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AUDIT REPORT

THE U.S. DEPARTMENT OF ENERGY'S EFFORTS TO PRESERVE THE KNOWLEDGE BASE NEEDED TO OPERATE A DOWNSIZED NUCLEAR WEAPONS COMPLEX

OCTOBER 1998

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

Department of Energy

Washington, DC 20585

October 2, 1998

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman
Acting Inspector General

SUBJECT: INFORMATION: Audit Report on "The U.S. Department of Energy's Efforts to Preserve the Knowledge Base Needed to Operate a Downsized Nuclear Weapons Complex"

BACKGROUND

In the past, nuclear testing and the continuous development of new nuclear weapons have been the basis for confidence in the safety, reliability, and performance of the nuclear weapons stockpile. However, due to recent changes in the U.S. nuclear posture, confidence in the stockpile must now be sustained without these activities. Specifically, the Department of Energy (Department) has ceased conducting nuclear tests, production of fissile materials, and production of new-design nuclear warheads. The Department must now rely on scientific understanding and expert judgment, rather than on nuclear testing and the development of new weapons, to predict, identify, and correct problems affecting the stockpile. The scientific understanding and judgment will be based on the knowledge created by the Department and its predecessor agencies throughout the history of the nuclear weapons program, as well as such factors as nonnuclear testing and advanced computer modeling.

To preserve the knowledge base, the Department must assemble, maintain, and assure user-friendly access to a comprehensive, well-organized archive of data, information, and knowledge regarding nuclear weapons. The objective of this audit was to determine whether the Department had developed a program to preserve the knowledge base needed to operate a downsized nuclear weapons complex. In particular, we assessed the Department's efforts to preserve the data, information, and knowledge needed to ensure the vitality of the weapons complex.

RESULTS OF AUDIT

The Department had not developed a coordinated, integrated program to preserve the knowledge base of the downsized nuclear weapons complex. Although each of the weapons complex sites included in our audit was conducting archiving and knowledge capture activities, there was little overall consistency among the sites in terms of planning, approach, and progress made. This situation occurred because the Office of Defense Programs had not assigned programmatic responsibility for development and implementation of a performance plan for knowledge preservation activities that would address issues such as the nature, timing, and funding of such activities and had not assigned programmatic responsibility for the integration of site activities.

Without a coordinated, integrated program for knowledge preservation, the Department risks not identifying and using all information that would provide continued high confidence in the nuclear stockpile. Specifically, the Department cannot ensure that all relevant information will be included in a comprehensive, well organized, and easily accessible knowledge base, and that priorities for the capture of data, information, and knowledge are appropriate and consistent throughout the nuclear weapons complex. In addition, disparities in knowledge preservation planning, approach, and progress may raise impediments to the integration of the various site activities.

MANAGEMENT REACTION

The Assistant Secretary for Defense Programs concurred with our report's findings, conclusions, and recommendation. Consistent with our recommendation, the Assistant Secretary has designated the Director of Advanced Design and Production Technologies as the program official responsible for archiving, and for overseeing the development of a strategic plan to address the issues noted in our report. The Assistant Secretary stated that a final draft of the plan will be completed by January 15, 1999.

Attachment

cc: Deputy Secretary
Under Secretary

THE U.S. DEPARTMENT OF ENERGY'S EFFORTS TO PRESERVE THE KNOWLEDGE BASE NEEDED TO OPERATE A DOWNSIZED NUCLEAR WEAPONS COMPLEX

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OVERVIEW

INTRODUCTION AND OBJECTIVE

Maintaining a credible nuclear deterrent is a cornerstone of U.S. national security policy. The President has stated that the maintenance of a safe and reliable nuclear weapons stockpile is a supreme national interest. The Department of Energy's (Department) Office of Defense Programs is charged with ensuring the safety, reliability, and performance of this stockpile. In the past, nuclear testing and the continuous development of new nuclear weapons have been the basis for high confidence in the stockpile. However, due to recent changes in the U.S. nuclear posture, confidence in the stockpile must now be sustained without these activities. Specifically, the Department has ceased conducting nuclear tests, production of fissile materials, and production of new-design nuclear warheads.

The Department must now rely on scientific understanding and expert judgment, rather than on nuclear testing and the design and production of new weapons to predict, identify, and correct problems affecting the safety, reliability, and performance of the stockpile. The scientific understanding and judgment will depend on the base of knowledge created by the Department and its predecessor agencies throughout the history of the nuclear weapons program, as well as non-nuclear tests and advanced computer modeling. To preserve and use the knowledge base, the Department must assemble, maintain, and assure user-friendly access to a comprehensive, well-organized archive of data, information, and knowledge regarding nuclear weapons.

Elements of knowledge preservation include archiving of data and information, as well as recording of interviews with weapons experts who have retired or will retire in the near future. Archiving activities consist of researching, cataloging, analyzing, and preserving the design, test, engineering, materials, and manufacturing data for weapons and weapons effects experiments, and making this base of knowledge accessible for use in current operations across the weapons complex. Preservation and reanalysis of past nuclear and non-nuclear test data will be used to validate new experimental facilities and improved computational capabilities to be used in predicting, identifying, and correcting problems affecting the stockpile in the future.

Interviews with retiring or retired weapons experts (hereafter referred to as knowledge capture activities) provide, from individuals and panels of experts in a particular weapon area, information that despite its value, may not be formally documented. Such information includes knowledge about problems encountered in designing the weapon, reasons for design

choices, operational safety, and the "art" of weapons design and production. Both archiving and knowledge capture activities will be used to train the new generation of personnel that will provide the technical judgment needed for future stockpile assessments.

The objective of this audit was to determine whether the Department had developed a program to preserve the knowledge base needed to operate a downsized nuclear weapons complex. In particular, the objective included assessing the Department's efforts to preserve the data, information, and knowledge needed to ensure the vitality of the weapons complex.

CONCLUSIONS AND OBSERVATIONS

The Department had not developed a coordinated, integrated program to preserve the knowledge base of the downsized nuclear weapons complex. Although each of the weapons complex sites included in our audit was conducting archiving and knowledge capture activities, there was little overall consistency among the sites in terms of planning, approach, and progress. The Office of Defense Programs, which is responsible for ensuring the safety, reliability, and performance of the nuclear weapons stockpile, had not assigned programmatic responsibility for developing and implementing a performance plan for knowledge preservation and for integrating site activities. A plan is needed to address the nature, timing, and funding of knowledge preservation activities throughout the Department. An integrated program is also needed to ensure that all relevant information is included in a comprehensive, well organized, and easily accessible knowledge base, and that priorities for the capture of data, information, and knowledge are appropriate and consistent throughout the weapons complex.

Effective October 1, 1998, the Government Performance and Results Act of 1993 will require the Department to prepare performance plans that complement its Strategic Plan. This planning process provides the means to ensure that the activities of the organizational components of the nuclear weapons complex are consistent with one another and with the Department's strategic goals and objectives. Consistent with this Act, we recommend that the Assistant Secretary for Defense Programs assign programmatic responsibility for developing and implementing a performance plan for knowledge preservation activities and for integrating site activities. This will help ensure that site knowledge preservation priorities and activities are appropriate and consistent with one another and with overall knowledge preservation goals of the Department.

Two prior Office of Inspector General reports, which also discuss Departmental efforts to collect and utilize information, are discussed in Appendix 2.

Office of Inspector General

PRESERVATION OF DATA, INFORMATION, AND KNOWLEDGE

Approaches To Knowledge Preservation Differ

Each of the weapons sites included in our audit was conducting archiving and knowledge capture activities. However, there was little overall consistency among the sites in terms of planning, approach, and progress.

Planning

Planning for knowledge preservation activities was inconsistent across the weapons complex. Sandia National Laboratories (Sandia), Lawrence Livermore National Laboratory (Livermore), the Y-12 Plant (Y-12), and the Pantex Plant (Pantex) had developed plans that encompassed archiving and knowledge capture activities. However, Los Alamos National Laboratory (Los Alamos) and the Kansas City Plant (Kansas City) had not yet developed overall plans for archiving and knowledge capture. In addition, the plans that were prepared did not always address important issues related to knowledge preservation activities.

For instance, Sandia's implementation plan for archiving activities dealt mainly with providing the infrastructure and standards for the electronic archiving, storage, retrieval, and exchange of information. Important issues such as the creation of comprehensive indices of site information holdings, which information should be electronically archived, and prioritization for these activities were not addressed. Further, Livermore's plan was comprehensive in terms of the knowledge preservation strategies it discussed, but lacked sufficient detail as to how these strategies would be accomplished. For example, the plan discusses the importance of being able to identify what information exists and where it is located by searching across collections of bibliographic data from various sources. However, the implementation steps indicate only that this will encompass one specific collection of such data and "several others," and do not specify how this search capability will be provided.

Approach

The weapons complex sites visited also lacked uniform approaches to knowledge preservation activities. For example, in conducting knowledge capture activities, Sandia had produced over 870 videotapes covering 132 individual and panel discussions on weapon-related topics, and initiated a pilot project to convert the video to digital format so that it could be viewed and searched using a desktop computer. The

project leader for this activity estimated that the cost-to-date was approximately $4.5 million. She added that Sandia planned to produce another 60 videotapes in the future, and digitally format videotapes to provide desktop access and search capability for all videos. Los Alamos also conducted knowledge capture activities, but had videotaped only about 24 panel discussions and had no plans to convert them to digital format. A Los Alamos official estimated that the videotapes cost approximately $400,000 to produce. In contrast, Pantex had initiated a video knowledge capture project, but changed its approach because officials believed that the videotapes did not provide value-added information. Pantex is continuing to capture knowledge through interviews, but documents the results on paper rather than via videotape. While each site may have unique needs, the dissimilar levels of effort and resources devoted to these activities illustrate the need for a coordinated and agreed upon knowledge preservation approach among the weapons sites if information is to be effectively and efficiently shared among sites.

Progress

Progress in conducting knowledge preservation activities also varied among the sites. In general, the weapons laboratories had made greater progress than the production plants in implementing archiving and knowledge capture programs. As noted above, Sandia and Los Alamos had made significant progress in conducting knowledge capture activities. Livermore had also initiated a knowledge capture project, completed approximately 200 hours of videotaped interviews, and planned to add digital video search capability via desktop computer. With respect to archiving, Sandia had efforts underway to electronically archive and provide better access to weapons data. At Los Alamos, eight laboratory divisions have converted information to electronic format and made it available "on-line." Livermore had created a database of nuclear design data and information containing over 4,000 documents and over 8,000 data files with full content search capabilities.

In contrast, Y-12 had completed a knowledge capture project encompassing nuclear safety, hazardous and toxic material handling, and critical production processes, but was unable to implement planned archiving activities. Pantex had established the capability to convert documents to electronic format and conducted a pilot project to archive data for 11 production units of a particular weapons system, but was unable to fully implement planned archiving activities. Officials at Y-12 and Pantex indicated that they lacked the funding to do so. Kansas City

had conducted pilot archiving and knowledge capture projects, but limited expansion of these efforts pending more unified Departmental direction regarding these activities.

Preservation Of The Stockpile Without Nuclear Testing

The Department's Stockpile Stewardship Plan (SSP) illustrates the importance of efforts to preserve the knowledge base of the nuclear weapons complex. The SSP describes how the Office of Defense Programs will continue to ensure high confidence in the nuclear weapons program as the U.S. national security strategy shifts from the design, production, and testing of weapons to science-based stewardship of a smaller, less diverse stockpile. Specifically, the SSP states that a critical element in maintaining the nuclear weapons stockpile and associated hardware in the absence of nuclear testing is the ability to assemble, maintain, and assure user-friendly access to a comprehensive, well-organized record of past weapons design and testing data, weapon effects testing data, and scientific and engineering experience. The Department's efforts to archive and capture data, information, and knowledge are intended to create this base of information.

Programmatic Responsibility And Performance Plan

The Department had not developed a coordinated, integrated program for knowledge preservation because the Office of Defense Programs had not assigned programmatic responsibility for developing and implementing an overall performance plan and for integrating the various site efforts. Although the need for knowledge preservation was articulated in the SSP, the Office of Defense Programs had not developed a policy or plan that addressed key issues such as the nature, timing, extent, and funding of knowledge preservation activities throughout the weapons complex, as well as the responsibility for and approach to the integration of site efforts.

While the Nuclear Weapons Information Group (NWIG) was chartered to assume leadership and provide guidance related to nuclear weapons information management issues, it did not have sufficient authority to address major issues such as funding of knowledge preservation activities at specific sites. Rather, NWIG is a collaborative working group that includes members from each of the Department organizations involved in nuclear weapons research, development, testing, and production. NWIG has been working primarily towards developing a uniform indexing system for identifying information held at each site, developing standards for long-term storage of information and

transmission of information between sites, and developing a methodology to preserve need-to-know access controls when information is electronically accessed. NWIG does not have authority over the implementation of these standards at the sites or over the timing, extent, and funding of site efforts.

Critical Element Of Stockpile Stewardship

Without a coordinated, integrated program for knowledge preservation, the Department risks not identifying and using all information that would provide continued high confidence in the nuclear stockpile. In the absence of programmatic responsibility for developing and implementing an overall performance plan for knowledge preservation, and integrating site efforts, the Department cannot ensure that all relevant information will be included in a comprehensive, well organized, and easily accessible knowledge base and that priorities for the capture of data, information, and knowledge are appropriate and consistent throughout the nuclear weapons complex. In addition, disparities among weapons complex sites in the planning, approach, and progress of knowledge preservation activities may impede the integration of site efforts. Resolution of these issues is especially important so that the knowledge developed over the history of the nuclear weapons program can be used as baseline information to validate new experimental facilities and improved computational capabilities to be used in predicting, identifying, and correcting problems affecting the stockpile in the future.

RECOMMENDATION

We recommend that the Assistant Secretary for Defense Programs assign programmatic responsibility for developing and implementing a performance plan for knowledge preservation activities and for integrating site activities throughout the Department for the nuclear weapons complex. The plan should include requirements for:

- the nature, timing, and extent of archiving and knowledge capture activities;
- funding of archiving and knowledge capture activities; and
- responsibilities for and approach to the integration of the weapons complex site efforts to assemble, maintain, and assure access to a comprehensive, well-organized record of past weapon design and testing data, weapon effects testing data, and scientific and engineering experience.

MANAGEMENT REACTION

The Assistant Secretary for Defense Programs concurred with report's findings, conclusions, and recommendation. Consistent with our recommendation, the Assistant Secretary has designated the Director of Advanced Design and Production Technologies as the program official responsible for archiving, and for overseeing the development of a strategic plan to address the issues noted in our report. The Assistant Secretary stated that a final draft of the plan will be completed by January 15, 1999. Management's specific comments are included in Appendix 3.

AUDITOR COMMENTS

Management's comments are responsive to our recommendation.

APPENDIX 1

SCOPE

The audit was performed between October 1997 and August 1998. We performed audit work at Headquarters, Sandia National Laboratories, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, as well as the Y-12, Pantex, and Kansas City Plants.

METHODOLOGY

To accomplish the audit objective, we:

- held discussions with personnel from the Office of Defense Programs regarding efforts to preserve the knowledge base of the weapons complex;
- reviewed sections of the Department's Stockpile Stewardship and Management Plan relating to efforts to archive, capture, and provide enhanced access to nuclear weapons data, information, and knowledge;
- held discussions with personnel involved in efforts to archive and capture data, information, and knowledge at weapons complex sites;
- reviewed weapons complex sites' plans relating to archiving and knowledge capture activities; and
- evaluated site efforts to archive and capture, and provide enhanced access to nuclear weapons data, information, and knowledge.

The audit was performed 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. Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed at the time of our audit. We did not rely on computer-processed data to accomplish our audit objective.

An exit conference was waived by the Office of Defense Programs.

APPENDIX 2

PRIOR OFFICE OF INSPECTOR GENERAL REPORTS

This review concerned the Department's efforts to develop an integrated approach to collect and facilitate the use of information. Prior Office of Inspector General reviews related to such efforts include:

- *Audit of the Department of Energy's Scientific and Technical Information Process*, Report Number DOE/IG-0407, dated June 17, 1997. This audit found that (1) the Department and its contractors had not implemented systems to effectively identify, collect, and disseminate scientific and technical information on a life-cycle basis as required and (2) the Office of Scientific and Technical Information was not receiving all scientific and technical information generated by the contractors.

- *Audit of Departmental Receipt of Final Deliverables for Grant Awards*, Report Number DOE/IG-0415, dated December 4, 1997. This audit found that many grantees did not provide final technical and financial reports. Without final deliverables, the Department could not demonstrate that the public benefit specified in the grant instrument was achieved.

APPENDIX 3

DOE F 1325.8
(08-93)
United States Government **Department of Energy**

memorandum

DATE: September 8, 1998

REPLY TO
ATTN OF: DP-44.L.Thomas-3-6572

SUBJECT: Initial Draft Report on "The U.S. Department of Energy's Efforts to Preserve The Knowledge Base Needed to Operate A Downsized Nuclear Weapons Complex"

TO: Acting Deputy Inspector General for Audit Services, IG-30

Thank you for the opportunity to review and comment on the subject draft report.

Overall, Defense Programs (DP) agrees with the report's findings, conclusions, and recommendations. As indicated in the attached Management Response to the report, DP recognizes the importance of preserving the information and knowledge base of the nuclear weapons program and has already taken substantive actions to ensure such preservation. Toward that end, and consistent with the Inspector General's recommendations, DP has designated the Director of Advanced Design and Production Technologies as the program official responsible for archiving responsibilities and for overseeing the Nuclear Weapons Information Assessment Working Group's development of a strategic plan to address this issue. The DP Management Response provides a more complete picture of DP effort in this area and we strongly suggest these comments be included in the report.

We look forward to receiving the final report when it is completed. In the meantime, if you have any questions, please do not hesitate to contact Linda Thomas, of the DP Audit Liaison Staff, at 3-6572.

Victor H. Reis
Assistant Secretary
for Defense Programs

Attachment

MANAGEMENT RESPONSE
ON INSPECTOR GENERAL DRAFT REPORT,
"THE U. S. DEPARTMENT OF ENERGY'S EFFORTS TO PRESERVE THE KNOWLEDGE BASE NEEDED TO OPERATE A DOWNSIZED NUCLEAR WEAPONS COMPLEX"

INFORMATION MANAGEMENT:

- DP recognized the importance of preserving the information and knowledge generated by the weapons program. As a result, DP charted the Nuclear Weapons Information Group in November 1995. This group was to define and develop requirements, tools, and formats to enable continuing and appropriate access to nuclear weapons data, information, and knowledge across the complex.

- The Deputy Assistant Secretary for Military Applications and Stockpile Management issued an April 25, 1997, memorandum requesting a plan to immediately begin archiving, in an electronically retrievable format, data being routinely being generated in the weapons program.

- This activity was re-articulated again in October 1997 with assigning of archiving responsibilities to the Director, Office of Advanced Design and Production Technologies.

- On February 5, 1998, the Deputy Assistant Secretaries for Research and Development DP-10, Military Applications and Stockpile Management, DP-20, and Modeling and Simulation, DP-50, directed an assessment to take a comprehensive look at archiving activities across the complex and provide a report of current activities and future needs by June 30, 1998.

- The Nuclear Weapons Information Assessment Working Group (NWIAWG) was formed to carry out this assessment. The NWIAWG completed it's work in June and briefed the Deputy Assistant Secretaries for DP on the assessment results on June 17, 1998. The DASs agreed with the findings and recommendations and directed that a strategic plan be written to address the management of nuclear weapons information and for integrating these weapons information management and knowledge preservation activities across the complex. Strategic planning to address the finding of the working group report and the IG report will commence on September 1, 1998, with a final draft plan to be completed by January 15, 1999.

DNFSB 93-6:

Weapons Safety Specifications (WSS) Archiving Program Pursuant to the DNFSB 93-6 Maintaining Access to the Nuclear Weapons Expertise:

- The DOE Implementation Plan, dated October 13, 1995, which was initiated in fiscal year (FY) 1995 for the Weapons Archiving Program for the WSS documents delegates the implementation responsibilities to appropriate operations and area field office program managers. The plan identified 12 weapons systems/programs (7 LANL and 5 LLNL systems) for archiving and knowledge preservation for each WSS to be completed over a 3 year period. FY 1998 is the final year of this implementation plan. Examples of the weapons systems that were completed over the 3 year period are: W69, W56, W76, B53, W62, W78, B61 (all mods), W87, and W88. The following weapons systems are in various stages of completion and they are scheduled for completion in FY 1998: B83, W80, W84. The requirement to perform knowledge capture in conjunction with WSS development was also completed in the above weapons systems.

- Funding for these programs was allocated without a separate individual line-funding for the knowledge preservation and archiving programs, however, funds were allocated from the overall weapons production and stockpile management budget. This funding arrangement has worked well and is planned to continue in the future.

- In order to support the production archiving program staff participation in various archiving program supporting activities, on December 3, 1996, the Deputy Assistant Secretary for Military Applications and Stockpile, DP-20, memo requested the Albuquerque Operations Office (AL) to create a funding mechanism (code) that the production plants staff can charge against in order to support the nuclear weapons information group activities.

IG Report No. DOE/IG-0428

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