DOE/IG-0417

AUDIT REPORT

THE U.S. DEPARTMENT OF ENERGY'S MANAGEMENT OF RESEARCH AND DEVELOPMENT INTEGRATION

MARCH 1998

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

DEPARTMENT OF ENERGY
Washington, DC 20585

March 13, 1998

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman
Principal Deputy Inspector General

SUBJECT: INFORMATION: Audit Report on "Audit of the Department of Energy's Management of Research and Development Integration"

BACKGROUND

The Congress, independent task forces, and advisory groups have pointed out the need for the Department to improve its integration of research and development (R&D) projects. In the past, R&D management was carried out by different program offices with the research being performed both internally and externally to the Department. We conducted this audit to determine whether the Department had a system in place to integrate R&D projects.

RESULTS OF AUDIT

The Department did not have a systematic process to facilitate the integration of R&D projects. There was no process to ensure projects were jointly planned, budgeted, and managed. Further, the Department had developed a 5-year plan for improving the integration of basic energy research with other energy programs, but the plan was never implemented. This resulted because the Department had not clearly established organizational responsibility or authority for integrating research across programs. Therefore, the Department may be missing opportunities to use R&D dollars more effectively to meet its mission.

We found that, independent of our review, you had reached similar conclusions about the need for greater integration of the Department's R&D programs. Consequently, the Under Secretary has instituted a number of actions for improving the integration of R&D projects.

MANAGEMENT REACTION

Management concurred with the finding in the report and initiated corrective actions.

Attachment

cc: Deputy Secretary
Under Secretary

AUDIT OF THE DEPARTMENT OF ENERGY'S MANAGEMENT OF RESEARCH AND DEVELOPMENT INTEGRATION

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Overview

INTRODUCTION AND OBJECTIVE

The Department of Energy (Department) spent about $6.5 billion on research and development (R&D) activities during Fiscal Year 1997 and plans to spend about $6.7 billion in Fiscal Year 1998. The management of R&D was carried out by different program offices responsible for areas such as defense, environmental remediation technologies, high energy and nuclear physics, health and environment, and basic energy research. This research was performed both internally and externally to the Department. The internal research was carried out at the Department's laboratories which included nine multi-program and 11 program-dedicated laboratories that are operated by various universities and contractors. External R&D research was carried out under contracts with industry, universities, public and private research institutions, and R&D consortia. Instruments used to convey funding to these R&D performers included Department awarded grants, cooperative agreements and contracts, and laboratory-awarded research subcontracts.

Planning, budgeting, and management of the Department's research projects occurred within separate program offices. Because program offices were managed independently, there was little effort to coordinate the planning and budgeting of research across program lines to integrate the research. In conversations with responsible R&D program officials, this management approach was frequently described as "stovepiping," communications were all within the cognizant program office with little or no connection to other programs, thereby resulting in fragmentation of the Department's R&D programs.

Concerns about this management style at the Department have been a long standing issue. The Department has been criticized for the lack of integration[1] between its R&D projects. Past studies and reviews have found that the Department needs greater integration of its R&D programs to achieve the vital mission in energy R&D more effectively.

The objective of this audit was to determine whether the Department had a system in place to integrate research and development projects.

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[1]The Department defines integration of R&D projects as the effective coordination and collaboration between basic and applied technology research programs and across applied technology programs in planning, budgeting, and management.

OBSERVATIONS AND CONCLUSIONS

The Department did not have a system in place to ensure that R&D projects were integrated although Congress and others had called for such an approach. Specifically, there was no process to ensure projects were jointly planned, budgeted, and managed. In addition, although the Department had developed a 5-year plan for improving the integration of basic energy research with other energy programs, it was never implemented. This occurred because the Department had not clearly established organizational responsibility or authority for integrating research across programs. As a result, the Department may be missing opportunities to use R&D dollars more effectively to meet its mission.

The Office of Inspector General met with a member of the Under Secretary's staff on January 16, 1998. At that meeting we learned that, independent of our review, the Secretary had reached similar conclusions about the need for greater integration of the Department's R&D programs. We were informed that the Under Secretary is now Chair of the Department's R&D Council and that he had issued a new charter for the Council. The new charter specifically identified the need to improve the integration between basic and applied research.

The audit identified a material internal control weakness that management should consider when preparing its yearend assurance memorandum on internal controls.

/s/
Office of Inspector General

Integration of Research and Development Projects

Congress And Others Called For An Integration System

Over the past decade, Congress and several task forces and advisory groups have pointed out the need for the Department to improve its integration of R&D projects[2]. In 1992, Congress enacted the Energy Policy Act that directed the Secretary of Energy to prepare and submit to Congress a 5-year program plan for improving the integration of basic energy research programs with other energy programs within the Department. The plan was to include an identification and evaluation of new programs, procedures, mechanisms, and related policy options that could improve the integrating process.

In June 1995, a Task Force on Strategic Energy Research and Development reported that the Department needed integration across its energy research and development programs. Similarly, in September 1997, the President's Committee of Advisors on Science and Technology (PCAST) found the need for better integration between basic and applied research programs. The PCAST recommended that the Department use mechanisms such as co-management and co-funding to improve integration.

The Department Had Not Developed A System To Integrate Research And Development Projects

The Department did not have a system in place to ensure that R&D projects were integrated. Specifically, there was no process to ensure projects were jointly planned, budgeted, and managed. In addition, the 5-year plan to improve integration between basic energy research and other energy programs was not implemented.

Program managers stated that the majority of their projects were planned, funded, and managed independently of other program offices instead of as a system with different programs working together toward a common goal. Moreover, according to managers, scientists, and other officials from six major program offices to whom we spoke, there was no Departmental policy, guidance or procedure that detailed how integration was to occur. The projects that were integrated happened more in an ad hoc fashion with little involvement from senior Department management. In instances where a project was jointly planned, budgeted, and managed by different program offices, it was frequently the result of an initiative external to the Department. Two examples of such projects were Climate Change and The Partnership For A New Generation of Vehicles. Both of these projects were initiated by the White House.

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[2] See Appendix 3 for a summary on reviews that recommended integration of R&D projects within the Department.

There was no policy or guidance that explained integration or how it was to be accomplished, thus leaving individuals to come up with their own interpretation of what integration meant and how it would be achieved. Program managers, scientists, and other officials believed integration occurred because they attended workshops where information was shared or because the results of their research had been published. It was a common belief that good communication between programs and researchers naturally led to effective integration. However, mechanisms to formalize that communication at any stage of a project were not developed. Therefore, senior management and others were often unaware of other research activities that could benefit from their projects.

Front-end planning, establishing priorities, and levels of funding research efforts were the responsibility of the program offices. Program offices had their own goals, but they did not necessarily define the overall intended outcome of research projects. There was no system that required detailed plans for R&D projects between all program offices. Such a system would integrate basic research and technology development projects.

The Science and Technology business line in the Department's Strategic Plan included an objective with a strategy to manage the national laboratories, science user facilities, and other research providers and facilities in a more integrated, responsive, and cost-effective way. One performance measure to support this strategy was "through Fiscal Year 2000, improve science-technology integration by increasing the percentage of Department projects that undergo up-front coordination of all members by the innovation pathway, i.e. basic researchers, technology developers, and implementers defining needs together." However, because there was no system to integrate R&D projects, the Department may have difficulty in establishing a baseline for this performance measure and obtaining the necessary information to evaluate the effectiveness of achieving the goal and objective.

In an effort to improve integration and meet the requirements of the Energy Policy Act, the Department developed a 5-year plan in 1993 for improving the coordination and collaboration of basic energy research with other energy programs. The plan contained a six-step process that was designed to reach out to the highest levels of the Department to create the opportunities for, and to remove the barriers to, improved integration.

Under the 1993 plan, each Assistant Secretary was directed to set aside an agreed-upon small portion of their energy R&D budget for project integration and to incorporate improved integration as a distinct element of the Department's annual planning and budgeting cycle. In addition, the 5-year plan suggested that the Department was to formulate and announce a policy strongly supporting the concept that project integration was a part of every R&D manager's job and the mission of every Department R&D program. The policy was to endorse joint planning and implementation of basic and applied research and technical development as a tool for improving the Department's effectiveness.

This 5-year action plan represented the beginning of a Departmental process that, when fully developed and implemented, was to have resulted in better integration. However, it was never implemented and management officials could not provide an explanation as to why. Many of the Department officials interviewed about the plan were unaware that it had been signed and submitted to Congress.

Authority And Responsibility For Integration Had Not Been Assigned

The Department had not clearly assigned organizational responsibility or authority to integrate R&D projects. The Research and Development Council (Council), which was established in response to the Galvin Report[3], was to coordinate and integrate R&D projects across the Department. However, all the members were peers, Assistant and Deputy Assistant Secretaries, who had no authority over programs other than their own. Further, these officials naturally operated in an environment in which they were competing for the Department's finite research funds. Moreover, the Council, which was to report to the Under Secretary, was not given the necessary authority to require all program offices to comply with directed actions of the Council.

According to its members the R&D Council had made little progress in fulfilling its charter and had a long way to go before integration took place. Our review disclosed that the Council served more as a vehicle to share information and as a promotional tool rather than as a mechanism to integrate R&D projects. We did note, however,

[3] *Alternative Futures for the Department of Energy National Laboratories,* April 1995.

that through workshops and meetings, the Council made progress by bringing attention to the fact that integration needed to be improved.

Use Of Research And Development Funds Could Be Improved Through Better Integration

Members of the Council had not developed any policy or guidance on the meaning of R&D project integration or the implementation of such a program at the Department of Energy. The Council did develop an action plan but many of the tasks had not been completed. According to the Vice Chair and Executive Director of the Council, the action plan was no longer effective and a new plan had not been developed.

With increased scrutiny over research expenditures, the Department's challenge will be to maintain its quality research investments and assure that maximum benefits are realized from R&D. Better integration of its R&D projects would provide the Department with the opportunity to achieve this maximization of resources to meet its science mission. If more projects were jointly planned, budgeted, and managed, each program office would have general knowledge of what other program offices were doing.

In addition, such knowledge would help prevent unplanned duplicate research efforts. A prior Office of Inspector General report dated August 23, 1996, identified duplication of research activities caused by a lack of integration. The "Audit of the Management of the Cooperative Agreement with Texas to Fund the Amarillo National Resource Center for Plutonium" found that the Department had limited involvement in the Center's research projects and had not provided adequate management, direction, and control to ensure that the Center's activities were beneficial and not duplicative. In addition, a subsequent review performed by the Department's Office of Fissile Materials Disposition, showed that during the first 2 years of the Center's operation, the Department had funded about $1.8 million for research that duplicated research conducted at the Department's national laboratories. The unnecessary duplication occurred because the roles and responsibilities for coordinating the research efforts were not clearly defined.

In contrast, the Department has demonstrated effective coordination of the efforts of program managers and scientific and technical information professionals on at least one major project at its Combustion Research Facility (CRF), a user facility where programs and disciplines are co-located. According to Department officials, the Petro Environmental Research Forum (PERF) project at the CRF successfully demonstrated

how integrating basic and applied research can help solve an industry problem. The PERF project was jointly planned, budgeted, and managed between the Offices of Energy Research, Energy Efficiency and Renewable Energy, and the Gas Research Institute. Each entity provided funds, personnel, and time to work on enhancing the design of industrial burners. The project had a mission, specific goals, established timelines, and an expected output that was understood by all participants. The responsible Program Manager at the CRF stated that without integration, the design of industrial burners would not have been improved. Without this improvement new tools needed to meet new emissions standards would not have been developed.

The lack of a system for integration prevents the establishment of a baseline for performance measures, which enable management to identify areas needing attention and opportunities for improvement. Performance measurement information is needed to evaluate annual accomplishments and gauge progress toward the Department's long-term strategic objectives for research integration. In addition, the Government Performance and Results Act of 1993 will require annual performance plans that complement the Strategic Plan. The annual plans will set annual goals with measurable target levels of performance, and annual program performance reports that compare actual performance to the annual goals.

We were pleased to learn that, concurrent with our review, the Under Secretary had been working to improve the integration and alignment of the Department's laboratories with the Department's missions. At a meeting with a member of the Under Secretary's staff in January 1998, we learned that the Under Secretary will now chair the R&D Council and that a new charter has been issued. The purpose of the Council will be to coordinate and integrate R&D across the Department, thereby improving the linkage between basic and applied research and technology development. The Council is also responsible for facilitating more effective planning, budgeting, management, and evaluation of the Department's Energy R&D Programs.

RECOMMENDATIONS

To facilitate the Under Secretary's efforts to improve the management of R&D projects, we recommend that organizational authority and responsibility be formally designated to ensure a system is in place to integrate R&D projects, when applicable. The designated organization should, as a minimum:

1. Reevaluate, update, and reissue the action plan developed in 1993 to incorporate integration mechanisms such as joint planning, budgeting, and management across programs. Responsibility should be assigned to ensure that the steps in the plan are implemented.

2. Consider consolidating the Council and any other groups such as the Energy Resources Board into one group whose purpose would be to assist in the implementation of actions necessary to establish a system to improve integration across the Department.

3. Require each R&D project to have a plan that shows how the research ties into the Department's mission and as a minimum, include the goals, timeline, and expected output from the research.

MANAGEMENT REACTION

The Under Secretary concurred with the finding in the report and stated that individual programs at the Department need to do a better job of integrating their research programs with one another to support the Department's missions and the nation's future. He advised us of a number of alternative actions for improving the integration of R&D projects that appear to meet the intent of our recommendations. Specifically, the R&D Council, now chaired by the Under Secretary, had its responsibilities expanded and accountability to the Department strengthened to more fully integrate and manage R&D both within and across program areas. In addition, each of the Department's four business lines have been directed to develop technology roadmaps that will serve as a primary tool to "strategically manage" the cross-cutting R&D needs and capabilities of the Department. The Under Secretary's comments on the report have been included in their entirety in Appendix 1.

AUDITOR COMMENTS

Management's comments provided alternative actions that are responsive to the recommendations in this report.

Appendix 1

March 9, 1998

MEMORANDUM FOR: Gregory H. Friedman
Principal Deputy Inspector General

FROM: Ernest J. Moniz
Under Secretary

SUBJECT: Management Response to Draft Report on "Audit of the Department of Energy's Management of Research and Development Integration"

Management concurs in the findings of the report.

DOE's important national missions can only be accomplished with strong R&D programs. But the individual programs at DOE need to do a better job of integrating their research programs with one another to support the Department's missions and the nation's future. At the same time, the DOE laboratories must be viewed as the valuable national system that they are, and not simply as a set of independent institutions. The cross-disciplinary excellence displayed at so many laboratories will be enhanced by increasing the collaboration between the DOE laboratories. DOE needs to turn the laboratories into a fully integrated DOE laboratory system.

DOE must continue to improve the laboratory governance system and the overall management of the laboratories. The Galvin Report, the Institute for Defense Analyses "120-Day Study," and recent Laboratory Operations Board reports -- all of which the Department strongly supported -- raise important management issues. The Department has already made substantial progress on many of these issues, though much work remains to be done.

The DOE laboratory system is a prized national asset. The responsibility to maintain and improve the excellence of that asset is one of the most important responsibilities facing any Secretary of Energy. His specific charge to the new Under Secretary was to see to the steady improvement and integration of DOE's R&D program. The specific actions undertaken by the Secretary and Under Secretary since November 1997 include the following:

(1) *R&D Council.* DOE is expanding the responsibilities and strengthening the accountability of the DOE R&D Council. The Council, now chaired by the Under Secretary, comprises the principal secretarial officers who oversee most DOE R&D programs. It has a new charter, issued on January 13, 1998, to more fully integrate and manage the Department's R&D, both within and across program areas. The Council is being used as a forum to ensure the DOE R&D program fully integrates the requirements and capabilities of all DOE program areas and laboratories, as well as the requirements and capabilities of DOE's partners -- e.g., DoD (requirements) and industry and academia (R&D capabilities). In addition to providing stronger high level guidance, support, and leadership to the entire R&D enterprise, the R&D Council will be responsible for the oversight and implementation of numerous R&D management improvements.

(2) *Technology Roadmaps.* Technology roadmaps address specific scientific and technical problems by defining goals, engaging in a consensus building process with R&D performers and stakeholders, and developing R&D plans most likely to achieve success. Technology roadmaps will serve as a primary tool with which to "strategically manage" the cross-cutting R&D needs and capabilities of the Department. In particular, they will be used to meld the individual DOE laboratories into a stronger and more integrated national laboratory *system*. They will be used to establish clear linkages between DOE missions, the programs designed to accomplish those missions, the technologies required to make those programs successful, and the specific R&D programs or tasks required to "produce" those technologies. The roadmaps will be developed along the Department's business lines, under the guidance of the corresponding R&D Council Working Group. In addition, cross-cutting roadmaps will be developed to strengthen enabling technologies for multiple missions.

The R&D Council has directed that each of the four DOE business lines develop and present for review roadmaps in critical technology areas. By encouraging the development of roadmaps that connect program objectives with a "bottom-up" scientific and technical definition of problems, the Department can better define, review, improve, and adapt plans to accomplish what are often highly complex missions. This process is moving forward with the full cooperation of the national laboratory directors. Several prototype roadmaps will be completed by the summer of 1998. A schedule will be developed, by the summer of 1998, for the completion of the remaining roadmaps.

(3) *The Selection of R&D Performers.* The Department, under the guidance of the R&D Council, will be intensifying its evaluation of the ways in which grants and contracts are awarded, including technology transfer and partnership agreements, to ensure they are made on the basis of sound scientific and technical review. This evaluation will, in particular, consider the important role of peer review, and the adequacy of competition in the making of awards.

Appendix 2

SCOPE

The audit was performed between June and December 1997. We focused on evaluating how the Department was integrating basic and applied research projects at senior management levels. We did not, however, as part of this audit effort, evaluate the current status of integration at the laboratories.

METHODOLOGY

To accomplish our objective, we obtained and reviewed applicable laws and Departmental orders pertaining to R&D integration. We also reviewed related reports issued by the Office of Inspector General, the General Accounting Office, and various Task Force and Advisory Groups. Discussions were held with various committees established to improve integration and with senior Department Officials and Program Managers from the offices of: Energy Research, Fossil Energy, Defense Programs, Nuclear Energy, Energy Efficiency and Renewable Energy, and Environmental Management. These discussions covered the Department's response to critics for the lack of integration, what actions were planned to improve integration, and how the program offices were integrating R&D projects.

Reviews were performed to determine the effectiveness of established coordinating committees and groups, what the barriers to integration were and how they could be removed. Site visits were made to the Combustion Research Facility at Sandia National Laboratory and Lawrence Livermore National Laboratory both in Livermore, California. We performed analyses to determine the benefits received from joint planning, budgeting, and management of combustion projects and determined what interactions and guidance the field had received from Headquarters pertaining to integration. We also reviewed the Department's Strategic Plan, dated September 1997, to determine whether performance measures had been developed that related to the integration of R&D projects.

The audit was made 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 integration of R&D projects. Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed. We did not rely on computer-processed data to accomplish our audit objective.

Appendix 3

Past studies and reviews dating from 1986 to 1997, that found the Department needed greater integration of R&D projects were:

- *The Coordination of Long-Term Energy Research and Development Planning,* Report Number DOE/IG-0232**,** dated November 1986. This report discussed the Department's lack of a unified long-term R&D plan. It was recommended that the Secretary of the Department direct the appropriate office to develop, coordinate and publish a Departmental order regarding the program planning process.

- *Alternative Futures for the Department of Energy National Laboratories* (Galvin Report) dated April 1995. This report stated that the Department should achieve greater integration among its applied programs and between applied and basic energy research performed at the labs.

- *Energy R&D: Shaping our Nation's Future in a Competitive World* (Yergin Report) dated June 1995. This report discussed the need for integration across the Department's energy research and development programs.

- *Management of the Cooperative Agreement with Texas to Fund the Amarillo National Resource Center for Plutonium,* Report Number WR-B-96-08, dated August 1996. This report discussed duplication of research activities caused by a lack of integration.

- *The Laboratory Operations Board,* in September 1997, reported that greater integration across R&D programs was needed and that it was not clear whether adequate joint planning was taking place.

- *The President's Committee of Advisors on Science and Technology,* in September 1997, found that there needed to be better integration between basic and applied research programs. They recommended the Department use mechanisms such as co-management and co-funding to make this improvement.

IG Report No. DOE/OIG-0417

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