

DOE/IG-0457

AUDIT REPORT

FOLLOW-UP AUDIT OF PROGRAM ADMINISTRATION BY THE OFFICE OF SCIENCE



JANUARY 2000

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

January 24, 2000

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman (Signed)
Inspector General

SUBJECT: INFORMATION: Report on "Follow-up Audit of Program Administration by the Office of Science"

BACKGROUND

In August 1995, the Office of Inspector General issued a report on the *Audit of Program Administration by the Office of Energy Research*. The audit concluded that Energy Research, now known as the Office of Science, was not directing funds to specific projects, and that its field work proposals did not contain milestones, metrics, or other performance criteria that could be used to evaluate research progress. We recommended that management review the administrative process and consider (1) authorizing work based on requests received, and (2) evaluating research progress based on metrics in work authorizations.

Management partially agreed with the finding and recommendations. However, it expressed concern that unnecessary requirements on research performers could reduce desirable flexibility, stifle creativity, and lead to inferior results.

The objective of this audit was to determine whether the Department instituted corrective action in response to the recommendations in the 1995 report.

RESULTS OF AUDIT

The current review disclosed that the Department took corrective action in response to the recommendation to authorize work based on requests received. In Fiscal Year (FY) 1999, work authorizations clearly identified funding amounts and the particular projects that were funded. However, the Department did not take appropriate action in response to our second recommendation which concerned the need to evaluate project progress based on formal metrics in work authorizations. We found that, as was the case in 1995, the Office of Science was not evaluating research projects using milestones or metrics. The Department's program managers contended that basic research did not lend itself to the identification of scheduled activities or numerical measures. We believe that, without such measures, the Department was not in a position to fully evaluate the performance and progress of certain research projects managed by the Office of Science.

MANAGEMENT REACTION

Management did not concur with the finding and recommendations. It stated that research progress should not be measured only against performance criteria and metrics at the individual task level; that it uses peer reviews to ensure research programs are of high quality and meet Department objectives; and, that the use of milestones and metrics would be a waste of the taxpayers' money and would be potentially destructive to the quality of the subject research.

We agree that there are a number of methodologies that should be used to measure research progress. While we acknowledge that the development and execution of metrics to evaluate basic research projects is a challenging task, the results of our audit support the view that they can play an important role in determining research progress. This is especially true if the metrics are used in conjunction with other evaluative factors such as peer reviews, annual reports, and research presentations. While the eventual outcome of basic research is difficult to predict, taxpayer interests dictate that the Department make every reasonable effort to assure that, "... the basic research programs that the nation funds generate the kinds of knowledge that have given us great practical benefits in the past." [*Evaluating Federal Research Programs*, the National Academy of Sciences, 1999.] We believe the milestone and metrics described in this report can be useful tools in achieving this goal.

Attachment

cc: Deputy Secretary
Under Secretary

FOLLOW-UP AUDIT OF PROGRAM ADMINISTRATION BY THE OFFICE OF SCIENCE

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OVERVIEW

INTRODUCTION AND OBJECTIVE

The Office of Science (SC), formerly known as the Office of Energy Research (ER), is responsible for approving and managing research projects funded at the Department's national laboratories. The laboratories submit field proposals for research projects to the SC for funding consideration. The proposals are evaluated and selected for funding by SC program managers, with support from a peer review process. The program managers approve the tasks and provide work authorizations and other funding guidance to the laboratories after specific projects have been selected. In FY 1999, SC provided \$1.7 billion to the laboratories for research projects.

In August 1995, the Office of Inspector General (OIG) issued Report DOE/IG-0376, *Audit of Program Administration by the Office of Energy Research*. The audit was performed to determine whether the Department had established performance expectations, including performance criteria and metrics, and used these expectations to monitor progress for research performed at national laboratories. The audit determined that the Department had not directed funds to specific projects, and the proposals that were funded did not contain performance criteria or metrics that could be used to evaluate research progress. The absence of documented performance criteria and metrics in the work authorizations made it impossible to determine whether the laboratories' performance met the Department's expectations. We recommended that ER review the administrative process and give consideration to (1) authorizing work based on requests received, and (2) evaluating research progress based on the metrics in these authorizations.

In response to the audit recommendations, ER stated that it would convene a process improvement team to (1) examine the format of field proposals to see whether changes in requested information and aggregation levels would improve their use as a research tool; (2) consider modifications to research authorizations to better indicate the Department's expectations and performance criteria with respect to modified field research proposals; and (3) develop a phased implementation plan to incorporate the recommendations of the process improvement team into the FY 1998 and FY 1999 budget cycles. However, management was concerned that unnecessary requirements on its research performers could reduce desirable flexibility, stifle creativity, and lead to inferior results.

The objective of this audit was to determine whether the Department took appropriate action in response to recommendations in Report DOE/IG-0376.

**CONCLUSIONS AND
OBSERVATIONS**

The Department took appropriate corrective action in response to Recommendation 1—to authorize work based on requests received. However, it did not take appropriate action in response to Recommendation 2—to evaluate progress based on metrics in work authorizations.

In response to the prior audit, the Department improved its administrative process for funding research projects. In FY 1999, work authorizations clearly identified funding amounts and the particular projects that were funded. In most cases, the work authorizations identified field work proposal numbers, project names, or principle investigators' names for the proposals that received funding. These changes were consistent with the intent of Recommendation 1 in the prior report.

Although improvements were made in the funding process, the Department did not improve its process for evaluating contractors' progress on research projects. In FY 1999, the Department was still not evaluating research projects using milestones or metrics. Of the 241 FY 1999 work authorizations reviewed, 84 percent did not include any milestones or metrics to evaluate research progress. Milestones were not used because the Department's program managers did not believe that basic research lent itself to the identification of scheduled activities or numerical measures. As a result, the Department could not objectively measure performance of research projects and make sound budgetary decisions based on objective measures.

The audit identified issues that management should consider when preparing its yearend assurance memorandum on internal controls.

(Signed)

Office of Inspector General

MILESTONES WERE NOT USED

Work Authorizations Did Not Include Milestones

The Department did not take appropriate action in response to the prior audit to evaluate progress based on metrics in work authorizations.

To determine whether the Department's actions satisfied the intent of the prior recommendations, we reviewed 241 field research proposals that received initial funding in FY 1999 at the Argonne, Brookhaven, and Oak Ridge National Laboratories for the scientific disciplines of Biological and Environmental Research (BER), Basic Energy Science (BES), and High Energy Physics (HEP). Of the 241 proposals reviewed, 19 included task-oriented milestones; 20 included a single, annual report milestone; and 202 did not include any milestones or metrics that could be used to evaluate research progress. Also, in the 39 instances where milestones were included, there was no indication that the proposed milestones were evaluated or approved by the SC program managers before the work was authorized. The following table summarizes the results of our review:

<i>Office of Science Fiscal Year 1999 Field Work Proposals Funded</i>						
<i>Science</i>	<i>Funding (\$000)</i>	<i>Total Proposals</i>	<i>Field Work Proposals</i>		<i>Type of Milestones</i>	
			<i>Without Milestone s</i>	<i>With Milestone s</i>	<i>Annual Report</i>	<i>Task Oriented</i>
BER	\$ 49,705	95	70	25	10	15
BES	135,813	133	119	14	10	4
HEP	20,995	13	13	0	0	0
	\$206,513	241	202	39	20	19

Many of the field work proposals contained no milestones, but identified specific activities in other sections of the proposal that could have been used to measure research progress in FY 1999. For example, a BER project funded for \$600,000 at Argonne National Laboratory contained no milestones in the "milestone schedule" section of the proposal. However,

another section of the proposal stated, “In FY 1999, protein maps will be completed and proteins from control and treated cells will be compared.” This statement could have been used to establish a milestone and measure results; however, no milestones were used.

Another BER proposal, funded for \$200,000 at the Brookhaven National Laboratory contained no milestones, but identified five activities scheduled for completion in FY 1999. The activities included: “Clone, express and analyze for solubility at least one 96-well tray of yeast proteins, with appropriate controls . . . Begin to analyze insoluble proteins in detail, to look for better ways to increase solubility . . . (and) Increase the pace of structure solving. . .” It appears that milestones could have been established for each of these activities; however, no milestones were used.

Also, a BES proposal that was funded for \$1.6 million at Oak Ridge National Laboratory, contained a single milestone—to submit an annual report. However, the narrative section of the proposal identified eight activities scheduled for completion in FY 1999. The activities included: “Design and test stage for in-situ hot-stage nanoindentation in the SEM Convert PEELS to energy-filtered imaging on 200 kV FEG-AEM (and) Perform first experiments on new generation of atom probe position-sensitive detectors. . . .” Milestones could have been established for each of these activities, but were not.

Corrective Actions and Departmental Policy Required the Use of Milestones

The prior OIG report on ER program administration determined that the proposals that were funded did not contain performance criteria or metrics that could be used to evaluate research progress. To correct these concerns, ER stated that it would convene a process improvement team to (1) consider modifications to research authorizations to better indicate the Department's expectations and performance criteria with respect to modified field research proposals, and (2) develop a phased implementation plan to incorporate the recommendations of the process improvement team into the FY 1998 and FY 1999 budget cycles.

In addition to the Department's proposed corrective actions, Departmental policy is to monitor contractor performance in terms of work accomplishment. Departmental Order 412.1, *Work Authorization System*, requires that work authorizations include, at a minimum, a milestone for the submission of an annual progress report. The order

gives the program manager the prerogative to require the laboratory to include additional tasks and their associated completion dates in the milestone schedule section of the work authorization.

Milestones are also established as a performance measure in the laboratories' performance based management contracts, as required by the Government Performance and Results Act of 1993. The contracts are intended to measure the management and operating contractor's actual performance against a set of performance measures. Each performance measure has subparts, or metrics, which are evaluated separately to arrive at a collective result. All of the laboratories reviewed had performance measures included in their contracts with the Department. Furthermore, under performance based management contracts, the laboratories receive incentive fees based in part upon the performance measures included in their contracts.

Program Managers Did Not Believe Milestones Were Useful

Program managers were concerned that unnecessary requirements on its research performers could reduce desirable flexibility, stifle creativity, and lead to inferior results. As a result, they did not believe that milestones were useful to measure research progress, and did not encourage their use in field proposals. The program managers stated that basic research, because of its uncertain nature, does not lend itself to identification of scheduled activities or numerical measures. Therefore, they prefer to evaluate research progress based upon peer reviews. Also, the program managers stated that milestones would not encourage contractors to be innovative in their research efforts.

Unlike SC's program managers, pharmaceutical companies engaged in drug discovery research require the identification and application of milestones to evaluate research progress and program manager performance. Discussion with representatives from five pharmaceutical companies determined that in all instances, the companies require milestones for basic research projects devoted to drug discovery. The representatives identified milestones as major tasks with assigned target completion dates, developed annually, that are to be accomplished over the funded term of the project. The drug companies' representatives stated that although the results of basic research are unpredictable, the work that is to be accomplished can be documented in the form of milestones. In fact, one drug company executive stated "It is unlikely that any private company engaged in basic research would not require milestones to evaluate performance."

Department Could Not Measure Contractors' Performance

In the absence of milestones for research projects, the Department could not objectively measure contractors' performance and make sound budgetary decisions based on objective measurements. The Department allows contractors broad latitude to propose initiatives for research that is of current interest to the scientific community. SC provides funds to the laboratories so contractors can pursue initiatives for the advancement of science. Accordingly, under the Department's planning process, SC relies on contractors to develop budget estimates, expend funds within broad areas of research and provide the results of peer reviews¹ used to evaluate the quality of the research. The program managers use peer reviews to determine the quality and progress of the contractors' research.

In contrast to the Department, pharmaceutical companies evaluate their researchers' progress by establishing and applying milestones. The companies evaluate progress in meeting the milestones, and if progress is not satisfactory, the project may be cancelled. In addition, the success of the program manager's decisions is also evaluated based upon the success of the projects. While peer reviews were also used to evaluate the success of the work, milestones were considered essential because they allow not only an assessment of the researchers' success, but also make the program managers accountable for their decisions.

The inclusion of milestones in SC work authorizations would improve both internal and external stakeholders' ability to evaluate the program as well as the business management aspect of contractor research activity. The inclusion of milestones could serve to align the research objectives between the Department and its contractors. Also, contractor performance, judged in relation to established expectations defined by the Department, should be used to make decisions concerning future budgetary allocations.

¹ As a scientific custom, peer review is an organized method for evaluating work that is used by scientists to certify the correctness of procedures and establish the plausibility of results.

RECOMMENDATIONS

We recommend that the Director, Office of Science:

1. Require the inclusion of task-oriented milestones as well as annual progress report milestones in field work proposals approved for funding; and
2. Use milestones to evaluate the effectiveness and efficiency of research program management in accordance with the contracts established by the Department with its management and operating contractors.

MANAGEMENT REACTION

Management did not concur with the finding and recommendations, stating that research progress should not be measured only against performance criteria and metrics at the individual task level. Management stated that while various milestones and metrics can be specified, they are only peripherally related to the activity being funded and do not provide useful and reliable measures of the quality and programmatic value of the subject research. Management stated that it uses peer reviews to ensure research programs are of high quality and meet Departmental objectives. Also, management stated that the peer review process is recognized as the best practice in the field of R&D management and is used by other Government agencies, such as the National Science Foundation and the National Institutes of Health. Additionally, management stated that the use of milestones in field proposals would constitute a discrepancy in how budgetary allocations are determined between the two primary types of research organizations—University grantees, for whom milestones are not required, and Departmental laboratories.

Management questioned the validity of comparing the use of milestones for pharmaceutical research to the basic research performed by the Department. Management stated that pharmaceutical companies fund a portfolio of research activities toward a specific end point, (e.g., develop a class of effective oral cancer therapies with no harmful side effects) and the pharmaceutical industry would manage those efforts through detailed milestones. Conversely, organizations such as the Department and the National Science Foundation support activities to advance knowledge or to underpin next-generation technologies for which detailed milestones would not be appropriate.

In management's view, the use of milestones and metrics would be a waste of the taxpayers' money and would be potentially destructive to the quality of research. Finally, management stated there must be an accompanying appreciation that milestones are not performance criteria, should not be so construed, and that SC does, in fact, manage its programs actively and effectively.

AUDITOR COMMENTS

We recognize that research progress should not be measured *only* against performance criteria and metrics at the individual task level. Rather, performance criteria and metrics should be used in conjunction with other evaluation factors, such as peer reviews, annual reports, and researcher presentations. While the eventual outcome of basic research may be difficult to predict, milestones can and should be used to evaluate progress toward the expected outcome of specific projects.

The use of milestones to determine budgetary allocations should not create a discrepancy between the Department's treatment of University grantees and its laboratory contractors. Grants are used to provide financial assistance where the Government does not expect to receive a direct benefit from performance. Contracts, on the other hand, are used to acquire goods or services for which the Government expects to receive a direct benefit. Performance criteria and metrics are not required for grants; however, they are normally required for contracts in order to evaluate the contractor's progress and to determine the amount of award fee earned.

We acknowledge that differences exist between the pharmaceutical industry and the Department's laboratories. However, as demonstrated by the examples in this report, proposals for the Department's individual research projects often include milestones and metrics sufficient for use in evaluating progress toward project completion. In this regard, the Department's projects are similar to those of the pharmaceutical industry.

We disagree with management's statement that the use of milestones and metrics would be a waste of taxpayers' money and would be potentially destructive to the quality of basic research. While the Department uses subjective measures such as quality, leadership, and relevance to agency goals in their peer review process, the process does not include objective performance measures, such as whether the work was accomplished within budget or on time. The absence of objective measures limits the Department's ability to make sound budgetary decisions and determine the appropriate amount of fee earned.

Appendix

SCOPE

The audit was performed from June 29 to September 27, 1999, at the SC in Germantown, Maryland. The scope of the work included funded R&D projects at Argonne, Brookhaven, and Oak Ridge National Laboratories for FY 1999, in the scientific disciplines of High Energy Physics, Biological and Environmental Research, and Basic Energy Sciences. These disciplines accounted for 79 percent of SC's budget of \$1.7 billion for research and development projects in FY 1999.

METHODOLOGY

To accomplish the audit objective, we:

- Reviewed OIG Report DOE/IG-376, *Audit of Program Administration by the Office of Energy Research*;
- Reviewed Departmental orders and directives related to the work authorization system;
- Reviewed management and operating contracts entered into by the Department with Argonne, Brookhaven, and Oak Ridge National Laboratories;
- Interviewed SC program managers for High Energy Physics, Biological and Environmental Research, and Basic Energy Sciences in Germantown;
- Reviewed work authorizations, program funding guidance, and field work proposals funded by SC in FY 1999; and,
- Discussed the appropriateness of milestones for basic research projects with representatives of private sector R&D companies.

The audit was conducted in accordance with generally accepted Government auditing standards for performance audits, and included tests of internal controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. 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; therefore, no assessment was made of data reliability.

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