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BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Significant Savings Possible Through More Efficient Depot Maintenance Of Army Combat Vehicles

For years, the Congress has expressed concern about the low productivity level and increasing maintenance costs at Defense depots. GAO reviewed operations at three Army combat vehicle depots in the continental United States-- Red River, Anniston, and Letterkenny-- and one in Mainz, West Germany, and found that productivity could be improved and maintenance costs could be reduced if the Army

- operated its three U.S. depots as efficiently as the one in Mainz,
- overhauled vehicles only when needed based on mileage and vehicle condition, and
- eliminated work at the depot level that could be accomplished at a lower level.

The Army also needs to establish realistic wartime requirements and match these with the facilities, equipment, repair parts, and staff needed.



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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

IN REPLY
REFER TO:

B-199281

To the President of the Senate and the
Speaker of the House of Representatives

This report discusses the effectiveness of the Army's mobilization planning for depot maintenance, ways to improve current Army procedures for determining depot maintenance peacetime requirements, and actions the Army should take to make its combat vehicle depots more productive.

We initiated this review to determine whether productivity at Army depots could be increased and whether maintenance costs could be reduced. This review is an important aspect of our continuing efforts to recommend logistics management improvements in the Department of Defense.

We are sending copies of this report to the Director of the Office of Management and Budget and the Secretaries of Defense and the Army.


Comptroller General
of the United States



D I G E S T

During fiscal year 1979, the Army spent about \$688 million on depot maintenance in the continental United States and in Europe, of which about \$263 million was spent to overhaul and repair combat vehicles and associated components at three depots in the United States--Red River, Anniston, and Letterkenny--and one in Mainz, West Germany. For several years, various congressional committees have expressed concern about the low level of productivity and increasing maintenance costs at Army and other Defense depots. (See ch. 1.)

DEPOT MOBILIZATION PLANNING

Effective depot mobilization planning requires reasonably accurate projections of wartime requirements and identification of resources needed--facilities, equipment, repair parts, and skilled people.

The Army has not done sufficient depot mobilization planning to accomplish the above objective. In the case of the Mainz Depot, the Army did not fully consider the probability of depot survival and Mainz's ability to hire and retain people in wartime. Other improvements could be made if the Army implemented the recommendations made by GAO in this report. (See ch. 2.)

DETERMINING PEACETIME
DEPOT MAINTENANCE REQUIREMENTS

If combat vehicle depots are to be efficient and effective in peacetime, there have to be procedures to ensure that costly depot maintenance resources are used only to satisfy legitimate requirements.

Current Army procedures do not ensure that depot resources are used in the most cost-effective manner possible. Consequently, opportunities to reduce maintenance costs are being lost. This situation has resulted, in part, because:

--Current overhaul selection criteria which are based on accumulated mileage do not adequately consider actual vehicle condition. In addition:

1. Reported mileage data are inaccurate.
2. Some low-mileage vehicles, in good condition, are inducted into depots for overhaul simply because they are to be reassigned to front-line units.

--Depot resources are used to perform maintenance work which should have been done below the depot level.

The Army has recognized the imprecise nature of its current overhaul selection criteria and is replacing them with a program based on condition, commonly referred to as reliability centered maintenance. Staff shortages have delayed implementation of the program. However, the Army has initiated actions, in response to GAO's preliminary findings to prevent the overhaul of low-mileage vehicles that are in good condition. (See ch. 3.)

DEPOT MAINTENANCE OPERATIONS

The Army could realize cost savings in overhauling and maintaining combat vehicles if its three U.S. depots were operated as efficiently as its Mainz Depot. The U.S. depots require more labor hours and longer time frames for similar overhaul or repair work than Mainz. Productivity at the three depots could be increased and sizable cost savings realized if (1) problems related to estimating labor requirements and work methods were alleviated and (2) the work measurement systems, including labor

standards and work methods were fully implemented. Problems noted include:

- Good estimating techniques, based on reliable work measurement data, are not used to identify and control labor requirements for combat vehicle overhauls and repairs. Instead, the depots use historical averages of prior work which perpetuate the mistakes and inefficiencies of prior estimates.
- The methods and standards program, which is the key to workloading and effective production control, lacks management emphasis, quality, and quantity.
- The labor and production reporting system does not contain reliable data for making decisions and analyzing variances between actual and expected results. Questionable rework and nonproductive time charges contribute to this lack of reliable data.
- Work methods emphasize overhaul rather than less costly repairs of major vehicle assemblies. (See ch. 4.)

RECOMMENDATIONS

In the area of mobilization planning, GAO recommends that the Secretary of Defense direct the Army to:

- Determine total combat vehicle maintenance requirements for Europe and the quantities to be satisfied by the Mainz Army Depot and other maintenance sources. The survivability of the Mainz Depot should be determined and its ability to hire and retain people also should be considered. If the survivability and hiring and retention problems cannot be overcome, other options should be identified for accomplishing European wartime maintenance and requirements.
- Establish more realistic wartime maintenance workloads for combat vehicle depots in the United States by (1) using

supportable labor standards, (2) reducing the work scope of equipment repairs, and (3) determining a better basis for wartime usage rates for secondary items.

- Determine contractor potential for doing more combat vehicle depot maintenance work so that the Army can effectively match requirements with available resources.
- Identify the extent of repair parts shortages and make sure the impact of such shortages on depot maintenance capacities and capabilities is appropriately considered in mobilization planning.

The following recommendations are made in the context of the Army's continuing efforts to improve its depot maintenance requirements determination procedures. The Secretary of Defense should direct the Army to:

- Discontinue the practice of selecting combat vehicles for overhaul on the basis of accumulated mileage.
- Periodically monitor and evaluate the progress made in implementing the reliability centered maintenance program for combat vehicles.
- Identify and assign work to the appropriate maintenance level so as to maintain expertise and capability at all maintenance levels. If this were done, below-depot units would have less incentive to pass work to the depots.

To improve the productivity of Army depots, the Secretary of Defense should direct the Army to:

- Estimate labor requirements on the basis of valid labor standards rather than on fixed prices or historical averages.
- Fully implement an effective work measurement system at U.S. depots, including improving work methods, labor standards, and staffing and monitoring implementation of the system.

- Require system discipline and integrity to overcome existing inadequacies and errors in the U.S. depots' and Mainz's present management information systems. Particular attention should be paid to accurately identifying and monitoring rework and nonproductive time and analyzing variances between actual and desired results.
- Initiate a formal information exchange of work methods and practices between the U.S. depots and Mainz and make the most cost-effective practices the standards for all depots to follow.
- Discontinue the practice of routinely overhauling vehicles and major assemblies at U.S. depots without prior inspection to determine if the condition of the vehicles or assemblies actually warrants such overhaul.

AGENCY COMMENTS

In a May 12, 1980, letter, GAO asked the Secretary of Defense to comment on this report within 30 days. Because written comments were not received within the time requested, GAO is issuing this report without Defense's comments. However, GAO met with Office of the Secretary of Defense and Army officials to obtain their oral comments, which have been included in this report where appropriate.

Defense and Army officials concurred with all the conclusions and recommendations contained in the report, except for a recommendation concerning identifying potential contractor sources in the United States. Army officials stated that, on an overall basis, the amount of work accomplished by contractor sources is sufficient to satisfy Defense guidance. While the Army does meet the minimum goals set forth by Defense guidance for contract work in peacetime, the amount of work contractors could do in wartime has yet to be fully explored. Such action is necessary to ensure that Army depot maintenance capacity in peacetime is restricted to the minimum essential to meet mobilization needs.

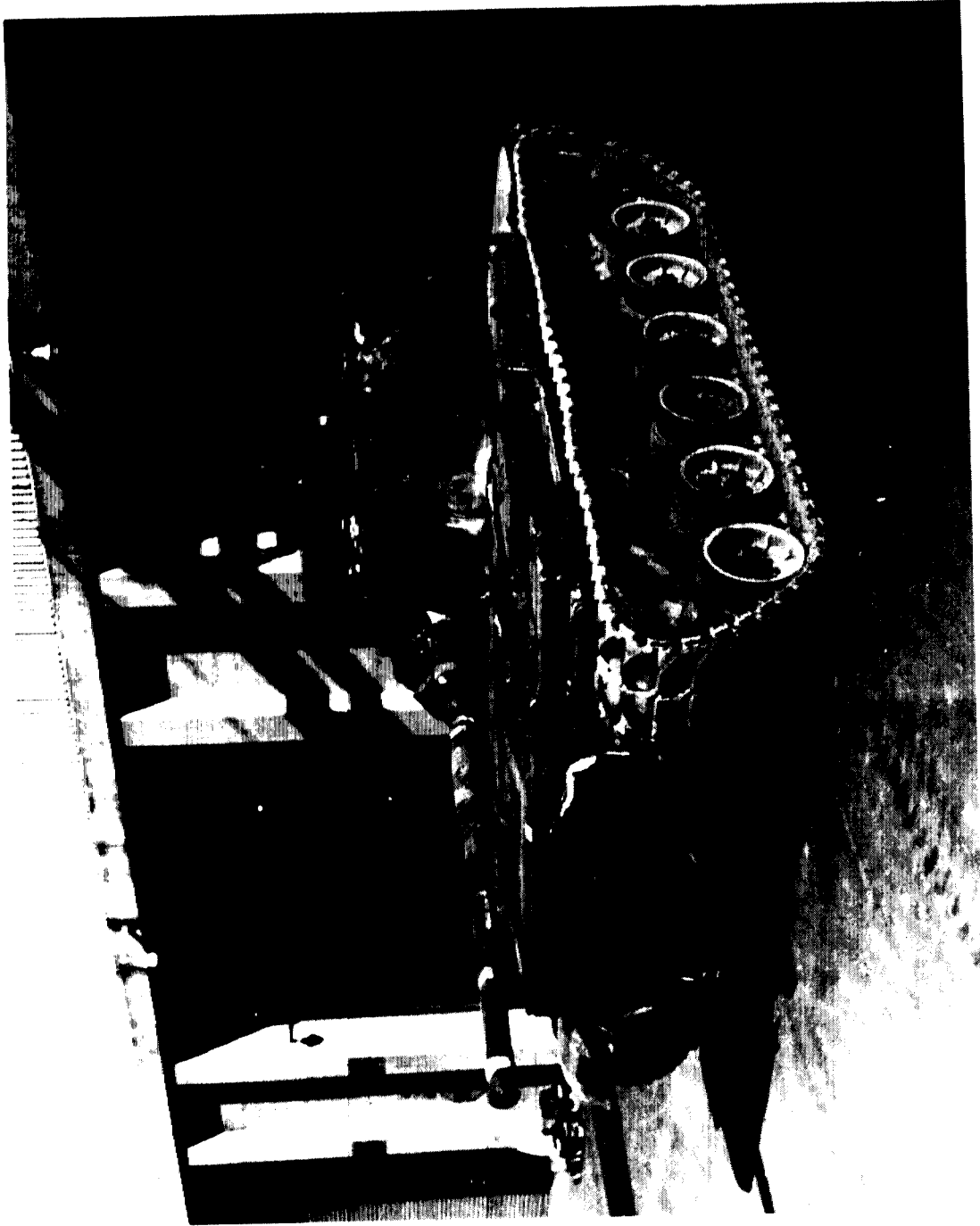


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ABBREVIATIONS

ARRCOM	U.S. Army Armaments Materiel Readiness Command
CONUS	continental United States
DARCOM	U.S. Army Materiel Development and Readiness Command
DESCOM	U.S. Army Depot System Command
DIMES	Defense Integrated Management Engineering System
GAO	General Accounting Office
LMI	Logistics Management Institute
MIS-Q	Management Information System-Quality
RCM	reliability centered maintenance
TARCOM	U.S. Army Tank-Automotive Materiel Readiness Command
USAREUR	U.S. Army, Europe



M-60A1 TANK BEFORE RECEIVING DEPOT-LEVEL MAINTENANCE.

SOURCE: U. S. ARMY



CHAPTER 1

INTRODUCTION

Keeping Army combat vehicles up-to-date and combat ready requires large funding and extensive maintenance, ranging from simple servicing to major overhauls and conversions. For several years, various congressional committees have expressed concern about the low level of productivity and increasing maintenance costs at Army and other Defense depots.

A sizable maintenance cost in the Army is that associated with combat vehicle depot maintenance. During fiscal year 1979, the Army spent about \$688 million on depot maintenance in the continental United States (CONUS) and in Europe, of which about \$263 million, or about 38 percent, was spent to overhaul combat vehicles and associated components.

LEVELS OF MAINTENANCE

The Army has four levels of combat vehicle maintenance--organizational, direct, general, and depot. Day-to-day maintenance is performed at the organizational level and encompasses minor adjustments to readily accessible mechanical/electrical systems and replacement or alinement of easily accessible parts. Direct support maintenance involves diagnosis and isolation of equipment malfunctions and replacement of defective components, such as engines, transmissions, and compressors. General support maintenance activities back up designated direct support units and do such work as diagnosis and isolation of equipment malfunctions, repairs of defective components, and heavy body repair. Organizational and direct support maintenance is normally done by military personnel; general support maintenance may be done either by civilian or military personnel. Funding for all below-depot maintenance is provided by the operating forces.

The Army's worldwide depot-level maintenance program is under the operation and management responsibility of the U.S. Army Materiel Development and Readiness Command (DARCOM). The command's responsibilities include overhauling end-items and components, repairing items that exceed the capability and capacity of lower level maintenance organizations, and applying product improvements to fielded material. Maintenance performed at this level generally supports the supply system by restoring unserviceable assets to prescribed levels of serviceability and modernizing serviceable assets. Depot-level maintenance for combat vehicles is done at three Army depots in the United States--Anniston, Red River, and Letterkenny--and one in Mainz, West Germany. All depot work for

combat vehicles is performed by a civilian work force-- Federal civilians in CONUS and contract employees at Mainz. 1/ During fiscal year 1979, this work force amounted to about 7,400 white and blue collar employees.

MAINTENANCE WORKLOAD FORECASTING AND SCHEDULING

Determining combat vehicle depot workloads includes four major steps:

- The combat vehicle forces to be supported are determined. This includes specifying the quantities and types of vehicles projected to be needed to meet specified force levels.
- The gross work requirements of the specified combat vehicle force levels are calculated, using maintenance policies, such as accumulated mileage between overhauls and modernization needs.
- After determining the types and quantities of combat vehicles to be overhauled, modified, or converted, maintenance requirements are matched with available resources. Financed requirements are allocated between contractors and Army depots. 2/ Unfinanced requirements, sometimes referred to as unfinanced backlog, are carried forward to the next funding period.
- A production plan and budget which reflect both financed and unfinanced requirements are developed. The plan includes (1) assigning workloads by type of vehicle to depots designated to be the "prime" facility for that type and (2) calculating the total cost of the production plan and resulting depot maintenance budget.

The Office of the Deputy Chief of Staff of the Army for Operations determines the forces to be supported and DARCOM and the appropriate readiness commands determine the types of vehicles needed.

Under DARCOM, the U.S. Army Tank-Automotive Materiel Readiness Command (TARCOM) and the U.S. Army Armaments

1/Limited depot-level maintenance work is also performed by some civilian contractors in the United States.

2/Work at the Mainz Army Depot is considered contract work.

Materiel Readiness Command (ARRCOM) determine the number of vehicles which will undergo depot maintenance. ^{1/} The commands also have inventory management responsibility for all supply support for combat vehicles.

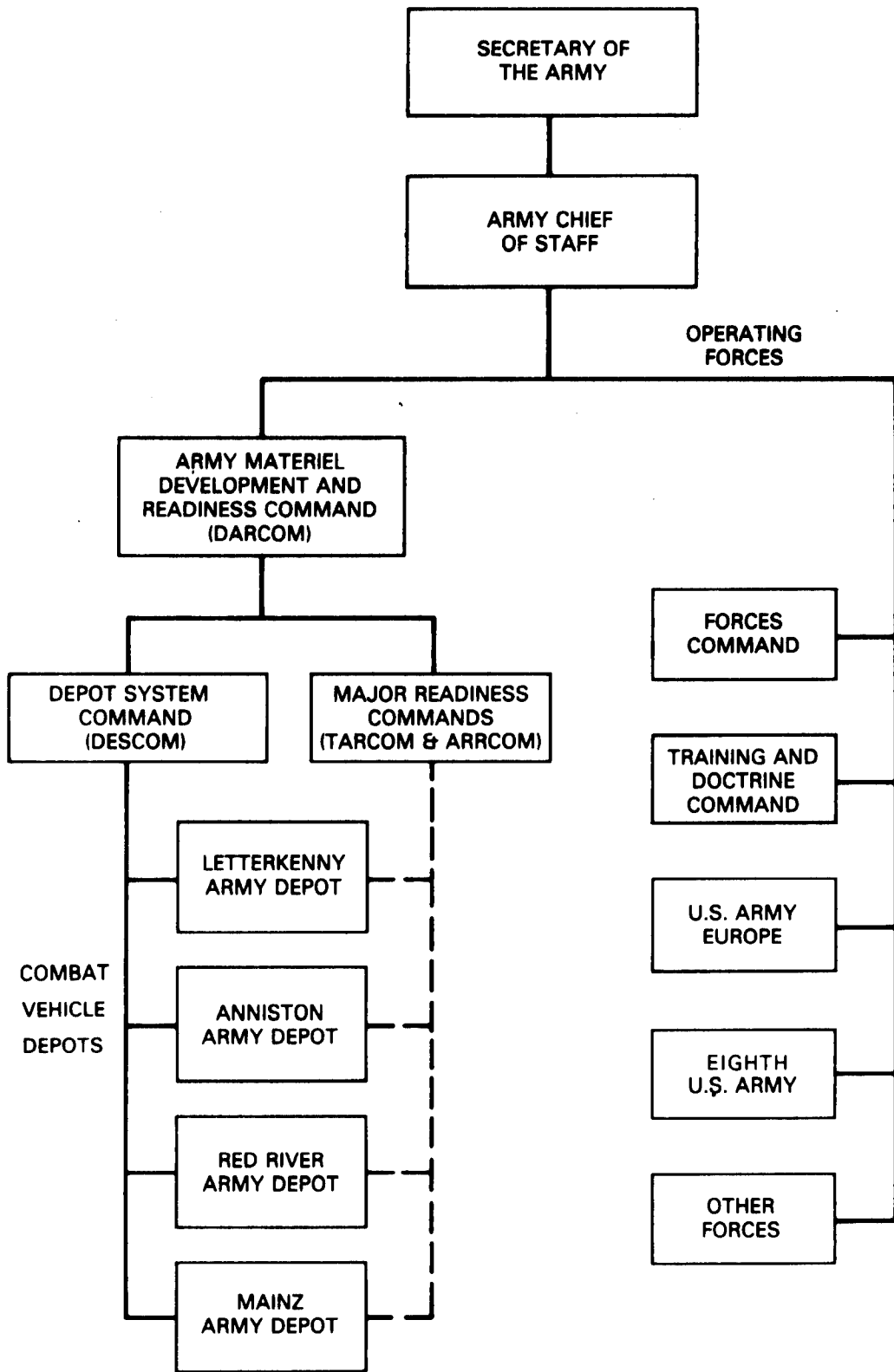
The U.S. Army Depot System Command (DESCOM) controls most, but not all, depot maintenance funds and assigns work to the depots. The chart on page 4 shows the organizational alinements.

SCOPE OF REVIEW

We reviewed Army policies, procedures, and practices for providing combat vehicle maintenance in the United States and Europe during peacetime and Army planning for similar work during wartime. We contacted officials at the Mainz and Letterkenny Army Depots as well as Army Audit Agency officials to obtain information regarding combat vehicle maintenance practices.

We conducted our work primarily at TARCOM, Warren, Michigan; DESCOM Chambersburg, Pennsylvania; and the Letterkenny and Mainz Army Depots, Chambersburg, Pennsylvania, and Mainz, West Germany, respectively. We also performed limited work at Headquarters, U.S. Army, the Pentagon; DARCOM, Alexandria, Virginia; Headquarters, U.S. Army, Europe, Heidelberg, West Germany; the Theater Army Materiel Management Center, Zweibruecken, West Germany; and the Germersheim Reserve Storage Activity, Germersheim, West Germany.

^{1/}The Theater Army Material Management Center has this responsibility in Europe.



CHAPTER 2

MOBILIZATION PLANNING: IMPROVEMENTS ARE

UNDERWAY BUT MORE NEEDS TO BE DONE

The objective of depot maintenance mobilization planning is to provide a plan which will assure that sufficient industrial resources exist to effectively support wartime operations. An effective plan requires reasonably accurate projections of wartime requirements and identification of resources needed--facilities, equipment, repair parts, and skilled people--to meet those requirements. Resources not available commercially or within the Department of Defense become needs under Defense procurement and modernization programs and require future expenditures.

The Army has not done sufficient depot maintenance mobilization planning to accomplish the above objective. Combat vehicle maintenance mobilization planning for Europe and CONUS depots could be improved if

- wartime requirements which are to be satisfied in Europe were determined and quantified,
- Army assumptions regarding the Mainz Army Depot's ability to meet assumed mobilization requirements recognized major constraints,
- the Army used more credible data and assumptions to estimate CONUS combat vehicle depot maintenance mobilization workloads, and
- available sources which could be used to satisfy CONUS mobilization requirements were fully considered.

The Army has recognized some of the above problems and has begun to improve its mobilization planning but it needs to do more.

COMBAT VEHICLE MAINTENANCE MOBILIZATION PLANNING IN EUROPE NEEDS IMPROVEMENT

Reasonably accurate predictions of combat vehicle maintenance requirements for the "most demanding" war scenario and identification of how much maintenance capacity and capability is needed to satisfy such predictions are critical in determining total combat vehicle depot maintenance needs. The Army currently considers an intense war scenario of short duration in Europe as most demanding. Therefore, it is

important that wartime maintenance requirements for combat vehicles in Europe be accurately identified and the role and capability of the Mainz Army Depot or other facilities to meet such requirements be clearly defined.

As detailed in the sections below, the Army has not yet determined numerical wartime maintenance requirements for Mainz, alternative maintenance sources, such as host nation support facilities, or the amount of work to be retrograded to CONUS depots, if any. Furthermore, the Army's assumptions regarding Mainz's ability to do more work in wartime than it currently performs in peacetime may not be realistic because of work force hiring and retention problems.

Maintenance requirements for Mainz have not been determined or quantified

Determining total wartime maintenance workloads is the first step in developing Mainz wartime requirements. Detailed analyses of probable workloads under modern warfare and available logistics support capabilities (depot and below-depot) should form the basis for decisions about specific maintenance resources needed (i.e., facilities, equipment, and skilled people). We found that although analyses of this nature were in process, the types and quantities of vehicles which will require maintenance at Mainz or at other depots had not been established.

The Army assumes that all projected below-depot maintenance requirements which cannot be accomplished at that level will be satisfied by the Mainz Army Depot, but Mainz may have difficulty in meeting this extra workload. On the basis of previous Army assessments of the current and projected capability of below-depot maintenance units in Europe and preliminary data developed by the Army on expected combat vehicle damage, operational failure rates, and vehicle recovery and evacuation rates, the amount of additional work Mainz will have to do is considerable. Therefore, Army mobilization planners believe that Mainz capacities and capabilities will be critical to satisfying total Army maintenance needs in Europe.

Is the Mainz Army Depot able to meet its assumed mobilization requirements?

According to Army officials, once the assumption was made that Mainz was needed to support Army wartime requirements in Europe, a mobilization plan which defined how the depot was to satisfy these requirements was developed. Several of the assumptions used in the plan may not be realistic because

(1) there are questions regarding the survivability of the Mainz Depot and (2) the depot may not be able to retain its peacetime work force in wartime or hire additional laborers to increase to a two- or three-shift operation.

Mobilization planning assumptions

To assist Mainz in developing its mobilization plan, DARCOM developed the following assumptions to support wartime requirements in Europe:

- Sufficient quantities of unserviceable assets would be available to use total plant capacity on a 24-hours-per-day, 7-days-per-week basis.
- Plant capacity would not be increased over that capacity available on mobilization day.
- Mainz would screen items before accepting them to assure induction of items that could most rapidly be repaired.
- The local labor force would be able to accommodate demands generated by mobilization losses and increased requirements.
- Mainz would initially transition from depot repair/overhaul standards to below-depot standards. The depot role would revert from below-depot level repair to overhaul when the in-theater, below-depot support base was fully operational.

Retention of current work force during wartime is questionable

The Mainz Army Depot's mobilization plan assumed that the depot would, at a minimum, retain current work force strengths during mobilization. It is doubtful that Mainz will be able to do this because (1) a large percentage of the contractor work force is subject to the draft by the German Army, (2) third country nationals working at the depot may not be willing to work during hostilities, and (3) all U.S. and local national civilians who are military dependents will be evacuated from the combat area.

Army officials state that, under West German laws, physically capable men between the ages of 18 and 65 are eligible for the West German military draft. At Mainz, about 78 percent of the current 2,617 contractor personnel fall into this category. Mainz has recognized the limitation in retaining

these people and is applying for exemptions of contractor employees from the West German Army draft.

Army officials also state that, pursuant to German law, exemptions for German citizens working for the U.S. Government may be granted by local German "county recruitment offices" on an individual case basis. Since petitioning for individual exemptions is a time consuming process and there is no assurance that such exemptions will be granted, U.S. Army, Europe (USAREUR), is testing the process in Zweibruecken, West Germany. If the test is successful, USAREUR will start processing the remaining locations in Germany, including Mainz. Once initial exemptions are granted, Mainz will continually update the files to obtain exemptions for newly hired personnel.

As the exemptions do not expressly apply to third country nationals--about 16 percent of the depot's work force fall into this category--USAREUR is also requesting exemptions for these individuals. We were told the results of the test in Zweibruecken would indicate whether the West German Government would consider third country national exemptions. West Germany told USAREUR officials that it could not and would not draft third country nationals. West Germany also said that third country nationals could not be forced to remain in West Germany or to continue working during hostilities.

According to a USAREUR official, another factor affecting the depot's ability to retain its work force in wartime is the U.S. evacuation policy relating to civilians. Under the current policy, the lives of U.S. or West German civilians cannot be jeopardized. The USAREUR official said that if the combat area moved westward, Mainz would be situated in the rear area combat zone, and under these circumstances, the depot would have to allow all U.S. and local national civilians who are military dependents to evacuate from the area.

Hiring additional employees
may not be feasible

During mobilization, Mainz has estimated that it will require 4,310 contractor personnel for a two-shift (16 hours) operation. This is an increase of 1,744 from its peacetime authorizations. It may not be feasible to hire additional employees because West German emergency legislation, which becomes effective upon declaration of military vigilance (a form of military alert), prohibits employers from firing employees and employees from resigning their jobs or transferring to other jobs. Moreover, individuals hired after

declaration of military vigilance would be subject to the German draft and would not be exempted.

Depot officials have not projected how long it will take to employ workers for a two-shift operation, but they estimate that at least 120 days after mobilization will be required. They assume that local nationals fleeing from forward areas could be hired at Mainz.

A USAREUR official told us that after declaration of military vigilance, no further exemptions from the West German military draft would be requested. He said USAREUR would only request exemptions for those local nationals employed in peacetime. Consequently, it could be expected that the West German Government would draft some of those individuals which Mainz hired after declaration of military vigilance.

In addition, upon declaration of military vigilance, all men between the ages of 18 and 65 and women between 18 and 45 are to remain at their jobs unless drafted by the German military. While this law provides assurance that Mainz can retain some of its work force during war, it could also hinder Mainz from hiring additional workers from other nearby plants.

Survivability of the Mainz Depot

Critical to depot maintenance mobilization planning for Europe is the survivability of the Mainz Army Depot. If the Army expects Mainz to survive a war in Europe, then it should make plans for accomplishing projected wartime workloads at the depot. If the Army does not expect the depot to survive, then it needs to develop plans to identify alternate sources of maintenance capability, such as using host nation contractors or retrograding work to CONUS depots.

We found that the Army has yet to determine the survivability of the Mainz Depot. Several Army officials have expressed concern that Mainz may not be able to survive during hostilities since it is (1) a prime target for enemy forces, (2) subject to internal sabotage, (3) too close to the rear combat zone, and (4) not mobile.

In developing the depot mobilization plan, Mainz officials recognized the depot's vulnerability to enemy forces and requested additional protective forces during wartime. North Atlantic Treaty Organization policy is that the tenant forces are to provide such protection, however, no U.S. ground forces have been made available. In lieu thereof, the Mainz Commander received authorization to post a company of civilian labor guards around the perimeter of the depot.

According to USAREUR officials, even with that security in place, it is doubtful that key Army logistics installations in the rear combat zone such as Mainz would be defensible against such varied enemy threats as internal sabotage, commando raids, and air attacks.

Another consideration is that Mainz is not mobile. We were told that the plant was a fixed operation and equipment could not be moved to safe areas if necessary.

Since serious doubts exist about the survivability of Mainz during wartime, we asked Army officials whether they had planned for alternate maintenance sources, such as using host nation contractors, host nation military facilities, and CONUS depots. We were told that they had not but some thought was being given for doing so.

MOBILIZATION PLANNING FOR CONUS DEPOTS

While mobilization planning for combat vehicle maintenance in Europe revolves around trying to satisfy wartime maintenance needs within the theater of operations, planning for CONUS combat vehicle maintenance depots revolves around (1) providing maintenance support to deploying units and (2) repairing all unserviceable assets located in CONUS facilities as quickly as possible to support the war effort in Europe. Generally, these two functions represent the mobilization workload CONUS depots are expected to satisfy during the initial phases of a war. Workloads which exceed Army organic depot maintenance capability will be considered for interservice and commercial contract sources.

The Army addressed all of the above matters in its 1978 depot maintenance mobilization plan. However, as noted in the following sections, we found that the plan was based on questionable procedures, and assumptions which distorted wartime depot maintenance workloads and available commercial sources had not been adequately considered.

Are mobilization requirements for combat vehicle depots reasonable?

As in the case of Mainz, reasonably accurate depot maintenance mobilization requirements--expressed in terms of labor hours--are necessary to determine how much combat vehicle depot maintenance capability and capacity needs to be retained during peacetime.

The Army is well aware of the need for determining valid wartime requirements for its combat vehicle depots. The Army did develop requirements as part of its 1978 depot maintenance

mobilization plan. We found that these requirements were questionable because:

- Overstated peacetime labor standards were used to project wartime labor hour requirements.
- The scope of repair work was not reduced as required by DARCOM guidance.
- Requirements for secondary items were computed based, in part, on unsupported assumptions.

Approved plan

The 1978 depot maintenance mobilization plan includes mobilization requirements for major and secondary items for the first 6 months of a conflict. Total maintenance requirements for CONUS combat vehicle depots amounted to about 14.9 million labor hours. Mobilization requirements in this plan primarily consist of (1) repairing, on an accelerated basis, all unserviceable equipment on hand in the CONUS depots or going to the depots at the outbreak of the conflict, (2) repairing or overhauling serviceable equipment currently in the hands of deploying combat or combat support units, and (3) repairing unserviceable assets which will be generated by deploying units. The plan does not include requirements in support of U.S. allies, other services, and returns from the theater of operations. We were told that requirements in support of allies and other services were not computed unless there was an ongoing maintenance program for these customers during the planning period. If that were the case, Army planners assumed that the wartime requirement would equal the peacetime requirement. Since there was no peacetime program for foreign customer combat vehicles during fiscal year 1978 (the planning period), the wartime requirement was assumed to be zero. Requirements associated with returns from the theater of operations were also determined to be zero because Army planners assumed that the time to return combat vehicles to CONUS depots, repair them, and then reship them to the battlefield would exceed the projected duration of the conflict.

Assumed relation between peacetime and mobilization overstates labor hour requirements

Critical to the determination of labor hours needed to support mobilization requirements are valid direct labor standards for doing the assigned work. Overstated or understated labor standards will result in corresponding overstated or understated maintenance workloads, and ultimately, excessive or insufficient personnel requirements.

DESCOM has the responsibility of converting gross requirements provided to it by the Army's major readiness commands into depot workloads (expressed in labor hours). To do this for the requirements identified in the 1978 mobilization plan, DESCOM used existing peacetime labor standards provided to it by the depots. Labor standards submitted were not validated for their reasonableness.

Analyses we conducted on the validity of CONUS depot labor standards used showed that the standards contained a substantial amount of unproductive time--ranging between 15 and 50 percent--and were substantially higher than those reported at Mainz for overhauling the same piece of equipment. For example, the standard for an M-578 combat recovery vehicle at Letterkenny in 1979 was 1,502 labor hours compared to 795 labor hours at Mainz--a 47-percent difference. Similar differences were also evident for component repairs. Problems with the CONUS depots' labor standards programs are discussed in detail in chapter 4.

The following example illustrates the impact of overstating peacetime labor standards. The 1978 mobilization plan projects that the mobilization workload for a self-propelled howitzer is the current CONUS peacetime labor standard of 2,626 labor hours for overhauling that piece of equipment times an expected workload of 109 howitzers. If the Mainz overhaul standard of 2,050 labor hours was used, the mobilization workload for CONUS depots would decrease by 62,784 labor hours ($2,626 - 2,050 = 576$ labor hours \times 109 howitzers).

Work scope not reduced

Labor hours assigned to the repair of depot maintenance mobilization requirements did not take into account that the scope of repair work should be reduced during wartime. One of the assumptions provided to DESCOM by Army mobilization planners was that the work scope would be reduced as much as possible, provided it did not affect the operation and safety of equipment; that is, painting, body repairs, and replacing appearance items would not be done. Time savings amounting to as much as 50 percent could be generated if, for example, pieces of equipment were repaired to "inspect and repair as necessary" rather than overhauled. The former procedures are scheduled to be used at Mainz for the first few months of a war.

Army mobilization planners could not explain why the work scope had not been reduced as planned. One planner commented that one reason may have been that the amount of non-critical work on Army equipment had not yet been quantified

by the depots. Although most planners agreed that some allowance should be made for reducing the work scope during wartime, they were uncertain about how large such an allowance should be.

Wartime usage rates for secondary items are questionable

According to existing Army criteria, items, such as engines, transmissions, and recoil mechanisms which are currently overhauled or repaired at combat vehicle depots, are considered secondary items. About 28 percent of the Army's combat vehicle mobilization requirements fall into this category.

Mobilization requirements for these items are computed by means of an elaborate process which considers such factors as expected combat usage and the amount of equipment available when war breaks out. One of the key factors which determines the combat usage of an item is the "X-factor." This factor translates the average peacetime usage rate into an expected wartime usage rate. For combat vehicle items, the value of the X-factor ranged from 2.0 for engines and transmissions to 10.0 for recoil mechanisms; that is, during wartime, these items are expected to be used from 2 to 10 times more frequently than in peacetime.

The X-factor has a sizable impact on mobilization requirements, but the Army has no reasonable basis for values assigned to this factor. No historical data or scientific studies are available which could be used to support the X-factor value. We were told that in place of such information the values assigned are based on best judgment and could not be validated.

In response to our prior report commenting on the X-factor, 1/ Army officials agreed that a better basis for the factor needed to be established. They noted that two pilot projects 2/ were underway which would accomplish this for two weapons systems. Work on other systems is to follow provided

1/"Army Plans to Modernize the Rock Island Arsenal May Be Inappropriate" (LCD-79-418, June 6, 1979).

2/The two projects are called "SPARC" (Sustainability Predictions for Repair Part Requirements for Combat) and "PRECOMP" (Prediction of Contingency Maintenance and Parts Requirements).

that appropriately trained personnel and sufficient funds are available.

Determination of resource needs

Once wartime depot maintenance workloads have been quantified, additional analyses are needed to identify sources of maintenance capacity and resources. Capabilities of the two basic sources of maintenance capacity--commercial contractors and Defense depots--need to be assessed to determine how much work could and should be handled by each source.

Contractor support potential not determined

The Army has not identified how much contractor support would be available in the United States during mobilization. Therefore, the Army is uncertain as to how much work private industry can do, and as a result, it cannot be certain about the amount of organic 1/ resources required.

According to various Government directives, 2/ the Army is to rely on private industry for depot maintenance services unless exclusions have been authorized by a higher authority. According to Department of Defense Directive 4151.1, organic depot maintenance capacity will be planned to accomplish no more than 70 percent of the gross mission-essential work in peacetime. The remainder--about 30 percent--is to be done by contract. Defense views organic maintenance as (1) a controlled source of competence, (2) an assurance of initial surge capability, and (3) a base for expansion. Contractors are to provide a broader maintenance base capable of expanding in wartime.

In fiscal year 1979, contractors did about 38 percent of the peacetime Army combat vehicle depot maintenance. Of this total, about 11 percent was accomplished by contractors in CONUS and the remainder by contractors in Europe.

As discussed on page 5, the Army has not identified depot maintenance mobilization requirements for Europe. Requirements to be accomplished by CONUS contractors amount to about

1/Organic depot maintenance is done by a military department using Government owned or controlled facilities and military or Federal civilian personnel.

2/Applicable directives include Office of Management and Budget Circular A-76, Army Regulation 235-5, and Department of Defense Directive 4151.1.

4 percent of CONUS maintenance mobilization requirements. Basically, contractors will do the same work they are doing in peacetime, which is repairing/overhauling M-88 tank recovery vehicles.

In prior reports, we emphasized the need for the Army to identify private industry's capacity and capability to meet mobilization requirements. A June 6, 1979, report on Army arsenals 1/ pointed out inadequacies in the Army's mobilization planning with private industry. Army officials concurred with our findings and initiated actions to identify private industry's capacity and capability to satisfy the arsenals' mobilization requirements. Such actions are essential if capacity planning for Army maintenance facilities is restricted to the minimum essential to mobilization requirements.

Organic capability

One portion of the depot maintenance mobilization plan required the depots to determine how much of the workload assigned to them by DESCOM could be satisfied within established time frames. The combat vehicle depots projected that they could satisfy all the assigned workloads.

We did not evaluate these projections because at the time of our review the Army Audit Agency was reviewing mobilization planning at the CONUS depots. Preliminary information the Army Audit Agency provided us showed that (1) a substantial portion of workload assigned to the depots could not be accommodated in the first 6 months after mobilization and (2) assigned workloads did not take into account when the material was needed by units going to the theater of operation. Such shortcomings may increase the need for alternate maintenance sources, such as contractors and other Defense depots. As previously mentioned, the Army plans to make only minimal use of these sources.

Another potential problem affecting organic capability is the validity of Army assumptions regarding the availability of repair parts needed to support wartime requirements. In the 1978 depot maintenance mobilization plan, the Army assumed that repair parts to support 180 days of programmed peacetime workloads would be on hand at the time of mobilization. However, our analysis showed that only about 90 days of parts are available. Further, we were told that the leadtimes for

1/"Army Plans to Modernize the Rock Island Arsenal May Be Inappropriate" (LCD-74-418).

obtaining essential repair parts from producers exceeded 6 months. Additionally, repair parts requirements for equipment having primarily a wartime mission, such as the M-551 armored reconnaissance vehicle and the M-48 tank, were not established.

CONCLUSIONS

Maintenance depots capable of repairing complex combat vehicles are necessary for national defense. They are required to ensure that sufficient industrial capacity and capability exists to meet mobilization needs. To determine what capacity and capability is needed and where it is needed, the Army must have reasonable estimates of combat vehicle maintenance workloads for both Europe and CONUS and match these workloads with private industry and organic capacities and capabilities.

In Europe, the Army has placed considerable reliance on the Mainz Army Depot for combat vehicle maintenance during wartime, but it has not determined the probability of the depot's survival. The Army believes that sufficient workloads will materialize to require the depot to go to multishift operations, but it has not determined definitive workloads. Efforts are underway to quantify these expected workloads. Even if sufficient workloads materialize, it is doubtful that the depot could go to multishift operations because there is no assurance that it could retain its current work force or hire additional laborers during wartime. Also, in-theater or other options for accomplishing maintenance work which cannot be done at Mainz have not yet been identified.

Regarding mobilization planning for CONUS combat vehicle depots, the Army's depot maintenance mobilization plan outlined a methodology to be used to determine gross mobilization requirements and how and where these requirements were to be satisfied. The assumptions, data, and procedures used to translate these requirements into specific workloads may be questionable because they were based on overstated labor and repair standards and otherwise lacked foundation, thereby reducing their credibility as a basis for planning.

The Army has not determined contractor potential for accomplishing combat vehicle depot maintenance. Further, it has made no assessment of the impact of repair parts shortages on the capability of organic depots. Until the Army makes such determinations, it cannot effectively match requirements with resources or realistically determine to what extent its organic facilities are needed.

RECOMMENDATIONS

We recommend that the Secretary of Defense direct the Army to:

- Determine total combat vehicle maintenance requirements for Europe and the quantities to be satisfied by the Mainz Army Depot and other maintenance sources. The survivability of the Mainz Depot should be determined and its ability to hire and retain people also should be considered. If the survivability and hiring and retention problems cannot be overcome, other options should be identified for accomplishing European wartime maintenance requirements.
- Establish more realistic wartime maintenance workloads for combat vehicle depots in the United States by (1) using supportable labor standards, (2) reducing the work scope of equipment repairs, and (3) determining a better basis for wartime usage rates for secondary items.
- Determine contractor potential for doing more combat vehicle depot maintenance work so that the Army can effectively match requirements with available resources.
- Identify the extent of repair parts shortages and make sure that the impact of such shortages on depot maintenance capacities and capabilities is appropriately considered in mobilization planning.

CHAPTER 3

DETERMINING PEACETIME DEPOT MAINTENANCE REQUIREMENTS

The Army's procedures for determining peacetime depot maintenance requirements for combat vehicles do not ensure that depot resources are used in the most cost-effective manner possible. Consequently, opportunities to reduce maintenance costs are being lost. This situation has resulted, in part, because overhaul selection criteria do not adequately consider actual vehicle condition, some vehicles are overhauled unnecessarily, and work is accepted by depots which should be accomplished at a lower level.

The Army has recognized the imprecise nature of its current overhaul selection criteria and has started a program to replace them with one based on definitive condition criteria. Staff shortages, however, have delayed implementation of the program. However, the Army has initiated actions, in response to our preliminary findings, to preclude the overhaul of low-mileage vehicles in good condition.

SELECTING COMBAT VEHICLES FOR DEPOT OVERHAUL: PROBLEMS AND PROPOSED SOLUTIONS

Under present criteria, combat vehicles which have accumulated a designated number of miles since new or their last overhaul are routinely considered for depot maintenance. Historically, the Army, as well as industry, generally has recognized vehicle mileage or operating hours as a basis for establishing maintenance intervals. But while an indicator of use or wear, accumulated vehicle mileage or operating hours alone do not show actual vehicle condition and type of usage, and frequently mileage is inaccurate. As a result, some vehicle overhauls may have been unnecessary.

To improve vehicle selection and to avoid unnecessary overhauls, the Army is implementing a program referred to as reliability centered maintenance. When this program is implemented, vehicles will be selected for overhaul based on condition evaluation criteria rather than accumulated mileage since their last overhaul. Although potential benefits are substantial and risks appear small, the Army has been slow in staffing the program.

Mileage is not a desirable basis for selecting overhaul candidates

At present, accumulated mileage is one of the primary bases used for determining the number of combat vehicles

requiring depot overhaul in both the United States and Europe. However, mileage may not be the best available criterion because it does not indicate vehicle condition or its remaining useful life. Moreover, mileage data used to identify overhaul candidates are often suspect. In many cases, we found that vehicles inducted into the depots showed mileage in excess of established criteria but were still in good condition. On the other hand, some vehicles with low mileage were in deplorable condition.

To illustrate, during fiscal year 1979, the Mainz Army Depot overhauled 488 U.S. M-113A1 armored personnel carriers. Of these, 77 percent had more miles than the current 6,500-mile criterion. The following examples show vehicles with recorded mileage in excess of the established 6,500-mile overhaul criterion.

<u>U.S. Army No.</u>	<u>Mileage</u>	<u>No. of miles over criterion</u>
12-D-85069	11,582	5,082
12-C-48268	10,984	4,484
12-B-59368	9,484	2,984
12-E-35269	9,209	2,709
12-D-58364	8,916	2,416
12-A-45970	8,775	2,275

Mainz production personnel told us that many of the vehicles whose mileage exceeded the established criterion were in good condition, while others which had accumulated less mileage were in deplorable condition. According to production personnel, mileage is not the principal factor in vehicle condition. Their experience shows that the condition of a vehicle is influenced most by the quality of the below-depot level maintenance which has been done and the care with which the vehicle is operated.

Similar conclusions also were reached in an ongoing pilot program for M-60A1 tanks conducted by TARCOM. Under this program, military units in CONUS were required to perform a technical inspection of M-60A1 vehicles which had accumulated at least 5,000 miles since new or their last overhaul (6,000 miles is the current criterion for M-60A1 tanks). Disregarding actual mileage as a deciding factor, TARCOM personnel reviewed inspection reports to determine whether the

actual condition of these vehicles indicated the need for depot overhaul. Program results as of October 1979 showed the following:

<u>M-60A1 pilot program status report</u>	<u>No. of vehicles</u>
Vehicles inspected	260
TARCOM evaluations completed	254
Vehicles selected for overhaul	68
Vehicles not selected for overhaul	186
TARCOM evaluations in process	6

The above status report indicates that only 68, or about 27 percent, of all the tanks evaluated were in a condition which required overhaul.

Inaccurate mileage data

Vehicle mileage reports which Army managers use for making their overhaul decisions are often inaccurate. Officials in both Europe and CONUS depots concede that mileage reports are inaccurate.

Generally, mileage reports are prepared from logbooks which are the official records of vehicle mileage. In some cases, logbooks are missing and odometer readings or estimates are used to report mileage. As shown below, there are differences between the mileage readings shown in logbooks and odometer readings for vehicles overhauled at two depots.

<u>Vehicle</u>	<u>U.S. Army No.</u>	<u>Logbook mileage</u>	<u>Odometer mileage</u>
<u>Mainz</u>			
M-60A1	9-B-6889	6,472	24
M-60A1	9-B-6670	3,164	164
M-60A1	9-B-5609	4,219	978
M-60A1	9-B-6601	5,657	4,152
M-60A1	9-B-6651	5,832	1,892
M-60A1	9-B-1236	4,114	1,216
<u>Letterkenny</u>			
M-109	9-B-8662	5,219	2,411
M-109	12-A-48166	4,937	3,492
M-109	12-A-54266	3,951	1,417
M-109	12-A-48366	3,503	3,167

Army officials stated that these examples are not unique. On the basis of their experience, mileage entries in logbooks are frequently invalid because field units fail to record entries as required and do not attempt to reconcile differences between logbook entries and odometer readings.

Another reason for inaccurate data is that odometer readings are also unreliable. Analyses conducted at Mainz and Letterkenny showed that this lack of reliability was due to (1) odometers subtracting mileage when vehicles operate in reverse, (2) broken odometers not being repaired or replaced, and (3) replaced odometers not accounting for actual mileage. For example, on 5 of 16 vehicles we tested at Letterkenny, the odometer was broken or replaced and reset before the vehicle was shipped to the depot for maintenance.

Unnecessary overhaul of low-mileage vehicles

The Army does not always use accumulated mileage to determine combat vehicle depot overhaul requirements. For example, in fiscal year 1979 USAREUR determined that some M-60A1 tanks with bulldozer blades which became excess to front-line units required overhaul because they were being

transferred to other front-line units as replacements. According to USAREUR officials, a vehicle receiving less than condition "A" overhaul (like new) is unacceptable to front-line units. We were told "conventional wisdom" dictates that repairing the vehicles would be unacceptable since repair only brings a vehicle to condition "B" (serviceable but not like new).

We found that 22 of the 30 M-60A1 tanks with bulldozer blades overhauled in fiscal year 1979 had less than the 5,000-mile criterion. A number of these had very low mileage, and some had been overhauled about 1-1/2 years earlier.

<u>U.S. Army No.</u>	<u>Serial No.</u>	<u>Date received for overhaul</u>	<u>Mileage</u>	<u>Last overhaul at Mainz</u>	<u>Months since last overhaul</u>
9-B-5562	2214	1-30-79	757	8-17-77	17
9-B-7462	3195	1-17-79	1,198	9-27-77	16
9-B-6799	2595	7-25-78	1,616	3-24-75	40
9-B-6692	2473	1-11-79	1,662	None	-
9-B-7467	3289	9-14-78	1,674	9-22-75	36
9-B-7565	3449	1-4-79	1,838	8-19-77	17
9-B-7460	3280	9-11-78	1,842	2-3-76	31
9-B-6633	2422	9-11-78	1,867	2-5-76	31
9-B-6599	2411	9-11-78	2,016	1-15-76	32
9-B-6914	2709	9-14-78	2,540	9-24-73	60

According to an August 8, 1979, memorandum for the record, Mainz staff questioned the need for overhauling tanks with low mileage and suggested that the vehicles be classified as repair candidates. Although USAREUR officials were aware of the depot's concerns, they directed the depot to overhaul all the vehicles without regard to mileage since they believed the vehicles were in poor condition. However, the tanks were not inspected before overhaul to verify that the condition of these vehicles warranted a complete overhaul. Extra costs may have been incurred to overhaul rather than to repair tanks. On the basis of fiscal year 1979 data, the average cost to repair M-60A1 tanks at Mainz was about \$51,000, or 40 percent less than overhaul costs of about \$84,000.

Mainz plans to overhaul 14 M-60A1 tanks with bulldozer blades during fiscal year 1980. USAREUR and Mainz officials did not have mileage data to support the need to overhaul these vehicles but informed us that they would use the same rationale they used in fiscal year 1979.

In an October 29, 1979, letter to the Secretary of the Army, we questioned the Army's decision to overhaul vehicles without regard to condition or mileage. Accordingly, we suggested that the Army defer the fiscal year 1980 program until it had inspected each vehicle in the program to determine if and to what extent it required maintenance. We estimated that

savings amounting to about \$500,000 could be realized if the 14 tanks in the fiscal year 1980 program were repaired rather than overhauled. (See app. I.)

In its January 9, 1980, reply, the Army agreed to verify the condition of each tank in the fiscal year 1980 program to ensure that the tanks were actual depot overhaul candidates rather than candidates for maintenance less than overhaul. (See app. II.)

In February 1980 the Army, referring to our review findings, formally notified its major readiness commands and all its combat vehicle depots that (1) accumulated mileage was to be used only for management planning and budgetary purposes and (2) the extent of depot maintenance would be based solely on condition verified by technical inspection. Furthermore, the Army reemphasized that the depots were responsible for determining the scope and magnitude of repair necessary to restore an item to a serviceable condition. We believe that these actions, if properly followed, should prevent future overhaul of vehicles with low mileage and in good condition.

Selecting overhaul candidates
based on condition--reliability
centered maintenance

Selecting vehicles for overhaul on the basis of their condition is a concept developed as part of an innovative maintenance philosophy generally referred to as reliability centered maintenance (RCM). When applied, RCM replaces routinely scheduled maintenance with only that maintenance determined necessary to retain vehicle safety and reliability. Maintenance programs for Army aircraft based on reliability analysis were initiated in 1973. The Army states that since that time, annual aircraft overhauls have been reduced by 50 percent. Savings due to the reduction in overhauls were estimated to amount to about \$47 million annually in 1975 and 1976. 1/

On the basis of successful application of RCM to aircraft programs, the Army decided in 1976 to expand it to combat vehicles. As part of this effort, the Army directed TARCOM to evaluate the feasibility of selecting combat vehicles for depot overhaul based on an assessment of vehicle condition. Following a study in 1977, TARCOM concluded that even though a number of risks were associated with implementing

1/A portion of the total savings was also attributed to reduced flying hours.

on-condition selection of combat vehicles for depot maintenance " * * * it is believed intuitively that selecting overhaul candidates because of their condition rather than because they have accumulated a prescribed mileage must result in a better system * * *." Risks cited include the following:

- On-condition selection may not generate overhaul candidates in sufficient quantities to maintain depot work forces adequate for mobilization. However, as discussed in chapter 2, existing depot forces may exceed wartime needs.
- Fewer combat vehicles may be overhauled with a consequent raising of the average age or mileage of the combat vehicle fleet. The impact of this situation on field maintenance costs and on the combat readiness of field forces is unknown.
- Vehicle evaluation guides to be used in assessing vehicle condition may be inadequate. Although these guides are to be used by March 1980, they have not yet been tested. TARCOM officials stated that the Army's desire for immediate implementation did not give the command sufficient time for testing.

TARCOM has not met established milestones for implementing on-condition selection of combat vehicle overhaul candidates. A lack of both civilian and military personnel to adequately staff the program has been the major factor contributing to the delay.

TARCOM estimated that 20 civilian and 6 military personnel would be needed to implement the on-condition selection process. Although the 26 positions were authorized, only about 20 percent of these positions had been filled as of January 1980.

After our audit work, TARCOM informed us that (1) on January 20, 1980, it awarded a contract that provided for 16 evaluators to implement the program, (2) the six military personnel assigned to the program had been trained, and (3) candidate vehicles had been selected and evaluations were to begin at Forts Hood and Bliss on March 17, 1980.

DEPOT RESOURCES ARE USED TO DO BELOW-DEPOT MAINTENANCE

Contrary to the Army maintenance concept of performing maintenance work at the lowest possible level, the Army is currently performing many tasks at combat vehicle depots which

could be performed at lower levels--direct support and general support levels. As a result, many USAREUR general support units do not repair combat vehicles and are not becoming familiar with equipment they would have to repair in war. Factors contributing to this shift of below-depot work to the depot level are (1) USAREUR's current funding arrangements which encourage field units to pass work to the depot and (2) a lack of capability and capacity at the direct support and general support levels.

Results of a 1978 study conducted at the Mainz Army Depot showed that major assemblies, such as engines and transmissions, overhauled at the depot level could have been inspected and repaired at a lower level. This type of workload represented about 28 percent of the fiscal year 1979 workload at Mainz.

During the period August 15 through November 15, 1978, Mainz inspected all major assemblies received from the V Corps. The results of this limited inspection program, summarized below, showed that most assemblies could be repaired at general support or direct support units, and that some assemblies are turned in with no defects. Only 13 of the 474 assemblies inspected during the period required repairs which only a depot is authorized to perform.

**SCHEDULE SUMMARIZING MAINZ MAINTENANCE OBSERVATIONS
FOR ALL V CORPS DIRECT EXCHANGE COMPONENTS/ENGINES
AUGUST 15 - NOVEMBER 15, 1978**

ASSEMBLY TYPE	TOTAL OBSERVED	MAINTENANCE SCRAP	LEVEL AT WHICH DEFECTIVE PARTS COULD HAVE BEEN REPLACED ACCORDING TO TECHNICAL MANUAL (NOTE A)				
			DEPOT	GENERAL SUPPORT	DIRECT SUPPORT	NO DEFECT (NOTE B)	NOT SHOWN
ENGINE 6V53	155			141	4	10	
ENGINE 6V53T	7			7			
ENGINE 8V71T	47			47			
ENGINE V8-300	7			7			
ENGINE AVSI 1790-6A	14			13	1		
TRANSMISSION TX 100-1	23			22		1	
TRANSMISSION CD 860-6A	37		13	17	3	4	
TRANSMISSION XTG 250-1A	2			2			
TRANSMISSION XTG 411-2A	10			8		1	1
TRANSFER TYPE M113	61	12		48	1		
TRANSFER TYPE M548	23	11		12			
TRANSFER FOR TRANSMISSION XTG411-2A	11			10		1	
TRANSMISSION XT 1410-2	2			1	1		
FINAL DRIVE M80	41				11		
OUTPUT REDUCTION M88	8				8		
DIFFERENTIAL DS 200	26			26			
TOTAL	474	23	13	361	59	17	1

A/ THE TECHNICAL MANUAL FOR EACH ITEM WAS USED TO DETERMINE WHAT LEVEL OF MAINTENANCE IS AUTHORIZED TO REPLACE THE DEFECTIVE PART.

B/ COMPONENTS WERE TESTED AND FOUND TO HAVE NO SIGNIFICANT DEFECT.

According to Mainz and USAREUR officials, combat vehicle assemblies are sent directly from direct support units to Mainz rather than being sent to general support maintenance units. Three reasons were given for this practice:

- USAREUR's general support units are responsible for tactical (wheeled) vehicle repair and do not have sufficient additional capacity to handle a significant combat vehicle assembly workload.
- General support units cannot determine what is wrong with an assembly because they lack adequate test stands and diagnostic equipment.
- General support units do not have the skills and equipment needed to make repairs which, according to technical manuals, can be performed at the general support level.

Letterkenny Army Depot officials also believe that some of the work now being done by the depot, such as repair of major vehicle assemblies and inspection and repair of vehicles, could be accomplished at lower levels if these units were properly equipped and trained. About 15 percent of Letterkenny's fiscal year 1979 workload fell into this category. According to Letterkenny officials, below-depot units lack the facilities, trained personnel, and time to do more difficult maintenance tasks. Further, personnel turnover and the time required to do routine maintenance also were cited as contributing factors.

A June 1979 study conducted by the Logistics Management Institute (LMI) entitled "Combat and Tactical Vehicle Maintenance by the Army" reported on the lack of capability at the general support maintenance level. It found that only one of eight general support maintenance companies in Europe was exposed to combat vehicle end-items and none was supporting major assemblies and components. LMI estimated that it would take months of intensive maintenance training for general support units to perform up to par.

LMI attributed some of this lack of combat vehicle repair capability to the current funding procedures which encourage units to pass work to the depot. Under current funding, repairs performed by general support units are paid for by mission funds. However, if vehicles are centrally overhauled or repaired at a depot, depot maintenance funds are used.

LMI concluded that, as a result, general support units were unprepared for war because they were not receiving the necessary training to perform in the traditional general

support role of supporting the theater supply system. Also, the units were not operating in a "support forward" environment under a "repair-and-return-to-user" concept. USAREUR officials agreed that the current practice of letting combat vehicle work migrate up to the depot level was inappropriate and that it affected the readiness of the general support units to perform their wartime mission. USAREUR officials contended that a recently initiated program to have soldiers repair combat vehicles will provide some general support units realistic training in carrying out their wartime support forward mission.

CONCLUSIONS

Vehicle mileage is an imprecise and unreliable indicator of the need for overhauling combat vehicles. Reliance on mileage as a criterion for overhaul is resulting in some vehicles being overhauled even though an assessment of vehicle condition indicates complete overhaul may not be required. This situation could be remedied if the Army fully implements the RCM program. Under this program, combat vehicles will be selected based on their condition rather than on accumulated mileage since their last overhaul. However, the Army is slow in implementing the program.

The Army has been sending low-mileage vehicles which are in reasonably good condition to Mainz for overhaul simply because they are to be reassigned to front-line units. Contrary to Army regulations, these vehicles were not inspected to determine whether overhaul was really necessary. Unless such determinations are made, the Army may be incurring added cost to overhaul vehicles whose condition and mileage warrant only limited repairs. The Army agrees and has initiated actions to overcome this shortcoming.

Depot resources are being used to perform maintenance work which should more appropriately have been done below the depot maintenance level. In the case of Mainz, about 28 percent of its workload should have been done below depot. With the exception of some assembly repairs, conscious decisions were made for Mainz to perform lower level maintenance. Factors which contributed to this were a lack of capability and capacity by direct and general support units and current funding arrangements in Europe. As a result, many general support units in Europe do not repair combat vehicles and are not becoming familiar with equipment they would have to repair in wartime.

RECOMMENDATIONS

We recommend that the Secretary of Defense direct the Army to:

- Discontinue the practice of selecting combat vehicles for overhaul on the basis of accumulated mileage.
- Periodically monitor and evaluate the progress made in implementing the RCM program for combat vehicles.
- Identify and assign work to the appropriate maintenance level so as to maintain expertise and capability at all maintenance levels. If this were done, below-depot units would have less incentive to pass work to the depots.

CHAPTER 4

OPPORTUNITIES EXIST FOR IMPROVING WORK MANAGEMENT AT COMBAT VEHICLE DEPOTS

The Army could realize sizable cost savings in overhauling and maintaining combat vehicles if its CONUS depots were operated as efficiently and effectively as its Mainz Army Depot. CONUS depots require more labor hours and longer time frames for similar repair or overhaul work than Mainz. Furthermore, labor hour usage for similar overhauls and repair work is increasing at CONUS depots and decreasing at Mainz.

The basic objectives of the Army's maintenance policies are to do only those tasks which are necessary and to do them in a timely and efficient manner. To be efficient and effective, the Army needs a sound maintenance management process which (1) identifies and defines depot workloads, (2) provides for efficient workload execution, (3) analyzes variances between actual results and established standards and takes corrective action where appropriate, and (4) updates management information system data files to reflect only valid labor charges.

Although Mainz could improve its operations in some areas, we found that, for the most part, Mainz's systems and practices meet the above objectives. However, CONUS depot systems and practices need further improvements in areas related to (1) estimating labor requirements, (2) work measurement, including methods and labor standards and labor and production reporting, and (3) work methods.

ESTIMATING LABOR REQUIREMENTS

We believe, and the Army recognizes, that a good estimate of labor requirements for overhauling combat vehicles should reasonably approximate the amount of labor that should be expended on an overhaul. Good estimates will preclude underusing a depot, overscheduling it, and overcharging a customer for actual work performed. Unreliable estimates can result in escalating labor repair requirements and further increases in future estimates.

To arrive at a reasonably reliable estimate, depots should have:

- Reliable determinations of the scope and quality of the work to be performed.
- Reliable historical data of actual labor requirements for similar work with the same scope and quality requirements.
- Job labor standards and reliable reports on current problems or conditions at a depot which would modify historical data.

According to Letterkenny officials, it is quite difficult for a depot to develop reliable estimates of work content or expected cost because the volume and depth of work vary even for the same type and model of a vehicle. Moreover, detailed work requirements are not actually known until a system or piece of equipment is actually disassembled.

The task of estimating requirements is even more difficult because the CONUS depots' work measurement system needs improvements to provide adequate information to make realistic workload estimates. (See pp. 33 to 43 for a discussion of work measurement problems.) The Army recognized the need for a more precise means to accomplish these tasks, and in 1975, proposed the use of work measurement data under a concept referred to as "single standards" to identify how much time it should take to complete a specific task or overhaul. Also, reasons for not meeting the single standard, such as lack of skilled people, lack of repair parts, and lower than expected labor productivity, were to be identified under this concept. Although the Army has implemented the single standards concept for supply functions, it has not yet done so for maintenance functions. This delay appears to be primarily due to a lack of reliable work measurement data in the depot maintenance area.

Lacking definitive, predictive, and reliable work measurement data, CONUS depots use historical averages of previous work experience as the basis for production planning and recovery of overhaul and repair costs, whereas production planning at Mainz is based on reliable labor standards and accurate management information system data. Historical averages used at CONUS depots are expressed in terms of total costs incurred and are known as fixed prices.

Letterkenny officials advised us that they charge their customers for work performed on the basis of fiscal year 1977 fixed prices. According to these officials, the 1977 fixed prices were based on labor and material standards in existence at that time. Since then, however, fixed prices have not been based on standards; instead they are derived from the

1977 fixed prices adjusted by annual cost growth factors (inflation plus factors for net operating result adjustments) provided by DESCOM. ^{1/} The annual inflation factors and the historical averages do not correspond to increases in labor hours, labor costs, and materiel requirements. Furthermore, we found that increased labor costs are offset by reductions to other costs, such as materiel. These arbitrary adjustments distort the various overhaul cost elements and make estimates of labor requirements meaningless.

The fixed-price method does not provide CONUS Army managers with valid data on requirements and costs to do a specific job. Instead, it tends to perpetuate prior estimating deficiencies and results in a tendency for actual labor hours used to approximate the estimates. On the other hand, in Europe, where reasonably valid labor standards are used to help determine the annual workload for Mainz, management does have the information necessary to estimate labor requirements in a reasonably accurate manner. Experience shows that the labor hours required to overhaul combat vehicles and engines of the same type are not only higher, in most cases, for CONUS depots than for Mainz, but furthermore, labor hours are increasing at CONUS depots and decreasing at Mainz.

This information is illustrated by the following table which compares fiscal years 1977 and 1979 labor hours expended on the overhaul of selected equipments.

^{1/}DESCOM officials informed us that about 50 percent of the maintenance workload was covered by fixed prices. They stated that the remainder was covered by single standards.

Fiscal year	Type of equipment overhauled	Average staffhours per overhaul		Difference	
		CONUS	Mainz	Hours	Percent
1979	M-109 howitzer	2,758	a/1,968	790	40.1
	M-60A1 tank	b/2,428	a/2,241	187	8.3
	8V71T engine	159	a/130	29	22.3
1977	M-109 howitzer	2,622	1,994	628	31.5
	M-60A1 tank	b/2,391	2,421	-30	-1.2
	8V71T engine	146	142	4	2.8

a/Figures based on data through Mar. 1979.

b/DESCOM data. Data submitted by the Anniston Army Depot after our review showed 2,292 staffhours for FY 1979 and 2,229 staffhours for FY 1977. We did not validate these numbers.

Not only are labor hours for the overhaul of most major pieces of equipment substantially lower at Mainz than at CONUS depots, but labor hours for like overhaul and repair tasks generally are also lower at Mainz. The following table compares fiscal year 1979 labor hours for selected tasks applicable to the M-109A1 vehicle.

Task	Fiscal year 1979 standard hours per task		Difference	
	CONUS	Mainz	Hours	Percent
Final hull assembly	136	105	31	29.5
M-145 telescope mount	81	31	50	161.3
Final drive	27	8	19	237.5
M-15 quadrant	15	18	-3	-16.7
Recondition M-117 telescope	37	30	7	23.3

Besides requiring more labor hours than Mainz to complete a maintenance program, CONUS depots require more calendar days (flow time) for vehicle "turnaround," as shown in the following table.

<u>Type of vehicle</u>	<u>Flow times in days</u>		<u>Percent difference</u>
	<u>CONUS depots</u>	<u>Mainz</u>	
M-109 howitzer	92	42	119
M-113A1 light vehicle	42	33	27
M-60A1 tank	60	41	46

We recognize that a distinction has not been made in the above tables between increases in CONUS depots' labor requirements caused by expanding work done and increases caused by lack of control over labor efficiency. Moreover, we did not consider the differences between the CONUS depots and Mainz in physical layout, facilities, equipment, percentage of depot capacity used, and accounting differences. While these factors may help explain some of the differences between the CONUS depots and Mainz for major pieces of equipment, they do not completely explain the different trends or the large difference for like tasks and flow days. To determine the other reasons for these differences, the depots need an effective management system which identifies the time it should take to do a job and how much it actually took for each task and each major piece of equipment. Such information is normally provided through an effective work measurement system.

WORK MEASUREMENT SYSTEM

The advantages of using a good work measurement system to control job costs have been recognized in both Government and industry for years. In 1965 the Department of Defense established the Defense Integrated Management Engineering System (DIMES) which required each Defense agency to establish a work measurement system to be used for developing budget estimates, staffing requirements, productivity indicators, and other management purposes.

Although DARCOM and DESCOM issued instructions to carry out the intent of DIMES, we found that of the Army's four combat vehicle depots, only Mainz was effectively using its work measurement system.

Two key elements are essential in a good work measurement system:

- Accurate labor standards which take into account properly developed work methods. These tell a manager how many labor hours a job should take and how much it should cost.

--A properly designed and integrated management information system which, among other things, tells a manager how much time a job actually took and how much it actually cost.

Methods and standards

Job design or work methods and labor standards are generally considered to be the heart of a work measurement system. These two techniques determine the best ways of making repairs through a logical sequence of tasks and establish criteria to measure how these tasks are carried out. Normally, a methods analysis is completed before standards are developed. To do otherwise would build gross inefficiencies of an existing job into the standards developed. However, judgment must be used in selecting appropriate jobs. For example, it would be uneconomical to spend money to optimally design jobs which are done infrequently. Therefore, as a rule, the job design effort is reserved for frequently done jobs which consume a large proportion of resources. Such jobs are often referred to as "high burner" jobs.

Labor standards predict the time required for an experienced person to complete a task or job at a normal pace in a predetermined sequence and manner, considering personal needs. Conceptually, labor standards provide workers with target goals so that they may measure their own productivity and strive for more efficiency and effectiveness. They also provide management criteria with which current operations may be evaluated and a basis from which the cost of future work may be estimated.

Methods and standards need to be constantly assessed and upgraded to assure the accuracy of the standards and to improve the efficiency of depot operations. At CONUS depots, we noted that

- management lacked commitment to a sound methods and standards program;
- a methods analysis had not been adequately emphasized; and
- labor standards were of questionable accuracy, were not used for negotiating workloads, and were not properly maintained and upgraded.

Management lacks commitment
to methods and standards

In a study of methods and standards programs in use at 11 Federal agencies, the Army Management Engineering Training Agency found that the success of an agency's methods and standards program largely depends on the support given to it by top management. Two key measures can be used to identify management's commitment to the methods and standards program:

--Progress in covering its employees with standards.

--The number of work measurement technicians assigned to the program.

Management at Mainz emphasizes labor standards coverage, and about 98 percent of depot maintenance personnel are covered by standards. On the other hand, management at DESCOM and the three CONUS depots do not place high priority on a sound methods and standards program. Progress in covering CONUS depot personnel with standards is slipping, as illustrated below:

<u>Fiscal year</u>	<u>Percent of authorized depot personnel covered by labor standards</u>
1975	60.2
1976	58.3
1977	59.7
1978	59.2
1979	56.5

The lack of emphasis on methods and standards at CONUS depots is further demonstrated by the decline in personnel available to maintain them. At Letterkenny, staffing declined from 22 in fiscal year 1971 to 8 in fiscal year 1979. The reduction of personnel at this depot is not unique. On the contrary, an overall decrease in methods and standards staffing has occurred at the CONUS depot complex, as shown in the following table:

<u>Fiscal year</u>	<u>No. of methods and standards personnel authorized</u>
1975	144
1976	136
1977	132
1978	121
1979	115

In addition, headquarters staffing for methods and standards is minimal. For example, in a recent report on Army labor requirements, 1/ we noted that Army headquarters had only one person assigned to work measurement. Army officials considered this insufficient to do an effective job monitoring Army efforts in methods and standards.

The situation at DESCOM is similar. One person is assigned to monitor and review the depots' methods and standards program. Officials stated that a minimum of two full-time industrial engineers or management analysts should be assigned.

Concomitant with the lack of management commitment on a sound methods and standards program has been a deemphasis on improving work methods and maintaining accurate labor standards. These areas, if properly emphasized as they are at Mainz, could result in substantial labor productivity improvements.

Management needs to emphasize
methods improvements

According to Army regulations, methods studies should be conducted before labor standards are established. However, in contrast to Mainz, Letterkenny has done little to implement these regulations.

A methods study is a critical analysis of how a job or work operation should be done. The analysis is then used to eliminate all unnecessary work and determine the best sequence and best methods for performing the job. Methods

1/"Improvements Needed in Army's Determination of Manpower Requirements for Support and Administrative Functions" (FPCD-79-32, May 21, 1979).

improvement studies ultimately provide greater efficiency and economy of resources.

Sizable savings can result from concentrated efforts to improve work methods. To illustrate, the Air Force's Sacramento depot documented savings of \$17.4 million between fiscal years 1974 and 1976. Among the Army depots, Corpus Christi attributed savings amounting to \$585,000 during fiscal year 1977 to methods improvements; Mainz reported first year savings of about \$400,000 in fiscal year 1979 and reductions of 8,250 direct labor hours.

Despite the significant potential, progress at Letterkenny in this area has been very slow. We found that only 22 methods improvement studies had been made between fiscal years 1975 and 1979. Of these, only two actually had been implemented. These two studies generated savings amounting to about \$71,800. When asked why the number of studies was so low, methods and standards officials commented that the primary reasons for not increasing the number of studies were a lack of resources and a low rate of acceptance of completed methods studies by the directorate for maintenance.

Labor standards

According to DARCOM Regulation 5-9, dated April 1978, standards coverage of productive direct labor is expected and attainable by using three categories of labor standards:

- Category I (engineered standards) is developed by various industrial engineering techniques, such as time studies and work sampling.
- Category II (estimated standards) is based on historical performance data or technical estimates.
- Category III (staffhour allowances) includes all other labor performance measurement techniques which do not qualify as either category I or II.

Category I standards are considered to be more reliable than category II standards for the same work, but are more costly to develop. Therefore, category I standards should be used for high-volume/high-cost work and those activities that are critical to the production process.

At Letterkenny, we noted the following on the accuracy, maintenance, and use of labor standards:

- Only about 16 percent of total maintenance production hours were covered by category I standards. This

compared to 23 percent for Red River, 32 percent for Anniston, and 78 percent for Mainz. Even the 16 percent-engineered coverage figure for Letterkenny is inflated because some of the engineered standards were adjusted upward to include inefficiencies of from 7 to 39 percent. As a result, the adjusted standards should no longer be termed engineered standards.

- Category II standards were not realistic. They had been inflated gradually to include avoidable delays and inefficiencies. We found that these standards were as much as 298 percent greater than the time prescribed by engineered standards previously used at Letterkenny for the same work.
- As previously discussed, standards for Letterkenny generally were higher than those at Mainz for the same tasks performed.
- Contrary to Army regulations which require that labor standards be established or validated by a qualified work measurement specialist, nonengineered standards were prepared and controlled by maintenance personnel. On-site assistance by the methods and standards branch was not provided.
- Labor standards usually were not used in the workload negotiation process as prescribed by DARCOM guidance. Instead, fixed prices based on historical data, which incorporated past inefficiencies and mistakes, were used to negotiate most depot workloads.

In its review of the Anniston Army Depot, the Army Audit Agency reported 1/ similar problems. It found that:

- The majority of standards were established based on estimates made by maintenance personnel rather than studies made by qualified work measurement specialists.
- Maintenance personnel changed established engineered standards without on-site validation by methods and standards personnel.
- Standards prepared by maintenance personnel were found to be overstated--some by as much as 97 percent--when standards were reestablished by qualified work measurement specialists.

1/"Draft Report of Audit Depot Maintenance Anniston Army Depot" (U.S. Army Audit Agency, SO 80-8, Oct. 1979).

In contrast to CONUS depots, Mainz makes extensive use of engineered standards to manage and control labor resources. Engineered coverage of maintenance staffhours was 78 percent, and standards were frequently checked to maintain their accuracy. Avoidable delays and inefficiencies were clearly identified, and attempts were made to minimize them. Furthermore, standards were used extensively in the contract negotiation process.

Mainz officials told us that the reason for this emphasis on labor standards was to develop a data base which would allow the Government to evaluate the contractor's performance. This evaluation is used to determine how much profit the contractor should be granted.

In discussing the results of our review, DESCOM officials concurred that there are problems with the CONUS depots' methods and standards program, but they stated that they initiated several actions to improve depot productivity and to reemphasize the depots' methods and standards program. One action is the DESCOM productivity improvement program which was started in October 1979. This program places priority on productivity/work methods improvement and increasing labor standards coverage. Another action taken is that depot commanders will be rated on the basis of productivity improvement performance and labor standards coverage. Officials cited other actions, such as including a proposal for increased staffing and organizational changes to the CONUS depots' methods and standards function.

Improvements are needed in combat vehicle depot management information system

A key to controlling labor requirements and improving combat vehicle depot productivity is an effective management information system which gives management the information needed to identify and correct problem areas. At CONUS depots, improvements are needed in labor and production reporting procedures and practices and in evaluating variances between standards and actual results. At Mainz, on the other hand, management constantly evaluates labor performance and variances and uses the results as the basis for the contractor's award fee, but there are errors in labor production reporting.

Labor and production reporting

The labor and production reporting system is to provide managers with information for analyzing and evaluating organizational performance and workload planning and control. Tests we made and those made by the Army Audit Agency of the system

at Letterkenny and other CONUS combat vehicle depots show that the system contains some inaccurate information on rework and nonproductive time charges.

Reporting of labor hours and production data at combat vehicle depots in CONUS and at Mainz generally originates with work center supervisors rather than with individual workers. These supervisors are responsible for the accuracy of the data submitted to cost accounting. We tested the accuracy of the data contained in the labor and production reporting system at Mainz for 50 randomly selected workers for a 2-day period. We compared labor charges reported to information obtained from interviews of the individuals at Mainz who had performed the maintenance tasks. We found that about 10 percent of the labor hours reported did not agree with the information obtained from the interviews. Reasons for these differences were (1) time was charged to only one item, although individuals worked on a variety of items, and (2) individuals claimed to have worked on different items than those reported.

At Letterkenny, we reviewed only current labor and production reporting procedures and found that the procedures did not assure accurate labor reporting. The current reporting method at the depot requires that a work center supervisor, without input from individual workers, accurately reports labor charges for all of his subordinates who work at different stations, on different jobs, and on several shifts. For example, at one work center the supervisor had to keep track of labor charges for 30 employees at five work stations on as many as seven different job orders for two shifts. Only 1 to 2 hours were used to accomplish this task. Work center supervisors use informal records, such as notebooks, to aid them in preparing labor and production reports.

In a 1979 report on labor reporting practices at Letterkenny, 1/ the Army Audit Agency took exception to these procedures. The report stated that the depot's labor reporting procedures permitted inaccurate labor reporting and made verification of labor transactions extremely difficult. To overcome the above deficiencies, the Army Audit Agency recommended, among other things, that (1) each employee, rather than the work center supervisor, prepare labor and production cards to record labor hours expended on individual job orders and functions and (2) the depot's Internal Review and Audit

1/U.S. Army Audit Agency Report (NE-79-212), Letterkenny Army Depot, Chambersburg, Pa., Aug. 1, 1979.

Compliance Division periodically verify the accuracy of reported labor hours.

Depot officials disagreed with these recommendations. They stated that having each employee prepare individual labor and production data would cause more errors, complicate existing audit trails, and increase training requirements. However, in November 1979, DESCOM directed the depots to start procedures to provide individual employee labor and production input and to use real-time audit techniques to assure accuracy.

Rework time not
reported accurately

Accurate reporting of rework time is necessary for management to know how effective maintenance operations are in terms of cost and quality of work. However, because of inadequate system discipline, inaccuracies exist in the reporting of rework time.

Two types of systems are used to report rework at CONUS depots. One is the labor and production reporting system which records time for (1) reworking production units which contain defects and which are rejected by supervisors or operating personnel and (2) reworking units rejected by quality control inspectors. The other is the Management Information System-Quality (MIS-Q) report which is used to report to DESCOM rework time only for units rejected by quality control inspectors.

On the basis of the above procedures, rework time recorded in the production reporting system should exceed the rework time recorded in the MIS-Q report. However, rework times we obtained for 12 work centers for a 6-month time period (May-Nov. 1979) showed that in 8 work centers, rework hours shown in the MIS-Q report exceeded the time recorded in the labor and production reporting system. This is illustrated in the table on the following page.

<u>Work center</u>	<u>Rework hours reported by labor and production report</u>	<u>MIS-Q</u>	<u>Difference between MIS-Q and labor and production report</u>
5A137	77.0	103.0	26.0
5A147	72.0	90.7	18.7
5A161	199.0	152.8	-46.2
5A430	310.0	482.0	172.0
5C111	179.0	163.2	-15.8
5C118	894.0	1,415.5	521.5
5C119	12.8	299.2	286.4
5C128	-	385.1	385.1
5C130	2,732.0	705.5	-2,026.5
5C310	570.0	699.9	129.9
5C350	4.0	83.8	79.8
5C361	2,213.0	627.2	-1,585.8

Reported indirect and nonproductive time is questionable

The validity of direct labor time charges at Army depots depends to a large extent on the accuracy of indirect labor time charges and the proper recording of all nonproductive time. For CONUS depots, indirect labor and nonproductive time charges were questionable. For example, a 1978 DARCOM review of the accuracy of direct labor charges at Letterkenny noted that unavoidable delays were recorded as direct rather than indirect labor time. According to the report, this was done to keep indirect labor charges to a minimum. DARCOM recommended that this practice be stopped and unavoidable delays be recorded as indirect time. Further, evidence of incorrect time charges can be found through work sampling (ratio-delay) studies conducted by the Letterkenny methods and standards division and the Army Audit Agency at Letterkenny and Anniston in 1977 and 1979, respectively. These studies reported that about 39 percent of the work force at Letterkenny and 29 percent of the work force at Anniston were not used in a productive capacity, although according to depot reports, they were almost 100 percent productively used.

We were informed at the completion of our review that DESCOM had directed the depots to enforce existing procedures and establish controls to assure timely and accurate reporting.

Variance analysis

A variance analysis enables management to determine the effectiveness of depot operations by comparing actual performance to desired results (standards). Corrective action should

be taken when there is a sizable difference between current performance and desired results.

At CONUS depots, the primary tool for determining labor effectiveness is the depot's monthly labor performance effectiveness report for each work center. Labor performance effectiveness in this report is determined by dividing standard hours by actual hours. ^{1/} At Letterkenny, a production effectiveness rate between 80 to 120 percent for a work center is acceptable. Rates falling outside this range are to be analyzed to determine the reason(s) for the variance. While this procedure was generally followed, the general lack of reliable labor standards and accurate data made the results of existing variance analyses meaningless.

In contrast, comparing actual accomplishments to standards to determine work performance is more meaningful at Mainz. As previously discussed, the depot's labor standards are reliable and labor hour reporting is reasonably accurate.

We found that generally, Mainz did a credible job tracking work performance and analyzed large variances from the 100 percent labor efficiency goal for each work center. Variances are studied and appropriate corrective action is taken if, during 1 month, deviations of plus or minus 25 percent occur, or if over a 3-month period, deviations of plus or minus 15 percent occur. In the repair assembly area, however, we noted that the depot's procedures resulted in overstated labor efficiencies. Currently, Mainz uses actual repair labor hours and compares them with labor hour standards for overhauling the assembly to determine labor efficiency. Making such comparisons results in overstated labor efficiency levels and distortions in reported work performance levels, because actual hours to repair an assembly should be less than the standard for overhauling the assembly. For example, during the first quarter of fiscal year 1979, Mainz reported an efficiency level of 103 percent for the 6V53 engines; however, 18.3 percent only needed repair. If time to work on engines which were repaired was not included in the overhaul category, the 103-percent efficiency level would have been reduced.

WORK METHODS

The time and number of calendar days required to return the same piece of equipment or component to an acceptable

^{1/}Standard hours are developed by multiplying the standard time needed to produce a unit of production by a number of good units (total units - rework units = good units).

condition vary significantly between Mainz and CONUS depots. As previously discussed, Mainz requires less labor hours and less calendar days for similar work than CONUS depots. One work method contributing to Mainz's better performance is repairing rather than overhauling major assemblies.

Decisions on overhaul versus repair

Many assemblies on combat vehicles do not require complete disassembly and overhaul. As discussed in chapter 3, overhaul involves more labor and material costs than repair. Mainz has a preinspection program to determine whether an assembly should be overhauled or repaired.

The Depot Maintenance Work Requirement for combat vehicle overhaul states that assemblies, such as engines, will be removed from vehicles, disassembled, and overhauled or replaced, if inspection shows that components are not within tolerances. Mainz officials believe that significant savings can be achieved by not disassembling all assemblies. However, they were unable to quantify such savings.

According to Mainz maintenance managers, an engine is considered for repair if

- the crankshaft turns,
- there is an acceptable level of compression, and
- the engine has no apparent damage.

Final decision to repair is on a case-by-case basis and depends to a large extent on the inspector's judgment. If, after repair, the engine fails final tests, it is returned to production for disassembly and complete overhaul. Similar preinspections are performed for other assemblies, such as transmissions, final drives, and transfers.

To determine the extent engines arriving on vehicles are repaired, we sampled preinspection reports for the 8V7T and 6V53 engines. During fiscal year 1979, about 70 percent of the 8V7T engines and 30 percent of the 6V53 engines were repaired rather than overhauled.



M-110 HOWITZER TURRET DISASSEMBLED

SOURCE: U. S. ARMY

<u>Engine model</u>	<u>No. of engines</u>			<u>Percent</u>
	<u>processed</u>	<u>reviewed</u>	<u>repaired</u>	
6V53	1,071	129	38	29.5
8V71T	<u>246</u>	<u>84</u>	<u>59</u>	70.2
Total	<u>1,317</u>	<u>213</u>	<u>97</u>	45.5

Age did not appear to be the deciding factor on whether the engines should be overhauled or repaired. Some engines repaired during fiscal year 1979 had not been overhauled since 1972, and many were overhauled in 1977.

In contrast to the procedure at Mainz, the level of maintenance to be performed on items in CONUS depots has been determined before their arrival at the depot by the appropriate readiness commands. The depot has accepted an overhaul program to complete a specified number of items at a fixed-unit price. Upon receipt of the overhaul program item, depot inspectors at Letterkenny perform a brief (2-hour) visual inspection to determine only if it is economical to overhaul the item. No effort is made to determine if the item needs only repair rather than overhaul. Depot inspectors commented that the 2 hours allocated to perform an examination of the item is not sufficient to make such determination.

A 1979 Army Audit Agency report ^{1/} also noted that none of the overhaul items were inspected by depot personnel before induction into the shops. Anniston officials stated that they were not responsible for deciding that the items designated by the readiness commands for overhaul actually needed overhaul. Instead, the depot procedures were to overhaul items without further inspection or evaluation. The report concluded that items should not be overhauled routinely without prior inspection and made a recommendation to that effect.

CURRENT ARMY EFFORTS

During our review, DESCOM initiated a limited study to review and evaluate the factors responsible for the difference in direct labor hour expenditures in the overhaul of the same type of vehicle at Mainz and CONUS depots. According to this study, Mainz and CONUS maintenance operations are generally similar. However, the difference in operations contributes to the significant variances. For example,

^{1/}"Draft Report of Audit Depot Maintenance Anniston Army Depot" (U.S. Army Audit Agency, SO 80-8, Oct. 1979).

- Mainz applies pre-shop analysis and performs only the disassembly and repair indicated to return the item to serviceable condition. CONUS depots, on the other hand, perform complete disassembly of an item and return it to a "like new" condition. The study estimated that this different procedure accounted for about 525 staffhours in the case of the M-110 howitzer.
- Mainz does not abrasively clean the hull and performs only limited stripping, smoothing, and repainting. CONUS depots abrasively clean the hull and completely paint it. CONUS depots spend about 60 additional staffhours per end-item following their procedure.
- Mainz classifies about 75 percent of its quality inspectors as overhead, whereas CONUS depots record 75 percent or more of the quality inspectors' time as direct labor.

Despite these differences, the study noted that the end-items produced at Mainz were acceptable to its customers and apparently met performance standards of Army units. The study recommended that DESCOM take action to ensure adequate dissemination of information of these different procedures to all functionally affected depots.

While such action is a step in the right direction, we believe that a formal mechanism for sharing among depots the best work methods and practices should be established. Such a mechanism would provide a means for comparing depot performance in detail and would result in more efficient depot operations.

CONCLUSIONS

The success, efficiency, and effectiveness of a depot's operation depend on good management systems and depot work practices. Army CONUS combat vehicle depots are not operated as efficiently and effectively as the Mainz Army Depot. Productivity at CONUS depots could be increased if areas related to estimating labor requirements, work measurement, and work methods were improved. At the time of our review, the Army was studying some opportunities for improving depot operations.

Good estimating techniques are not used at CONUS depots to control labor requirements for combat vehicle overhauls. Instead, the depots are using historical averages of prior work which, of necessity, perpetuate the mistakes and inefficiencies of prior estimates. The methods and standards

program, which is the key to workloading and effective production control, lacks management emphasis, quality, and quantity, and the labor and production reporting system does not contain reliable data for making decisions and analyzing variances between actual and expected results. Additionally, work methods emphasize overhaul rather than less costly repairs of major vehicle assemblies. Although we found some problems in Mainz in these areas, for the most part, Mainz's management systems and practices were superior to those of CONUS depots.

RECOMMENDATIONS

We recommend that the Secretary of Defense require the Army to:

- Estimate labor requirements on the basis of valid labor standards rather than on fixed prices or historical averages.
- Emphasize the implementation of an effective work measurement system at CONUS depots, including improving work methods, labor standards, and staffing and monitoring the implementation of the system.
- Require system discipline and integrity to overcome existing inadequacies and errors in the CONUS depots' and Mainz's present management information systems. Particular attention should be paid to accurately identifying and monitoring rework and nonproductive time and analyzing variances between actual and desired results.
- Initiate a formal information exchange of work methods and practices between CONUS depots and Mainz and make the most cost-effective practices the standards for all depots to follow.
- Discontinue the practice of routinely overhauling vehicles and major assemblies at CONUS depots without prior inspection to determine if the condition of the vehicles or assemblies actually warrant such overhaul.



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



LOGISTICS AND COMMUNICATIONS
DIVISION

October 29, 1979

The Honorable Clifford L. Alexander, Jr.
The Secretary of the Army

Dear Mr. Secretary:

We are currently evaluating Army depot maintenance practices for combat vehicles. The review will be completed in early 1980 and we intend to brief your staff in detail about our observations at that time. In the meantime, we would like to call to your attention our concern with a fiscal year 1980 overhaul program at the Mainz Army Depot involving 14 M60A1 tanks with bulldozer blades.

We believe this program is questionable because our review of a similar fiscal year 1979 program disclosed that (1) Mainz Army Depot managers do not believe the condition of many of the tanks justified overhaul, and (2) vehicle mileage readings were substantially below established mileage criteria.

The Army currently overhauls tanks on the basis of mileage. The criterion for M60A1 tanks in Europe is 5,000 miles. During fiscal year 1979, as part of an Army effort to replace high mileage vehicles in front line units in Germany, 30 M60A1 tanks with blades received overhaul at the Mainz Army Depot. Of that total 19 had less than 4,000 miles and 11 had less than 3,000 miles. One vehicle, for example, had only accumulated 757 miles and had been overhauled 17 months earlier.

An August 8, 1979, memorandum prepared by Mainz Army Depot staff questioned the need for overhauling these tanks. It stated that the condition of these vehicles did not justify overhaul. Instead it suggested that the vehicles should be inspected and repaired as necessary. Based on fiscal year 1979 data the average cost of repair was about 40 percent less than overhaul.

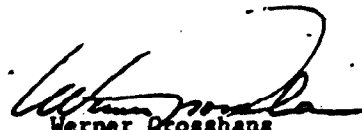
Although USAREUR officials were aware of the depot's concern, they directed the depot to overhaul the 30 vehicles in order to bring them to standards acceptable to front-line units, that is like new (Code "A") condition. They told us that condition code "A" can only be obtained through overhaul, since repairs bring a vehicle only to condition code "B". USAREUR considers code "B" unacceptable from a readiness point of view.

While we recognize the Army's need for a high readiness posture, we question the decision to overhaul without regard to condition or mileage. In fact, current Army efforts are being directed to use condition rather than mileage as a maintenance criterion for inducting combat vehicles into the depots.^{1/} These efforts are part of Army initiatives to implement the reliability-centered maintenance (RCM) concept. Under this concept, scheduled maintenance actions are limited to those absolutely necessary to insure equipment safety and reliability. The major benefit expected from the RCM concept is increased operational readiness of equipment which, in turn, should result in dollar savings. Based on fiscal year 1979 data, if the 14 tanks in the fiscal year 1980 program were repaired rather than overhauled, cost savings amounting to about \$500,000 could be realized.

In view of the above and the potential savings which may be achieved by repairing rather than overhauling, we believe the Army should defer overhauling the vehicles in the FY80 program until it has inspected each of these vehicles to determine if and to what extent they require maintenance.

We would appreciate receiving your views on the above suggestion and being advised of any action you plan to take on this matter.

Sincerely yours,



Werner Drosshans
Associate Director

^{1/} Starting in fiscal year 1980 combat vehicle depot maintenance candidates are to be selected using condition rather than mileage as a criterion. Actual inductions are to start in fiscal year 1981.



DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, D.C. 20310

Jan. 9, 1980

Mr. Werner Grosshans
Associate Director
Logistics and Communications Division
US General Accounting Office
Washington, DC 20548

Dear Mr. Grosshans:

This is in reply to your letter to the Secretary of the Army regarding your letter report dated 29 October 1979, pertaining to the FY 80 overhaul program at the Mainz Army Depot (GAO Code No. 947376; OSD Case No. 5313).

The inclosed statement provides the Department of the Army position which reflects agreement with the audit recommendation.

Sincerely,

A handwritten signature in black ink, appearing to read "Roy A. Werner".

1 Incl
as stated

Roy A. Werner
Principal Deputy Assistant Secretary of the Army
(Installations, Logistics and
Financial Management)

DEPARTMENT OF THE ARMY POSITION
ON
GAO LETTER REPORT, DATED 29 OCTOBER 1979

ARMY'S COMBAT VEHICLE PROGRAM
OSD CASE #5313

ISSUE: USAREUR (TAMMC) and Mainz Army Depot disagreed on what level of effort was required to restore 30 combat vehicles to an issuable condition in FY 79.

COMMENT: This appears to be more of an interpretation problem rather than an intentional violation of established Army policy which allows repaired equipment to be issued to front line units. USAREUR personnel may have misinterpreted the definition of Code A condition to mean that the finished product must be either "like new" or "completely overhauled" which was the basis for their insistence that all items designated for issue to front line units be overhauled. The Army definition of Code A condition, summarized above, includes all levels of maintenance actions (including repair and reconditioning) which allow end items to be issued to all customers without restrictions. To preclude a recurrence of above situation in USAREUR, reaffirmation of Army policy relative to the repair and restoration of Army assets to an issuable condition will be made.

ISSUE: FY 79 program vehicles mileage readings were substantially below established mileage criteria.

COMMENT: Concur that some of the 30 M60A1 tanks with bulldozer blades had less than 5000 miles which was the criteria at the time of selection of the tanks programed for overhaul at Mainz Army Depot. Army policy, however, also allowed combat vehicles to be selected for depot maintenance due to conditions other than accumulated mileage. It was the considered judgement of personnel involved that the tanks in question met the criteria for depot maintenance and that overhaul of the tanks was necessary to sustain the required readiness of the US Army in Europe.

ISSUE: Based on fiscal year 1979 data, if the 14 tanks in the fiscal year 1980 program were repaired rather than overhauled, cost savings amounting to about \$500,000 could be realized.

COMMENT: In regard to the FY 80 tank program at MZAD (14 bulldozer tanks included), the criteria used to select these tanks as candidates for depot overhaul would indicate they fall within DA policy and guidance as specified in AR 750-1 dated 1 April 1978 with change one. In view of GAO's finding however, verification of the condition of these tanks will be made to assure that they are true depot overhaul candidates rather than candidates for maintenance less than overhaul. The appropriate MRC will issue instructions to report any vehicle which is determined by inspectors to be restorable to an issuable condition with less than overhaul. Upon receipt of the above information, the MRC will negotiate a change for those vehicles that require repair less than overhaul. It should be noted therefore that any consideration for changes to the program will be undertaken at some appropriate point in the program year.



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