



AUDIT OF MANAGEMENT CONTROLS OVER SELECTED
ENERGY RESEARCH MAJOR SYSTEM ACQUISITIONS

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U.S. DEPARTMENT OF ENERGY
OFFICE OF INSPECTOR GENERAL

AUDIT OF MANAGEMENT CONTROLS OVER SELECTED
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SUMMARY

The Department of Energy (DOE) designates its most significant projects as major system acquisitions based on national urgency, importance, size, complexity, and dollar value. At the time of our review, the Office of Energy Research was responsible for managing eight of DOE's 52 major system acquisitions. The objective of this audit was to determine whether Energy Research was meeting the intent of Departmental policies in the management of its major system acquisitions, and whether current project management practices provided DOE with the controls necessary to ensure that major system acquisitions were being managed in an economical and efficient manner.

Our audit disclosed that "other project costs" for major system acquisitions were not adequately included in the project management system and received less management attention than construction costs under this system. The audit also disclosed that certain project management practices did not ensure that the objectives of ensuring accountability, traceability, and visibility of decisions at all levels were met. These conditions occurred, in part, because prior Departmental guidance did not emphasize management of "other project costs," and the Office of Energy Research had not fully implemented revised guidance on managing these costs as part of total project costs. The report includes recommendations addressed to the Office of Field Management and the Office of Energy Research to improve the management of major system acquisitions.

We had excellent cooperation during the audit from both Field Management and Energy Research staff. We found that Department staff working on these projects were committed to their successful completion and dedicated to achieving project goals. The Office of Field Management concurred with the recommendations directed to their office and indicated that corrective actions are underway or planned. Throughout the audit, however, Energy Research staff expressed their opinion that the system and procedures utilized were adequate and did

not fully concur with all of the report findings and recommendations. We recognize the difficulties inherent in dealing with other project costs on major system acquisitions and acknowledge Energy Research's efforts to manage this significant category of costs. However, the audit results support the need for enhancements to ensure that greater emphasis is placed on the management of other project costs. Part III of the report contains a detailed discussion of managements' comments and auditor response.

Office of Inspector General
Office of Inspector General

PART I

APPROACH AND OVERVIEW

INTRODUCTION

The Department of Energy (DOE) designates its most significant projects as major system acquisitions based on national urgency, importance, size, complexity, and dollar value. Major system acquisitions include projects with a total cost or annual funding in excess of \$100 million and projects designated by management as warranting special attention.

The objective of our audit was to determine whether the Office of Energy Research (Energy Research) was meeting the intent of DOE policies in managing its major system acquisitions and whether current project management practices provided the Department with the controls necessary to ensure that major system acquisitions were being managed in an economical and efficient manner.

SCOPE AND METHODOLOGY

At the end of Fiscal Year 1992, Energy Research was responsible for eight of the Department's 52 major system acquisitions. We reviewed three of those eight projects: the Advanced Photon Source under construction at Argonne National Laboratory; the Relativistic Heavy Ion Collider under construction at Brookhaven National Laboratory; and the Superconducting Super Collider. On October 28, 1993, after our audit work was completed, the Congress determined that Fiscal Year 1994 funds appropriated for the Superconducting Super Collider would be used for the orderly termination of the project. Superconducting Super Collider issues are included in this report because they are cross-cutting in nature and have potential applicability to future projects. Planned costs for the three systems reviewed totaled \$9.5 billion, with the Superconducting Super Collider accounting for \$8.2 billion.

We performed audit work at Department Headquarters and the laboratories where the selected major systems were being constructed. The audit included reviews of applicable DOE orders and implementing guidance, conceptual design reports, project plans, project management plans, progress reports, field work proposals, and field budget requests. The Superconducting Super Collider project was the subject of extensive reviews during the course of our audit. Rather than duplicate effort, we relied on the results of other reviews in some instances for data in support of this audit. We also conducted interviews

with over 75 key DOE and contractor officials at Headquarters and field locations.

The audit was conducted in accordance with generally accepted Government auditing standards for performance audits. It included tests of internal controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. Since the review was limited, it would not necessarily disclose all internal control deficiencies that may exist. We did not rely extensively on computer-processed data and, therefore, did not fully examine the reliability of the data.

The firm of Irving Burton Associates, Inc. participated with the Office of Inspector General in conducting the audit. The audit began in January 1993 and covered activities between January 1989 and May 1993, with primary emphasis on Fiscal Years 1990-92. The Office of Energy Research and the Office of Field Management both waived the exit conference.

BACKGROUND

The Office of Energy Research carries out activities related to the Department's energy research and development missions. Energy Research had a Fiscal Year 1992 budget of approximately \$3 billion; over \$775 million (about 26 percent) was for construction projects. The systems included in our audit accounted for approximately 85 percent of its Fiscal Year 1992 construction project budget, with the Superconducting Super Collider alone representing 62 percent of the budget.

Since its implementation in 1978, the project management system has evolved as the principal control mechanism to foster the concepts of baseline management, accountability, and performance assessment. Recent changes have emphasized control of baselines and baseline changes including transition planning. The system is characterized by an extensive review process, including annual validation reviews by the Department, semiannual reviews by Energy Research, and monthly reviews by the DOE project manager.

The Program/Project Management Division under the Associate Deputy Secretary for Field Management initiates and updates project management system guidance, monitors system implementation, and reviews and concurs on reporting requirements. The Office of Management within the Office of Energy Research advises the Director of Energy Research and participates in planning and implementation activities

associated with major system acquisitions, including program/project organization involvement and business strategies.

OBSERVATIONS AND CONCLUSIONS

The major system acquisitions reviewed during this audit represent three of the most significant and challenging projects undertaken by the Department. We found that DOE and contractor management staff working on these projects were committed to their successful completion and dedicated to achieving project goals. The project management system used by DOE management was generally being complied with, and had been refined to make it even more effective. Recent emphasis on management of total project costs rather than just those costs related specifically to construction was a particularly noteworthy improvement.

While significant and worthwhile accomplishments were evident in the Department's existing project management system, we concluded that additional improvements could be made to further enhance project management and oversight. The Office of Energy Research needed to put in place management controls to ensure that the intent of project management guidance was consistently implemented. The Office of Field Management needed to strengthen project management practices and facilitate adherence to the intent of project management guidance.

We found that almost \$439 million of planned other project costs were not adequately addressed by the project management systems and were given considerably less management attention than construction costs. Other project management practices did not always provide visibility over key decisions nor maintain accountability and traceability over management actions. For example, cost growth occurred without formal recognition by the DOE project manager, and contingency management practices further reduced visibility over the cost status of project elements. On major system acquisitions, the DOE project manager serves as the focal point between the Department and the contractor. The project manager is expected to maintain control over the project and is responsible for exercising appropriate management decisions, as well as informing senior management of existing or potential problems.

The Secretary of Energy testified before the Congress that significant steps would be taken to improve management and oversight of contractors in the future. We believe that the recommendations in this report will improve the Department's focus on management and oversight of contractor operations.

The audit observations concerning the exclusion of costs from project controls, as well as the need for visibility and accountability over key decisions, in our opinion, represent weaknesses that should be considered by management when preparing the yearend assurance memorandum on management controls.

Part II of this report provides details on our findings and recommendations. Part III includes detailed management and auditor comments.

PART II

FINDINGS AND RECOMMENDATIONS

1. Management of Total Project Costs

FINDING

The Department of Energy's (DOE) project management system is the principle control system used to manage total project costs of major system acquisitions. We found that "other project costs" were not adequately included in the project management system and were given less management attention. For example, independent cost estimates for two projects did not assess the reasonableness and completeness of almost \$439 million in planned other project costs. In addition, improvements were needed in the content of status reports submitted to DOE management and in the level of detail included in budget documents. These conditions existed because prior Departmental guidance did not emphasize management of total project costs. While current guidance has improved, additional emphasis was needed. All needed controls were not put in place by the Office of Energy Research to ensure consistent implementation of guidance. As a result, there was no assurance that other project costs planned for the major system acquisitions reviewed would be adequate to fund all requirements and would be used in the best interests of the Department.

RECOMMENDATIONS

We recommend that the Director, Program/Project Management Division of the Office of the Associate Deputy Secretary for Field Management:

1. Establish controls to ensure that independent cost estimates for major system acquisitions include total project costs.
2. Revise DOE Order 4700.1 to include specific requirements that:
 - a. establish interim milestone dates for other project cost activities; and
 - b. ensure that procedures for development and periodic updating of project research and development plans, along with significant measurable milestones are set forth in the Project Management Plan.

We recommend that the Director, Office of Management, Office of Energy Research:

1. Require that quarterly project status reports submitted by DOE project managers to Headquarters contain milestone information on other project cost elements to include research and development in support of construction.
2. Require that milestone data prepared for project costs financed by operating expense funds be included in field work proposals/field budget requests.

MANAGEMENT REACTION

The Associate Deputy Secretary for Field Management concurred with the intent of the finding and recommendations and added that initiatives were in process or were planned to ensure that independent cost estimates encompass total project costs and that other project cost activities be properly managed. The Director, Office of Management, Office of Energy Research, concurred in principle with Recommendation 2.a., but did not fully concur with Recommendation 2.b. stating that appropriate information on other project cost status and milestones was included in project plans and quarterly status reports. In addition, field work proposals are prepared 2 years in advance for budget requests that include the overall goals and objectives. Part III of this report includes management and auditor comments.

DETAILS OF FINDING

BACKGROUND

Total project costs are all cost specific to a project incurred prior to the operation of the facility. They consist of the construction costs of the project, referred to as "total estimated costs," plus all remaining costs, labeled "other project costs." These remaining costs include: conceptual design reports; research and development required both prior to start of construction and subsequently for fabrication, testing and rework of prototype equipment; and one-time costs related to testing, startup, operator training, and commissioning.

As shown in the following schedule, total project costs planned for the three acquisitions we reviewed were estimated at \$9.5 billion at the end of Fiscal Year 1992, with total estimated costs and other project costs about \$7.2 billion and \$2.3 billion, respectively.

| <u>Project</u> | <u>Total Estimated Costs</u> | <u>Other Project Costs</u> | <u>Total Project Costs</u> |
|------------------------------------|--------------------------------------|------------------------------------|------------------------------------|
| (in millions) | | | |
| Advanced Photon Source | \$ 456 | \$ 336 | \$ 792 |
| Relativistic Heavy Ion Collider | 406 | 103 | 509 |
| Superconducting Super Collider | <u>6,347</u> | <u>1,902</u> | <u>8,249</u> |
| Total | \$7,210 | \$2,341 | \$9,550 |

PROJECT MANAGEMENT CRITERIA

DOE Order 4700.1, *Project Management System*, establishes management principles for acquisition of significant projects. DOE Notice 4700.5, *Project Control System Guidelines*, issued August 1992 clarifies policy for applying control systems to the overall management of projects. A cornerstone of the Department's project management policy is the concept of accountability at appropriate levels. An essential element of accountability is overall project control of technical scope, cost and schedule baselines, as well as associated research and development and transition planning.

Funding for other project costs is provided by operating expense funds. These costs involve activities that are subject to change and, therefore, flexibility is needed in managing them. DOE Order 5700.7C, *Work Authorization System*, establishes a work authorization and control process for contractor work financed by the operating expense fund.

MANAGEMENT OF TOTAL PROJECT COSTS

Other project costs on two projects were not adequately included in the Department's prescribed project management system, and were given less management attention than construction costs. Independent cost estimates did not assess the reasonableness and adequacy of almost \$439 million in planned other project costs. Project management control systems

needed to be expanded to include reporting on other project costs and increase the level of detail surrounding the related activities in project status reports and budgetary submissions to DOE Headquarters.

Independent Cost Estimates

Independent cost estimates for two of the projects reviewed did not assess the reasonableness and completeness of documentation for about \$439 million in planned other project costs. An independent cost estimate serves as an analytical tool to validate, cross-check, or analyze the cost estimates that were developed by proponents of a project. The estimate also serves as a basis for verifying risk assessments. Independent cost estimates are developed by the Department's Program/Project Management Division of the Office of the Associate Deputy Secretary for Field Management. Cost estimates were performed as part of the Energy Research Semi-Annual reviews, but, by definition, these program office reviews are not independent.

Other project costs of about \$336 million on the Advanced Photon Source project and \$103 million on the Relativistic Heavy Ion Collider had not been included in the independent cost estimates conducted on these projects. Other project costs on the Advanced Photon Source increased almost 100 percent between project conception and construction start. Management attributed this increase to a change in the definition of project costs which added new cost categories. Other project costs on the Collider increased 59 percent after project conception, due in part to a delay in the project's start and a lengthening of the project schedule. The magnitude of the other project costs (approximately 42 and 20 percent of total project costs, respectively) requires management to ensure that estimates are valid.

Project Management Control Systems

The overall project management control systems used to monitor progress on two projects did not adequately include other project costs. Attempts were made during the early phases of the projects to monitor costs related to research and development by using research and development plans. However, the plans were incomplete. While the project management control system on the Superconducting Super Collider project included other project costs, system implementation difficulties decreased its usefulness.

Advanced Photon Source. About \$75 million of the estimated \$336 million in other project costs for this project had been funded at the end of Fiscal Year 1992. Since the project's early phases, concern had been expressed about how these costs were being managed. For example, in 1989 a DOE review team official noted the contractor's lack of accounting over other project costs. This review, discussed further on page 18, found that the contractor's report did not include cost or schedule status of the research and development portion of the project.

At the DOE project manager's request, a revised research and development plan was published in July 1992. During our field visits, we found no evidence that the plan was being used by either Department or contractor personnel, even though the potential existed to evaluate progress against milestones.

Relativistic Heavy Ion Collider. Through Fiscal Year 1992, \$34.9 million of the estimated \$103 million in other project costs on this project had been funded. Research and development plans were prepared in 1987 and 1988, but a draft update issued in November 1990 was not finalized. Although the plans addressed the major tasks to be undertaken before and during construction, only completion dates for major research and development milestones were shown; no start or interim milestone dates were identified.

Project cost performance reports did not include status information for research and development activities, even though the DOE project manager had, as early as February 1991, requested this information. The DOE manager stated that at this stage there were no plans to incorporate research and development activities into cost performance reports, noting that these activities were subject to baseline control and narrative status at the subsystem level was included in monthly reports. The manager stated that emphasis would be placed on incorporating startup and commissioning activities into the system. For example, the Department requested that narrative status on planning activities for startup and commissioning be included in the contractor's monthly progress reports beginning in September 1992 to assure that planning activities would proceed well in advance of the work scheduled to begin 2 years in the future. We noted, however, that contractor reports prepared for the last 3 months of calendar year 1992 did not implement this request.

Project Status Reports

Project status reports needed to be expanded to facilitate more effective management of other project costs. Project managers of major system acquisitions are required to submit quarterly reports on project baselines and present a clear picture of project status and resource utilization. The reports are intended to highlight the status and activities of major acquisitions and keep DOE senior management apprised of existing or potential problems to allow timely followup action.

We found that progress reports did not contain sufficient information on other project costs to keep management adequately informed. For example, the report on the Relativistic Heavy Ion Collider project for the first quarter of Fiscal Year 1993 did not include any research and development milestones even though about \$35 million had been expended on these activities and the first two milestones had slipped. Contractor reporting requirements established by one project manager did not include any milestones related to other project cost activities. Thus, neither DOE representatives on site or those at the Headquarters level were adequately informed of the status of other project cost activities through the prescribed reporting system.

Budgetary Submissions for Other Project Costs

The level of detail included in budgetary submissions supporting other project costs needed expansion if field work proposals/field work requests were to be used effectively by managers to monitor project status. The interrelationship of other project cost activities to overall construction activities dictates, in our opinion, close monitorship of such activities and the establishment of prerequisite measurement tools to do so.

In reviewing field work proposals, we found that the budgetary submissions for the three projects we reviewed did not include detailed milestone data. Although DOE orders provided for the completion of a proposed schedule with start and completion dates (if requested by the program manager when funds had been authorized), such requests were not made; therefore, the utility of these budgetary submissions as a tool for progress measurement after funds were authorized was diminished.

REASONS FOR CURRENT MANAGEMENT PRACTICES

The limited inclusion of other project costs in the project control systems for the Advanced Photon Source and Relativistic Heavy Ion Collider projects was caused, in part, by Departmental guidance that did not emphasize management of total project costs to include other project costs. The Department revised its guidelines such as DOE Notice 4700.5 to ensure that total project costs are accounted for within the project management system. This guidance also requires development of schedules that represent all work scope regardless of funding source to ensure that all known requirements affecting a project are identified and considered in developing project baselines.

In our opinion, however, project management practices had not been effectively updated for the two projects at existing laboratories, even though unfunded other project costs at September 30, 1992, totaled \$329 million. The management philosophy applied by the Office of Energy Research to other project costs on its major system acquisitions was essentially to separate these costs from construction costs and apply different criteria. In our opinion, guidance needs to promote change in management philosophy, and the Office of Energy Research needs to establish additional controls to ensure consistent implementation of guidance.

The Office of Energy Research also needs to ensure that projects are not so fully funded that project management becomes less challenging than it should be. While we recognize that no two projects warrant identical allocations of other project costs, we noted that on two projects other project costs were between 25-30 percent of construction costs, and on a third project other project costs represented almost 75 percent of construction costs.

IMPACT OF CURRENT MANAGEMENT PRACTICES

The project management practices we noted raise concern as to whether estimates of other project costs yet to be funded for these projects are adequate and would be used properly. Comprehensive independent cost estimates should improve identification of all relevant costs at the start of a project. In our opinion, independent cost estimates that exclude other project costs from their scope increase the likelihood of future cost increases.

2. Project Management Practices

FINDING

The objectives of the Department's project management system include ensuring accountability, traceability, and visibility of management decisions at all levels as well as reporting accurate, valid, and traceable performance and trend data to management. Certain project management practices we reviewed did not ensure that these objectives were consistently achieved. Cost growth occurred without formal recognition by the Department; some other changes that impacted baselines were not formally processed; and contingency practices limited visibility over the cost status of individual project elements. Contractors also did not implement progress reporting that provided management with accurate, comprehensive information. These conditions occurred because the policy establishing thresholds for cost changes did not ensure that incremental growth would be appropriately accounted for, replan actions were considered to be approved by the Department outside of formal change control procedures, and the Department did not consistently take action to ensure that contractor progress reporting was timely and meaningful. As a result, the Department did not always assume adequate responsibility for project actions, and senior management did not have assurance that it consistently received the information needed to provide early indicators of potential problems; validate corrective actions; and make informed decisions.

RECOMMENDATIONS

We recommend that the Director, Program/Project Management Division of the Office of the Associate Deputy Secretary for Field Management:

1. Revise the provisions of DOE Order 4700.1 regarding cost thresholds to require that accumulated cost growth exceeding any fixed threshold value established when a project is started be recognized in a formal change action and approved by DOE's project manager.
2. Identify cost-effective incentives that can be incorporated into the project management control system to encourage timely and accurate reporting of project status.

We recommend that the Director, Office of Management, Office of Energy Research:

1. Ensure that project management plans for future major system acquisitions require that any use of contingency funds be approved by DOE's project manager (i.e. is a Level 2 change).
2. Ensure that actions with significant project-wide impact, such as replans, are processed through the change control system.

MANAGEMENT REACTION

The Associate Deputy Secretary for Field Management concurred with the overall intent of the finding and recommendations and stated that initiatives were in process or planned to make implementation and policing of established controls more visible. The Director, Office of Management, Office of Energy Research, stated that they concurred in principle with Recommendation 2.a. and Recommendation 2.b. and stated that projects already control the disbursement of funds to the contractor. In addition, project management was in compliance with the change control system. Part III of this report includes management and auditor comments.

DETAILS OF FINDING

PROJECT MANAGEMENT CRITERIA

The Department's project management criteria discussed in Finding 1 provides the means to ensure that fundamentally sound project control systems are in place and provide valid, useful data to management in time to aid in decision making processes. The establishment and maintenance of project baselines are the most important aspects of project control, and changes to baselines must be controlled to avoid distortions in performance reporting. Two objectives of the Department's formal change control process are to ensure that decisions are made at the appropriate management level and to enhance accountability and traceability in decision making. Baseline changes approved by the DOE project manager are called "Level 2" changes. To increase visibility over changes, quarterly progress reports should include all DOE-approved changes.

The objective of project control system reporting is communication of timely, accurate information to the appropriate management level enabling analysis, evaluation, and corrective action of project performance against approved baselines.

Reporting by the project manager to higher management should present a clear picture of project status and resource use. Using cost performance reports, managers can compare work planned against work performed and determine cost and schedule variances. Managers can also use cost and schedule trends to forecast an "estimate at completion" and assess the reasonableness of contractor plans to recover any cost overruns or schedule slippage. The discipline required to produce valid reports also helps ensure that key elements of the contractor's overall management system (such as accounting and budgeting) are functioning properly.

PROJECT MANAGEMENT PRACTICES

The DOE project manager is responsible for tracking, reporting, and managing baselines and related changes. It is the project manager's responsibility to clearly lay out and have approved procedures used for management of funds and baseline changes and to clearly support project actions in formal reports to establish traceability and an audit trail. Project management practices, however, did not consistently provide visibility over key decisions nor maintain accountability and traceability over management actions.

Change Control Practices

Incremental Cost Growth

Several Advanced Photon Source project elements had experienced significant growth since project inception, but cost growth trends were not evident from the information reported to senior management. Level 2 cost changes were not reported because the cost growth was incremental, rather than large individual increases. Because baselines were revised after each change, however, the reports also showed only minor cost variances. Project management and overhead costs are examples of this treatment.

The project management budget-at-completion at the end of Fiscal Year 1992 was \$9 million over the original baseline estimate, and actual costs incurred exceeded the original estimate for project management by approximately \$314,000. Excluding the impact of directed changes (discussed below), the budget-at-completion for overhead costs exceeded the original baseline estimate of \$11.3 million by \$10.9 million. However, although no Level 2 cost changes had been approved by the Department, cost status was calculated against revised baselines and reported variances were minor in both cases.

Department management provided supporting documentation showing that some of the cost growth resulted from DOE-directed changes imposed on the project regarding accounting practices. But, Field Management officials stated that DOE policy requires directed changes be approved as part of the project's baseline change control approval process. Further, our analysis of the supporting documentation showed that even without the effect of the directed changes, four project areas experienced cumulative cost growth ranging from approximately \$5 to \$11 million dollars.

Replans and Other Actions

During the first several years of the Advanced Photon Source project, semi-annual replans occurred but were not properly processed through formal change control procedures. Replans assessed all or significant portions of the project, adjustments were made to cost baselines and schedule milestones, and existing variances were frequently eliminated. Contingency funds were used as needed to make up differences between the revised estimate and the previous estimate. While replans can be an excellent informal mechanism for assessing project status, replan actions that result in baseline changes should be subject to formal change control procedures so that baseline integrity and accurate progress reporting are maintained.

Some later replan actions were processed in the change control system, but cost increases and decreases were grouped together. As a result of using the net effect of such actions, changes that should have received DOE project manager approval did not. For example, one change action increased the conventional facilities baseline by a net amount of \$3.9 million, under the \$5 million threshold for Departmental approval, but included planned reductions of \$11.8 million. Because (as confirmed by Field Management) cost thresholds apply to cost decreases as well as increases, this action should have been approved by the DOE project manager.

In another case, a replan action was processed for one project area that exceeded the established threshold of \$5 million by \$700,000, but was not formally approved by the Department. Management stated that the net effect of several changes processed at that time was under the cost threshold. Further, the contractor determined that these changes were within their authority and making the "noncontroversial" changes would simplify discussions with DOE Headquarters. The contractor also stated that the change was made to an internal baseline (below the DOE-approved baseline), and approval was not required unless the change exceeded the official baseline. An important function of the Department's project control system,

however, is to provide early warnings to management of project areas where prompt action could prevent future cost growth or schedule slippage. We noted that the budget-at-completion for this project element at January 1993 exceeded the original baseline estimate by approximately \$8 million.

Contingency Practices

Cost contingency is the amount withheld by the Department from the contractor's budget authorization that represents the cost uncertainties associated with the project cost estimate. Contingency is a part of the total project costs and must be defined in the Project Management Plan. Contingency fund management is a key Government function that should not be delegated to the contractor; DOE orders specify that the (Level 2) cost threshold include "all proposed changes for which use of project contingency is required." Although different contingency practices may be acceptable, they must be integrated with the change control and reporting process. On the two Collider projects, DOE project managers appropriately considered contingency use to be a Level 2 change, and believed this policy provided the Department with a strong management control tool.

On the Advanced Photon Source project, however, the DOE project manager provided contingency funds to the contractor through construction directives, as provided for in the approved Project Management Plan. But the directives did not provide adequate controls over contingency fund applications. The Office of Field Management has stated that contingency practices must be integrated with the change control and reporting processes. While the overall percentage of contingency available to the project was monitored by the Department, the allocation of funds to specific project areas or tasks was not identified as a Level 2 action. During Fiscal Years 1991 and 1992 the contractor processed over 100 change requests involving a net use of over \$22 million in contingency funds applied to project baselines.

The intent of establishing Departmental control over contingency funds, in our opinion, is to improve contractor discipline in achieving project goals within performance measurement baselines (excluding contingency), rather than assuming that contingency funds "belong" to the contractor and will be available for use. Contingency funds not required to meet original project goals can be utilized for other purposes such as accelerating project schedules.

Progress Reporting

Although progress reporting was a requirement on the three projects reviewed, contractors did not take timely action to ensure that they had systems in place producing valid, comprehensive data that could be relied upon by DOE management.

Four years into the Superconducting Super Collider project, a Departmental review team evaluated the project and business management systems being used and found that these systems were only marginally useful because they could not adequately track project progress and had only limited ability to provide consistent and accurate financial data. Another review analyzed project reporting and identified numerous data quality issues.

A Departmental assessment of the Advanced Photon Source project's initial cost performance reports expressed concern that the reports did not provide the data needed by management to make appropriate decisions, and noted that the reports would not likely improve unless the contractor received "strong feedback early on" in the process. This early review was requested by the DOE project manager to determine whether the contractor's system was making satisfactory progress. A Departmental review about 2 years later found that the contractor's monthly reporting still needed to become more consistent, more accurate, and "generally contain a more effective portrayal of project status." Although corrective action was reported as completed in a subsequent review, we found Fiscal Year 1992 reports that showed negative budgeted-cost-of-work-scheduled (periodically used to eliminate schedule variances) and data that did not track from month to month.

A September 1992 Departmental review of the Relativistic Heavy Ion Collider project's management control system (part of an appraisal process that began in February 1991) found that the information reported by the contractor was insufficient to effectively document progress and performance. The contractor had not implemented reporting instructions received from the DOE project office over 18 months earlier. A follow-up appraisal conducted in March 1993 concluded that corrective actions had been completed.

Senior management was unable to get meaningful estimate-at-completion data on the Advanced Photon Source in the cost performance reports, and discontinued use of this report. The DOE project manager stated that trend analysis was accomplished by other means, including presentations at semi-annual Headquarters program reviews and contingency analyses. External reviews of the Superconducting Super

Collider project disclosed that the estimate-at-completion portion of the project management control system was not fully functional and could not generate reliable forecasts. For example, the May 1993 computer-calculated estimate-at-completion showed an overrun of \$124 million, while an independent Departmental assessment of the project reported an estimate-at-completion with an overrun of about \$1.6 billion. Generating credible forecasts through project completion is a primary function of a project control system.

REASONS FOR MANAGEMENT PRACTICES

These conditions occurred because Departmental policy did not ensure that incremental growth exceeding established thresholds would be formally approved by the responsible DOE official; replans were considered to be approved by the Department outside of formal change control; and the Department did not consistently take action to ensure that contractor progress reporting was timely and meaningful.

Change Thresholds

Thresholds for determining what changes must be approved by the Department are established by senior DOE officials when a project is formally initiated. Current policy regarding cost thresholds applies to individual change actions. For example, if the dollar threshold for cost changes requiring Departmental approval is \$5 million, a single change request affecting a designated work breakdown structure level would need to exceed \$5 million before approval would be required. This policy allows incremental cost growth exceeding \$5 million to occur and not be formally approved by the Department. If variances reported to management are calculated against increased baselines, but significant incremental growth is not periodically captured as a Level 2 change, senior management is not ensured accurate visibility over cost growth trends.

The Relativistic Heavy Ion Collider project manager established a threshold level of zero (i.e., any cost change to the baseline) for certain project areas warranting close attention. Such a policy prevents incremental growth in these key areas accumulating without Departmental approval.

Periodic Replans

Office of Energy Research policy allowed replans on a periodic basis, rather than when necessitated by changed circumstances. Replans were generally associated with reviews of the projects conducted by the office's Construction Management Support Division. We found that contractors

interpreted approval of project status by the review team as approval of revised project baselines; but, replan actions should be processed as formal change actions to ensure baseline integrity and accurate progress reporting. We note that replans and other program office reviews may be excellent informal mechanisms for assessing project performance and progress, and annual replans may be of value in adjusting to reduced funding levels. However, semi-annual replans tend to obscure long-term trends in cost growth or schedule slippage that might benefit from the development and implementation of corrective action plans.

Project Reporting

The Department recognized the problems with progress reporting. Departmental guidelines note that on past projects, managers had difficulty assessing and analyzing project status because reports were improper or contained inaccurate data. Contractor management did not always place sufficient emphasis on implementing and maintaining satisfactory cost and schedule control systems. Strong encouragement is needed to ensure timely implementation of project management systems, since contractor performance is then evaluated based on the data generated. Departmental policy requires compliance reviews be completed on new major system acquisitions and major projects shortly after an approved baseline is in place to ensure that the data are consistent and valid. Having DOE project managers periodically assess the data being generated after system approval would provide additional assurance as to the validity of such data and the accuracy of overall project status being reported over the life of the project, and thus on managements' ability to rely on analyses based on the data to assist in decision making.

DEPARTMENTAL PROJECT MANAGEMENT

Departmental management did not always assume adequate responsibility for contractor actions as anticipated by its project management system. Senior DOE management also did not have assurance that it consistently received the information needed to provide early indicators of potential problems, validate corrective actions, and make informed decisions to ensure that resources were utilized in the most efficient and effective manner. Program office practices should enhance, but not replace the Department's established system.

Although project management guidance expects accurate reporting of project status, a Government report on Department of Defense projects and prior Office of Inspector General work indicate that incentives are generally lacking for project

officials to disclose potential problems and concerns to senior officials. The Department of Defense report concluded that appropriate incentives need to be created to ensure that senior leaders received realistic perspectives on the cost, schedule, and technical status of projects. Certain project management practices cited in our audit report also did not indicate that DOE management consistently received complete and accurate information on project status. Energy Research major system project costs have generally increased over original estimates. Thus, Departmental accountability and visibility over cost growth trends are important to ensure that cost growth is justified and that limited resources are used effectively.

PART III

MANAGEMENT AND AUDITOR COMMENTS

The Associate Deputy Secretary for Field Management concurred with the overall intent of the report and recognized the need for greater emphasis on management of total project costs and strengthened project management practices. The Director, Office of Management, Office of Energy Research, did not fully concur with the findings and recommendations and stated that additional controls were not justified in terms of need or possible benefit that could be gained. Managements' comments to each of the recommendations as well as managements' overall comments are included below.

Management of Total Project Costs

Recommendation 1

The Director, Program/Project Management Division of the Office of the Associate Deputy Secretary for Field Management:

1. Establish controls to ensure that independent cost estimates for major system acquisitions include total project costs.
2. Revise DOE Order 4700.1 to include specific requirements that:
 - a. establish interim milestone dates for other project cost activities; and
 - b. ensure that procedures for development and periodic updating of project research and development plans, along with significant measurable milestones are set forth in the Project Management Plan.

Management Comments. The Associate Deputy Secretary for Field Management agreed with the intent of Recommendation 1.a. Several guidance memoranda have been distributed to program and operations offices to define, standardize, and emphasize total estimated costs, other project costs, and total project costs. The Program/Project Management Division has addressed total project costs in all recent independent cost estimates and current independent cost estimate procedures require total project costs to be addressed. DOE Orders 5700.2D and 4700.1

will be updated to include wording to ensure that independent cost estimates for major system acquisitions encompass total project costs.

The Associate Deputy Secretary for Field Management also agreed with Recommendation 1.b. stating that the revision to DOE Order 4700.1 would include specific requirements for managing other project cost activities. Interim milestone dates will be mandated for all discrete efforts that are measurable. However, interpretation of some results, research and development for example, must be left to program experts. While the baseline estimate must ensure that funding is defined, justified, and as accurate as can be determined at the initial stage of the project, the project manager must be held ultimately responsible for management of this effort. The project manager's methodology for managing these efforts must be approved as part of the Project Management Plan, and funding approvals must be visible, must be based on measurable results, and must have periodic plan updating and revisions as appropriate.

Auditor Comments. Management actions are responsive to Recommendation 1.

Recommendation 2

The Director, Office of Management, Office of Energy Research:

1. Require that quarterly project status reports submitted by DOE project managers to Headquarters contain milestone information on other project cost elements to include research and development in support of construction.
2. Require that milestone data prepared for project costs financed by operating expense funds be included in field work proposals/field budget requests.

Management Comments. The Director, Office of Management concurred in principle with Recommendation 2.a. However, Energy Research believed that appropriate information on other project cost status was included in project plans and quarterly status reports as required. The Office of Management did not fully concur with Recommendation 2.b. stating that field work proposals are prepared 2 years in advance for budget requests, and these proposals outline overall goals and objectives. Also, more detailed information on milestone data is included in research and development plans and other project documentation for other project costs, as appropriate.

Auditor Comments. Project managers of major system acquisitions are required by DOE Order 4700.1 to submit quarterly reports to provide the status of projects relative to established baselines and present a clear picture of project status and resource utilization. The audit showed that quarterly progress reports prepared by project managers for the systems reviewed did not provide adequate visibility for other project cost activities.

Actions being taken by the Office of Field Management to require the establishment of interim milestone dates for all discrete efforts that are measurable should improve future reporting. Our recommendations to the Office of Management are designed to promote more consistency in implementing this requirement. We recognize that field work proposals presently focus on overall goals and objectives. Including milestone data on other project costs in these proposals would expand that focus and provide a tool for progress measurement after funds are authorized. While research and development plans should include more detailed information on milestone data, these plans are maintained locally. On the other hand, field work proposals/field budget requests are provided to Departmental program managers. The interrelationship of other project cost activities to overall construction activities dictates, in our opinion, close monitorship of such activities and the establishment of prerequisite management tools to do so.

Project Management Practices

Recommendation 1

The Director, Program/Project Management Division of the Office of the Associate Deputy Secretary for Field Management:

1. Revise the provisions of DOE Order 4700.1 regarding cost thresholds to require that accumulated cost growth exceeding any fixed threshold value established when a project is started be recognized in a formal change action and approved by DOE's project manager.
2. Identify cost-effective incentives that can be incorporated into the project management control system to encourage timely and accurate reporting of project status.

Management Comments. The Associate Deputy Secretary for Field Management concurred with the intent of Recommendation 1.a. and stated that guidance to clarify similar policy issues in the form of a draft Departmental notice was developed in August 1993, but issuance was postponed due to a Departmental

moratorium on new directives. Guidance from this draft notice will be incorporated into an upcoming revision to DOE Order 4700.1. The position of the Office of Field Management is that a project manager is ultimately responsible for documenting and reporting all changes to the project within the present monthly and quarterly reporting requirements. This reporting must ensure traceability so that outside auditors and reviewers can easily track the actions taken.

The Associate Deputy Secretary for Field Management concurred with Recommendation 1.b. and stated that the intent of DOE Notice 4700.5 is to empower DOE field project managers with the authority to determine the appropriate application of project controls, including status reporting, for the management of their projects. A certification program to train field project managers on the use of project controls has been established. The Office of Field Management has recommended to the Office of Human Resources that specific language be included in field project manager performance appraisals to ensure accountability for promoting accurate reporting of project status at that level of management. The Office of Field Management also commented that since the contract award fee criteria may be the single mechanism available and recognized DOE-wide to incentivize contractors, contract award fee criteria in cost plus award fee contracts will be used as a means to provide cost-effective incentives to ensure timely and accurate reporting of project status.

Field Management also commented that in February of 1994 the DOE's Contract Reform Team released a report recommending actions that will significantly improve the Department's contracting practices, and that report was strongly endorsed by the Secretary of Energy. As a result, Field Management anticipates that the improvements will result in a more consistent and efficient level of contract administration in several areas, including a cost incentive for contractor cost reduction programs.

Auditor Comments. Management comments are responsive to Recommendation 1.

Recommendation 2

The Director, Office of Management, Office of Energy Research:

1. Ensure that project management plans for future major system acquisitions require that any use of contingency funds be approved by DOE's project manager (i.e. is a Level 2 change).

2. Ensure that actions with significant project-wide impact, such as replans, are processed through the change control system.

Management Comments. The Director, Office of Management, stated that they concurred in principle with Recommendation 2.a. stating that the projects already control the disbursement of funds to the contractor by construction directives and change control, per plans and thresholds approved by senior DOE management. Some flexibility in the use of contingency funds should be allowed for efficiency and it is more effective to allow some decisions to be made at the lowest management levels. Any use of contingency funds has to be reported by the contractors; thus, Energy Research project management becomes aware of any lower level use of contingency. The Director also stated that they concurred in principle with Recommendation 2.b. stating that project management was in compliance. In the early stages of projects, there may be significant cost optimization that result in trade-offs between various work breakdown structure elements. Certain changes to funding profiles affecting all elements may be combined and processed as single actions. These replans were reviewed as part of the Semi-Annual Review Process, so adequate documentation exists describing the changes.

Auditor Comments. While flexibility in the use of contingency funds may be desirable under certain circumstances, this flexibility must be integrated with the change control and reporting process. We found that this was not always the case. The use of contingency funds was not integrated with the change control process whereby use would be approved and reported as a Level 2 (Departmentally-approved) change. Project managers "becoming aware" of contractor application of contingency funds after the fact does not satisfy the intent of establishing Departmental control over contingency fund use.

The issues identified in the audit show that significant changes with project-wide impact were not subject to formal change control. Establishing thresholds for change control in compliance with Departmental policy is an important front-end control for project management, but does not ensure that the intent of change control will be met as the project matures. Actions with significant project-wide impact should be processed through change control as early as possible to allow the intent of the process to occur, which is to ensure visibility over these actions, explore alternative actions and determine the appropriate level of management involvement necessary before a decision is made. Replans and other actions representing cost increases should not be offset by processing them with other cost decreases to avoid the prescribed threshold. These actions

should be processed as separate actions in order that Departmental officials may be alerted to potential problems and able to address them up front. Significant changes, when combined, may not be visible to senior management. Further, combining the actions does not promote traceability of the decision making process throughout the life of a project. The Semi-Annual Review should supplement the formal change control process, not replace it.

Overall Management Comments. The Associate Deputy Secretary for Field Management agreed with the overall intent of the report for greater emphasis on management of total project costs and strengthened project management practices. The Office of Field Management stated that management controls were in place but implementation and policing of current internal management controls need to be made more visible to ensure adherence. To this extent, the Office of Field Management is taking a number of new initiatives to be more responsive to customers in project management including the reorganization and development of statements of missions and functions, delegating specific authority to Departmental Operations Offices, and emphasizing adherence to established processes and management practices. An effort to revise DOE Order 4700.1 will be initiated after January 1, 1994. Moreover, the Office of Field Management intends to issue policy that sets the framework for establishing specific requirements with the project manager responsible for implementing acceptable procedures.

The Director, Office of Management, Office of Energy Research, did not fully concur with all of the findings and recommendations stating that they are not justified in terms of need or possible benefits that could be gained. Energy Research acknowledged that prior to May 1990, the Department emphasized total estimated costs for construction and, as a result, other project costs received less emphasis. It was further acknowledged that for some projects, not all of the other project costs were included on construction project data sheets, which at times resulted in understated amounts for total project costs. However, the Department increased its control of total project costs as part of construction project data sheets in May 1990. The Office of Management concluded that present policies, orders, and guidelines for managing operating funds associated with construction projects were adequate and that the Office of Energy Research was in compliance with the Departmental project management orders referenced in the audit report. In addition, Energy Research did not agree that other project costs should be managed in accordance with the provisions of DOE Order 4700.1, and instead emphasized compliance with DOE Order 5700.7C. Field

Management agreed with the Inspector General report in that other project costs are included within the scope of DOE Order 4700.1.

The Director, Office of Management, Office of Energy Research, considered the management controls in place for the operating funded portion of projects to be appropriate, recognizing that many tasks need flexibility in controlling them in order to meet mission requirements. The Director further stated that other project costs are incurred for complex, one-of-a-kind research tasks where precise estimates are difficult to pinpoint because of the "state of the art" nature of the projects. Some costs (for example, conceptual design) are expended before construction start is approved and others are essentially manpower efforts. The Office of Management concluded, therefore, that it is not meaningful to use the same measurement tools for other project costs that are used for construction costs and that the audit report was confusing in that it heavily considers the project management system process and does not emphasize results.

Overall Auditor Comments. The comments of the Office of Field Management are considered responsive to the audit findings. Of particular note is the acknowledgment that greater emphasis is needed in the management of total project costs, to include other project costs, and the commitment to developing additional policy setting the framework for specific requirements applicable to project managers. We view the recognition by the Office of Field Management that change is needed as a very positive step since that office is the proponent for DOE Order 4700.1, Project Management System.

The comments of the Office of Energy Research tended to emphasize the office's compliance with current policies and procedures. While we acknowledge that measurement tools for other project costs must recognize the nature of such costs, the information set forth in Finding 1 shows that existing practices and procedures do not adequately ensure that funding for other project costs is adequate and would be used properly in the best interest of the Department. Additional emphasis on process, as well as the intent of requirements to manage total project costs, is reflective of the specific responsibilities that are assigned to DOE project managers of major system acquisitions to manage total project costs. The audit report does not mandate that other project costs be managed in exactly the same manner as construction costs or that Energy Research follow exactly the same requirements for both total estimated costs and other project costs. Rather, the audit results support the need for enhancements to the project control system to ensure that greater emphasis is placed on the management of other project

costs; the goal of such enhancements is to ensure that Departmental project management responsibilities are achieved for total project costs.

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