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United States Government Accountability Office
Washington, DC 20548

April 29, 2005

The Honorable Terry Everett
Chairman
The Honorable Silvestre Reyes
Ranking Member
Strategic Forces Subcommittee
Committee on Armed Services
House of Representatives

Subject: Nuclear Weapons: Preliminary Results of Review of Campaigns to Provide Scientific Support for the Stockpile Stewardship Program

In 1992, the United States began a unilateral moratorium on testing nuclear weapons. Subsequently, in 1993, the President and the Congress directed the Department of Energy (DOE) to establish a program to ensure the preservation of the United States' core intellectual and technical competencies in nuclear weapons without testing.¹ In response, DOE developed the Stockpile Stewardship Program to (1) increase understanding of the basic phenomena associated with nuclear weapons, (2) provide a better predictive understanding of the safety and reliability of nuclear weapons, and (3) ensure a strong scientific and technical basis for future U. S. nuclear weapons policy objectives. The National Nuclear Security Administration (NNSA), a separately organized agency within DOE, is responsible for carrying out the Stockpile Stewardship Program. This responsibility encompasses many different tasks, including activities associated with the research, design, development, simulation, modeling, and nonnuclear testing of nuclear weapons, as well as the planning, assessment, and certification of the weapons' safety and reliability. Three nuclear weapons design laboratories support NNSA's mission: Lawrence Livermore National Laboratory (LLNL) in California, Los Alamos National Laboratory (LANL) in New Mexico, and Sandia National Laboratories in California and New Mexico.

In 1999, DOE developed a new structure for the Stockpile Stewardship Program that included a series of what DOE called "campaigns," which DOE defined as technically challenging, multiyear, multifunctional efforts to develop and maintain the critical capabilities needed to continue assessing the safety and reliability of the nuclear stockpile into the foreseeable future without underground testing. DOE originally created 18 campaigns that were designed to focus its efforts in science and computing, applied science and engineering, and production

¹National Defense Authorization Act for Fiscal Year 1994, Pub. L. No. 103-160, §. 3138 (Nov. 30, 1993).

readiness. Other program activities associated with the Stockpile Stewardship Program include “directed stockpile work,” which includes the activities that directly support maintaining the current weapons in the stockpile, and “readiness in technical base and facilities,” which includes the physical infrastructure and operational readiness required to conduct campaigns and directed stockpile work activities.

The Stockpile Stewardship Program is now over 10 years old, and NNSA’s campaign structure is in its sixth year. In this context, you asked us to determine (1) how NNSA has organized the campaigns to provide the scientific capabilities required to support the nuclear stockpile, (2) the extent to which the scientific campaigns have met their overall goals and supporting milestones, and (3) the effectiveness of NNSA’s current planning process for the campaigns. To address these issues, we identified the six individual NNSA campaigns that primarily deal with providing the scientific capability required to support the nuclear stockpile. For these campaigns, we reviewed NNSA campaign planning documents and other documents related to campaign performance, such as external review panel reports. We also interviewed campaign program managers at NNSA, LLNL, and LANL. We focused our work principally on two campaigns—the Primary Assessment Technologies (Primary) and Secondary Assessment Technologies (Secondary) campaigns—because these campaigns set the requirements for the experimental data and computer models needed to assess and certify the performance of nuclear weapons. We briefed your staff on the preliminary results of our review in April 2005. This letter summarizes our briefing. Enclosure I contains the briefing slides we presented. We conducted the work for this letter from August 2004 through April 2005 in accordance with generally accepted government auditing standards. Our work is continuing, and we expect to issue a final report on NNSA’s Stockpile Stewardship Program scientific campaigns in December 2005.

In summary:

NNSA has six individual campaigns that are intended to provide the scientific capability required to support the nuclear stockpile. The Primary and Secondary campaigns are designed to analyze and understand the different scientific phenomena that occur in the primary and secondary stages of a nuclear weapon during detonation.² As such, the Primary and Secondary campaigns set the requirements for the experimental data and computer models needed to assess and certify the performance of nuclear weapons. Four other campaigns—Dynamic Materials Properties, Advanced Radiography, Advanced Simulation and Computing, and Inertial Confinement Fusion and High Yield—provide the experimental and computational support needed to meet the goals set by the Primary and Secondary campaigns. For example, the Advanced Simulation and Computing campaign provides the leading-edge computers and models needed to

²Modern nuclear weapons have two stages: the primary, which is the initial source of energy, and the secondary, which is driven by the primary and provides additional explosive energy.

simulate the performance of nuclear weapons without underground testing. From fiscal year 2001 to fiscal year 2004, NNSA spent about \$5.8 billion on these six campaigns.

The Primary and Secondary campaigns have not achieved the overall goals originally established for them in 1999; however, the Primary and Secondary campaigns have made progress in completing important supporting milestones. Initially, the Primary campaign set goals for certifying the primary stage of a nuclear weapon to within a stated primary yield level during the 2005 to 2010 time frame. The goals for the Secondary campaign were closely linked to the goals established for the Primary campaign. However, achieving these goals has been technically challenging and has depended on the timely completion of major facilities such as the National Ignition Facility (NIF) at LLNL and the Dual Axis Radiographic Hydrodynamic Test Facility (DARHT) at LANL—both of which have experienced major delays due to problems with technical issues and project management and are still not complete.³ In 2003, NNSA modified the original goals for the Primary and Secondary campaigns and extended them into the 2010 to 2014 time frame.

Between 1999 and 2003, NNSA did not have a uniform planning process for approving and tracking campaign milestones, and the planning process that did exist was not applied in a consistent manner at LANL and LLNL. However, in 2003, NNSA implemented a new planning process for the campaigns, including the establishment of a uniform set of requirements for campaign program and implementation plans. In addition, NNSA implemented a system for tracking the progress of major milestones through the use of a milestone reporting database and a quarterly performance review meeting for managers involved in the Stockpile Stewardship Program. However, NNSA officials have acknowledged that current campaign plans still do not provide clear linkages between goals and supporting milestones, and they do not adequately coordinate and set priorities for the scientific research currently conducted across the weapons complex. In response, NNSA officials are revising campaign plans and overall milestones for the Primary campaign for fiscal year 2006. Finally, NNSA, LANL, and LLNL officials have endorsed the use of a new methodology for assessing and certifying nuclear warheads. This methodology, known as the Quantification of Margins and Uncertainties, draws together data from simulations, experiments, and expert judgments to quantify confidence factors for the key potential failure areas in a nuclear weapon. However, NNSA and laboratory officials, as well as outside experts, acknowledge that this methodology is still incomplete and evolving. According to NNSA plans, full implementation of this methodology is not expected until the 2010 to 2014 time frame.

³DARHT was originally scheduled for completion in 2003 and is now scheduled for completion in 2008. NIF will not be complete until 2008, 5 years after the original completion date of 2003.

We provided NNSA with a draft of our report and received oral comments from NNSA's Assistant Deputy Administrator for Research, Development, and Simulation. NNSA generally agreed with our findings. With respect to our statement on the implementation of the Quantification of Margins and Uncertainties methodology, NNSA stated that it plans to establish intermediate milestones to support the implementation of this methodology prior to 2010. NNSA also stated that it believes this methodology provides a clearer and more comprehensive approach to assessing the performance of nuclear weapons than was provided by the initial goals established for the Primary and Secondary campaigns. In addition, NNSA made technical clarifications that we incorporated as appropriate in this report.

As agreed with your offices, we will make copies of this letter available to others upon request. This letter will also be available at no charge on GAO's Web site at <http://www.gao.gov>.

If you or your staff have any questions about this letter or need additional information, please contact me at (202) 512-3841 or James Noel, Assistant Director, at (202) 512-3591.

Major contributors to this letter include Jason Holliday, Keith Rhodes, Judy Pagano, Doreen Feldman, Carol Herrnstadt Shulman, and Peter Ruedel.

A handwritten signature in black ink that reads "Gene Aloise". The signature is written in a cursive style with a large, looped initial "G".

Gene Aloise
Director, Natural Resources
and Environment

Enclosure

Preliminary Results of Review of Stockpile Stewardship Program Scientific Campaigns



Preliminary Results of Review of Stockpile Stewardship Program Scientific Campaigns

Briefing for the Staff of the
Strategic Forces Subcommittee
Armed Services Committee
House of Representatives

April 4, 2005



- The President and the Congress in 1993 directed that a science-based Stockpile Stewardship Program be developed to maintain the nuclear stockpile without nuclear testing.
- In 1999, the Department of Energy (DOE) developed a new program activity structure for stockpile stewardship that included campaigns, which are programs designed to develop and maintain the critical capabilities needed to enable the continued assessment of the certification basis of the stockpile into the foreseeable future without nuclear testing.
- The National Nuclear Security Administration (NNSA), a separately organized agency within DOE, is responsible for carrying out the Stockpile Stewardship Program.
- Three nuclear weapons design laboratories support NNSA's mission: Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), and Sandia National Laboratories.



- We are reviewing NNSA's management of the campaigns that provide scientific capabilities required to support the Stockpile Stewardship Program. Specifically, we are determining:
 - How NNSA has organized the campaigns to provide the scientific capabilities required to support the stockpile,
 - The extent to which the campaigns have met their overall goals and supporting milestones, and
 - The effectiveness of NNSA's current planning process for the campaigns.



- To address these issues, we have performed the following work to date, focusing principally on the Primary and Secondary Assessment Technologies campaigns:
 - Identified six campaigns that deal primarily with providing the scientific capability required to support the stockpile;
 - Interviewed program managers at NNSA, LLNL, and LANL;
 - Reviewed campaign planning documents; and
 - Reviewed other documents related to campaign performance, such as external review panel reports.



- Six individual NNSA campaigns provide the scientific capability required to support the stockpile.
- The Primary and Secondary campaigns have not achieved the overall goals established for them in 1999. However, they have made progress in completing supporting milestones.
- NNSA has made changes to improve its planning process for the campaigns but still lacks a road map that describes how the Primary and Secondary campaigns will achieve their long-term goals.



- Six individual NNSA campaigns provide the scientific capability required to support the stockpile.
 - Two campaigns—Primary and Secondary Assessment Technologies—set the requirements for experimental data, codes, and models needed to assess the performance of a nuclear weapon.
 - Four other campaigns support the needs of the Primary and Secondary campaigns.
 - Dynamic Materials Properties campaign
 - Advanced Radiography campaign
 - Advanced Simulation and Computing (ASC) campaign
 - Inertial Confinement Fusion (ICF) and High Yield campaign



NNSA Expenditures for Campaigns, Fiscal Years 2001-2004

Dollars in millions

	FY 2001	FY 2002	FY 2003	FY 2004	Total
Primary	45.5	48.8	46.3	40.1	180.7
Secondary	40.0	39.2	46.8	53.1	179.1
Dynamic Materials Properties	72.6	75.2	81.0	85.4	314.2
Advanced Radiography	78.4	93.5	70.5	52.1	294.5
ASC	705.0	645.1	759.7	719.1	2,828.9
ICF	471.6	553.0	493.2	467.2	1,985.0
Total	1,413.1	1,454.8	1,497.5	1,417.0	5,782.4

Source: NNSA.



- The Primary and Secondary campaigns have not achieved the overall goals established for them in 1999.
 - In 1999, DOE established a planning structure for the campaigns, including a mix of goals and milestones contained in program and implementation plans for each campaign.
 - The Primary campaign set goals for certifying weapons to within a stated yield level in the 2005-2010 time frame. These goals were closely linked to the goals established for the Secondary campaign.
 - DOE recognized that achieving these goals would be technically difficult and would depend on the completion of major facilities such as the National Ignition Facility (NIF) and the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility.
 - Major facilities such as NIF and DARHT are still not complete, with inadequate project management and technical problems as major causes.
 - NNSA modified the goals for the Primary and Secondary campaigns in 2003, with key milestones now due in the 2010-2014 time frame.



- However, the Primary and Secondary campaigns have made progress in completing supporting milestones.
 - Between 1999 and 2003, NNSA did not have a uniform planning process for approving and tracking campaign plans and milestones. As a result, we were limited in our ability to assess campaign performance.
 - In addition, LANL and LLNL officials did not initially implement the campaign planning structure in a consistent manner.
 - However, by reviewing plans and conducting interviews with NNSA and LLNL officials on a subset of technical milestones, we verified that most of the technical milestones we examined for the Primary and Secondary campaigns have been achieved.



- NNSA has made changes to improve its planning process for the campaigns.
 - In 2003, NNSA implemented a new planning process for the campaigns, including a uniform set of requirements for campaign program and implementation plans.
 - NNSA also implemented a system for tracking the progress of major milestones through the use of quarterly performance reviews.
 - This planning structure has taken place within the context of a larger, agency-wide process called the Planning, Programming, Budgeting, and Evaluation process, which NNSA implemented in fiscal year 2004.



- However, NNSA still lacks a road map that describes how the Primary and Secondary campaigns will achieve their long-term goals.
 - NNSA officials have acknowledged that current campaign plans do not provide clear linkages between goals and long-term milestones, and do not adequately coordinate and prioritize the scientific research currently conducted across the weapons complex.
 - NNSA officials are revising campaign plans and high-level milestones for the primary campaign for fiscal year 2006.
 - NNSA and the weapons labs have endorsed the use of the Quantification of Margins and Uncertainties methodology for assessing and certifying nuclear warheads. However, NNSA and lab officials, as well as outside experts, acknowledge that this methodology is still incomplete and evolving. According to NNSA plans, full implementation of this methodology is not expected until the 2010-2014 time frame.

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