audit Report on "Development and Implementation of the Department's Enterprise Architecture"

BACKGROUND

The Department of Energy's $2.5 billion in annual information technology expenditures is among the largest investments of its kind in the Federal sector. Under the *Clinger-Cohen Act of 1996*, the Department and all other agencies must implement what is commonly referred to as an "enterprise architecture," a framework for reducing costs and achieving efficiencies through sound business processes and technology investment management. Agency enterprise architectures serve as organizational blueprints that define – in business and technology terms – how an agency operates today, intends to operate in the future, and intends to invest in technology to transition to the future. Consistent with the support found in the President's Management Agenda, strong functional enterprise architecture is essential to maximizing the usefulness of the Department's information technology program.

Since 1998, we have reported on the performance of the Department's efforts to implement and operate an effective architecture. We initiated this follow-up audit to determine whether the Department had developed and implemented an enterprise architecture to guide its sizable information technology investment.

RESULTS OF AUDIT

Despite significant effort, the Department had not fully defined its current or future information technology requirements, essential elements if an architecture is to be an effective tool in managing information technology investments. Additionally, the Department had not taken the necessary steps to ensure that program office architectures were complete, and were compatible with and supported the overall architecture design.

The Department's development efforts were incomplete because it had not defined the roles, responsibilities, and authorities necessary to develop and implement a Department-wide architecture. Further, the Department did not have a formal program plan that established the scope, schedule, and cost of the development effort; nor, had it established performance goals to measure progress toward the development of an architecture.

During the course of our review, the Department took several steps towards developing an integrated enterprise architecture. For example, the Department established and began populating an Enterprise Architecture Repository with an end-goal of describing its current information technology inventory and future requirements. It also made organizational changes and other improvements designed to integrate the architecture efforts of the program offices with the overall Departmental architecture. While these improvements were notable, we made several recommendations that we believe are necessary for the Department to fully implement a corporate approach for managing information technology investments by taking advantage of opportunities for cost savings and operational efficiencies.

We believe that the importance of the enterprise architecture concept in a complex, multi-faceted organization like the Department of Energy cannot be overstated. Since 1998, our reports have shown that the lack of such an architecture contributed to more than $155 million in lost opportunities for information technology-related savings.

MANAGEMENT REACTION

Management generally concurred with the intent of our recommendations; however, they did not agree with a number of the report's conclusions. Management believed that its recent actions, such as establishing an architecture repository and working group, will facilitate its architecture efforts. While we consider management's recent actions to be positive steps, we disagree with a number of their comments regarding efficacy of the current architecture. The Department has a number of obstacles to overcome before its enterprise architecture may be considered complete and fully functional. Management's comments are summarized in our report.

Attachment

cc: Deputy Secretary
Chief of Staff
Administrator, National Nuclear Security Administration
Under Secretary for Energy, Science and Environment
Principal Deputy Assistant Secretary for Environmental Management
Principal Deputy Assistant Secretary for Fossil Energy
Director, Office of Management, Budget and Evaluation/Chief Financial Officer
Director, Office of Science
Chief Information Officer

REPORT ON DEVELOPMENT AND IMPLEMENTATION OF THE DEPARTMENT'S ENTERPRISE ARCHITECTURE

TABLE OF CONTENTS

ENTERPRISE ARCHITECTURE DEVELOPMENT AND IMPLEMENTATION

Development Efforts

The Department of Energy (Department) had not fully developed and implemented an architecture to manage information technology investments. In particular, it had not defined all requirements essential to making investment decisions and had not ensured that program-level architectures were complete and compatible with or supported the Department's overall structure.

Information Requirements

The Department had not completely defined its current or future requirements such as desired systems, supporting applications and hardware, and technology standards. While progress has been made identifying current business processes and the supporting applications, the Department has not defined its target architecture to include elements such as desired applications and hardware requirements. Efforts to define data necessary to support business requirements also remain incomplete. The Department had not identified all elements of its target architecture such as detailed requirements for its desired network and communication infrastructure. For example, the Department had not evaluated whether significant changes to its existing national and site-level networks and communications methods are necessary to satisfy future needs.

Additionally, the Department had not developed plans for transitioning to a desired architecture. Such plans are essential for ensuring that future system developments are compatible and are not duplicative. For example, the Department had not developed a plan for eliminating long standing problems with duplicate systems across the enterprise. As noted in our report on *Corporate and Stand-Alone Information Systems Development* (DOE/IG-0485, September 2000), the lack of a system inventory and comprehensive architecture resulted in about $38 million being spent to develop and maintain duplicative systems.

Recently, the Department established an Enterprise Architecture Repository (Repository) that, among other things, will include a complete inventory of existing systems and describe requirements for the future

information technology environment. At the time of our review, the Department had not fully populated the Repository with inventory and requirements data.

Program-Level Efforts

Program office architecture development efforts were also missing key components and were not fully integrated with the Department-wide efforts to ensure that the most efficient approaches to meeting information needs were identified. For example, the Office of Environmental Management's (EM) architecture included information about how the program's systems were linked to its business functions, but did not define how future investment requirements would support the program's mission or include a plan for implementing such requirements. Additionally, although the Office of Science (Science) developed a program architecture, it was limited to Headquarters and excluded contractor and field site investment information.

During our review, we noted that certain program elements had not integrated their architecture information with the Department-wide effort. For example, EM, the National Nuclear Security Administration (NNSA), and Science were developing architectures separate from one another and could not ensure that cross-cutting information systems were not redundant. Specifically, the lack of common elements in program architectures, such as complete system inventories and planned future information technology requirements, made it difficult to identify and eliminate duplicative investments. Recently, the Department has begun efforts to integrate the architecture, to include populating the Repository with program-level business and system information.

As we noted in our report on the *Management of the Department's Personnel Security and Access Control Information Systems* (DOE/IG-0651, June 2004), the lack of an architecture that crossed programmatic lines and included all systems contributed to duplicative and redundant development of a number of security and access control systems. Additionally, our report on the Department's *Business Management Information System*

(DOE/IG-0572, November 2002), disclosed that programs were developing separate systems that were not capable of full integration due to the lack of an architecture.

The Office of the Chief Information Officer (CIO) and EM advised us that the program office architectures are integrated with the overall architecture design. The Office of the CIO indicated that periodic guidance documents, an enterprise architecture working group, and an architecture repository have ensured that program office architectures supported compatibility with the Department-wide effort. Finally, the Office of the CIO stated that it has established desktop standard guidance, such as eXCITE, and associated enterprise agreements to support architecture development and implementation.

EM further elaborated that it was using the same Enterprise Architecture development tool and models as the Department to ensure integration. Additionally, EM pointed out that it had an up-to-date inventory of systems in the Repository and had conducted reviews to eliminate duplicative systems. We acknowledge that the Office of the CIO, EM and other programs have recently adopted measures to improve integration of their efforts with the Department's overall architecture. Furthermore, we recognize that EM has taken positive steps to identify and eliminate duplicative systems.

Despite these efforts towards improving integration of program-level efforts with the Department's development of an overall architecture, we noted that further improvements are needed. For example:

- The periodic guidance referenced by the Office of the CIO has generally not been mandatory, did not contain information regarding standardization of all information technology systems at field sites and contractors, and was not formally released. As a result, the programs are not required to follow the standards contained in the guidance when they develop their future technology requirements.

- While we agree that the enterprise architecture working group is a positive step, program officials we spoke with during the course of the audit questioned the effectiveness of the group. For

example, one official responsible for developing a program-level architecture expressed frustration that there was little feedback to the programs, very little two-way communication between the Office of the CIO and programs, and limited training to support the architecture efforts.

- As previously noted, the Repository is still being populated and much of the information relating to the Department's desired information technology environment has not been included.

- Although the Department developed desktop standards as part of eXCITE, the initiative is limited to Headquarters and does not include all program offices.

Policies, Plans and Performance Measures

The Department has not fully developed and implemented an enterprise architecture because policies were not in place to guide development at all organizational levels, no formal program plan existed, and performance goals tied to budget needs had not been established.

Policy

A policy describing the roles and responsibilities for developing and implementing an enterprise architecture had not been developed. According to guidance published by the Federal Chief Information Officers' Council (CIO Council), such a policy should include a description of the relationship of the architecture to the Department's strategic plans and capital planning process; a commitment to develop, implement, and maintain an architecture; and, a description of the enforcement policy. The current Department order on information technology management requires the Chief Information Officer (CIO) to facilitate development and maintenance of an information technology architecture.

Current Departmental policy, however, does not delineate roles, responsibilities, or authorities of Department elements to ensure consistent development and implementation of an architecture. While the Department has begun drafting an update to this order, the draft does

not include enforcement policies or describe methods to integrate program architectures with the Department-wide effort.

Program Plan

The Department also did not have an approved program management plan for addressing the development and implementation of an architecture. According to CIO Council guidance, such a plan should include the scope, cost, and schedule of the architecture initiative, incorporating information about how program-level efforts would complement the overall enterprise architecture, as well as the roles and responsibilities for completing the effort. Although the Department had developed a draft project plan to support the efforts, as required by project management directives, it excluded the scope of the development effort, costs, and definitive milestones. An official in the Office of the CIO recently told us that a complete project plan did not exist for the ongoing development of the Department's architecture.

Performance Goals

Officials also did not consistently emphasize the development and implementation of an enterprise architecture in its performance goals and measures. Although the Department's 2003 Annual Performance Plan included a goal to develop an enterprise architecture, the goal was not met and it was dropped from the 2004 Annual Performance Plan because of changing priorities. Similarly, we found that certain program offices did not establish performance measures for the development of their information technology architectures. While the status of the Department's architecture effort was tracked as part of the President's Management Agenda (Agenda) scorecard, the Department's budget request did not contain goals that linked funding for architecture efforts to performance, missions, or achievement of the Agenda's goals.

Cost and Operational Impacts

As a result of the problems identified, the Department does not have an agency-wide architecture despite the expenditure of $14 million and 10 years of effort. Without

improvements, the Department may be unable to implement an effective corporate approach for managing information technology investments. As demonstrated by a series of reports issued since 1998, the lack of an architecture contributes to costly and potentially incompatible and non-integrated systems. Specifically, the lack of an enterprise architecture contributed to more than $155 million in lost savings (see Appendix 2).

Additionally, without adequate program planning, the Department could not ensure that the architecture development effort was well organized, program-level efforts were consistent with Department-wide efforts, and that its costs and schedule were controlled. Further, the absence of meaningful performance goals and measures increase the risk that the Department will be unable to manage its progress towards implementing an enterprise architecture.

RECOMMENDATIONS

To ensure successful completion and implementation of an enterprise architecture, we recommend that the Department's Chief Information Officer, in coordination with the Administrator, National Nuclear Security Administration, and the Program Secretarial Officers:

1. Modify existing policy and guidance for the enterprise architecture to describe the:

    - Relationship of the architecture to the Department's strategic plans and capital planning process;
    - Commitment to develop, implement, and maintain an architecture;
    - Enforcement policy to implement the architecture; and,
    - Roles and responsibilities, down to the program-level, including the Department's contractors.

2. Develop, approve, and implement a program management plan that includes elements of cost, scope, and schedule for developing both program-level and the Department-wide architecture; and,

3. Incorporate efficiency measures for architecture development and implementation efforts into the Department's annual performance budget.

MANAGEMENT REACTION

Management generally concurred with the intent of the recommendations, but initially disagreed with the focus of several recommendations. Based on management's comments and a number of discussions with program and Office of CIO officials, we modified our recommendations to recognize that the architecture should be viewed as an ongoing program and that performance measures should be included in the Department's budget to guide its further development. After reviewing modifications to the report, officials from the Office of the CIO indicated that management generally concurred with each recommendation, but continued to disagree with certain conclusions.

In commenting on our conclusion that the Department had not defined its information technology requirements needed to make investment decisions, the CIO stated that architecture standards are updated and published in each version of the enterprise architecture. Management also asserted that investments are reviewed annually for compliance with the enterprise architecture as part of the capital planning and investment control process.

Additionally, as we noted in the body of this report, management indicated that it has taken actions necessary to ensure that program office architectures are integrated with support, and are compatible with the Department's architecture. Management also cited initiatives that it has underway to consolidate all aspects of common information technology services throughout the Department as examples of integration.

EM asserted that a project plan was followed during development of its program architecture and that its major investments and systems are aligned to the Agenda, as well as Departmental and program strategic goals, as part of the Repository. Finally, EM responded that it uses a capital planning and investment control process that includes architectural compliance to manage its investments. During a subsequent conversation, an EM official commented that EM's enterprise architecture efforts have

always been directed towards the development of the Department's enterprise architecture rather than focused on a stand-alone program architecture.

The Office of Fossil Energy recognized that much work needs to be done toward developing and implementing an enterprise architecture, but believed that the Department had taken positive steps to improve its architecture efforts. Science and NNSA had no comments on the draft report.

AUDITOR COMMENTS

Management's comments are generally responsive to the intent of our recommendations.

Contrary to the impressions given by management's comments, our audit disclosed that a complete and approved enterprise architecture does not exist and is not being implemented across the complex. While we concur that the Department has developed architecture-related standards and guidance, these efforts, as discussed in the body of this report, were not sufficient and did not result in a complete and usable enterprise architecture.

Our finding in this area is bolstered by a September 2004 assessment conducted by the Office of Management and Budget (OMB). In that assessment, the Department achieved a score of 2.25 out of 5.0 on its latest architecture assessment largely because it had not defined its target architecture or associated transition plan. The lack of a completed architecture was also cited as a contributing factor to the Department's failure to achieve "green" on the latest Agenda e-Government scorecard of December 31, 2004. Finally, we note that in March 2005, an Office of CIO official stated that the Department needed to develop a detailed enterprise "To Be" architecture and migration plan.

Further, although investments are reviewed as part of the capital planning process, the results of the review are limited because the process was undertaken utilizing an architecture that was incomplete and not formally released. For example, OMB's recent assessment disclosed that the Department's enterprise architecture did not demonstrate the ability to make improved resource allocation decisions. We also noted that the Department's internal architecture *Completion and Use Plan* indicates

that the Department will begin to include examples of improved resource allocation decisions in annual enterprise architecture submissions to OMB by September 2005.

During meetings to discuss management's comments, EM clarified that its project plan was not intended to encompass the development of a complete program architecture. Specifically, an official acknowledged that EM's project plan was designed to support development and population of an architecture repository. As such, EM's program-level architecture did not conform to Departmental and OMB guidance. For instance, EM's documentation did not define how the target architecture would support the program's mission or a plan for implementing such requirements. We acknowledge that EM has taken positive steps by implementing a capital planning process and conducting e-Government reviews to identify and eliminate duplicative systems.

Appendix 1

OBJECTIVE

To determine whether the Department had developed and implemented an enterprise architecture to guide its sizable information technology investment.

SCOPE

The audit was performed between October 2003 and March 2005 at Department Headquarters in Washington, D.C., and Germantown, MD; the National Energy Technology Laboratory, Morgantown, WV, and Pittsburgh, PA; the Chicago Office and Argonne National Laboratory, Argonne, IL; and the Fermi National Accelerator Laboratory, Batavia, IL. We also obtained information from the Oak Ridge Reservation, Oak Ridge, TN, and the Lawrence Livermore National Laboratory, Livermore, CA.

METHODOLOGY

To accomplish our audit objective, we:

- Reviewed applicable laws and regulations pertaining to development and implementation of an enterprise architecture. We also reviewed reports issued by the Office of Inspector General and the Government Accountability Office;
- Reviewed numerous documents related to the Department's enterprise architecture efforts, including documents supporting past development efforts;
- Reviewed guidance issued by OMB and the CIO Council;
- Held discussions with program officials and personnel from Department Headquarters and field sites reviewed, including representatives from the Offices of Environmental Management; Science; Chief Information Officer; and Nuclear Energy, Science, and Technology; as well as the NNSA; and,
- Reviewed the *Government Performance and Results Act of 1993* and determined if performance measures had been established for enterprise architecture development.

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. Accordingly, we assessed internal controls regarding the development and implementation of the Department's enterprise architecture. 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 also assessed performance measures in accordance with the *Government Performance and Results Act of 1993* regarding development of an enterprise architecture. As noted in the report, the Department did not consistently emphasize development and implementation of an architecture in its performance goals. We did not rely on computer-processed data to accomplish our audit objective.

An exit conference was held with the Office of Science on March 7, 2005, and the Office of Environmental Management on March 8, 2005. The Offices of the Chief Information Officer and Fossil Energy, and the National Nuclear Security Administration waived exit conferences.

Appendix 2

PRIOR REPORTS

Enterprise Architecture Reports

The following audit reports issued by the Office of Inspector General since 1998 have highlighted the impact of the Department's failure to implement an enterprise architecture. Together, these reports demonstrate more than $155 million in lost cost savings and operational inefficiencies resulting from the lack of an architecture.

- *Nuclear Materials Accounting Systems Modernization Initiative* (DOE/IG-0556, June 2002). The Department may not realize its anticipated potential annual operating savings of $66 million. The Department had not adequately managed its activities to redesign or modernize its nuclear materials accounting systems. Moreover, planned and ongoing system development efforts were not fully consistent with the Corporate Systems Information Architecture. Organizations were allowed to continue to develop or upgrade accounting and production related systems at a projected cost of over $7.5 million.

- *Telecommunications Infrastructure* (DOE/IG-0537, December 2001). The Department annually spends at least $4 million more than necessary to operate and maintain its telecommunications infrastructure. Duplicative data transmission infrastructures existed across the Departmental complex.

- *Information Technology Support Services Contracts* (DOE/IG-0516, August 2001). Significant savings of as much as $44 million over a three year period are possible if the Department adopts an enterprise-wide approach to acquiring information technology support services. Headquarters and field elements routinely obtained information technology support services without making maximum use of existing Federal contracts designed for this purpose. Further, the Department had not established requirements for Headquarters program offices to consolidate the acquisition of information technology support services and for all Departmental organizations, including contractors, to formally consider the use of existing Federal contracts when acquiring information technology support services.

- *Virus Protection Strategies and Cyber Security Incident Reporting* (DOE/IG-0500, April 2001). The Department could improve consistency, increase overall coverage, and save as much as $3 million by adopting an enterprise-wide approach to virus protection software acquisition. As a result, the Department spent over $3.8 million annually for a computer incident response capability that cannot adequately assess the threat experience of the complex as a whole.

- *Commercial off-the-Shelf Software Acquisition Framework* (DOE/IG-0463, March 2000). Without a framework, the Department had been unable to take advantage of enterprise-wide software contracts that could have resulted in savings of $38 million. Specifically, the Department had not developed and implemented software standards or effectively used enterprise-wide contracts, key components of a

commercial off-the-shelf framework. The Department's inability to establish a framework was due to its decentralized information technology strategy and lack of organizational support.

Other Related Reports

- *Management of the Department's Personnel Security and Access Control Information Systems* (DOE/IG-0651, June 2004). The Department had spent or plans to spend at least $13 million to develop, implement, or maintain multiple systems that will not fully benefit the complex. The Department had not developed a comprehensive framework for modernizing its personnel security and access control information systems and did not always follow sound system development practices. Absent a coordinated approach, the Department is unlikely to achieve its objective to improve the cost-effectiveness and efficiency of these critical systems.

- *Management Challenges at the Department of Energy* (DOE/IG-0626, November 2003). The Department continued to experience challenges in a number of important areas, including information technology management. Specifically, the Department had not satisfied the requirements of the *Clinger-Cohen Act* to effectively manage information technology. Program elements were developing separate systems that were not capable of full integration with other business systems, did not link performance and financial data, and did not replace inefficient program and site-level financial management systems.

- Special Report on *The Department of Energy's Implementation of the Clinger-Cohen Act of 1996* (DOE/IG-0507, June 2001). The Department had not satisfied major requirements of the *Clinger-Cohen Act* to develop and implement an integrated, enterprise-wide information technology architecture and acquire information technology related assets in an effective and efficient manner. Despite many years of effort and significant expenditures, the Department had yet to deploy an integrated, enterprise-wide information technology architecture. Because of its decentralized approach to information technology management, the Department has been unable to constrain duplicative information systems development and effectively deploy corporate-level systems.

- *Corporate and Stand-Alone Information Systems Development* (DOE/IG-0485, September 2000). The Department spent at least $38 million developing duplicative information systems. Despite efforts to implement several corporate-level applications, duplicative and/or redundant computer systems existed or were under development at virtually all organizational levels within the Department. Many organizations continued to invest in custom or site-specific development efforts that duplicated corporate systems.

- *Review of the U.S. Department of Energy's Information Management Systems* (DOE/IG-0423, August 1998). The Department had not developed and implemented an Information Technology Architecture. Additionally, only one program office had initiated development of its information architecture. The lack of an architecture could adversely affect the successful attainment of a strategic goal for $100 million in cost avoidances. These problems occurred due to a lack of organizational support for an Information Technology Architecture.

Government Accountability Office

- *Information Technology: Leadership Remains Key to Agencies Making Progress on Enterprise Architecture Efforts* (GAO-04-40, November 2003). Attempting to modernize and evolve information technology environments without an enterprise architecture often results in operations and systems that are duplicative, not well integrated, unnecessarily costly to maintain and interface, and ineffective in supporting mission goals. The Department had only achieved stage 1 of 5 on the Government Accountability Office's Management Maturity Framework (Version 1.1). Specifically, the Department lacked an automated tool and written and approved policies, among other things, for developing and implementing an architecture.

IG Report No. DOE/IG-0686

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