



UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

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ENERGY AND MINERALS
DIVISION

E-203691

APRIL 29, 1982

The Honorable James P. Edwards
The Secretary of Energy

Dear Mr. Secretary:

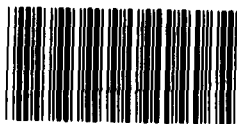
Subject: DOE Needs to Strengthen Its Computer
Performance Evaluation Activities
And Improve Its Documentation of
Procurement Actions (FMD-82-71)

We have completed our review of the acquisition of automatic data processing (ADP) equipment at selected installations of the Department of Energy (DOE). We performed our review at DOE's Office of ADP Management and the Energy Information Administration (EIA) in Washington, D.C., and at the DOE Operations Office and Sandia National Laboratories in Albuquerque, New Mexico. Despite the limited scope of our review, our findings may have implications for other DOE components because they address the basic procedures involved in acquiring ADP equipment.

We focused our review on DOE's management controls over the acquisition process for acquiring new ADP equipment. Our review was performed in accordance with standards for auditing governmental organizations, programs, activities, and functions, as prescribed by the Comptroller General of the United States. In conducting our audit, we reviewed DOE's policies, procedures, and guidelines on the management and acquisition of ADP resources. In addition, we interviewed DOE officials responsible for the ADP systems reviewed and examined contract files and related records. We also performed a technical analysis of ADP utilization at EIA and Sandia, and discussed the results of this analysis with the installations' computing officials. In March 1982 we discussed a draft of this report with officials of DOE's Office of ADP Management, and we considered their views in preparing this report. The details of our audit objectives, scope, and methodology are provided in enclosure I.

As you know, DOE's investment in ADP equipment is substantial, and an additional several hundred million dollars could be needed over the next several years to enhance or replace equipment currently in use. To keep these costs to a minimum, procurements

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must be limited to those necessary to an efficiently managed computing environment. To create such an environment at DOE installations, it is necessary to identify current data processing requirements, resource demands, likely future changes, and the performance of computing equipment available. Guidance in this area is provided to Federal agencies by Federal Information Processing Standards Publication 49, which recommends a systematic approach to computer performance management. 1/

While DOE encourages installations to evaluate the performance of their installed equipment, it does not require them to do so on a regular basis. Our review of two major ADP equipment acquisitions conducted by EIA and Sandia National Laboratories shows that neither installation had an adequate computer performance evaluation function at the time it purchased additional ADP equipment. Although several computer performance factors led each installation to determine that it needed new ADP equipment, a primary concern at each location was management's belief that the computing system's central processor was reaching its full practical utilization. Our review shows, however, that neither installation based its acquisition on an accurate assessment of the current utilization of its processor, the processor's capability to meet immediate and longer term needs, or the possibility of modifying the equipment to optimize its performance. We also found that insufficient documentation on the procurements prevented adequate review and control of the acquisitions by higher levels of DOE management.

For example, at the Sandia National Laboratories, an administrative data processing computing system was purchased because Sandia officials believed that the installed equipment could not process the computing workload. Although the system was in operation 24 hours per day, our analysis shows that the system's central processing unit was being used less than half of the time available. Another reason cited by Sandia for the procurement was the high level of interactive use of the computer--use by entering data directly into the computer for processing. However, our review shows that interactive use was greatly overestimated, and without an adequate computer performance evaluation program, Sandia did not have appropriate information needed to make system changes which might have facilitated the interactive use of its computer.

1/"Guideline on Computer Performance Management: An Introduction," May 1, 1977, National Bureau of Standards, Department of Commerce.

In reviewing EIA's acquisition we found that EIA entered a noncompetitive lease to meet its future data processing requirements. Although EIA's utilization studies showed that it was making intensive use of its installed computing systems and that they could not meet future requirements, EIA did not adequately monitor the utilization of the systems during the 5 months preceding the lease of new equipment. Our review of the systems' utilization during that period shows that, while EIA believed its workload was increasing, it was actually decreasing. We also found that the use of the new computing system was much less than EIA had forecasted. Based on our analysis, we believe that the additional requirements could have been handled with the previously installed equipment to provide sufficient time for making a competitive procurement to meet EIA's long-term needs.

Our review also shows that DOE needs to strengthen its documentation of ADP procurement actions to ensure that its management has better control over acquisitions. In an interim report dated June 19, 1981, 1/ we noted that Sandia did not document that it had considered all alternatives to meet its requirements for additional scientific computing capabilities. We noted a similar lack of documentation in each of the two procurements discussed in enclosure I.

To make ADP resources more responsive to DOE's needs and to provide appropriate management control over computer system acquisitions, we recommend that the Secretary of Energy strengthen ADP acquisition management by directing the Assistant Secretary, Management and Administration, to take the following actions.

- Require DOE installations to implement a computer performance management program, as recommended in Federal Information Processing Standards Publication 49, to measure and evaluate the performance of its computer facilities in support of management goals and objectives.
- Require DOE installations requesting additional ADP equipment to report to the Office of ADP Management on the nature, extent, and results of computer performance evaluations performed prior to acquiring new equipment.

1/"Greater Use of Satellite Telecommunications to Link ADP Facilities Could Save Millions," EMD-81-102, June 19, 1981.

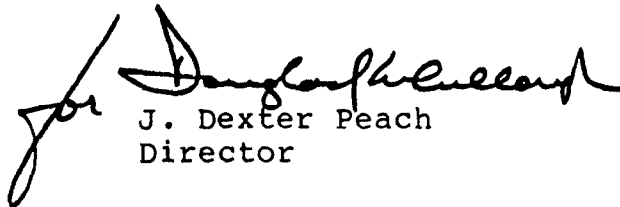
--Require DOE installations to certify in their procurement requests that they have available documentation on their computer performance evaluations and other major required procurement actions, such as validations of data processing requirements and analyses of alternatives to the procurements.

As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs within 60 days after the date of this letter; a like statement to the House and Senate Committees on Appropriations should accompany the agency's first request for appropriations made more than 60 days after the date of this letter.

We are sending copies of this letter to the Director, Office of Management and Budget, and the congressional committees identified above.

We appreciate the courtesies and cooperation extended to us during our review.

Sincerely yours,


J. Dexter Peach
Director

Enclosure

DOE NEEDS TO STRENGTHEN ITS COMPUTER
PERFORMANCE EVALUATION ACTIVITIES AND
IMPROVE ITS DOCUMENTATION OF
PROCUREMENT ACTIONS

The use of ADP resources is pervasive in carrying out DOE's operations. There is no feasible alternative to using these resources in performing numerous functions related to scientific research and engineering, weapons related testing and production, and information processing and administrative support. In 1980, DOE estimated that its ADP equipment inventory had a purchase value of \$750 million. The cost of additional equipment needed to enhance or replace this equipment could amount to several hundred million dollars over the next several years.

For DOE to have assurance that its substantial investment in ADP resources is cost effective, it needs to make accurate assessments of its current and future computing requirements and follow uniform procurement procedures. Federal regulations require agencies, before acquiring additional ADP equipment, to assure that they determine the possibility of improving the performance of existing data processing facilities through interim upgrade or modification of equipment, or through changes in software, scheduling of workload, improved computer-center operations, or extended hours of system operation. In each of these areas there are cost, efficiency, and other types of trade-offs that should be evaluated in considering whether to make the changes or purchase new equipment.

Although DOE has issued guidance in this area, it does not require installations to perform computer performance evaluations on a regular basis to determine whether the systems or their individual components are meeting performance goals. In reviewing two large ADP procurements at the installations we visited, we noted that procurement decisions were guided by inadequate assessments of computing requirements. The installations believed the computing systems' central processors were rapidly approaching their full practical utilization. However, without having detailed information on the utilization of the processors, the installations could not make an adequate determination of the processors' ability to meet the data processing requirements. We also noted that documentation of these procurements was not sufficient to enable higher level DOE management officials to adequately review and control procurement decisions.

OBJECTIVES, SCOPE,
AND METHODOLOGY

Our review assessed management controls over the acquisition process used to acquire DOE's ADP equipment. We performed our work at DOE's Office of ADP Management and EIA in Washington, D.C., and at the DOE Operations Office and Sandia National Laboratories in Albuquerque, New Mexico. We selected the EIA and Sandia acquisitions for review because each location had completed a large

acquisition, and the ADP capacity at these locations exceeded 10 percent of DOE's total ADP capacity. Our review was performed from June 1980 to September 1981. Since then, we have had several discussions with DOE officials to supplement and update information and to confirm our findings.

In conducting our review, we evaluated DCE's policies, procedures, and guidelines on the management and acquisition of ADP resources. We also interviewed DOE officials responsible for managing the ADP systems reviewed and examined contract files and related procurement records and documentation. In addition, we discussed EIA's ADP procurement with representatives of the General Services Administration to determine the extent of its review of the acquisition.

In performing our audit, we evaluated DCE's acquisition studies and analyses carefully to determine if they represented the computing environment when they were prepared and adequately considered all alternatives available to meet the computing needs. At each location, a primary reason for making the procurement was management's belief that the computer's central processor was reaching its full practical utilization. Therefore, we performed a technical analysis of ADP equipment utilization at the locations visited and discussed these analyses in detail with EIA and Sandia computing officials. Also, in March 1982 we met with officials of DOE's Office of ADP Management to obtain their views on our draft report. Their comments were considered in preparing this report.

In conducting our review, we followed the standards established by the Comptroller General of the United States for auditing governmental organizations, programs, activities, and functions.

NEED TO STRENGTHEN COMPUTER PERFORMANCE EVALUATION

To achieve cost effective management of computing resources, it is necessary to determine the amount of computing capacity needed in an efficiently managed computing environment. Computer performance evaluation methods provide quantitative and well documented information on the performance of a computer system or its individual components. With this information, management can obtain maximum benefits from its investment in computer hardware and software by optimizing computerized operations. For example, the information can be used for making changes in hardware or software programs, modifying operational strategies, or justifying the purchase of a new computer system.

Computer performance evaluation is a key aspect in the overall management of computing resources. The performance evaluation function should determine the extent to which performance objectives are being met, and it should determine the relationships between performance and utilization of ADP equipment. The computer performance evaluation group should report to systems

programers those aspects of performance which might be improved by system modification, including modifications to hardware, software, and data storage.

This type of efficiently managed computing environment would enable management to know how current computer resources are being used and how they would satisfy users' requirements. More specifically, they would provide a continuous process for obtaining information on (1) the data processing workload including its history of growth, its present resource demands, and its likely growth in the future, and (2) the performance of computing resources with respect to meeting user requirements. Guidance toward this end is provided in Federal Information Processing Standards Publication 49, "Guideline on Computer Performance Management: An Introduction," which calls for agencies to implement a structured effort to measure and evaluate the performance of a computer facility in support of established management goals and objectives.

DOE encourages its installations to use computer performance evaluation techniques, but does not require the installations to regularly perform the evaluations. However, before the installations are permitted to purchase additional computing equipment, they are required to evaluate existing equipment to determine whether its enhanced use would be an adequate alternative to purchasing new equipment. If such evaluations are not performed, the installations must explain the reasons for the omission in documenting their justification of need for the additional ADP equipment. The installations are not required, however, to report on the nature, extent, and results of any computer performance evaluations performed.

Based on our review of two acquisitions made by Sandia and EIA, DOE needs to place more emphasis on these evaluation activities. Neither installation had an adequate computer performance evaluation function in place and, as a result, each installation acquired new ADP equipment without fully assessing the capabilities of existing equipment.

Sandia's procurement was based
on inadequate information

To handle its increasing administrative data processing workload, Sandia purchased a new computer system having several times the processing and storage capacity of its previously installed system. The new system was purchased primarily because Sandia believed that its ADP workload exceeded the useful capacity of the administrative data processing center and that the computing system's capacity could not be expanded. Among other concerns, Sandia also believed that the system could not provide a quick response capability needed by its interactive computer system users--users who enter data directly into the computer for immediate processing.

When Sandia determined that its computing system did not adequately meet its needs, no computer performance evaluation function was in place to measure the utilization of the system and its individual components. Therefore, its observations regarding system performance were based on empirical evidence, including users' complaints that the system was providing poor response time in meeting their needs. Based on these observations, Sandia stated in its long-range ADP plan for 1979 that the capacity of its computing system was exhausted during daytime hours.

However, our analysis of system utilization information for October 1979 shows that the computer's central processing unit was used less than 30 percent of available daytime prime time processing hours. In addition, data processing time was available during other hours when only 39 percent of available central processing time was used. On an annual basis, the processor was used only 29 percent of the time available.

To confirm these findings, we analyzed Sandia's computer utilization data for its new computer during the first 11 months of operation. We found that the system was operating only one-third of the available time and was using only 7 percent of the capacity available. This analysis showed that Sandia's initial system could have absorbed the total administrative workload well within the limitations of its central processor.

Sandia's estimation of the interactive use of its computing system was also a factor in its decision to purchase new, higher capacity equipment. In its procurement justification documentation, Sandia stated that its installed system could accommodate only 30 to 35 interactive users before other work being handled by the system was impaired. However, Sandia could not document its analysis of this observation which was based primarily on complaints made by the system's users. Nor could Sandia provide any evidence that it had attempted to adjust its operating system to facilitate the interactive use. Such adjustments, including modifications to the computer's operating system to shift the assignment of work to alternative peripheral information storage devices, are commonly made to alleviate this type of problem.

Our analysis also shows that Sandia overestimated the amount of its interactive workload. In its long-range plan published in January 1979, Sandia stated that the interactive workload accounted for 90 to 95 percent of the total workload during prime time processing hours. Our analysis shows, however, that during October 1979 Sandia's interactive processing accounted for only about one-third of the processing performed during prime time hours. Further, interactive use decreased on the new computer system. In the first 11 months of operation, the new system's interactive users accounted for about one-fourth of total processing performed.

While we do not question Sandia's contention that it was not obtaining satisfactory performance from its computing system, we believe that, by carefully studying the utilization of its system, Sandia could have identified basic causes of its problems. Because the basic causes of the problems were not identified, Sandia continued to have similar problems with its new system, even though that system had a capacity several times larger than the previous system. To correct this situation, Sandia conducted computer performance evaluation techniques to identify the reasons for its data processing problems and made needed improvements. Had these techniques been used before the new acquisition, the need for the additional equipment might have been eliminated.

EIA's requirements were overstated

In September 1979, GSA delegated to EIA procurement authority to upgrade its ADP systems by entering a sole-source direct lease of equipment on a month-to-month basis. EIA contended that it did not have the time necessary for a competitive procurement process because its existing computing systems were already being utilized beyond their optimal operating level. In its procurement request, EIA pointed out that the utilization of its systems consistently exceeded 95 percent of available time during weekday prime time processing hours and that its workload was growing.

While such intensive use of its computing equipment would clearly require remedial action, the answer may have been to shift part of the data processing workload to non-prime time processing hours. EIA computing officials and officials of DOE's Office of ADP Management assured us that this option was examined and found to be not practical. However, these officials were not able to provide us with any study showing reasons that the alternative was not feasible or its advantages and disadvantages.

In making its procurement, EIA also stated that the total prime and non-prime time utilization of its central processors was approaching 65 percent of capacity. EIA pointed out that a study conducted by the Federal Computer Performance Evaluation and Simulation Center (FEDSIM) indicated that utilization of the central processing unit should not exceed 65 percent of total available time. The FEDSIM analyst who developed the 65 percent utilization rate told us, however, that this rate was not intended to be used as a strict standard. He indicated that the maximum rate should be determined on the basis of a study of the individual operating system and the nature and characteristics of the workload processed. EIA was unable to provide any documentation showing that a study of these factors was prepared.

Although EIA's computing systems were used extensively during prime time hours, our review shows that a significant amount of processing time was available and unused. Our analysis of utilization statistics for fiscal year 1978--the year which preceded the acquisition and which was used for EIA's projections of future

growth--shows that the average monthly utilization of each of EIA's two systems was only about 60 percent of available time.

Although EIA had performed a similar analysis and reached the same conclusions, it forecasted significant increased utilization in future years. However, EIA did not continue to perform adequate, detailed evaluations of the utilization of its computer systems' central processors. Based on the historical data it had available, EIA concluded that its available resources would be exhausted by July 1979. Our analysis shows that actual utilization in fiscal year 1979 was below 65 percent for each computing system. Because EIA did not adequately monitor the actual utilization of its systems during the 5-month period prior to its acquisition, EIA continued to believe that its data processing requirements were growing, whereas they were actually decreasing, with only a little more than half of the capacity of the larger system being utilized.

Likewise, utilization data for the new computing systems shows that growth in EIA's data processing requirements during fiscal year 1980 was only about half of the growth that EIA had forecasted. Our analysis shows that the additional requirements could have been handled with the previously installed equipment to provide sufficient time for making a competitive procurement to meet EIA's long-term needs.

EIA computing officials were unable to explain to us the reasons for the reduction in data processing requirements. They stated, however, that in making the procurement they reacted more to indications of poor computer performance than to the actual utilization of the systems' central processing units. They said that they had experienced severe constraints on their ability to satisfy demands on the existing system and were constantly aware of user complaints.

EIA computing officials also pointed out that cost savings were achieved through their sole-source procurement action because the new systems were less expensive to operate than the replaced systems. While operations costs for the new systems were lower, it is not possible to quantify the cost savings that might have been obtained by delaying the procurement until competitive offers could have been obtained from computer vendors. Such offers might have resulted in reduced acquisition as well as operations costs.

NEED FOR BETTER PROCUREMENT DOCUMENTATION

DOE's Office of ADP Management is responsible for ensuring that all Federal ADP policies, procedures, and regulations are followed in making ADP acquisitions. However, DOE's field installations have major responsibilities for demonstrating and documenting their computing requirements before carrying out the procurement. The installations are required to consider all relevant factors that support the proposed acquisition. This includes a

validation of data processing needs, an evaluation of the installed equipment's performance, and a study of the alternatives available for meeting the computing requirements. Our review shows that DOE needs to improve its documentation for these functions to effectively implement its policy of decentralizing ADP acquisition management functions, while providing for sufficient control and review at appropriate levels.

Although acquisition documents originate at individual DOE installations, they are reviewed at field offices, program offices, and, ultimately, DOE's Office of ADP Management. As the documents move through these organizational levels, good documentation of the reviews previously made is needed to ensure that each successive office which reviews and approves the documents is aware of substantive questions and concerns previously raised and their resolution. For example, when an installation requests additional computer hardware, it is important for DOE headquarters officials to know whether DOE field offices thoroughly reviewed the studies on which the need was based and the options that were considered.

Procurement officials of the Albuquerque Operations Office told us that the methodology used to review acquisition plans can vary from procurement to procurement. These officials told us that a detailed review to verify the information in the plans--including information on computer performance evaluations and validations of data processing needs--is made in some cases but not all cases. In reviewing Sandia's acquisition of its administrative processing system, we were unable to determine the extent of the review that actually did take place. For example, documentation was not available to show whether the Operations Office had verified that the installed system had inadequate processing capability, that improvements to the installed system were not possible to make, or that Sandia had adequate information on the utilization of the system. Each of these considerations was central to Sandia's contention that additional computing equipment was needed.

During our review, we noted similar documentation problems in Sandia's procurement actions to purchase a major scientific computing system for its research and development work. In our June 19, 1981, letter report 1/ on this procurement, we pointed out that, although DOE procedures require complete information on each major ADP acquisition, Sandia did not provide information on whether

--data processing needs were validated and the performance of installed equipment evaluated,

1/"Greater Use of Satellite Telecommunications to Link ADP Facilities Could Save Millions," EMD-81-102, June 19, 1981.

- a determination had been made that the computing needs could not be satisfied by excess Government-owned equipment, and
- it was feasible to meet the computing needs by sharing equipment with other users.

We also stated that:

"* * * neither Sandia Laboratories nor DOE's Office of ADP Management have documentation fully demonstrating that appropriate studies have been performed to evaluate the feasibility of alternative approaches to providing Sandia with the needed computer capacity. In discussions with Office of ADP Management officials, we were told that all procurement alternatives were considered, but records were not maintained on the alternatives and the reasons that they were not feasible."

In response to our letter report, DOE's Assistant Secretary, Management and Administration, informed us that DOE suspended procurement actions until Sandia had re-examined and documented all alternative procurement actions.

Our review of EIA's acquisition also showed a need for better documentation of actions taken in the procurement process. For example, EIA's sole-source procurement of a computing system was based on its position that only one computer vendor was able to meet its technical requirements within the required time period. However, EIA could not provide documentation to show that it had made a thorough study of all sources of computing equipment. Also, as previously discussed, EIA's stated requirements were not based on an adequate assessment of its computer system utilization data. (See pp. 9 and 10.)

EIA computing officials told us that they had reviewed trade publications to survey the available equipment and had discussed computing requirements with three vendors. However, EIA could not identify the vendor representatives contacted or tell us the specific requirements it identified to each vendor. EIA also did not have documentation on any of its contacts with third-party vendors--vendors who purchase and lease or resell computer manufacturers' equipment.

Also, EIA's procurement request stated that it had in place a system performance committee that performed hardware, software, and procedural evaluations on a regular basis and that directed all of its actions to maximize system responsiveness and productivity. Although responsible EIA officials told us that the committee carried out its functions, EIA was not able to provide documentation on the committee's purpose, organization, or activities. EIA was also unable to document any hardware or software studies of

the computing system or the criteria used for making performance measurements or evaluations on a regular basis.

CONCLUSIONS AND RECOMMENDATIONS

Because of DOE's extensive use of computers, and their substantial cost, it is essential that DOE installations obtain the full practical use of their ADP resources. At the installations reviewed, however, purchases of new equipment were made without the benefit of information based on an adequate assessment of the utilization of the computer's central processor. With such information, it might have been possible for the installations to modify and enhance the capabilities of the computing systems to delay or cancel acquisition of new equipment. We also found that the documentation prepared on these procurements was not adequate for ensuring adequate review and control of the acquisition at higher DOE management levels.

To make ADP resources more responsive to DOE's needs and to provide appropriate management control over computer system acquisitions, we recommend that the Secretary of Energy strengthen ADP acquisition management by directing the Assistant Secretary, Management and Administration, to take the following actions.

- Require DOE installations to implement a computer performance management program, as recommended in Federal Information Processing Standards Publication 49, to measure and evaluate the performance of its computer facilities in support of management goals and objectives.
- Require DOE installations requesting additional ADP equipment to report to the Office of ADP Management on the nature, extent, and results of computer performance evaluations performed prior to purchasing the new equipment.
- Require DOE installations to certify in their procurement requests that they have available documentation on their computer performance evaluations and other major required procurement actions, such as validations of data processing requirements and analyses of alternatives to the procurements.