REPORT TO THE CONGRESS

Reduced Requirements For Modular Electronic Equipment For Aircraft B-133396

Department of the Air Force

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

JULY 3, 1973

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON D C 20548

B-133396

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

We are reporting on reduced requirements for modular electronic equipment for aircraft in the Department of the Air Force

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U S.C 53), and the Accounting and Auditing Act of 1950 (31 U S C 67)

We are sending copies of this report to the Director, Office of Management and Budget, the Secretary of Defense, and the Secretary of the Air Force

Elmer B. Staats

Comptroller General
of the United States

Contents

ABBREVIATIONS

AFLC	Air Force Logistics Command
AMA	Air Material Area
CONUS	Continental United States
DOD	Department of Defense
GAO	General Accounting Office
LRU	line replaceable unit
MSD	Multi Sensor Display
SCARS	Serialized Control and Reporting System

COMPTROLLER GENERAL'S REPORT TO THE CONGRESS

REDUCED REQUIREMENTS FOR MODULAR ELECTRONIC EQUIPMENT FOR AIRCRAFT
Department of the Air Force
B-133396

D I G E S T

WHY THE REVIEW WAS MADE

The Air Force has invested billions of dollars in electronic equipment used in aircraft (avionics) For example, the avionics and spare parts for its F-111D aircraft alone have cost more than $900 million

GAO reviewed how the Air Force determined requirements for avionics spares used in the A-7D and F/FB-111 aircraft to determine whether the Air Force had realized all the advantages of the modular design concept for avionics

Background

A significant development in the field of electronics has been the introduction of modular design, under this concept many expensive "black boxes" making up an avionics system contain plug-in-type components known as modules

The principle advantages of modular design are

--Avionics units or black boxes can be rapidly replaced in aircraft on the flight line, so the time aircraft are out of service is minimized

--Most black boxes can be repaired rapidly and more time can be taken to repair modules.

Because avionics are becoming more and more costly, investment in less expensive spare modules, rather than in more expensive spare black boxes, means substantial savings

FINDINGS AND CONCLUSIONS

In reducing requirements, the Air Force could have achieved savings if it had taken full advantage of the modular design concept for avionics systems

GAO found that the Air Force could have substantially reduced its requirements for avionics spares for the A-7D and the F/FB-111 if its management personnel had used more realistic estimates in determining the requirements

The estimates used did not recognize all the advantages of modular design. For example, estimates were based on the premise that

--Repairing black boxes would take more time than was actually being experienced (See pp 8 and 9)

--More black boxes than modules were being sent to depot repair facilities. (See p 10.)

The second premise was the result of a management reporting system which did not routinely show actual repair cycle time As a result, expensive black boxes rather than less expensive modules continued to be bought, many black boxes were awaiting repair because of the

lack of subcomponents and maintenance capabilities to repair them

RECOMMENDATIONS OR SUGGESTIONS

The Air Force is considering modular design for other types of equipment in its inventory In view of the significance of the problem and to insure that the Air Force achieved maximum benefits from this concept, GAO proposed that the Secretary of the Air Force

--Evaluate other weapon systems using modular-type equipment to determine whether logistical support takes advantage of modular design

--Develop standard factors for each item, in the absence of experienced data, on the basis of equipment design specifications Use these factors in estimating spares requirements for new equipment and, as actual usage data becomes available, compare it against the estimates

--Provide for a continuing detailed review of individual, randomly selected requirements computations.

--Continue to improve management techniques and have operations continuously evaluated to insure prompt solutions to problems encountered in supporting current avionics systems

AGENCY ACTIONS AND UNRESOLVED ISSUES

The Department of Defense (DOD) generally agreed with the contents of GAO's draft report Also, DOD said the information GAO provided during the review had proven useful to Air Force logistics planning and had resulted in improved management (See app I)

The Air Force was kept informed of GAO's findings during the review so that it could take corrective actions The Air Force has reduced requirements for items for F/FB-111 and A-7D aircraft by $79 million More importantly, the Air Force has begun preventing a recurrence of the matters discussed in this report

Concerning GAO's suggestions, DOD said that

--The Air Force had analyzed 383 black boxes from 25 weapon systems and had made adjustments for factors and data involved

--Standards for estimating factors have been published and action has been taken to attain recommended goals

--Various management levels continually review requirements computations

--There are a number of management controls to identify problems and to provide data to solve them A new "cost critical" item program was being developed and was to be implemented in April 1973

MATTERS FOR CONSIDERATION BY THE CONGRESS

The Appropriations Committees of the Congress and other committees may wish to consider the matters discussed in this report in connection with the military departments' fund requests for new weapons systems or equipment and the supporting spare parts.

CHAPTER 1

INTRODUCTION

One of the key functions of logistics is to insure that the right spare parts are available in the right quantity and at the right time and place to support and maintain military equipment and weapons systems.

Establishing spare parts requirements is difficult If too few spare parts are bought, operational readiness may be impaired, if too many are procured, money will be wasted. Buying the right amount is difficult because (1) operational programs may change, (2) the equipment may not require repair as expected, or (3) funds may not be available. Although some of these problems are difficult to resolve, their impact can usually be minimized through judicious evaluation of the data available at the time requirements are established. The Air Force has developed sophisticated management systems to aid its logisticians in making these decisions.

The Air Force Systems Command, through its Aeronautical Systems Division, develops, acquires, and modifies weapon systems. The Air Force Logistics Command (AFLC) provides worldwide technical and logistics support for these systems. It carries out its responsibilities at a headquarters and at five major installations or depots known as Air Materiel Areas (AMAs) Each AMA is responsible for the logistics support of specific aircraft, missiles, and equipment. At the AMA, each type of spare part is assigned to an item manager who determines its worldwide requirement.

MODULAR DESIGN AND THE MAINTENANCE CONCEPT

Modern avionics systems such as those used on the A-7D and the F/FB-111 aircraft are made up of as many as 134 "black boxes" called line replaceable units (LRUs) which can be removed and replaced when they fail. An LRU is in turn made up of a chassis and 10 to 40 plug-in-type components called modules which are also usually easily removable. The modules contain bit and piece parts which make up the various electronic circuits. Some LRUs may cost nearly half a million dollars and modules several thousand dollars. Pictures of a complete LRU and the same LRU disassembled showing the modules are on page 5.

The basic maintenance philosophy developed around these design features was to insure a minimum repair time on the LRU and to provide for more leisurely repair of the modules Accordingly, when an item of avionics equipment on an aircraft breaks down in the field, the faulty LRU can be identified and replaced with a serviceable unit. The LRU is sent to an intermediate field-level maintenance shop located on the same base as the aircraft for testing and repair. There the module causing the failure is identified and replaced with a serviceable module and the LRU is returned to service Modules requiring repair beyond the capability of the intermediate field levels are sent from the base to a depot for repair Part of the LRU illustrated on page 5 cannot be removed at the field level and failures in that part require that the LRU be sent to a depot.

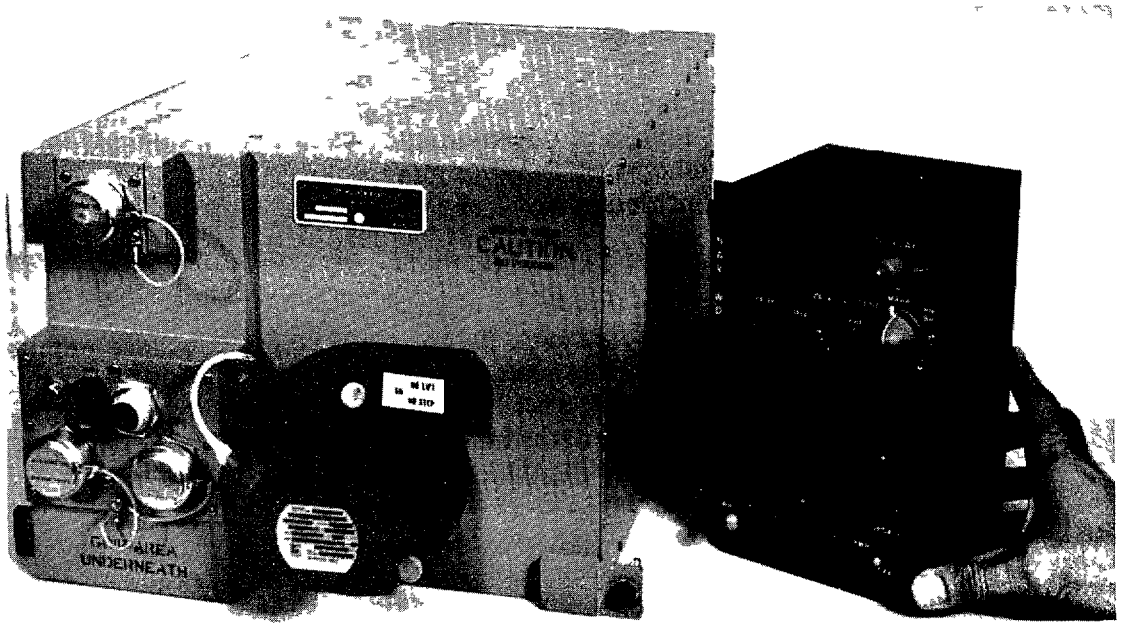
This maintenance concept requires only a limited number of LRUs in the field because they can be repaired by replacing faulty modules For modules, the situation is almost reversed. The field or intermediate level needs a much larger inventory of modules to replace faulty ones and keep the LRUs operational. Depots require few spares of either type since their function is to test modules and repair them by replacing bits and pieces, of which they need large quantities.

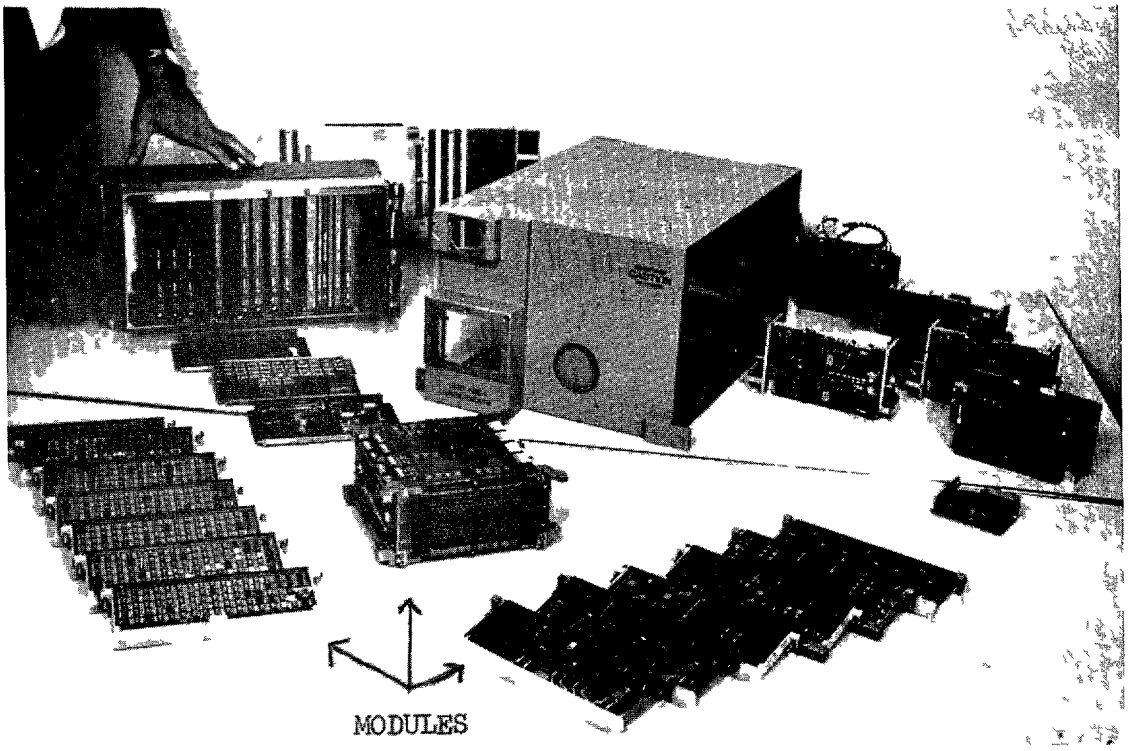
In contrast, repairing a nonmodular LRU used on older avionics systems tied up the whole LRU Under the nonmodular concept, LRUs had to be shipped to the depots for repairs other than minor maintenance because the required test equipment and skills were often not available at field or intermediate maintenance levels Hence large quantities of spare nonmodular LRUs were required.

Under the modular concept LRUs are not sent to a depot unless (1) some nonmodular part of the LRU requires repair at the depot or (2) the field or intermediate repair shop is unable to isolate the source of failure.

A comparison of the time required to repair modular and nonmodular LRUs is on page 6.

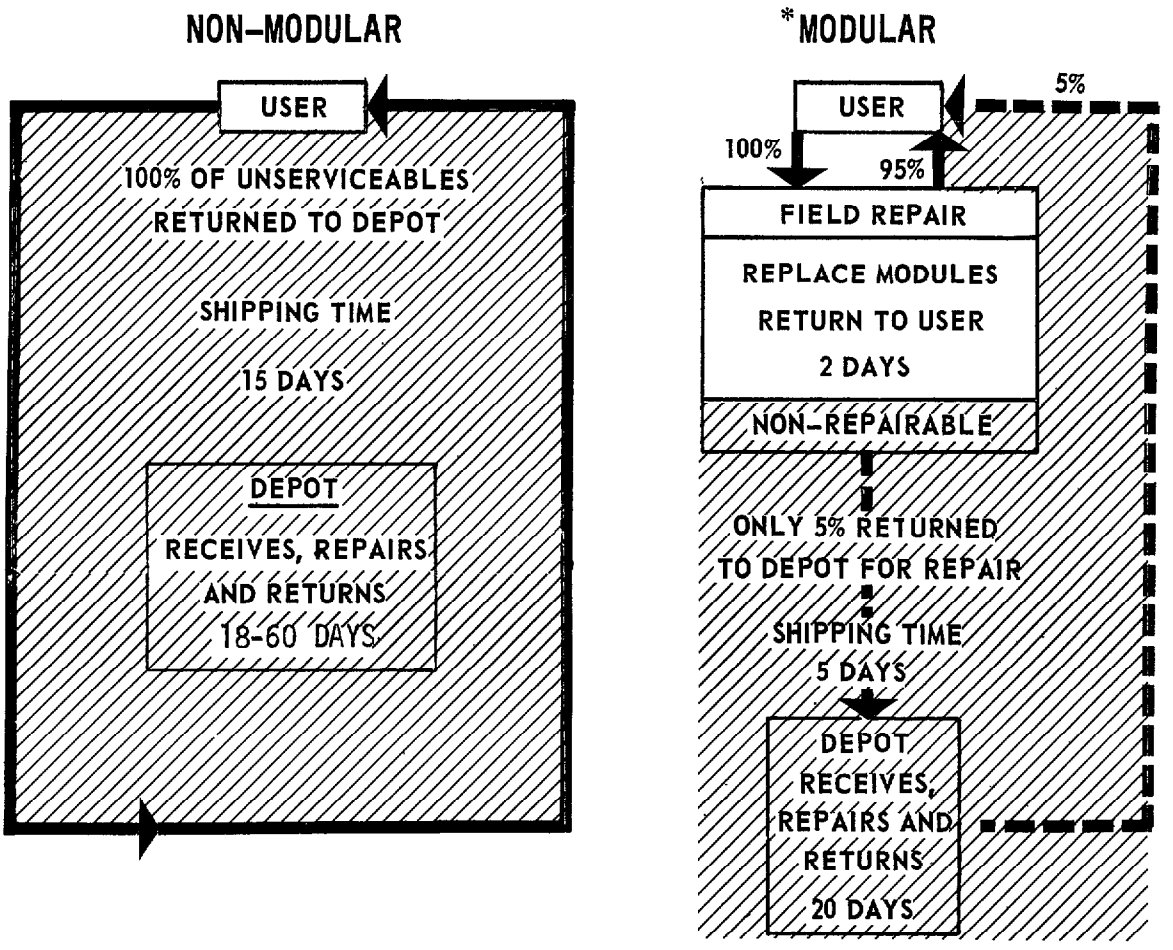
TC-2 COMPUTER (LRU) AND DISPLAY PANEL





TC-2 COMPUTER DISASSEMBLED SHOWING MODULES

LRU REPAIR CYCLE



*Percentages and times shown are goals to be attained under the modular concept

CHAPTER 2

ESTIMATES FOR DETERMINING AVIONICS SPARES REQUIREMENTS DID NOT REFLECT ADVANTAGES OF MODULAR DESIGN

The Air Force could have substantially reduced its computed requirements for avionics spares for the F/FB-111 and A-7D aircraft if it had used more realistic estimates (factors) for the repair of LRUs

We kept Air Force officials informed of our observations throughout the review, as a result of the information we provided, the Air Force has reduced its requirements by $79 million

FACTORS NOT CONSISTENT WITH MAINTENANCE PHILOSOPHY

Spare LRUs and modules are needed to keep aircraft or equipment operational while inoperable LRUs and modules are being repaired The number of spares needed is established by using such factors as the estimated number of flying hours, the estimated number of failures per flying hour, the repairability of the LRU at the field or depot level, and the length of the repair cycle

Changes in any of these factors can affect the number of spares required Initial failure rates and repair time estimates are usually obtained from the contractor who manufactured the item or from the weapon system manufacturer when these factors are not known from experience As the aircraft becomes operational, the actual experience gained is used to determine the requirements

We selected 16 LRUs for the A-7D and 23 for the F/FB-111 aircraft for which computed requirements were valued at about $24 million and $176 million, respectively We reviewed only those factors used to estimate how long the LRUs are in for repair--the time required to repair them at the base (base repair cycle), the number of LRUs to be sent to the depot because the base cannot repair them (not repairable this station), the time required to ship to and repair at the depot (depot repair cycle), and the time required to return LRUs to the base (base order and shipping time) The following table shows

those factors the Air Force was using when we began our review and those factors which we believe would have been more consistent with the equipment design as goals to attain

	Air Force factors		GAO-recommended factors
	Range	Average	
Base repair cycle (days)	3 to 10	7 3	2
Depot repair cycle (days)	18 to 60	40 4	20
Returns to depot (percent)	1 to 98	25 2	5
Base order and shipping time (days)	5 to 15	11 0	5

We determined our recommended factors from design specifications, equipment manufacturers' suggestions, and observations at selected base repair activities By using our recommended factors, the Air Force could have substantially reduced its computed requirements of $200 million

The following schedule illustrates how the use of our recommended factors would have reduced the computed requirement for one item This item is discussed further on page 10

	Air Force		GAO	
	Factor	Quantity	Factor	Quantity
Base repair cycle (days)	6	27	2	11
Depot repair cycle (days)	37	[a]95	20	6
Return to depot (percent)	25	10	5	5
Base order and shipping time (days)	15	21	5	2
Total computed quantity		153		24
War readiness materiel requirement		6		6
Total requirement		159		30

[a]Includes 42 for depot stock level We used zero quantity because under the modular concept a depot stock level would normally not be needed The further reduction from 95 to 6 is caused by the compounding effect of reducing returns to the depot and depot repair cycle factors

A discussion of the factors reviewed follows

Base repair cycle

We reviewed the manufacturers' original estimates available at the AMAs These estimates showed that the time needed to determine which modules were causing LRUs to fail and to replace faulty modules ranged from 1 to 10 hours for 37 of the LRUs we evaluated (data was not available for 2 LRUs) In addition, the Air Force allows 1 day to remove the LRU from the aircraft and to take it to the intermediate-level repair shop at the same air base The estimates derived in this manner indicated it would take about 2 days to repair the LRUs At field repair shops, actual repairs were being made in less than 4 days for some of the items evaluated and more often than not in 1 day or less

In contrast, before our review the Air Force used an estimated repair time of up to 10 days Only eight F/FB-111 LRUs had low repair times and this was due to intensive management The intensive management given these LRUs is discussed on page 13 Because the Air Force's estimates were high, it had several times the number of LRUs necessary to support field repair shop operations For example

> The use of a 10-day base repair cycle for the tactical computer on the A-7D required that 13 LRUs costing $1 2 million ($90,000 each) be available as spares The manufacturer had specified a 4-hour repair time, the Air Force was averaging 11 8 hours and, at one field installation, 4 hours We pointed this out to the Air Force and suggested that the base repair cycle be reduced to 2 days Subsequently, the Air Force lowered the base repair cycle to 4 days on this item and reduced its requirements from 13 to 5 LRUs

Air Force regulations state that the base repair cycle will be actual repair time up to a maximum 10 days We found that the estimate was actually the maximum base repair cycle allowable when no other estimated or actual data was available

Repair shops exceeded estimated repair times primarily because of a lack of replacement modules, test equipment, or skilled technicians Repair shop personnel provided data

showing repair times which were about the same as the manufacturers' estimates In our opinion, the optimum base repair cycle for most of the items we reviewed is 2 days

Rate of return to depots

The Air Force's estimate of the rate of return to depots was, in our opinion, usually overstated and inconsistent with equipment specifications and design

Data furnished by the contractor indicated that normally all LRUs could be repaired in the field repair shops and that faulty modules should be shipped to depots The Air Force projected that 75 percent of the total failures would be repaired at the base, the other 25 percent would have to be repaired at the depot The rates of return for the 39 items reviewed ranged from 1 to 98 percent The average was 25 2 percent We could not determine from the data on file or from discussions with Air Force personnel the reason the estimated return rates were so high when the design indicated returns to the depot should be minimal When the design called for sending the LRUs to the depot for certain types of failures, we did not question the rate of return to the depot

One of the most expensive pieces of equipment we evaluated was the Multi Sensor Display (MSD) used on the F-111D aircraft We believe it demonstrates the significance of the rate of returns to depots

> In September 1971 the Air Force determined it needed 159 spare LRUs at an estimated cost of $43 million, or about $288,000 each. The Air Force had arrived at this number of LRUs because it had estimated the rate of LRU returns to the depot at about 25 percent and had estimated that shipping and depot repair would take 52 days.
>
> Our evaluation of the Air Force's specifications and other pertinent data disclosed that the MSD was designed to be repaired in the field and that only its component modules should be sent to a depot for repair We pointed this out to the Air Force and suggested that the rate of return to the depot should be very limited. We were told that sometimes the field simply could not

tell what was wrong with the LRUs. By March 1972 the Air Force had reduced the rate of return to the depot to 5 percent and the shipping and repair time to 32 days. The computed requirements therefore dropped from 159 to 64.

Several Air Force personnel told us that rates used to compute requirements were high because the field repair shops lacked modules and repair facilities and that therefore more LRUs were sent to depots than the maintenance concept called for. Air Force regulations provide that, if returns to the depot result from a parts shortage or a lack of facilities, these returns be excluded when computing requirements so that these problems can be highlighted. Also the regulations state that all available solutions (e.g., more equipment and personnel) should be explored before buying additional spares.

Information as to why LRUs were returned to the depot was available but was not routinely furnished to personnel who determined requirements. On the basis of the maintenance concept, LRU specifications, design, and actual returns to the depot (except those caused by a lack of parts), we believe a projected 5-percent rate of return is adequate to compute requirements.

Depot repair cycle and shipping times

Depot repair cycles were also overstated In 1971 the Air Force assumed it would take 15 days each way to ship spare LRUs between the base and the depots (The Air Force used 5 days for items receiving intensive management) The 15 days is based on aircraft deployment at both Continental United States (CONUS) and overseas locations The Air Force expected it would take up to 50 days to repair LRUs at the depot.

In contrast to the 15 days used, CONUS bases were achieving actual shipping times of from 1 to 5 days. The Air Force has since reduced the estimated shipping times to 5 days for some additional items, but we believe the shipping time for all the items reviewed should be between 2 and 5 days for CONUS bases.

In the case of the F/FB-111, the estimates of repair times at the depots far exceeded those recommended by the contractor and included numerous allowances for contingencies

such as lack of parts and facilities. The times used were also much greater than actual repair times being achieved.

Most of the A-7D LRUs were being sent to the contractor for repair because the Air Force could not repair them. Again, estimates far exceeded what the contractor was achieving or what we believe could have been achieved

> Estimated repair times used to compute spares requirements ranged from 30 to 50 days. Our visit to the contractor disclosed that almost two-thirds of the repairs were being made in about 13 days For the remaining one-third, repair times averaged about 70 days. Contractor personnel told us repairs could have been made in a matter of hours if an adequate supply of modules and bits and pieces had been available The Air Force had not reduced any of these factors at the time of our review.

On the basis of actual repair times being experienced, as well as estimates by maintenance personnel, we believe 15 days would be a reasonable estimate of the time needed at the depot for repair.

SAVINGS AVAILABLE THROUGH INTENSIVE MANAGEMENT TECHNIQUES

The Air Force was not fully using certain management techniques to reduce its investment in LRUs

AFLC developed the Serialized Control and Reporting System (SCARS) to keep down its investment in expensive spares by reducing the amount of time these items are out of service for repair

SCARS offers an excellent technique to manage LRUs This system calls for continuous evaluation of operations to insure prompt identification of and solutions to problems, it also offers a potential for savings. Several of the items we reviewed had received SCARS management and, as noted on page 11, the estimated shipping time for these items was 5 days.

Most of the F/FB-111 items we sampled qualified for SCARS. We determined that requirements could have been reduced by almost $38 million if four more F/FB-111 items had been receiving SCARS management. We suggested that SCARS be expanded but Air Force officials expressed little enthusiasm and stated that expansion would require more people. We were later told AFLC was reducing staffing levels substantially

For one LRU, AFLC personnel went beyond SCARS management. They were tracking and charting not only the location and status of the LRU but also all the modules which went into the LRU. The advantage of this was that it visibly linked the LRU and its modules so, when an LRU became unserviceable, management could direct attention to the defective module It also identified which modules were causing logistic support problems

Furnishing this data to management should help focus attention on the need for an adequate stock of serviceable modules at the intermediate level

INFLATED FACTORS PREVENTED PROBLEMS FROM BEING HIGHLIGHTED

Standards for evaluating performance have to represent the best reasonably attainable performance if they are to be

useful. If the goal is set too high, variances will provide a poor performance picture, if the goal is too low, they will present an unrealistically excellent performance. In either case management is not aware of the true situation.

Because the management reporting system did not show actual rates of return and repair cycles, the Air Force was unaware of the true cause of its support problems As a result, it spent millions of dollars buying expensive LRUs when often only relatively inexpensive bits and pieces were needed. The F/FB-111 is a case in point. Initially, the contractor underestimated the failure rate on certain modules and their related bits and pieces. As a result, the field encountered a continuing shortage of serviceable modules and the depot lacked modules and bits and pieces By early 1971, as many as 100 failed LRUs were being set aside each month at one base because serviceable replacement modules were not available In many cases the modules were not available to the field because there were no bits and pieces at the depot to repair them. In accordance with Air Force regulations (since waived for many F/FB-111 LRUs), the base held failed LRUs for 30 days, waiting for modules, and, when the needed modules were not received, shipped the entire LRU to the depot

The field's lack of parts was not pointed out to management because the field, in accordance with prescribed supply procedures, normally canceled its order for the needed modules when it sent LRUs to the depot The depot did not reinstate the need for the modules. As a result, the need for LRUs increased but the field's need for modules was never made known to management Also, many LRUs were set aside at the depot for months because of the shortage of bits and pieces to repair modules

This situation tended to give credence to the factors used initially to determine LRU requirements As predicted, LRUs were frequently tied up for days at the base, many LRUs were being sent to depots for repair, and the depot was taking months to return them to service Personnel who computed requirements were not aware of the true situation. For example, in reply to our inquiry about the use of a lengthy depot repair cycle for computing requirements for one LRU, Air Force officials stated that some LRUs required up to 7 months to repair.

In 1971 the Air Force began to identify its true needs and to procure needed bits and pieces. However, due to the long leadtimes necessary to obtain some of the items from the manufacturers, the situation could not be resolved for several months.

CHAPTER 3

INTERNAL AUDIT ACTIVITIES

Early in 1971, the Air Force Auditor General issued a report on "Selected Aspects of Logistics Support Relating to Line Replaceable Units, Subassemblies, and J 79 Engines for F-4 Aircraft." Based on audit work performed between June 1969 and September 1970, the report discussed

1. The validity of a standard 10-day base repair cycle for LRUs.

2. The use of repair cycle factors which did not reflect the interdependency of LRUs and modules (the quick LRU repair capability).

3. The inclusion of a factor for LRUs sent to the depot for lack of parts in the rates of return.

The Air Force concurred with its auditors and stated that it would implement corrective action by about April 1971. It observed, however, that the F-4 had been procured under an older system and that management techniques used for new weapons were designed to prevent occurrences similar to those uncovered by the auditors. For example, they stated that the optimum repair level analysis was being used on current weapon systems to select the most economical and advantageous level of repair over their life cycle.

In our review of the A-7D and the F/FB-111, we found that·

--As late as September 1971 the 10-day standard was still being widely used to estimate base repair.

--Using the optimum repair level analysis on these weapon systems apparently did not result in the selection of an optimum repair level for LRUs.

The Air Force Audit Agency's examination adequately identified specific problems, their causes, and solutions, but management has not taken complete corrective action

Air Force auditors were also reviewing selected aspects of avionics support for the F/FB-111 at the time of our review Our examination was directed toward evaluating whether the Air Force was achieving the advantages of modular design, and we coordinated with the Audit Agency and considered information it developed during our review

CHAPTER 4

CONCLUSIONS AND AGENCY ACTIONS

CONCLUSIONS

Equipment design directly affects logistics support and dictates how often equipment will fail, where and what repairs should be made, and what and how many parts will be required to make these repairs. Today, technological improvements occur so fast and are so significant that associated systems, such as logistics, have to be continuously reappraised

The Air Force recognized the improvements in technology and tailored some of the A-7D and F-111 avionics systems to the modular concept When the time came to buy the spare parts, however, it did not take full advantage of the benefits the concept offered. As a result, a paradox was created LRUs were procured unnecessarily and yet the avionics systems could not be fully supported.

The Air Force could have substantially reduced its requirements for the items reviewed. We recognize that problems such as lack of trained technical personnel and test equipment shortages will interfere with a goal of adequate LRU utilization But, only when the Air Force computes requirements using factors which reflect the goal will it be able to study the cost trade-offs (LRUs versus additional training expenses, etc.) of various solutions Also, requirements computations should point out inventory management problems so solutions other than acquiring more parts can be considered

In our opinion, the basic contributors to the problems noted in computing LRU requirements were that Air Force item managers

--were not fully aware of the economies offered by the modular concept,

--were not routinely provided with the data needed to take advantage of the modular concept, and

--were reluctant to reduce estimated factors or standards because they did not have confidence in the reliability of parts to support avionics repair

Accordingly, in a draft of this report we proposed that, because the problems noted were significant, the Secretary of the Air Force should evaluate other weapon systems using modular-type equipment to determine whether logistical support takes advantage of modular design.

The Secretary should also

--Develop realistic standards--on the basis of equipment specifications--to be used in estimating spares requirements on new weapon systems and use actual data to update the estimates.

--Provide for a continuing detailed review of individual, randomly selected requirements computations.

--Establish special management controls, such as SCARS, to rapidly indentify and solve problems being encountered in supporting current avionics systems.

AGENCY ACTIONS

The Department of Defense (DOD) commented on our findings and suggestions in a letter dated April 9, 1973.

DOD generally agreed with the contents of our draft report and said that information we provided during our review had proven useful in Air Force logistics planning and had resulted in improved management. To increase opportunities for savings, DOD will emphasize full use of the modular concept in all ongoing and future programs for support of major weapons systems and equipment. The Army and Navy have been provided with copies of the draft report.

In response to our proposals (see app. I) DOD informed us that

--Each AMA was directed to review all avionics systems using modular-type equipment to insure that planning for logistics support took full advantage of modular design The AMAs analyzed 383 high-cost LRUs from 25 weapons systems and made appropriate adjustments for factors and data elements involved

--The Air Force has published standards for estimating the repair cycles and shipping time factors used in forecasting spares requirements for new weapons systems. Action has been taken to attain the goals we recommended, but these goals have not been realized to date and may require a reassessment in the future.

--Continuing reviews of requirements computations are made at various levels and include semiannual reviews by teams from headquarters which at times are accompanied by management analysts from the Office of the Secretary of Defense. Procedures for testing personnel are being refined for the standard training programs at all AMAs, to help identify general training needs.

--The Air Force uses a number of management controls and techniques to identify problems and to provide data to help solve the problems. Some of these programs are tailored to specific weapon systems. The Air Force was developing a "cost critical" item program which it planned to implement in April 1973 This program will closely control cost critical items through the logistics system

DOD also furnished more detailed information on matters in our draft report of concern to the Air Force As a result of its review of factors used in computing requirements for the 39 items we reviewed, the Air Force has reduced its requirements for these items by $79 million. A comparison of factors used at the beginning of our review and those currently in use are shown on pages 33 through 36 More importantly, the Air Force has reviewed other items to verify the validity of factors used in requirements computations and has begun preventing a recurrence of the matters discussed in this report Some of its efforts are presented on page 38

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Because the Air Force has begun taking aggressive corrective action, we are making no recommendations at this time At a later time we will examine the Air Force's effectiveness in determining requirements for modular spares

CHAPTER 5

SCOPE

We reviewed how factors measuring base repair cycles, depot repair cycles, and rates of return to the depots affected spares requirements. We did not evaluate the validity of flying hour programs, failure rates, or various additives such as war readiness materiel When equipment design called for return of the LRUs to the depot, we did not question the rate of return used by the Air Force.

We analyzed pertinent documentation at the Oklahoma City and Sacramento AMAs and at AFLC. We also visited and obtained usage data from various field installations and one contractor. We used data prepared by Air Force auditors to limit our audit coverage when warranted.

We discussed our findings with responsible Air Force officials at the AMAs and also at Headquarters, AFLC.

ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D C 20301

SR
INSTALLATIONS AND LOGISTICS

9 APR 1973

Mr Werner Grosshans
Assistant Director-in-Charge
Logistics and Communications Division
General Accounting Office
Washington, D C 20548

Dear Mr Grosshans

The Secretary of Defense has asked me to reply to your Draft Report of January 10, 1973, "Potential for Reducing Spare Parts Requirements by the Department of the Air Force" (OSD Case #3566)

This Report addresses the potential for economies in the investment of high-cost spares for the support of electronic equipment installed in aircraft, when such equipment and its components are designed to the modular concept The thrust of the Report is that when properly designed to this concept, the high-cost spare components are capable of expedited repair by the replacement of faulty plug-in type units known as modules. When these spares can be repaired at or near the operating site of the aircraft, an additional investment in overhaul pipeline quantities of these high-cost spares can be avoided The increasing application of the modular design concept to more and varied types of equipment is offering opportunities for significant savings in logistics support, both in the reduced investment in spares and in maintenance manhour costs

The Department of Defense is in general agreement with the contents of the Draft Report The information provided by your representatives during the course of the audit review has proven useful in Air Force logistics planning, and has resulted in management improvements, some of which are set forth in the comments provided below:

GAO Recommendation That the Secretary of the Air Force evaluate other weapon systems using modular type equipment to determine whether logistical support takes into account the advantages of modular design

Comment Headquarters materiel management personnel visited each of the five Air Materiel Areas (AMAs) in April and May of 1972 The purpose of these visits was to evaluate the effectiveness with which AMA management was assuring that maintenance concepts were reflected in the factors used to compute requirements During the course of these visits, AMA management was apprised of the findings reported by the GAO and potential problem

areas identified Subsequent to these visits, each AMA was directed to review all avionics systems using modular type equipment to assure that planning for logistics support took into full account the advantages of modular design These reviews covered 25 weapon systems and resulted in 383 high-cost spares (generally referred to as Line Replaceable Units (LRUs)) being analyzed and appropriate adjustments made for the factors and data elements involved.

GAO Recommendation. That the Secretary of the Air Force develop standards (in the absence of experience data for like or similar items) based upon equipment design specifications to be used in estimating spares requirements for new equipment and compare actual usage data against these estimates, as this data becomes available

Comment: As indicated below, action has been undertaken to attain the goals recommended for base/depot repair, Not Reparable This Station (NRTS) percentages, and order and shipping time These goals have not been realized to date and may require a reassessment in the future.

The Air Force has published standards for use in estimating the repair cycles and shipping time factors used in forecasting spares requirements for new weapon systems The standards for repair times have been based upon the experience data available for all other items in the inventory, and the order and shipping time standard has been based upon Military Standard Requisitioning and Issue Procedures (MILSTRIP) standards for overseas and continental U S. shipments

Item managers have been instructed to establish factors tailored to individual item characteristics and deployment locations Any factors used which exceed these standards, lacking actual experience data, require approval by higher level management.

Revised standards have also been developed for base repair cycle time which distinguishes LRUs from other items In addition, a report providing visibility of actual base repair time for the item manager has been established The actual data will be used unless it exceeds the established standards, in which case a validation action is required to determine the proper repair cycle time to be used in the computation.

Revised instructions on order and shipping time to clarify the distinction between continental U S and overseas locations have also been developed and issued In addition, improvements have been made in the reporting of actual order and shipping times being experienced by the item manager. The actual times reported are to be used unless they exceed the established standard by more than a three-day tolerance limit, in which case validation action is required to determine the proper order and shipping time to use in the requirements computation The order and shipping time is considered to be equivalent to the in-transit time portion of the depot repair cycle and the same procedure is applied

Instructions advise the item manager of the considerations to be made in establishing a rate at which unserviceable units will be returned to the depot for repair (i e , NRTS percentage) The NRTS rate is influenced by individual characteristics, availability of base equipment, and various levels of maintenance skills

A report was established in June 1972 which provides data on (a) base repair cycle time, (b) the number and type of base repair actions and (c) the units returned to the depot, including the reason why they were returned Additionally, instructions were issued in September 1972 regarding the review of the above data for LRUs

GAO Recommendation That the Secretary of the Air Force provide for continuing detailed review of individual requirements computations which would be randomly selected.

Comment. The Air Force does have a continuing review of requirements computations At the AMA level, such reviews are made on a day-to-day basis, as required The managerial level of review is in direct relationship to the extended value of the indicated action, i e , buy, termination or disposal Teams of Headquarters personnel visit each AMA semi-annually for a detailed review of requirements computations on selected and randomly sampled items Management analysts from the Office of the Secretary of Defense at times attend these semi-annual reviews

Maintenance concepts are considered during the course of these reviews with the objective that each requirements computation reflect the impact of this concept, as it has been implemented to date, and how it will improve or deteriorate in the future Elements such as hardware/software failures during program infancy, instability of design, and personnel learning curves are considered

The review process does provide an avenue for determining training needs However, the primary source for determining training needs is the evaluation by the supervisor of the employee's performance on the job. To further assist the supervisors in identifying general training needs, work is underway to refine testing procedures in relation to the standard training programs held at all AMAs.

GAO Recommendation. That the Secretary of the Air Force establish management techniques which would provide for the continuous evaluation of operations to insure prompt identification of the solutions to problems being encountered in supporting current avionics systems

Comment. As indicated in Draft Report, the Air Force employs a number of special management controls and techniques designed to identify problems and provide data which contribute to their solution Included among these are surveillance of supply effectiveness as measured in terms of backorders, percent of requisitions filled, and aircraft not operationally ready because of supply problems In addition, a special reporting system is maintained on the status of the weapon system which tracks the status of the system and includes progress against assigned objectives and all significant known problems affecting the system

APPENDIX I

The weapon system manager also uses special programs tailored to the weapon system for which he is responsible For example, the F/FB-111 system manager has established the following programs:

(1) Problem/Priority Identification Team (PIT) This team consists of systems and cost analysts, and industrial engineers charged with responsibility to identify, correlate, analyze, and consolidate all F-111 logistic support deficiencies in order to accomplish maximum cost effective logistic support to the F-111 family over its life cycle.

(2) Positive Action Team (PAT) This team, composed of engineers and technicians, has the responsibility for developing a means of providing rapid, effective and efficient corrective actions for hard-core logistics problems

(3) Specialized Management of LRUs is a program to expedite the return to depot for repair of those components of LRUs in short serviceable supply

(4) A special report has been established to provide the item manager for LRUs with visibility on the supportability of the LRU

Other system managers have adopted these or other special actions according to system management problems being experienced in different areas. For example, the A7D system manager is establishing the specialized management of LRUs described in (3) and (4) above

In addition to the special management controls mentioned above, the Air Force is developing a "cost critical" item program, with implementation planned for April 1973, which adopts features of the existing critical item system. This program will prescribe specialized procedures for the identification, reporting, control and management of "cost critical" items in supply, maintenance and transportation. These items will be subjected to close control through the logistics system and complement the world-wide requirements efforts described throughout the Draft Report

In addition to the foregoing, we are enclosing more detailed information, including drawings, pertaining to certain matters covered in the Draft Report which are of concern to the Air Force

You may rest assured that this Office intends to pursue all feasible opportunities for savings by emphasizing the full utilization of the modular concept in all on-going and future programs for support of major weapon systems and equipments To this end, we have provided copies of the Draft Report to the Army and Navy.

The opportunity to comment on this Report in draft form is appreciated

Sincerely,

[illegible] C KLOUCH
Acting Assistant Secretary of Defense
(Installations and Logistics)

Enclosure
as stated

COMMENTS ON SPECIFIC ITEMS OF CONCERN

IN DRAFT REPORT

GAO Comment (Chapter 1, pages 6-9)[1]: Modular Design and The Maintenance Concept

Comment: The Air Force has invested considerable effort and resources to improve the reliability and maintainability of weapon systems. One outgrowth of this effort has been the development of equipment which can be rapidly removed and replaced in aircraft on the flight line, thus minimizing the "turn-around" time of the aircraft

At a lower indenture, efforts have also been made to design these line replaceable units in such a way that their repair is also accomplished by the rapid removal and replacement of components in base maintenance shops

To the extent that these efforts are successful and delivered weapon systems and equipment are designed in this fashion, many economies can be achieved However, to the extent that these objectives are not realized, additional costs will be incurred to accomplish assigned missions and to provide effective supply support

The 39 A7D and F/FB-111 Line Replaceable Units (LRUs) represent varying degrees of the successful accomplishment of the modular design which permits repair through the removal and replacement of components The report includes an illustration of an LRU which is apparently a successful effort to fully incorporate modular design in equipment The TC-2 computer, used on both the A7D aircraft and the AC130 aircraft, is not, however, completely modular The Back Panel Assembly (circled in the attached drawing #1,[2] cannot be removed at base level Forty-two percent of the failures on this LRU have been beyond base repair capability and have had to be returned to the depot for repair The forecast is that 30 percent of future TC-2 computer failures will have to be returned to the depot for repair

Another example of the items reviewed by the GAO is included to illustrate equipment which is not completely modular in design and has integral features which limit to varying degrees the ability of a base maintenance shop to repair it A brief description of this example, with the repair procedure, is included

When the GAO conducted their review, the transmitter (drawing #2,[2] reflected a 6-day base repair cycle time and a need to return the item to the depot for repair 40 percent of the time Experience, to date, indicates 28 days have been required on the average to repair this item and 40 percent of all failures require depot level repair A description of this item, with the actions required to accomplish repair, is attached with the drawing

GAO notes

1 Page numbers refer to those in draft report

2 Drawings 1 and 2 referred to above have been omitted because they were not reproducible

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The purpose of providing these examples is to illustrate the differences that exist between initial design concepts and objectives and the actual hardware delivered to the inventory The thirty-nine items reviewed by the GAO are varied in the degree of module design involved and the NRTS percents and repair times must be varied accordingly

TRANSMITTER TYPE T-1084/APQ-130
P/N. 66700-506-21
FSN: 5841-005-6851BJ

DESCRIPTION:

The transmitter consists of an electron beam welded aluminum housing upon which are mounted the TWT, waveguide system, ION power supply and the cooling unit. The interior contains the electronic components which control operation of the transmitter, and which constitute the modulator The interior is divided into a high-voltage section and a low-voltage section. The high-voltage wet section is filled and pressurized by a liquid dielectric coolant (coolanol 25) which is circulated and cooled by the cooling unit The low-voltage section is pressurized by the compressed air source which pressurizes the entire waveguide system of the attack radar. It measures 22.3 X 16.6 X 11.0 inches and weighs approximately 155 pounds.

Maintenance concept for the intermediate or base level is to fault isolate to SRU level and remove and replace SRUs external to the high-voltage wet section. Existing intermediate level AGE will not fault isolate to components in the wet section This complicates the failure analysis in that external SRUs are sometimes removed unnecessarily Removal of the TWT or the cooling unit which is partly submerged into the wet section, items 9 and 19, are primarily the tasks which require extensive efforts to drain the cooling dielectric liquid from the wet section when it becomes contaminated. This effort is time consuming in that several processes are required to de-contaminate the wet section The liquid is evacuated under a vacuum with the aid of liquid nitrogen (LN_2). Then the unit is removed from the test stand (65AN) and a flushing fluid (TP25) is circulated in the wet section to remove all traces of the liquid dielectric and contaminants. The unit then must be inserted into a bake oven to dry the flushing fluid from the wet section. The unit is then returned to the fill test stand (65AN)and is re-filled under vacuum and tested for leaks. The transmitter is then placed on an automatic programmed test stand (6882) to perform functional testing with the new TWT or cooling unit installed. Test time is approximately 2 hours. If the transmitter is still faulty and failure is suspected to be in the high-voltage wet section, the transmitter is NRTS to the depot. All this effort is again

repeated by the depot when a failed component is removed from the wet section; specialized depot test equipment and skilled personnel are required to identify and accomplish repair in the wet section.

GAO Comment (Chapter 2, pages 10-15) Estimates used in determining Avionics Spares Requirements did not fully reflect advantages of modular design

Comment The FY72-3 computed requirement for the 39 A-7D and F/F3-111 avionics spares totaled $356 million including all War Readiness Spares Kit (WRSK) requirements Prior to review of these requirements by GAO, management actions were taken to defer the WRSK requirement Subsequent to the GAO review the requirements computation was reevaluated by using revised factors which resulted in a $79 million requirements reduction, leaving a balance of $277 million However, only $127 million was committed for procurement at the time of the GAO review

Continuing actions taken by the Air Force to augment and improve base maintenance capability have enabled the Air Force to achieve improvements in the elements reviewed by the GAO as follows

a Aggressive action in price negotiations has resulted in a stable or reduced unit cost

b The base repair cycle days, depot repair cycle days, return to depot percentage (NRTS%) and base order and shipping time factors used in the computation were developed considering the item's individual characteristics and the maintenance concept for each item The Air Force agrees that the factors used in June 1971 did not fully reflect the advantages of modular design Subsequent to June 1971, adjustments were made to these factors, which now fully reflect the extent of their design characteristics Schedules number one through four, attached hereto provide a comparison of the factors used in 1971 and the current factors for each of the four elements It should be noted that experience to date in many of these items has not yet attained the recommended goals In addition, it has been necessary to establish special support teams of contractor personnel equipped with depot level test equipment at Plattsburg and Cannon Air Force Bases (AFBs) to augment the base maintenance capability This action was required because intermediate Aerospace Ground Equipment (AGE)/software did not provide sufficient capability to fault isolate to a particular Shop Replaceable Unit (SRU) These augmentation teams will be maintained until such time as the intermediate AGE can demonstrate the capability to keep the LRU NRTS rate as low as that programmed for the intermediate AGE, and that the AGE will fault isolate to a true reparable module as the AGE specifications dictate

The times reflected on schedule #1 for base repair cycles are based upon the times being experienced on repair of these items with anticipated improvements The actual time required on one item is averaging 28 days excluding any delay for awaiting parts The Air Force will continue to assess base repair cycle time to attain the recommended goal.

Schedule #2 reflects the most optimistic NRTS percent considered attainable at this time for the items reviewed by the GAO The Air Force position with regard to establishing a standard for this factor is contained

in our comments on the related GAO recommendation

Information as to why items are returned to the depot for repair have been recorded in the computer system and are available to personnel determining requirements upon interrogation A revision to the system providing these data has been implemented, and the information is now automatically provided on a periodic basis

Schedule #3 reflects the order and shipping time used in the FY72-3 computation and the current factor The Air Force agrees that this factor reflected shipping times indicative of overseas and U.S. locations This time also is reflected in the depot repair cycle times as shown on schedule #4. Since usage of these items at the time of the GAO visit was forecast for only U.S. locations in most cases, the appropriate adjustment was made

SCHEDULE #1

BASE REPAIR CYCLE DAYS

	F/FB-111			A-7D	
	30 Jun 71	30 Sep 72		30 Jun 71	30 Sep 72
Item #	FY72-3	FY73-4	Item #	FY72-3	FY73-4
1.	6	4	1.	4	0*
2.	6	4	2.	10	6
3.	6	4	3.	10	0*
4.	6	7	4.	10	0*
5.	6	N/C	5.	10	2
6.	6	N/C	6.	10	2
7.	10	N/C	7.	10	2
8.	6	N/C	8.	10	3
9.	6	5	9.	10	3
10.	10	6	10.	10	2
11.	6	N/C	11.	10	2
12.	4	N/C	12.	6	0*
13.	4	N/C	13.	6	1
14.	4	N/C	14.	10	3
15.	4	N/C	15.	10	4
16	4	3	16.	10	4
17	3	N/C			
18.	3	N/C			
19.	5	N/C			
20.	5	N/C			
21.	6	N/C			
22.	10	4			
23.	6	4			

N/C - No Change

* these items are being managed under the Serialized Control and Reporting System (SCARS) The requirement to support base repair cycle time is being manually negotiated between the item manager and base activity.

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SCHEDULE "2

BASE NRTS PERCENT

Item #	F/FB-111 30 Jun 71 FY72-3	F/FB-111 30 Sep 72 FY73-4	Item #	A-7D 30 Jun 71 FY72-3	A-7D 30 Sep 72 FY73-4
1.	15	5	1.	20	30
2.	10	5	2.	20	20
3.	15	5	3.	20	35
4.	20	5	4.	20	N/C
5.	40	N/C	5.	75	5
6.	5	N/C	6.	10	N/C
7.	5	N/C	7.	30	15
8.	30	N/C	8.	98	5
9.	2	N/C	9.	5	N/C
10.	1	N/C	10.	5	N/C
11.	25	7	11.	5	N/C
12.	5	1	12.	70	63
13.	5	N/C	13.	30	N/C
14.	5	2	14.	5	N/C
15.	5	2	15.	5	N/C
16.	5	3	16.	70	20
17.	10	N/C			
18.	3	1			
19.	1	5			
20.	5	4			
21.	5	7			
22.	19	9			
23.	5	N/C			

N/C - No Change

SCHEDULE #3

ORDER AND SHIP TIME

	F/FB-111			A-7D	
Item #	30 Jun 71 FY72-3	30 Sep 72 FY73-4	Item #	30 Jun 71 FY72-3	30 Sep 7 FY73-4
1.	15	4	1.	5	0*
2.	15	4	2.	15	N/C
3.	5	4	3.	5	0*
4.	15	4	4.	5	0*
5.	15	4	5.	15	13
6.	15	4	6.	15	13
7.	15	4	7.	5	6
8.	15	4	8.	15	12
9.	15	4	9.	15	12
10.	15	4	10.	15	12
11.	15	4	11.	15	12
12.	5	4	12.	5	0*
13.	5	N/C	13.	15	N/C
14.	5	N/C	14.	5	6
15.	5	6	15.	5	6
16.	15	5	16.	15	N/C
17.	15	5			
18.	5	N/C			
19.	5	7			
20.	5	7			
21.	5	7			
22.	15	7			
23.	15	5			

N/C - No Change

* these items are being managed under the Serialized Control and Reporting System (SCARS). The requirement to support the order and shipping time is manually determined as a part of the negotiated base stock level.

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SCHEDULE #4

DEPOT REPAIR CYCLE

	F/FB-111			A-7D	
Item #	30 Jun 71 FY72-3	30 Sep 72 FY73-4	Item #	30 Jun 71 FY72-3	30 Sep 72 FY73-4
1.	37	21	1.	35	25
2.	29	15	2.	60	50
3.	37	21	3.	45	25
4.	25	14	4.	35	25
5.	37	26	5.	59	25
6.	29	18	6.	59	25
7.	29	18	7.	45	24
8.	37	26	8.	59	35
9.	29	18	9.	59	20
10.	29	18	10.	59	20
11.	29	18	11.	59	19
12.	18	15	12.	58	50
13.	18	16	13.	45	N/C
14.	18	16	14.	55	28
15.	18	17	15.	55	28
16.	26	20	16.	60	38
17.	40	21			
18.	18	20			
19.	20	22			
20.	20	24			
21.	20	18			
22.	43	33			
23.	36	31			

N/C - No Change

GAO Comment (Chapter 2, page 18)• "Inflated Factoıs Prevented Problems from Beıng Highlıghted"

Comment• The data elements used ın the requırements computatıon should reflect a reasonable estımate of the varıous segments of the logıstıc operatıon whıch they descrıbe, to ınsure that materıel necessary to support these operatıons can be obtaıned These data elements should not be artıfıcıally ıncreased to encourage an ıneffectıve operatıon nor should they be arbıtrarıly decreased merely to reduce materıel ınventorıes Eıther course of actıon results ın ıneffectıve operatıons

The repaır cycle tımes and the NRTS percentages revıewed by the GAO represented the best determınatıons avaılable to tne Aır Force at the tıme These factors were based upon ınputs from the manufacturers of the ıtems, usıng command personnel, engıneerıng and technıcal personnel, and consıdered both the desıgn of the ıtems and data reflectıng experıence on sımılar ıtems, as avaılable It ıs agreed that these factors dıd not fully reflect the objectıves establıshed for use ın the desıgn of the ıtems They dıd, however, represent the collectıve judgement of contractor, and Aır Force engıneerıng, technıcal and management personnel of the antıcıpated repaır and NRTS factors usıng the data avaılable at that tıme Subsequent to the tıme perıod of the GAO revıew the operatıons descrıbed by these data elements have been contınually measured, re-evaluated and ın many cases ımproved Thıs has been achıeved through ımprovement of test equıpment, maıntenance skılls, redesıgn of equıpment, changes ın maıntenance ınstructıons, and the use of contractor personnel and equıpment to augment base repaır, all of whıch could not be projected ın the earlıer requırements computatıons

The transportatıon tımes revıewed by the GAO were estımates ındıcatıve of both overseas and contınental Unıted States base locatıons Sınce only U.S. locatıons were ınvolved, these estımates could be and have been reduced

GAO Comment (Chapter 4, page 23 24)• Agency Action

Comment The Air Force has striven consistently to achieve an optimum balance between the cost of materiel and support effectiveness Many management techniques have been developed and implemented which have enabled reductions in cost without impairment of operational effectiveness The Air Force has, in many respects, led the way in the development and the use of high speed transportation and communications procedures, data processing techniques, and programs to achieve the integration of design and support in logistics management In addition, "prudent" risk taking has been a by-word in estimating materiel needs As a result, the cost of support materiel required as a percentage of weapon systems costs has been significantly reduced over time

This effort is being continued, some of the more recent efforts undertaken which are related to the subject of the GAO are listed below.

1 A study of the base repair cycle time was completed in July 1971 which resulted in a reduction of the base repair cycle to an average of six days used in the FY 72-3 computation.

2. A revision of the base repair cycle standard to six days for LRUs was completed in April 1972. This standard will be used in estimating time when experience data is unavailable

3 A revision of order and ship time standards to the latest MILSTRIP standards was issued in February 1972. This revision provides clarification of instructions to distinguish between CONUS and overseas locations

4. Revisions to the NRTS reporting system were completed in August 1972 These revisions make data more accessible and provide NRTS factors which have been adjusted to exclude NRTS actions resulting from lack of parts, base excesses and shop backlog

5 Revised definitions and explanations regarding the modular design concept are scheduled for publication in early 1973. These revisions will improve policy and procedural guidance on the development and implementation of the modular concept with emphasis on modularly designed equipment and systems.

6 An effort was undertaken in May 1972 to develop a system which will provide benefits similar to SCARS but with reduced manpower resources Scheduled for implementation in April 1973.

7 A new report was established providing visibility of actual base repair cycle time to item managers with breakouts of actions taken at base and returns to depot. The first report has been provided to the item managers with data as of 30 June 1972.

8 A report was established providing the inventory manager visibility of base order and shipping time by item, and in total by location The first report has been provided to the item managers with data as of 30 June 1972

9 Existing procedures were revised to provide explanation of relationships to be considered between LRUs and SRUs in the computation of requirements These revised procedures were published in September 1972

10 Headquarters materiel management personnel visited all AMAs to review the management of LRUs in April-May 1972

11 An AMA review and verification of base and depot repair cycle time, order and ship time, and NRTS percentage for all LRUs was completed in June 1972

APPENDIX II

PRINCIPAL OFFICIALS OF THE DEPARTMENT OF DEFENSE

AND THE DEPARTMENT OF THE AIR FORCE

RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES

DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
DEPARTMENT OF DEFENSE		
SECRETARY OF DEFENSE		
William P Clements, Jr (acting)	Apr 1973	Present
Elliot L. Richardson	Jan 1973	Apr 1973
Melvin R Laird	Jan 1969	Jan 1973
DEPUTY SECRETARY OF DEFENSE		
William P. Clements, Jr	Feb. 1973	Present
Kenneth Rush	Feb. 1972	Jan. 1973
David Packard	Jan. 1969	Jan 1972
ASSISTANT SECRETARY OF DEFENSE (INSTALLATIONS AND LOGISTICS)		
Arthur T. Mendolia	Apr 1973	Present
Hugh McCullough (acting)	Jan 1973	Apr. 1973
Barry J. Shillito	Feb. 1969	Jan 1973
DEPARTMENT OF THE AIR FORCE		
SECRETARY OF THE AIR FORCE		
Dr. Robert C. Seamans, Jr.	Jan. 1969	Present
UNDER SECRETARY OF THE AIR FORCE		
John L. McLucas	Mar. 1969	Present
ASSISTANT SECRETARY OF THE AIR FORCE (INSTALLATIONS AND LOGISTICS)		
Lewis E. Turner (acting)	Oct. 1972	Present
Philip N Whittaker	May 1969	Sept. 1972

	Tenure of office	
	From	To
DEPARTMENT OF THE AIR FORCE		
COMMANDER, AIR FORCE LOGISTICS COMMAND:		
General Jack J. Catton	Sept. 1972	Present
General Jack G. Merrell	Mar 1968	Sept. 1972