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BY THE U.S. GENERAL ACCOUNTING OFFICE

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# Report To The Secretary Of Defense

## Air Force Civil Engineer Cost Accounting System Reports Should Be Used More Effectively

Air Force civil engineer cost reports for maintenance and construction at Air Force bases show significant differences between planned and actual labor-hours. These differences are not being analyzed and action is not being taken to determine causes and correct the problems.

Better use of the reports by management should lead to more realistic work schedules and increased work force efficiency. This, in turn, could help reduce the large and growing backlog of civil engineer projects.

The Air Force should revise its regulations to require indepth analyses and followup of significant differences between planned and actual labor-hours on civil engineer projects.



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JANUARY 16, 1980



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

DIVISION OF FINANCIAL AND  
GENERAL MANAGEMENT STUDIES

B-159797

The Honorable Harold Brown  
The Secretary of Defense - 5

Dear Mr. Secretary:

We have reviewed the Air Force Civil Engineer Cost Accounting System at three installations. Base personnel management could be enhanced if several cost reports produced by the system were effectively used. 10

Base civil engineer officials do not analyze indepth significant differences reported between planned and actual labor-hours on projects. As a result, causes are not systematically being brought to base management's attention so that they can be corrected.

The reports are not being effectively used for several reasons. Air Force regulations do not require analyses of the staff-hour variances. Base civil engineer officials do not believe formal post analyses are necessary. They feel continuous project monitoring enables them to identify problems as they occur and solve them. However, the continual occurrence of significant labor-hour variances indicates planning or implementation problems that management is not solving. Also, base civil engineer officials believe these variances are attributable primarily to inexperienced planners and inadequately trained airmen, factors they claim are beyond their control.

We are recommending that<sup>35</sup> you direct the Secretary of the Air Force to revise Air Force regulations to require civil engineer officials to analyze labor-hour variances and correct the causes.

Our findings were discussed with Air Force base level personnel and Air Force Headquarters and Defense officials. Where appropriate, their comments have been considered in preparing this report.

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 not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report. We would appreciate receiving copies of these statements.

We are sending copies of this report to the Chairmen, House Committee on Government Operations, Senate Committee on Governmental Affairs, and House and Senate Committees on Appropriations and Armed Services; the Director, Office of Management and Budget; and the Secretary of the Air Force.

Sincerely yours,

A handwritten signature in black ink, appearing to read "D. L. Scantlebury". The signature is written in a cursive style with a long, sweeping tail that extends to the right.

D. L. Scantlebury  
Director

D I G E S T

Air Force Civil Engineer cost reports of planned and actual labor-hours on base projects are not being used to manage personnel effectively at three installations GAO visited.

The reports continually showed significant differences between planned and actual hours. However, base civil engineer officials are not analyzing the differences in depth. At one base, change orders are processed to eliminate them. Better use of the reports by management should lead to more realistic work schedules and increased work force efficiency. This, in turn, could aid in reducing the large and growing backlog of civil engineer projects.

Worldwide about 119 Air Force installations use the civil engineer cost accounting system. In fiscal 1978, it accounted for about \$2 billion in civil engineer projects and \$805 million in personnel costs.

To improve personnel management, actual performance must be compared to estimates and any variance analyzed. The comparison of actual and estimated data is designed to afford a basis for controlling current and future operations. At times, the analysis will show that the estimate was unrealistic or that actual job conditions were so different from those anticipated that the estimates were no longer valid. At other times the conclusion would be that the work force took longer than necessary to do its task. Whatever the reason for the variance, its cause should be determined and corrected.

If inaccurate estimates cause variances, management should take actions to improve the quality of the estimates in order to

schedule work realistically. If work force inefficiency causes variances, increased supervision may be required to ensure that planned projects are accomplished on time.

The large backlog of civil engineering projects shows the need for analyzing labor-hour variances and improving personnel management. The overall Air Force backlog has increased from \$205 million in October 1976 to \$299.9 million in January 1979. To the extent the backlog is caused by work force inefficiency, indepth analyses of labor-hour variances and improved management of base personnel would help reduce it.

Civil Engineer cost reports are not being effectively used because Air Force regulations do not require analyses of staff-hour variances, and base civil engineer officials do not believe a formal post analysis of projects is necessary. They believe that their continuous monitoring of projects enables them to identify problems as they occur and correct them. However, the continual occurrence of significant labor-hour differences indicates that project planning or implementation problems are not being solved.

Another reason base civil engineer officials do not analyze the differences is that they feel they have little or no control over reasons they believe are causing labor-hour overruns, such as inadequately trained airmen and planners. They stated that the airmen assigned to base engineering often do not have the necessary skills to do the work efficiently and that the grade level of planners is too low to attract qualified persons.

Officials could not document these reasons but feel an objective analysis would disclose them as primary causes of the variances. They believe that these problems can best be handled at Air Force Command or Headquarters rather than at base level and that any recommendation requiring them to analyze the differences indepth should also include a requirement for periodic Air Force analysis of base level findings. For problems not

controllable by base level officials, Air Force Command or Headquarters officials should be required to initiate corrective action.

We recommend that the Secretary of Defense instruct the Secretary of the Air Force to:

- Revise civil engineering regulations to require base level civil engineer officials to systematically analyze labor-hour variances and take corrective action.
- Clarify the regulations to preclude change orders being processed merely to eliminate labor-hour variances from cost reports.
- Require Air Force Headquarters civil engineer officials to periodically review results of base level labor-hour variance analyses to determine if there are Air Force-wide problems and to take appropriate corrective action.

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## CHAPTER 1

### INTRODUCTION

The design of the Air Force Civil Engineer Cost Accounting System was approved by us in March 1976. Our recent review of the system in operation at Travis Air Force Base, California, concluded that it was operating substantially in conformance with the approved system design. We so informed the Secretary of the Air Force in a letter report of November 30, 1979 (FGMSD-80-18).

The system is in operation at about 119 Air Force installations worldwide. In fiscal 1978, it accounted for about \$2 billion in civil engineer projects and \$805 million in personnel resources. At the three installations we visited (Travis, McClellan, and Mather Air Force Bases, California), completed projects totaled \$56.6 million in fiscal 1978 and 1,884 civilian and military personnel were employed as of May 1979.

The Civil Engineer Cost Accounting System is one of nine subsystems making up the Base Engineering Automated Management System. The system accumulates civil engineer project costs by combining the labor-reporting function, which provides staff-hour expenditures; the standard base supply system, which provides material costs; and the accounting system for operations, which provides payroll, contract, utilities, and other costs. The system enhances operation and maintenance resource management at the base level by providing computer-generated reports to track and evaluate specific civil engineer projects and monitor shop productivity.

The Civil Engineer Cost Accounting System accumulates costs for jobs under the work order method. Under this method, production is accounted for as a series of distinct jobs and costs are accumulated for each job. The method is a long-accepted management accounting and reporting tool in commercial and Government organizations and is usually used where jobs are undertaken to fill specific customers' orders.

Civil engineering's function is to maintain and improve Air Force real property in support of the Air Force mission and its people. Civil engineering projects include constructing new facilities; renovating and improving existing facilities; manufacturing and repairing equipment; installing, removing, and replacing equipment and parts; and maintaining and repairing grounds, pavement, and facilities. At Travis, these projects are performed by 25 shops, such as structural maintenance and repair, painting, plumbing, sheet metal, and masonry shops.



Civil engineering identifies jobs that need to be done through installation surveys and customer requests. These jobs are reviewed and, if required, the planning phase begins. First, a decision is made on the method of accomplishment-- by either contract, civil engineer operating shops, or self-help. Then, for work done in house, a work plan is developed, material and equipment requirements are identified, staff-hours are estimated using engineering performance standards, and a plan to time phase jobs for the shops to do is developed. A work order is prepared for each job and assigned a different number, which is entered into the cost accounting system. These numbers are used to accumulate costs, such as material and labor costs, under the work order method.

The civil engineer cost system provides base civil engineer officials various cost reports which track activity on work orders. The Cost Limitation Comparison Report is prepared as a project progresses and can be used to monitor projects which exceed 125 percent of the original estimate. At the completion of a project, a Completed Work Order Cost Report is prepared, which compares the actual labor and material costs with the original estimates. The Work Order Man-Hour Variance Report shows each shop's total estimated versus actual staff-hour usage for each work order completed in the previous month and the shop's total estimated versus total actual staff-hour usage on work orders for each of the previous 12 months.

## CHAPTER 2

### COST ACCOUNTING REPORTS CAN BE USED MORE EFFECTIVELY

Cost accounting reports identifying significant differences between planned and actual labor hours on civil engineer projects are not being effectively used at the three installations visited. As a result, problems in planning or implementing projects are not systematically being brought to the attention of base civil engineer officials so that corrective actions can be taken.

Civil engineers are not making indepth analyses to determine the causes of variances, a first step in taking corrective action. At one base, change orders are simply processed to eliminate variances. While civil engineer officials periodically discuss, as least in general terms, some variances and probable causes, the persistence of the differences affirms that base engineers are not taking effective corrective action.

There are several reasons why civil engineers are not analyzing variances and initiating corrective action. Air Force regulations do not require such analyses. Base civil engineer officials at the bases we reviewed do not believe a formal post analysis of variances is necessary. They said their continuous monitoring of projects enables them to identify problems as they occur and solve them. Further, they feel that the variances are attributable primarily to poor estimates and inadequately trained airmen and that they have little or no control over either. They stated that the grade level for planners is too low to attract qualified persons and that the airmen assigned to base engineering do not have the necessary skills to do the work efficiently.

### IMPORTANCE OF ANALYZING DIFFERENCES BETWEEN PLANNED AND ACTUAL PERFORMANCE

Effective management requires that objectives and goals be clearly established and communicated to supervisors and employees. Plans for achieving objectives and goals must be formulated, and they must be supported by estimates of the resources needed to carry them out.

To improve personnel management, estimates must be compared with actual performance and any variance analyzed. The comparison of actual and estimated data is designed to afford a basis for controlling current and future operations. At times, the conclusion from the analysis would be that the

estimates were unrealistic or that actual job conditions were so different from those anticipated that the estimates were no longer valid. In other cases, the conclusion would be that the work force took longer than necessary to do its task. Whatever the reason for the variance, the cause should be determined and corrected.

The mere fact that actual results differ from estimates, and are so reported, is only the prelude to managerial control. Identification of causes and the initiation of corrective actions are the essence of controlling and effectively managing a work force.

If inaccurate estimates cause variances, management should improve their quality in order to schedule work realistically. If work force inefficiency causes variances, increased supervision may be required.

The large backlog of civil engineering projects shows the need for analyzing labor-hour variances and improving personnel management. To the extent the backlog is caused by work force inefficiency, indepth analyses of the variances and better personnel management would help reduce it. McClellan Air Force Base's June 5, 1979, backlog report showed 914 projects requiring 64,612 staff-hours; Travis' May 9, 1979, backlog report showed 419 projects requiring 28,903 staff-hours; and Mather's May 31, 1979, backlog report showed 269 projects requiring 43,549 staff-hours.

The overall Air Force civil engineer backlog has increased from \$205 million in October 1976 to \$299.9 million in January 1979. Improved base level management of personnel should help reduce the Air Force-wide backlog.

COST REPORTS DISCLOSING SIGNIFICANT  
LABOR-HOUR VARIANCES ARE NOT BEING  
EFFECTIVELY USED

At the three installations visited, cost reports provided to management disclosed continuing significant differences between planned and actual labor-hours on civil engineer projects. These differences are not being analyzed and corrective action is not being taken.

Among the cost reports are the Cost Limitation Comparison Report, which lists work orders exceeding the estimated total cost by 25 percent; the Completed Work Order Cost Report, which provides the labor-hour variance for completed projects; and the Work Order Man-Hour Variance Report, which provides labor-hour variances by shop for the previous 12 months.

A July 1979 study of Completed Work Order Cost Reports done by civil engineering's analysis branch at Travis concluded that its labor-hour variances were excessive and must be reduced to improve work scheduling. Our analysis of Completed Work Order Cost Reports, which follows, showed that 54 percent of the fiscal 1979 work orders completed as of May 1979 had variances exceeding 25 percent while 30.5 percent had variances exceeding 50 percent.

Analysis of Fiscal 1979  
Completed Work Order Cost Reports

<u>Installation</u>	<u>Total projects (note a)</u>	<u>Extent of variances (note b)</u>			
		<u>Less than 25%</u>	<u>26-50%</u>	<u>51-75%</u>	<u>Over 75%</u>
Travis	228	93	47	35	53
McClellan	323	170	67	30	56
Mather	<u>153</u>	<u>61</u>	<u>51</u>	<u>19</u>	<u>22</u>
Total	<u>704</u>	<u>324</u>	<u>165</u>	<u>84</u>	<u>131</u>
Percentage of total		46	23.4	11.9	18.6

a/Includes only projects completed from October 1978 through May 1979 on which staff-hour estimates were over 10 hours.

b/Includes both overruns and underruns of labor-hour estimates.

The Work Order Man-Hour Variance Report, which provides a 12-month historical comparison, by shop, of actual versus estimated staff-hours and the variance, also indicates a continuing problem. At Travis, for the 12 months ended March 31, 1979, we selected 6 shops which accounted for 45.3 percent of the 90,217 hours accounted for by the 25 shops and found labor-hour overruns ranging from 30 to 130 percent. At Mather, for the same period, we selected 6 shops which accounted for 76 percent of the 55,504 hours accounted for by the 18 shops and found overruns ranging from 25 to 133 percent.

Examples of labor-hour variances

At Travis Air Force Base, we examined six completed work order folders to document specific examples of differences between planned and actual labor hours. The estimates

for two examples were based mostly on engineering performance standards, which give the labor-hours a qualified craftsman should need to do a defined amount of work. The four other estimates were based mostly on the planner's knowledge of shop time necessary to do the job. Each example is summarized below.

Case 1. The planning branch estimated a total labor cost of \$4,828 to drill about 270 holes in new concrete at runway ramps and block out red lines and repaint them on new concrete. The total actual labor cost was \$12,710, a 163.2-percent overrun. The plan estimated 375 hours for the pavement shop and 144 hours for the paint shop. The pavement shop overran its 375-hour estimate by 776 hours, or 204.2 percent, while the paint shop overran its 144-hour estimate by 144 hours, or 100 percent. The completed work order folder contained numerous general reasons for the overruns but did not explain how many extra hours were required for each one. The reasons dealt primarily with excessive time spent removing old paint and equipment difficulties experienced in drilling new holes. There was no verification or followup of the reasons.

Case 2. The planning branch estimated a total labor cost of \$2,779 to repair a primary underground distribution electric system. The total actual labor cost was \$7,099, a 155.4-percent overrun. The plan estimated 246 hours for the equipment shop and 160 hours for the electric shop. The equipment shop overran by 117 hours, or 47.5 percent, and the electric shop overran by 402 hours, or 251.2 percent. The folder did not explain the overruns.

Case 3. The planning branch estimated a total labor cost of \$5,117 for the paint shop to paint the interior of 12 apartments in 1 building. The estimate was based entirely on engineering performance standards. The total actual labor cost was \$10,153, a 98.3-percent overrun. The completed work order folder contained the following explanation: "Due to surface condition, majority of apartments had to be double-coated plus primed and patched. All furnishings in apartments had to be moved and replaced." The original estimate, however, allowed for a double-coat of paint and sanding. There was no verification or followup of the reasons.

Case 4. The planning branch estimated a total labor cost of \$2,041 to paint the exterior of one building. The total actual labor cost was \$5,475, a 168.3-percent overrun. The folder did not explain the overrun.

Case 5. The planning branch estimated a total labor cost of \$3,370 to enlarge a women's latrine, using engineering performance standards as a basis for 84.7 percent of the estimate. The total actual labor cost was \$8,296, a 146.1-percent overrun. The plumbing shop overran by 296 hours, or 302 percent, while the structural shop overran by 94.5 hours, or 192.8 percent. The folder did not explain the variances.

Case 6. The planning branch estimated a total labor cost of \$4,767 to repair drainage at three residences. The total actual labor cost was \$8,523, a 78.7-percent overrun. The equipment shop overran by 92 hours, or 63.8 percent, and the pavement shop overran by 495 hours, or 126.2 percent. The completed work order folder contained many reasons for the overrun, but did not explain how many extra hours were required for each one. The reasons included the need for ditches to be retrenched and concrete forms to be reformed because of 3 days of rain, and the delay in getting another shop to prepare new elevations. There was no verification or followup of the reasons.

Despite the extent of significant differences between planned and actual labor hours on civil engineer projects, civil engineer officials at the three installations visited are not systematically tracking, categorizing, or analyzing the reasons for the variances. At one installation, the Completed Work Order Cost Reports are reviewed by a clerk, and for all variances over 25 percent, the clerk asks the responsible shop to explain the differences. The explanations, however, are merely filed by the clerk in the completed work order folders with no formal followup or verification. At another installation, reasons for the variances are not documented.

At the third installation, the report monitor asks shop officials working on projects shown on the Cost Limitation Comparison Report as exceeding labor-hour estimates by 25 percent to explain the overruns. The explanations are merely filed in the completed work order folders with no formal followup or verification.

The explanations are used, however, as a basis for processing change orders to reflect the shops' new staff-hour estimates. Under this procedure, the original estimates are updated, thus removing the staff-hour differences from the cost system, distorting both the Completed Work Order Cost Report and the Man-Hour Variance Report. Base civil engineer officials processing the change orders stated that since the shops could explain the variances, there is no reason to maintain them in the cost system.

However, Air Force Regulation 85-1 requires that a change order be processed when there is a cost increase of at least 25 percent resulting from a change in the scope of work described on the original work order. The regulation does not authorize a change order when there is at least a 25-percent cost increase without a change in the project's scope.

Clearly the regulation intends that change orders will be processed when there is a change in the scope of work and not processed merely to authorize additional labor-hours to complete a project, with the result of eliminating the variances from the cost system. Processing change orders leaves no way to easily identify projects where overruns occurred, making it difficult to review reasons for the overruns and develop trends in their occurrence, so that corrective actions can be taken. Furthermore, the Work Order Man-Hour Variance and Completed Work Order Cost Reports are formatted to display labor-hour variances, indicating that variances should be maintained in the system for management's review.

The two installations which document reasons for labor-hour differences do not analyze them to spot trends so that causes can be corrected. Base civil engineer officials at the three installations said that the Cost Limitation Comparison Report provides them daily information on projects exceeding estimates by 25 percent and that these projects are discussed at weekly meetings with base civil engineer management. However, the reasons for the overruns or corrective actions taken are not documented. The continuing occurrence of significant differences between planned and actual labor hours reflected on the reports we reviewed, indicate problems in planning and implementing projects that are not being solved.

#### Why management did not analyze variances

Base civil engineer officials at the three installations did not analyze differences between planned and actual staff-hours for several reasons. First, they believed the Cost Limitation Comparison Report provided continuous review of civil engineer projects, and this oversight allowed them to discuss and resolve problems as they occurred.

Another reason was that base level officials felt they had little or no control over what they perceived to be the causes of the overruns, such as inadequately trained airmen and planners. Civil engineer officials explained that many airmen sent to Travis were inadequately trained and required on-the-job training. Since the engineering performance standards used in planning civil engineer projects assume an

average journeyperson level of competence, labor-hour overruns occurred when it was necessary for the craftspersons to do the project as well as train new recruits.

Similarly, the grade level assigned to planners was too low to attract the most qualified individuals. Civil engineer officials believed that planners should be at a grade level equal to or higher than that of shop personnel and should preferably be recruited from highly trained shop personnel, so their plans would be of higher quality and more acceptable to shop personnel.

These officials could not document these reasons as causes of the labor-hour differences, but felt an objective analysis of variances would disclose them as primary causes. They believed these problems could best be handled at Air Force Command or Headquarters rather than at base level and that any recommendation requiring them to analyze such variances indepth should also include a requirement for periodic Air Force analysis of the findings at base level. For those problems not controllable by base officials, Air Force Command or Headquarters officials should be required to initiate corrective action.

The Air Force's Civil Engineering Resources and Work Force Management Regulation, which was revised in September 1978, deemphasized the importance of analyzing staff-hour differences. The current regulation provides no guidance for following up such variances or a mechanism to track and categorize reasons for them. The previous regulation, although not requiring such a mechanism, did state that during the work order closing process, the work plan programmer should pay particular attention to the Completed Work Order Cost Report and, especially, labor-hour differences. It stated that although variances on only one work order are not in themselves significant, a trend of continuing variances indicates a need for appropriate management actions.

## CONCLUSIONS

Air Force civil engineer base officials need to more effectively use the variance data produced by their cost accounting system in order to increase managerial control over personnel resources, and provide more accurate and reliable schedules of projects to be accomplished. This should aid in reducing the large and growing backlog of Air Force civil engineer projects.

To do this, the officials should carry out systematic indepth analyses of significant differences between planned and actual labor hours and take action to correct the problems. The reasons for the differences should be categorized



and summarized, for example, by planners and by shops, so that trends can be identified. Base officials should be made responsible for either initiating corrective action or documenting why none was taken. Headquarters civil engineer officials should be made responsible for periodically reviewing results of the base level analyses to determine if there are Air Force-wide problems, and should either initiate corrective action or document why none was taken.

### RECOMMENDATIONS

We recommend that the Secretary of Defense instruct the Secretary of the Air Force to:

- Revise civil engineering regulations to require base level civil engineer officials to systematically analyze labor-hour variances and take corrective action.
- Clarify the regulations to preclude change orders being processed merely to eliminate labor-hour variances from cost reports.
- Require Air Force Headquarters civil engineer officials to periodically review results of base level labor-hour variance analyses to determine if there are Air Force-wide problems and to take appropriate corrective action.

## CHAPTER 3

### SCOPE OF REVIEW

We reviewed management use of Air Force Civil Engineer Cost Accounting System reports and evaluated data on staff-hour variances at Travis Air Force Base, Fairfield, California; and McClellan and Mather Air Force Bases, Sacramento, California.

We reviewed Department of Defense Instructions and Air Force Manuals and Regulations, performed test checks, traced transaction flows, and performed other audit routines as necessary to accomplish our objectives. We also interviewed Department of Defense and Air Force Headquarters and base officials to discuss policies, procedures, and related matters.

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