



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

# Audit Report

Dual Axis Radiographic  
Hydrodynamic Test Facility

DOE/IG-0599

May 2003



## Department of Energy

Washington, DC 20585

May 22, 2003

MEMORANDUM FOR THE SECRETARY

FROM:

*Greg Friedman*  
Gregory H. Friedman  
Inspector General

SUBJECT:

INFORMATION: Audit Report on the "Dual Axis Radiographic Hydrodynamic Test Facility"

### BACKGROUND

Since the cessation of nuclear weapons testing in 1992, the Department of Energy has sought to develop cutting edge technology to aid in its mission of certifying the reliability of the Nation's nuclear weapons stockpile. One critical facility under construction, the Dual Axis Radiographic Hydrodynamic Test (DARHT) Facility at the Los Alamos National Laboratory, will be the Nation's first hydrodynamic test facility capable of producing three-dimensional x-ray photographs. Hydrodynamic tests are used to obtain diagnostic information on the behavior of a nuclear weapon and to evaluate the effects of aging on the nuclear weapons remaining in the stockpile. DARHT is expected to play a crucial role in certifying that the weapons in the stockpile are safe and reliable.

We conducted the audit to determine whether the DARHT project was within schedule, cost, and technical scope.

### RESULTS OF AUDIT

The audit disclosed that DARHT will not be complete before June 2004, 15 months behind schedule. In addition, scope changes had reduced or eliminated work elements; critical activities had been shifted to other programs; and, at least two activities that were part of the original scope of work are being completed with non-project funds. These activities gave the erroneous appearance that total project cost had remained within planned budget.

We concluded that project management control, as exercised by the National Nuclear Security Administration (NNSA) and the Laboratory, needed improvement. Specifically,

- budget estimates were not realistic, given the project's technical complexity;
- a sufficient contingency fund had not been established; and,
- additional project funding had not been requested, even when needed.



As a result, DARHT lacked a viable baseline and at least an additional \$57.5 million in costs associated with the transferred work elements will have to be absorbed by other programs or projects. Of perhaps greatest importance, delays in the completion of DARHT have the potential to impede the performance of the Stockpile Stewardship Program, one of the Department's most critical missions. We recommended that NNSA adopt enhanced management controls on future projects.

In March 2003, NNSA announced that DARHT had been completed on time and within budget. We agree that construction is complete; however, as noted in this report, DARHT will not be operational for at least a year and is within budget only because certain project elements were artificially absorbed by other programs.

### MANAGEMENT REACTION

Management generally concurred with the finding and recommendations. A summary of management's comments and our response is included beginning on page five of our report.

#### Attachment

cc: Deputy Secretary  
Administrator, National Nuclear Security Administration  
Director, Policy and Internal Controls Management

# **DUAL AXIS RADIOGRAPHIC HYDRODYNAMIC TEST FACILITY**

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## SCHEDULE, COST, AND TECHNICAL SCOPE

### Background

The Dual Axis Radiographic Hydrodynamic Test (DARHT) facility is an experimental facility of the Stockpile Stewardship Program. The facility will provide high-speed, high-resolution flash radiographs to diagnose the results of hydrodynamic tests and dynamic experiments. Construction of DARHT began in 1988. Since that time, the project has undergone several baseline changes impacting different technical aspects of the project. Original plans called for the development of two single-pulse axes with similar capabilities at a cost of \$30 million. In 1998, the scope was changed to expand the capability of the second axis while at the same time increasing the cost to \$270 million. The following photograph shows DARHT's main facility, the Hydrotest Firing Site, under construction.



Although Los Alamos announced that the construction was completed in March 2003, the project will not be fully operational until commissioning activities are completed for the second axis. Commissioning activities are designed to achieve the full potential of the accelerator through gradual performance increases over time.

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Los Alamos' May 2000 Project Execution Plan defines specific project requirements and outlines the schedule, cost, and technical scope. It also describes the division of the project into two phases. Phase 1 included construction of the Hydrotest Firing Site, the Radiographic Support Laboratory, acquisition of the single-pulse x-ray machine for the first axis, and equipment for the first stage of emissions containment. Phase 2 included the construction of the vessel preparation facility and acquisition of the four-pulse x-ray machine for the second axis as well as equipment for the second stage of emissions containment.

## **Project Management Milestones**

The audit disclosed that the DARHT facility would not be fully operational until June 2004 – 15 months later than its projected completion date of March 2003. In addition, scope changes — which reduced or eliminated work elements and transferred critical activities to other projects — have been made, giving the appearance that the total project cost is within the planned budget.

### Schedule Changes

According to earlier planning documents, both phases of the DARHT project were to be completed by September 2002. Understandably, the Cerro Grande Fire of 2001 created some delay in DARHT's plans and a revised operational date of March 2003 was established. However, new estimates, in August 2001, changed the completion criteria and further delayed the operational date. This change eliminated the commissioning and confinement vessel work elements from the project and extended the fully operational date to June 2004.

### Project Scope

Initially, the completion of the project was to include all activities leading up to a "fully operational" DARHT facility. However, since the last congressional budget request was developed, critical work elements have been shifted to other programs or have been removed from the scope.

For example, in August 2001, NNSA approved a baseline change that removed the development of the confinement vessel system entirely from the DARHT project scope. Of the original \$11.9 million in capital funds for confinement activities, Los Alamos had already expended \$2.0 million. The remaining \$9.9 million was reprogrammed to other work elements within the DARHT project. Because the confinement

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vessel system is still necessary for DARHT to operate at its full capability, Los Alamos has committed to expending about \$27.6 million in non-project operating funds to complete it. Using operating funds for work that was originally capital funded is not consistent with guidance in the Department's Accounting Handbook.

In August 2001, the Department also approved a baseline change to remove commissioning for the second axis from the project scope. Originally, commissioning activities were included in DARHT's total project costs, similar to the funding methodology used for the commissioning of the first axis. However, Los Alamos is now completing commissioning activities using non-project operating funds from the Advanced Radiography Program. The latest estimate shows that Los Alamos will need at least \$29.2 million above and beyond the original project cost to commission the second axis. Commissioning activities need to be completed before DARHT can operate to its full capability.

Los Alamos also used \$325,000 of non-project funds to assemble five spare accelerator cells and planned to spend another \$325,000 to assemble five more. These shifts in critical work elements results in a total of at least \$57.5 million in non-project fund spending.

In addition to transferring the confinement vessels and commissioning from the DARHT project, NNSA and Los Alamos made the following scope adjustments:

- The size and emission capacity of vessels used to contain detonations during actual use of DARHT were reduced by approximately 50 percent and the \$10 million "saved" by this action was transferred to other project elements;
- The size of the Vessel Preparation Facility was reduced to less than a quarter of its original size and, similar to the above scenario, the \$7.5 million "saved" was transferred to another project element; and,
- Work to develop Photocathode Technology was discontinued. Again, money (\$686,000) was redirected elsewhere within the DARHT project.

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**Project Management Controls**

NNSA and Los Alamos officials did not make full use of available project management tools. Specifically, the cost of various work elements within the DARHT project was significantly underestimated. For example, Los Alamos officials budgeted less than \$1 million for the commissioning of the second axis – the same as was budgeted for the first – even though the technology needed to complete this phase was much more complex. As stated previously, the commissioning of the second axis is now estimated to cost \$29.2 million.

Los Alamos' estimate for contingency also was understated. According to NNSA guidance, contingency for special facilities for a first time, one-of-a-kind construction project such as DARHT, should be about 20–30 percent of the total estimated cost. However, Los Alamos allocated only 15 percent of the total estimated cost for Phase 1 contingency and 11 percent for Phase 2 contingency. This underestimation of costs adversely affected Los Alamos' ability to complete the project within budget.

NNSA directed Los Alamos to complete work on the more complicated second axis for \$155 million, bringing the total project cost to \$270 million. According to a project official, the \$155 million was inadequate but they chose not to request additional funds or go through a formal reprogramming process because they believed that either action could delay or even shut down the project. Instead, officials sought to acquire the needed funding by reducing the scope of selective work elements within the DARHT project and shifting other work elements outside of the project to other programs.

**Completion of the DARHT Facility**

According to revised project estimates, the critical capabilities that will be provided by the DARHT facility will be delayed by at least 15 months, potentially impeding the performance of the Stockpile Stewardship Program. In addition, \$57.5 million in costs, associated with work elements transferred outside of the project, are being absorbed by other Los Alamos programs and are not reflected in DARHT's total project cost. Although project officials believe that the facility will still provide the basic testing requirements, the scope reductions eliminated the flexibility to perform some tests. Further, the funds associated with the scope reductions were applied to other elements of the project rather than reducing total project cost.



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The lack of a viable baseline may cause serious concern in the future because NNSA is already conducting research on the next generation hydrodynamic test facility. Even though little is known about the future technology, the lack of accurate technical scope, schedule, and cost estimating at DARHT could adversely affect future hydrodynamic test facilities and other Los Alamos line-item projects.

## **RECOMMENDATIONS**

We recommend that the Administrator, NNSA:

1. Require Los Alamos to adjust the DARHT baseline to accurately reflect the total cost of bringing DARHT to full operations capability.
2. Ensure that guidance for estimating the cost of state-of-the-art, one-of-a-kind projects is followed, particularly as it pertains to contingency fund levels.
3. Ensure that guidelines for requesting additional funds or reprogramming funds are implemented.
4. Direct the Director, Office of Field Financial Management, to make a determination regarding the appropriateness of using non-project operating funds to complete the confinement and commissioning activities.

## **MANAGEMENT REACTION**

In general, NNSA acknowledged the validity of the findings and recommendations. Management concurred with recommendations two and three; however, with respect to recommendations one and four, management stated that it could not implement corrective actions because the project was in close out.

Management also stated that there were events that made it difficult for DARHT to meet cost, scope, and established milestone dates. Therefore, decisions were made to deviate from established procedures. With the establishment of NNSA in 2000 and with the changes in management roles and responsibilities announced in 2002, many of the problems identified are being corrected. Specifically, there are several

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processes within the NNSA structure that provide the type of guidance called for in recommendation two. In addition, the new DOE Order provides the guidance for extensive reviews of the cost, contingency, risk reduction and acquisition strategy.

**AUDITOR COMMENTS**

The actions taken by management to complete the project gave the appearance that the project was completed within schedule, cost, and technical scope. Although that was not the case, if management follows the guidance referred to in their comments, similar problems could be avoided in the future.

# Appendix 1

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**OBJECTIVE** The audit was conducted to determine whether the DARHT project was within schedule, cost, and technical scope.

**SCOPE** The audit was performed from March 2002 to January 2003 at NNSA Headquarters in Washington, D.C. and Los Alamos National Laboratory in Los Alamos, New Mexico. The scope of the audit included activities of the DARHT facility from October 1987 through October 2002.

**METHODOLOGY** To accomplish the audit objective, we:

- Identified the DARHT Project's technical scope, cost, and schedule;
- Evaluated the status of the scope, cost, and schedule;
- Reviewed Federal and NNSA regulations governing project management;
- Examined DARHT Project documentation, including the Project Execution Plan;
- Reviewed baseline changes;
- Analyzed the use of the contingency fund; and,
- Discussed DARHT Project activities with NNSA and contractor personnel.

We conducted the audit 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, the audit included reviews of Site Office and DARHT Project Office project management activities. Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed at the time of our audit. We did not conduct a reliability assessment of computer-processed data because only a very limited amount of computer-processed data was used during the audit. As part of our review, we evaluated the Site Office's expectations and performance measures for the DARHT Project. We determined that the

## Appendix 1 (continued)

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Site Office established performance measures for the DARHT Project in accordance with the Government Performance and Results Act of 1993.

We held an exit conference with NNSA Headquarters on May 1, 2003.

## Appendix 2

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### PRIOR REPORTS

#### OFFICE OF INSPECTOR GENERAL REPORTS

This review concerned the progress of the DARHT Project regarding scope, budget, and schedule. Prior Office of Inspector General reviews related to other large-scale projects include those listed below:

- *The Department of Energy's Tritium Extraction Facility* (DOE/IG-0560, June 2002). Completing the project within cost, schedule, and scope was at risk because the project team had not made full use of available project management controls. Concerns were raised that the facility would cost substantially more than the estimated total project cost and that the facility would not be completed on time. Also, the facility may not contain all elements of the original specifications. This is one report in a series of reports by the OIG critical of the planning, justification, and management of major projects by the Department and NNSA.
- *Relativistic Heavy Ion Collider (RHIC) Project* (DOE/IG-0543, March 2002). The project did not fully meet performance and cost expectations when it was designated as an operating facility. Specifically, expected beam collisions were not achieved and the project's budget was exceeded. Project expectations were not fully achieved because the NNSA did not adhere to project plans that called for beam collisions to be achieved before project completion and did not ensure that all costs specifically incurred for the project were included in total project costs.
- *Progress of the Spallation Neutron Source (SNS) Project* (DOE/IG-0532, November 2001). The SNS Project's technical scope was reduced to allow the cost and schedule components to be met. Specifically, the baseline did not provide for instruments to address the initially planned areas of science, complete user facilities, and critical spare parts. The condition existed because the NNSA decided to meet approved budget rather than ask Congress for additional funding.
- *The Need for the Atlas Pulsed Power Experimental Facility* (DOE/IG-0495, February 2001). Defense Programs determined that Atlas was needed to support its Stockpile Stewardship Program; however, as construction neared completion, Defense Programs stated it did not have the funds to operate the facility. Without operating funds, the NNSA will not be able to reap the benefits of the technology that this facility provides - validation of certain elements of nuclear weapons computer codes used to certify the safety, security, and reliability of the weapons stockpile.



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