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Lessons concerning logistics and maintenance problems arising from the purchase of the British-built Harrier aircraft system can be applied to future procurements of weapons systems. Findings/Conclusions: Maintenance and logistics support problems resulted from inadequate and untimely planning and a lack of experience in purchasing weapons systems from other countries. The Navy could not obtain necessary technical data from the United Kingdom and could not establish a system to repair the aircraft. Supply support in the United Kingdom was hindered by: competition for available spare parts, British vendors not meeting delivery schedules, and poor turn-around time for items repaired by British vendors. Recommendations: In purchasing foreign weapons systems, the Secretary of Defense should promptly make logistic support analyses and develop maintenance plans to support the system, provide for a contractor to support the system until the military service can, and require that supplemental guidelines be issued for integrated logistics support planning. (Author/DJM)

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# *REPORT TO THE CONGRESS*



*BY THE COMPTROLLER GENERAL  
OF THE UNITED STATES*

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## Problems In Supporting Weapons Systems Produced By Other Countries

Department of Defense

Planning needs to be improved before weapons systems produced by other countries are purchased. Lessons learned after purchasing the British-built Harrier aircraft system can be applied to future procurements.

The Secretary of Defense should take the lead in providing guidance specifically for systems produced by other countries.



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

B-173850

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

This report describes the maintenance and supply support problems encountered as a result of the Navy's acquisition of the British-produced AV-8A Harrier V/STOL aircraft and suggests procedures to be used to avoid similar problems in future foreign procurements.

This review was done as a result of self-initiated research. After discussions with Marine Corps officials, we decided that the low operational readiness level of the aircraft was due, in part, to providing logistics support for a foreign-produced system. In anticipation of future foreign procurements, we have highlighted the unique support problems and have recommended procedures to be taken to avoid similar problems.

We made our review pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), the Accounting and Auditing Act of 1950 (31 U.S.C. 67), and 10 U.S.C. 2313(b).

We are sending copies of this report to the Secretaries of Defense and the Navy.

A handwritten signature in black ink, reading "James B. Starks".

Comptroller General  
of the United States

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ABBREVIATIONS

GAO           General Accounting Office  
ILS           integrated logistics support  
NARFs        naval air rework facilities  
NORM         not operationally ready because of maintenance  
NORS         not operationally ready because of supplies  
V/STOL       vertical or short takeoff and landing

D I G E S T

In 1969 the United States agreed to purchase AV-8A Harrier aircraft from the United Kingdom. By early 1976, 97 aircraft had been delivered and 13 more were under contract. This was the first operational major weapons system purchased from another country.

The U.S. Marine Corps has used Harriers since April 1971 but has continuously had maintenance and supply support problems with them. As a result, Harrier operational readiness (when aircraft can be flown safely and perform at least one primary mission) during fiscal years 1975 and 1976 averaged 42 and 41.4 percent, respectively. The established minimum goal was 60 percent. (See p. 15.)

Maintenance and logistics support problems resulted from inadequate and untimely planning and a lack of experience in acquiring and supporting systems from other countries. For example, the Marine Corps used support data from the United Kingdom, attempting to adapt it to the Navy support system rather than following the normal integrated logistics support planning process, which requires planning well before a weapons system is used. (See p. 5.) Since U.S. and British maintenance and supply support systems are different, problems arose causing the Navy difficulty in developing maintenance and supply support for the Harrier. (See p. 9.)

Instead of doing maintenance engineering analyses--a key integrated logistics support function--the Navy planned to use British data to determine technical data requirements, maintenance repair levels, and spare and repair-part requirements. However, in 1974 the Navy contracted for the necessary analyses. (See p. 10.)

Because it could not obtain necessary technical data from the United Kingdom, the Navy could not set up a system to repair the aircraft. Nearly 5 years after the Harrier entered the fleet, the Marine Corps depot could repair only about 30 percent--instead of the normal 90 percent--of the repairable components. (See p. 18.)

Since the Navy did not have plans good enough to project the quantity of spare and repair parts needed, specialized provisioning teams were sent to the United Kingdom to do this. These teams were assisted by the British vendors. The supply support was further hampered by

--competition with the United Kingdom for available spare parts,

--British vendors not meeting delivery schedules for spare parts, and

--poor turnaround time for items repaired by vendors in the United Kingdom. (See p. 18.)

The Navy began providing its own logistical support after only 6 months, even though it intended to have the contractor provide support for 18 months. The Navy felt it could do the job early--saving \$5 million--and did not want to invest the time to familiarize the British contractor with U.S. maintenance philosophy. (See p. 11.)

The Navy realizes that its first logistics support planning was inadequate and has improved maintenance and logistics support for the Harrier fleet. Besides contracting for maintenance engineering analyses, maintenance plans, and technical data, the Navy has used existing programs to help maintain the Harrier. Also, a special transportation plan was initiated to move Harrier parts more quickly. (See p. 20.)

GAO recommends that the Secretary of Defense make certain that the following integrated logistics support functions be completed when any weapons system produced by another country is procured.

--Promptly make logistic support analyses and develop maintenance plans to support the system.

--Provide for a contractor to support the system until the military service can.

GAO also recommends that the Secretary of Defense require that supplemental guidelines be issued for integrated logistics support planning involving the acquisition of weapons systems built by another country. The guidelines should provide for:

--Assessing early the compatibility of the maintenance and supply support systems of the producer and the intended users, identifying notable differences and their potential effects on the system.

--Identifying early the technical data requirements necessary to develop maintenance skills and support capability and assessing early the availability of such data.

--Assessing early the ability of foreign vendors to provide necessary parts and supplies promptly.

--Determining whether the producer can provide supply support for the system until the intended user can establish an adequate support system.

--Identifying early the problems expected in transferring support of the system from contractor to purchaser.

The Assistant Secretary of Defense (Installations and Logistics) agreed with the report and said the lessons learned from the AV-8A Harrier program will be passed on to all

associated with system acquisitions. He did not, however, comment on whether the supplemental guidelines advocated by GAO would be prepared.

The Navy agreed with GAO's recommendation to complete the integrated logistics support functions when purchasing a system, but disagreed with the recommendation to issue supplemental guidelines on the logistics support of a system produced by another country. Navy said existing instructions, though not geared specifically to such procurements, meet the intent of the recommendation.

GAO does not agree that Navy instructions meet the intent of its recommendation. Existing instructions were tailored after domestic acquisitions and do not address the specifics included in the GAO recommendation.

The Secretary of Defense should take the lead in providing the necessary guidance to deal specifically with supporting systems produced by other countries. (See p. 24.)

## CHAPTER 1

### INTRODUCTION AND BACKGROUND

The British-built AV-8A Harrier is a single engine, single seat aircraft capable of vertical or short takeoff and landing (V/STOL). (See p. 4.) It is the free world's first operational V/STOL fixed-wing aircraft and is intended to provide support to ground troops. Hawker-Siddeley Aviation Ltd. is the airframe manufacturer and Rolls Royce Ltd. is the engine manufacturer.

### DEVELOPMENT OF THE HARRIER

The Harrier was designed as a followup project to the Hawker P.1127--a V/STOL aircraft built by Hawker-Siddeley--and was first flown in October 1960. Hawker-Siddeley produced the Kestrel, a modified version of the P.1127, in 1965 through a program sponsored by the United States, the United Kingdom, and the Federal Republic of Germany. After evaluating this program, the U.S. Army, Navy, and Air Force each concluded that the Kestrel was not suitable for their purposes. The British proceeded with the program and developed the Harrier. It became operational in the British Royal Air Force in 1969.

### ACQUISITION OF THE HARRIER

The U.S. Marine Corps became interested in the Harrier after a 1967 demonstration of the aircraft. In 1968 the Marine Corps established a requirement for a V/STOL close-air-support aircraft, and in September of that year the Secretary of Defense approved a request for acquisition of the Harrier.

The United States began the procurement process with a memorandum of understanding signed in October 1969. This document indicated the United States' intent to purchase and the United Kingdom's agreement to sell the aircraft and related supplies and services.

The actual contract for Harrier production is between the United Kingdom and Hawker-Siddeley. Individual letters of offer and acceptance are negotiated annually by the U.S. Naval Air Systems Command and the United Kingdom's Ministry of Defense Procurement Executive. These letters serve in place of a contract and establish hardware quantities and detailed services, together with associated costs.

## CONGRESSIONAL INVOLVEMENT

During congressional hearings for the fiscal year 1970 defense budget, the Department of the Navy requested \$57 million to procure 12 Harriers and spare parts. At that time the entire Harrier program called for procuring 114 aircraft over a 4-year period at a cost of \$385 million. Later negotiations changed the purchase terms to 110 aircraft over a 5-year period. The Navy recommended procurement from the United Kingdom because it would:

- Fill an immediate need since the United States would require approximately 2 years and \$300 to \$400 million to develop a comparable V/STOL aircraft.
- Provide impetus for U.S. industry to begin developing a V/STOL aircraft.
- Provide a return on the \$85 million U.S. investment already expended during the Kestrel development program.
- Fulfill a special U.S. procurement commitment to purchase \$50.5 million worth of British goods.

During these hearings the Navy advised the Congress that certain U.S. aircraft manufacturers were negotiating with Hawker-Siddeley for a license to build the Harrier in the United States.

The Congress approved funding to procure 12 aircraft and initial spares in fiscal year 1970. At the same time congressional direction indicated that Harrier production should be transferred to the United States.

The Navy requested funds to procure 18 additional Harriers in fiscal year 1971 and permission to transfer Harrier production to McDonnell-Douglas Aircraft--the U.S. licensee of Hawker-Siddeley. The Navy favored producing the Harrier through an American licensee, although a program to accomplish this would require a longer period to complete and cost an estimated \$623 million--\$238 million more than the original estimate for procurement from the United Kingdom. Numerous benefits of U.S. production were cited, such as

- gold flow from the United States would be reduced,

- the U.S. Treasury would receive tax dollars from the American licensee,
- the U.S. aerospace and related industries would hire more workers,
- V/STOL technology would be introduced to U.S. industry,
- the United States would not have to rely upon the United Kingdom for logistics support.

The House Appropriations Committee turned down the Navy request for transferring Harrier production to the United States because of the higher cost. This position was upheld in a joint House and Senate Committee conference. Congressional direction was for procurement from the United Kingdom over a 5-year period at an estimated cost of \$503.6 million. This congressional direction led to subsequent procurement requests for the balance of 110 Harrier aircraft produced in the United Kingdom.

At the time of our review, 97 aircraft had been delivered and the remaining 13 were expected by March 1977. Two operating squadrons and a training squadron of Harriers were based at the U.S. Marine Corps Air Station, Cherry Point, North Carolina, and another operating squadron was based in Iwakuni, Japan.



THE AV-8A HARRIER

## CHAPTER 2

### SUPPORT PLANNING FOR THE HARRIER

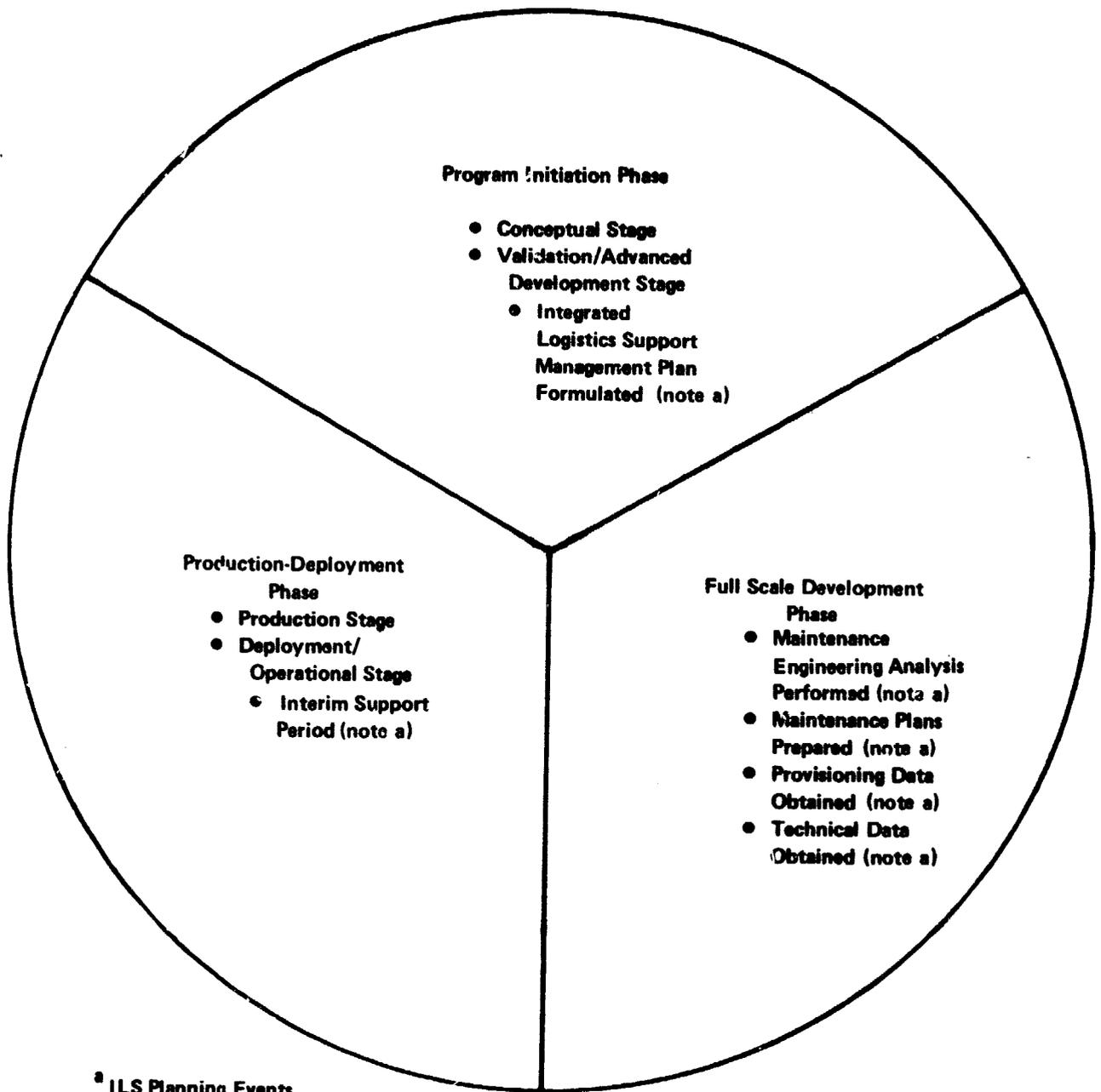
The Department of Defense uses the integrated logistics support (ILS) concept in acquiring defense equipment to make certain that adequate and timely logistics support will be available. ILS was set forth in 1964 to reduce the cost of weapons system ownership through a concentrated logistics management program in the early phase of a system's life cycle. It tries to identify in a systematic and orderly manner the functions which must be performed to operate and maintain new systems and the resources needed to perform those functions. The ILS concept, when applied to the acquisition process, normally is applied throughout program initiation, full-scale development, and production deployment. (See fig. 1A.)

However, the introduction of the Harrier into the Marine Corps inventory did not follow the normal ILS pattern. Instead of completing the ILS steps in the systematic manner shown in steps 1 through 3 of figure 1A, the entire ILS program for the Harrier was compressed into one step. (See fig. 1B.) Because of this compression some significant ILS steps were not completed and others were not timely. As a result, maintenance and supply problems were created which adversely affected the operational readiness and maintainability of the Harrier fleet.

### ILS IMPACT ON THE HARRIER

Since the Harrier was an aircraft developed by the British and acquired after it had become operational in the British Royal Air Force, the Navy initially anticipated getting much of the logistics support from the United Kingdom. The Navy also recognized that this unique acquisition would mean that ILS planning probably would not follow the normal process. Therefore, the Navy decided it would have to find a way to assimilate information and support from the United Kingdom and its prime contractor into an abbreviated ILS program, even though it might not lend itself to the accepted Navy way of doing business.

# NAVY WEAPON SYSTEM ACQUISITION AND ILS PLANNING EVENTS



<sup>a</sup> ILS Planning Events

Figure 1A

# COMPRESSION OF ILS PLANNING EVENTS HARRIER ACQUISITION

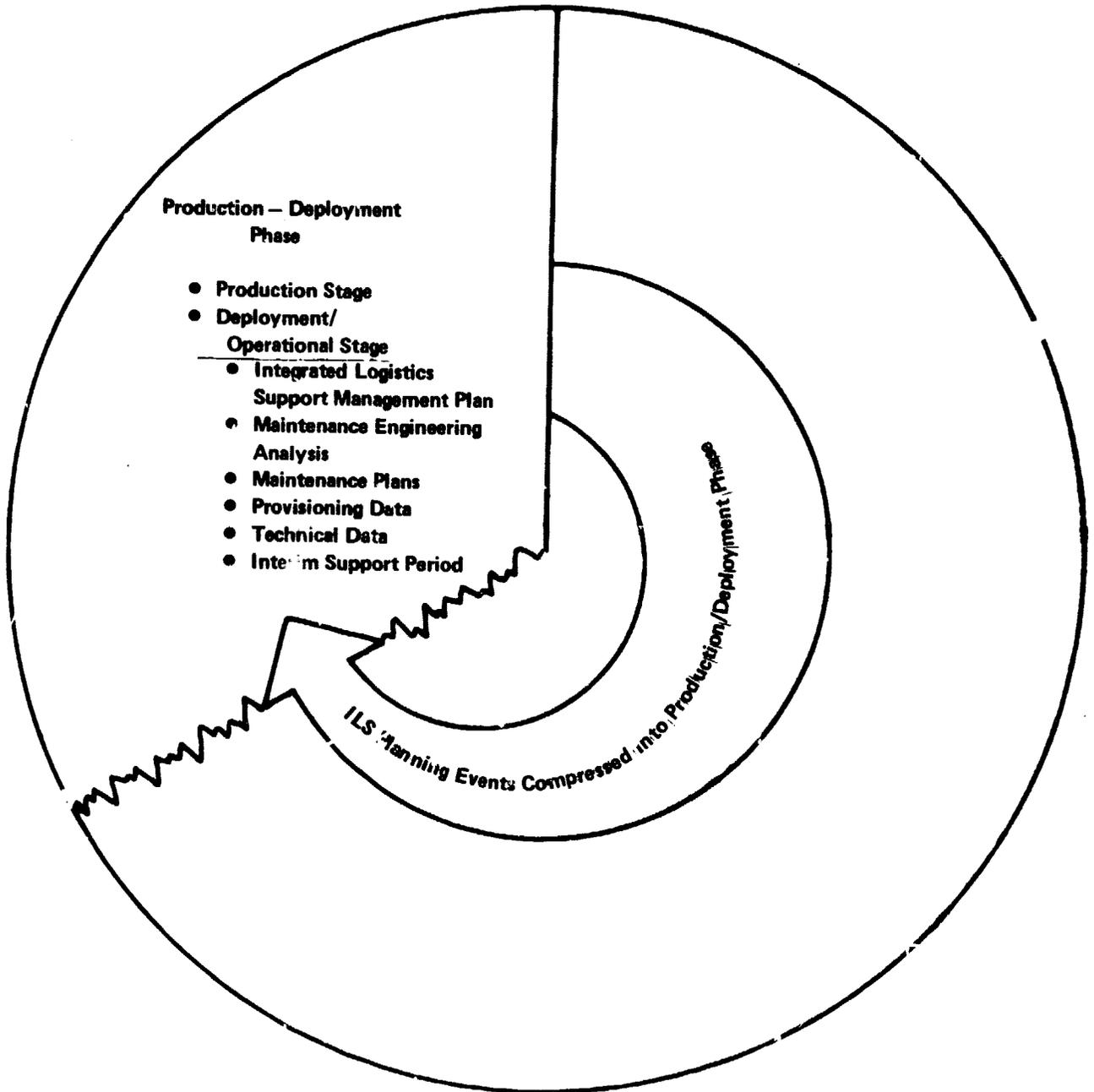


Figure 1B

## Maintenance engineering analyses 1/

A major problem arose early in the ILS program from the constraint of compressing all ILS steps into the production-deployment stage. This problem concerned one of the most important elements of ILS planning--maintenance engineering analyses. (Maintenance engineering analyses systematically identify maintenance requirements and resources needed to support the weapons system.)

The prime contractor normally conducts maintenance engineering analyses during the full-scale development phase of the acquisition cycle. As a product of maintenance analyses, the contractor also normally provides comprehensive maintenance plans for each significant subsystem of the weapons system. Some information identified by these plans concerns

- extent of maintenance to be performed at each of the three maintenance levels--organizational, intermediate, and depot;
- expected failure rate of each subsystem or component;
- identification of parts, tools, and test equipment required for maintenance;
- identification and description of all technical data necessary for maintenance tasks; and
- identification of all spare and repairable parts and the frequency with which parts should be needed.

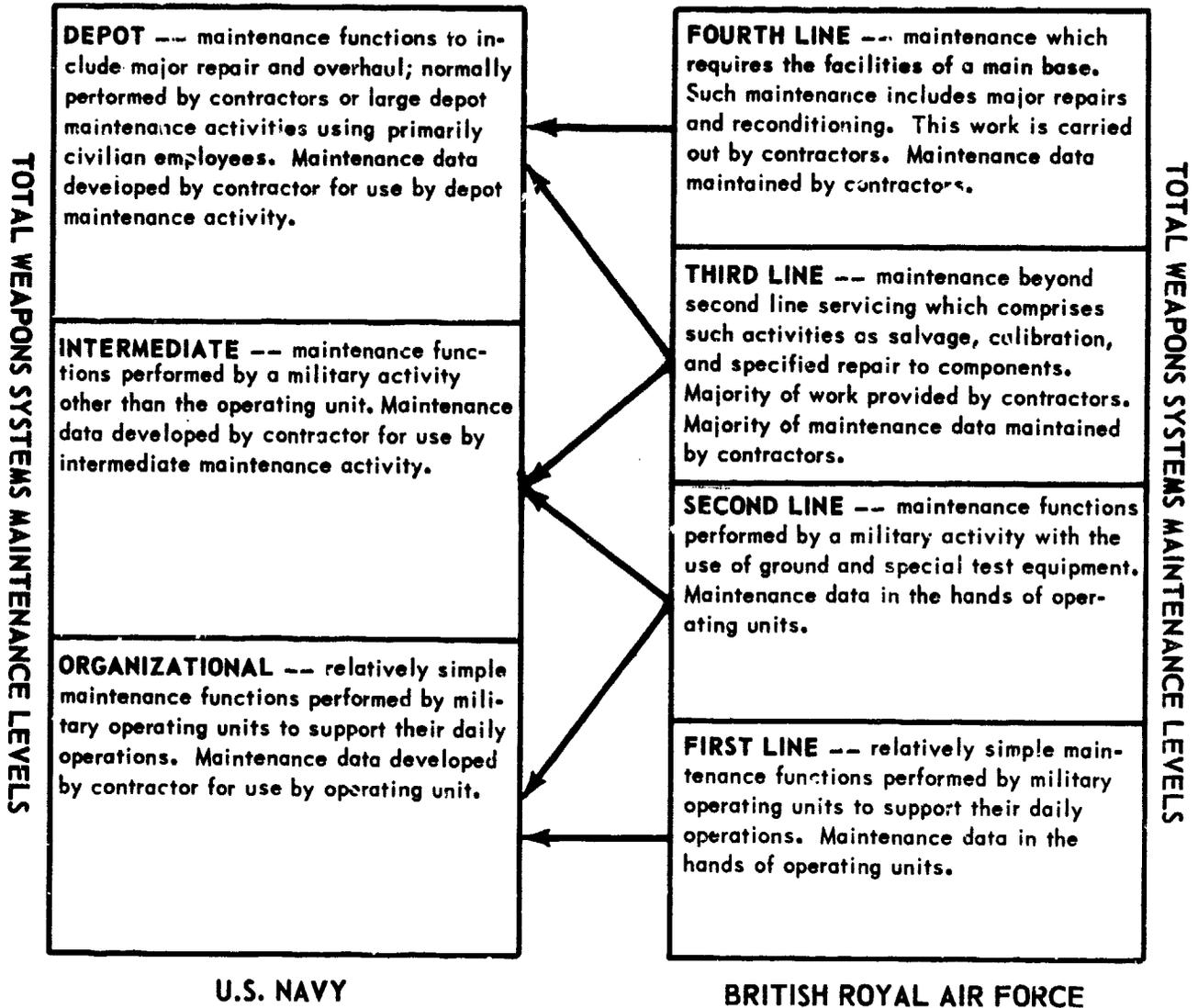
Since the Navy did not have its own prime contractor to conduct maintenance engineering analyses and provide detailed maintenance plans, it attempted to substitute information from the British Government, Hawker-Siddeley, and various sub-contractors as a basis from which to plan maintenance and logistics support for the Harrier.

As shown on the following page, a basic difference in maintenance levels exists between the United States and the United Kingdom. This difference precluded the Navy from

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1/Maintenance engineering analyses was the term used for this ILS step at the time the Harrier was purchased. The term was subsequently changed to logistic support analyses, but is basically the same function.

## MAINTENANCE LEVELS FOR U.S. AND BRITISH WEAPONS SYSTEMS



getting information necessary to adequately plan maintenance and logistics support for the Harrier.

In the case of the Harrier, the Navy did not envision the differences in maintenance philosophy or the impact this might have on establishing maintenance capabilities at the various levels. After recognizing that necessary technical data was not in the hands of the British Royal Air Force, the Navy requested that the information be provided by Hawker-Siddeley and its subcontractors. Hawker-Siddeley agreed, but subcontractors refused because they considered the information proprietary. The Navy could do little because the memorandum of understanding only provided that the United Kingdom would provide technical data to the extent it would not incur liability to others.

Another part of the ILS program that was adversely affected by the lack of adequate maintenance plans was initial provisioning for spares and repair parts. Since the Navy did not have provisioning data of its own, the initial Harrier spare and repairable parts lists were developed by specialized provisioning teams conducting onsite, indepth item selections with the assistance and engineering guidance of the respective British vendors. This provisioning effort was further hampered by the different maintenance philosophies of the Royal Air Force and the Navy.

Follow-on provisioning also presented problems. The Navy attempted to get parts-use data from the Royal Air Force but found that use data was maintained by the vendors that provided maintenance. When the Navy attempted to obtain use data from the vendors, it was confronted with problems similar to those encountered in attempting to obtain technical data.

It was not until 1974--over 3 years after receiving the first operational Harrier--that the Navy decided that maintenance and logistics support for its Harriers could not be adequately provided by the United Kingdom, Hawker-Siddeley, and the existing Navy support program. Consequently, in September 1974 the Navy contracted with McDonnell-Douglas Aircraft to perform 218 maintenance engineering analyses on problem components. McDonnell-Douglas was also required to develop related maintenance plans, which the Navy hoped would improve maintenance capabilities and logistics support.

## Contractor-provided logistics support

Normally for 18 to 24 months after initial delivery, the aircraft manufacturer furnishes required logistics support. This is called the interim support period. (See fig. 1A.)

Hawker-Siddeley prepared a plan under which it would provide logistics support for an 18-month period after the first 12 Harriers were delivered. However, before fully implementing the Hawker-Siddeley plan, the Navy decided it could reduce the investment of time required to completely familiarize the British contractor with the U.S. maintenance philosophy and save \$5 million by early transfer to Navy support. The Navy subsequently decided to move to Navy support after only a 6-month period.

The Navy later realized that it was unable to effectively provide the logistics support normally provided by the contractor. The lack of an adequate contractor-provided interim support period further contributed to continuing logistics support problems.

## ILS GUIDANCE NEEDED FOR FOREIGN-PRODUCED SYSTEMS

Both the Office of the Secretary of Defense and the Navy have issued extensive guidance on the development of ILS for major systems. However, because most of the system acquisitions are made from domestic suppliers, the guidance is based on domestic experience and does not reflect the peculiarities associated with acquisition from foreign governments/organizations. As the United States moves toward greater interdependence with the allies, foreign acquisition, no doubt, will take on added importance, accentuating need for more explicit guidance to deal specifically with foreign acquisitions.

As discussed in this chapter, the Navy encountered problems because the foreign producer could not provide adequate maintenance engineering analyses to develop maintenance plans. Problems also arose because the Navy decided on early transfer to Navy support rather than completing the contractor interim support period. These problems along with those discussed in the following chapter, which relate to obtaining necessary technical data and necessary parts and supplies from foreign vendors in a timely manner, cause us to believe that existing guidance is not adequate to deal with supporting foreign-produced systems.

## CHAPTER 3

### PROBLEMS IN SUPPORTING THE HARRIER

The inadequacy of Navy's planning efforts and insufficient experience in acquiring and supporting foreign-produced systems has resulted in (1) unmet minimum operational readiness goals, (2) complicated and ineffective maintenance and supply support, and (3) a reduction of the number of aircraft desired. The Navy is trying to cope with these problems and has taken actions which have improved the overall readiness and maintainability of the Harrier fleet.

#### READINESS GOALS NOT ACHIEVED

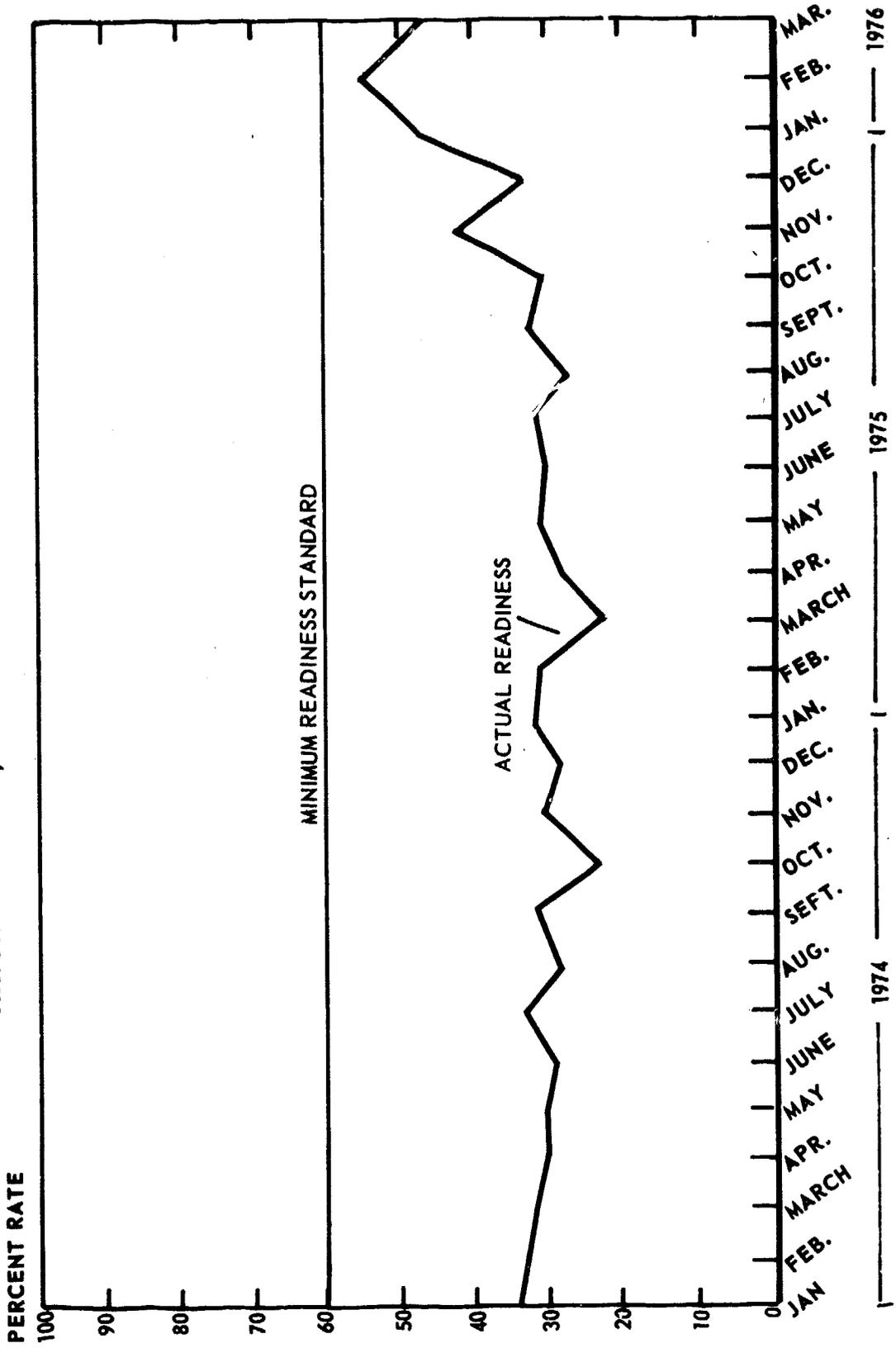
Navy squadrons classify aircraft into three major categories--operationally ready, not operationally ready because of supplies (NORS), and not operationally ready because of maintenance (NORM). An aircraft is considered operationally ready when it can be safely flown and can perform at least one of its primary missions.

The Navy has a peacetime readiness goal of 60 percent for tactical aircraft (including the Harrier). Although the Marine Corps has been operating the Harrier since April 1971, the Second Marine Aircraft Wing, which operates three of the four Harrier squadrons, has not achieved its readiness goal. As the chart on page 13 shows, monthly readiness levels from January 1974 through March 1976 ranged from 22 to 55 percent.

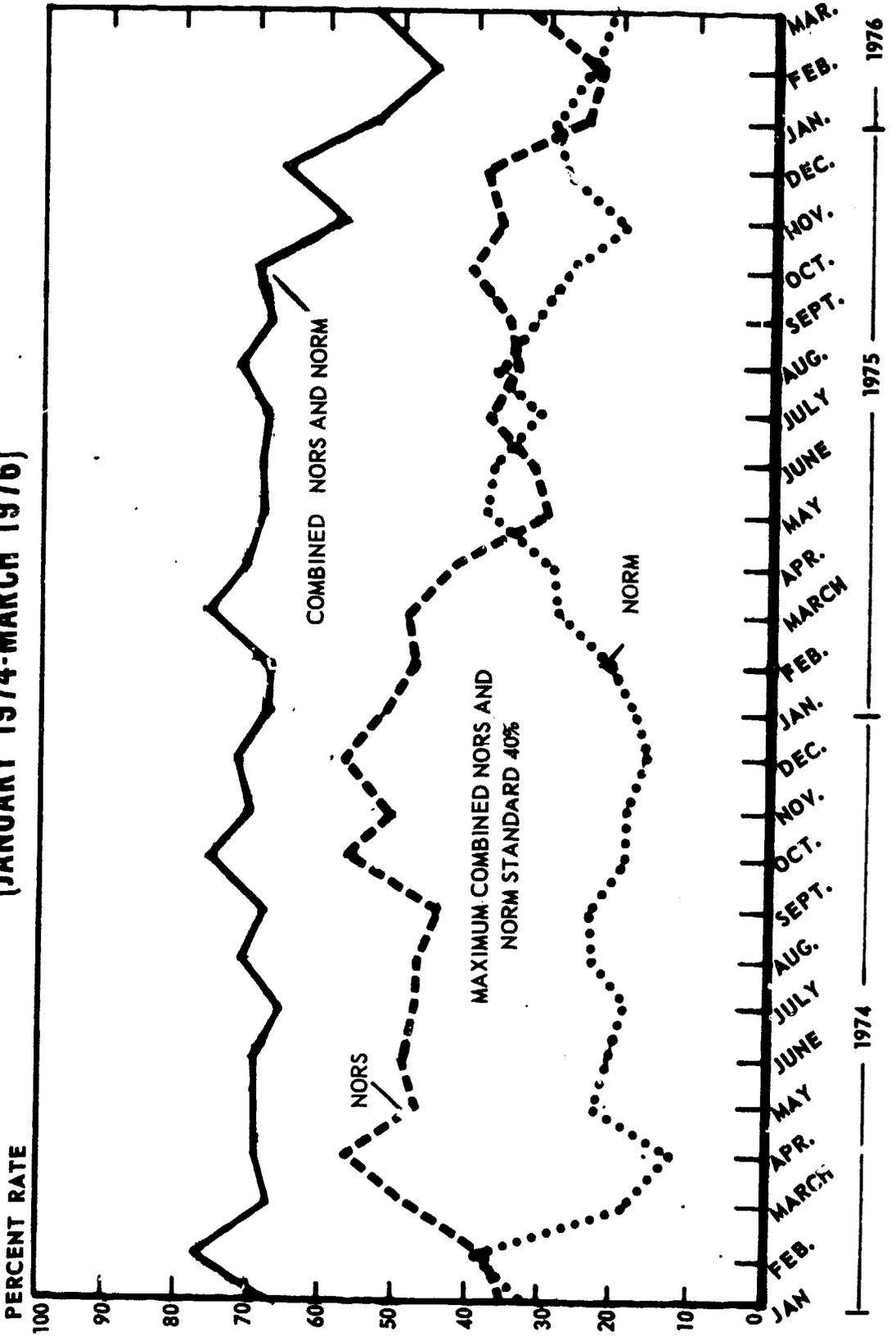
The overall operational readiness level is determined from the NORM and NORS readiness levels. The Navy does not have any separate goals for these two readiness categories, but as a combined total they should not exceed 40 percent. As the chart on page 14 shows, from January 1974 through March 1976, the monthly rate for NORS aircraft ranged from 22 to 57 percent and averaged 42 percent. In addition, the NORM aircraft rate ranged from 12 to 38 percent and averaged 25 percent. Thus, the combined average monthly rate of aircraft not operationally ready was 67 percent--well above the acceptable 40 percent level.

In commenting on our report, the Navy stated that our analysis focused on the operational readiness of Second Marine Aircraft Wing AV-8A aircraft and did not address the operations of the AV-8A squadron that has been deployed to the First Marine Aircraft Wing since August 1974. The Navy response showed that this squadron sustained an average

# MONTHLY READINESS LEVELS FOR HARRIER AIRCRAFT SECOND MARINE AIRCRAFT WING, JANUARY 1974-MARCH 1976



# MONTHLY NORS AND NORM RATES FOR SECOND MARINE AIRCRAFT WING (JANUARY 1974-MARCH 1976)



operationally ready rate of 70.7 percent during fiscal year 1975 and 48.2 percent during fiscal year 1976 while deployed.

We agree that this one squadron had a higher operationally ready rate but feel it should be recognized that this squadron represented only about one-fourth of the total aircraft in the fleet. The Navy provided operationally ready rates for all AV-8A aircraft, which showed an average readiness rate of 42 percent in fiscal year 1975, 41.4 percent in fiscal year 1976, and 40.6 percent in July 1976. While these average rates are slightly higher than the readiness rates indicated by our analysis, they are still well below the established 60-percent minimum goal.

The low readiness levels for the Harrier aircraft have had a direct effect on the number of flight-hours available for pilot proficiency. To maintain flying proficiency of its pilots, the Second Marine Aircraft Wing has flying requirements of 17 hours a month for squadron pilots and 10 hours a month for experienced staff pilots. However, the Wing reported that Harrier pilots have rarely been able to fly the required hours. For example, the pilots met the requirement for only 1 month in 1974, and none of the first 11 months of 1975. Thus, the Wing's proficiency may be jeopardized.

The Marine Corps' inability to attain readiness goals for the Harrier has been primarily caused by problems in the maintenance and supply support systems. Many of these problems can be directly attributed to the uniqueness of this procurement and the lack of adequate support planning.

#### MAINTENANCE SUPPORT FOR THE HARRIER

The Harrier is under the same organizational, intermediate, and depot maintenance system as other Navy and Marine Corps aircraft.

Organizational maintenance involves relatively simple functions necessary to support daily operations. Such functions include inspecting and servicing equipment and replacing defective parts. Individual squadrons are responsible for organizational maintenance.

Intermediate maintenance provides more complex support, including calibrating equipment, repairing or replacing equipment, and providing technical assistance to squadrons.

At Cherry Point, one intermediate maintenance activity serves the three Harrier squadrons.

The most extensive maintenance is done at the depot level. Overhaul and major repair of aircraft, engines, components, and related support equipment is included under this category. Depot maintenance is normally performed by the aircraft corporations that built the aircraft, commercial contractors which specialize in aircraft rework, and the six naval air rework facilities (NARFs) located throughout the country. Cherry Point is the designated NARF for depot maintenance of the Harrier.

Closely associated with these maintenance functions is the supply of necessary spare and repair parts. The Aviation Supply Office, Philadelphia, Pennsylvania, is responsible for procuring, cataloging, and distributing Navy and Marine Corps aviation spare parts and equipment throughout the world.

Maintenance and supply support for the Harrier has not been without problems. Some of the more serious problems have concerned developing a depot maintenance capability, transferring and using technical data, and obtaining parts and modification kits.

#### Delays in developing depot maintenance capability

Normally, after being in operation for 2 years, a Harrier should be processed through depot maintenance. The first Harrier was sent to the NARF in February 1973. This aircraft was inducted as a prototype and, while the NARF expected to complete maintenance in 100 to 120 workdays, it actually required 243 workdays. NARF officials attributed this delay to technical data problems and shortages of parts and modification kits, which precluded the NARF from establishing an adequate depot maintenance capability.

The next two aircraft were scheduled for depot maintenance during fiscal year 1974, but only one could be completed because technical data problems and parts shortages were still present.

In the first quarter of fiscal year 1975, three aircraft were placed into the depot maintenance process; however, once again the NARF was unable to complete maintenance due to a lack of parts and modification kits. These aircraft were scheduled to return to the Second Marine

Aircraft Wing after maintenance and certain modifications were completed. Since modifications were not completed, the Wing refused to accept them back into the operational fleet, and the aircraft were placed in outside storage at the NARF. (As of January 1976, two of the three were still in outside storage. See p. 19 for details concerning aircraft in outside storage.) Depot maintenance for five additional aircraft scheduled for fiscal year 1975 was canceled because of shortages of parts and modification kits.

The missing modification kits were only required for the first 30 aircraft delivered. Since these modification kits were still unavailable at the beginning of fiscal year 1976, the NARF began working on aircraft which did not require modifications. As scheduled, the NARF processed five aircraft through depot maintenance during the first half of fiscal year 1976. The time to perform maintenance on the aircraft exceeded estimates by an average of only 15 work-days. NARF officials attributed this success to (1) taking needed parts from newly received aircraft and installing the parts on aircraft further along in the maintenance process (backrobbing) and (2) obtaining parts from sources outside the normal supply system.

#### Technical data problems

To provide required maintenance support for the Harrier, the Marine Corps must have complete, accurate, and understandable technical data. Manufacturers usually provide publications of technical data as part of contract provisions. However, at all maintenance levels the Marine Corps experienced problems using technical data it had been provided. The problems have resulted to some extent because of differences between British and U.S. terminology. Some examples of these differences follow.

<u>U.S. terminology</u>	<u>British terminology</u>
wing	main plane
door	panel
wrench	spanner
flashlight	torch
plexiglass	perspex

Because of the terminology differences, U.S. maintenance personnel had problems understanding and using information in British technical publications. Moreover, officials at Cherry Point said that technical publications provided for

organizational maintenance were not geared to the skill level normally associated with the Marine Corps maintenance activities. As a result McDonnell-Douglas was contracted to re-write the technical publications for the Marine Corps organizational maintenance level.

The impact of the technical data problem is also evident at the depot maintenance level. The Cherry Point NARF has encountered many difficulties in obtaining necessary technical data. NARF officials told us that in domestic aircraft acquisitions, the NARF would develop the capability to repair at least 90 percent of repairable components in 1-1/2 to 2 years after initial involvement with the contractor. By December 1975, the Marine Corps had the Harrier about 5 years. Yet, the Cherry Point NARF could repair only 366 of 1,213--30 percent--of the repairable components of a Harrier. The NARF lacked technical data on 289 of the remaining 847 repairable components.

#### Shortage of parts, repairables, and modification kits

Parts shortages have been a problem for the Harrier. The manufacturer needs parts for production aircraft, and the Royal Air Force and the Marine Corps need parts for supply and maintenance support. According to aviation supply office officials responsible for Harrier supply support, this competition for spare parts has been a major contributor to long delays the Marine Corps has experienced in getting spare parts. Supply office officials also said that this problem could be aggravated when Spain begins to need spare parts to support Harriers it has purchased.

Parts shortages have also hampered engine overhaul and repair by causing work stoppages on the depot maintenance of the Pegasus F402 engine used in the Harrier. The expected time for an F402 engine overhaul is 64 days, but the average actual time on 21 overhauls has been about 155 days. Since February 1975, supply shortages have caused 11 work stoppages ranging from 14 to 87 days.

Another problem concerning Harrier aircraft involves repairable components. Since the Cherry Point NARF cannot repair many components, they are sent to contractors in the United States or the United Kingdom. However, these contractors have not been adhering to delivery schedules for returning components and turnaround time has been as long as 2 years.

Supply office officials said the long turnaround time is due, in part, to parts being stripped or damaged by Cherry Point personnel. For example, a supply office item manager said the repair turnaround time for the Harrier's receiver-transmitter had been increased due to the vendor's receipt of the item in a "cannibalized" condition. The vendor reported that five out of seven transmitters were missing power, amplifier, or generator modules when received for repair. It took the vendor up to 130 days to repair and return cannibalized transmitters, whereas uncannibalized transmitters were repaired and returned in about 50 days.

The lack of modification kits has adversely affected depot maintenance operations and the aircraft assigned to squadrons. As shown below, 14 operating aircraft were up to 19 months overdue for depot maintenance as of January 1976, but will not be worked on until modification kits are received.

<u>Months overdue</u>	<u>Number of aircraft</u>
6	1
7	1
12	2
13	4
15	3
18	2
19	1

#### REDUCTION OF OPERATING AIRCRAFT

In addition to adversely affecting the readiness of aircraft in the operational fleet, maintenance support problems have resulted in a reduction of the number of aircraft in the fleet. The first 12 Harriers delivered to the Marine Corps are no longer in the operating fleet. Two have crashed, two are used for testing, and the remaining eight are being stored at the Cherry Point NARF.

These eight aircraft, valued at approximately \$21 million, were transferred from the operational fleet during 1975 because they required depot maintenance and modifications. Limited depot maintenance, at a cost of \$124,000, was performed on two of the aircraft. However, since modification kits had not been received by early 1976, all depot maintenance on the eight aircraft was suspended.

Since arriving at the NARF, these eight aircraft have been stored outside in an unfenced area. Parts are not supposed to be removed from these aircraft without prior approval of the Naval Air Systems Command. Although such approval has not been granted, personnel from the NARF and from Cherry Point's operating squadron have removed and exchanged parts from these aircraft.

NARF officials have objected to storing the Harrier aircraft at the NARF because storage space is inadequate and security is limited. The officials explained that under current conditions, continued storage is detrimental to these aircraft. Hydraulic seals, fuel tanks, and gaskets are deteriorating, and the aircraft are corroding. Also, the limited depot maintenance previously performed on two aircraft may have to be repeated.

Naval Air Systems Command officials advised us that after our fieldwork had been completed the Cherry Point NARF received the modification kits and in June 1976 began working on a Harrier from storage. They plan to work on one aircraft per quarter if the necessary funds are available.

#### ACTIONS TO CORRECT PROBLEM AREAS

The Navy realized there might be problems in providing maintenance and logistics support for the Harrier. While it did not foresee all the problems that have arisen, intensified management has improved Harrier operational readiness.

In addition to contracting with McDonnell-Douglas for maintenance engineering analyses, maintenance plans, and development of technical data, the Navy has used existing maintenance support programs designed to help improve the operational readiness of any system.

The Component Pilot Rework program has been used since 1972 to assist the Cherry Point NARF to develop the capability to rework or overhaul Harrier components concurrent with the assumption of support responsibility of the end articles for the Harrier program. The program includes determining whether components can be economically overhauled, providing for necessary hardware and software procurements, and establishing configuration control of all procured elements.

The Closed Loop Aeronautical Management Program was also used for the Harrier. This program uses intensified management techniques to monitor and control spare, repairable

assemblies as they move through the various phases of logistics support. In this way the program attempts to maximize the availability of ready-for-use spare assemblies.

The Navy also implemented a transportation plan designed specifically for Harrier parts. The Harrier Movement Plan was used to insure visibility and expedited movement of material. It specifies how all Harrier material is to be shipped between countries. In addition, it calls for using freight forwarders and foreign carriers when necessary and for close monitoring and full documentation of material shipments.

A comparison of the transit times for different methods of moving parts shows the improvement in supply support as a result of the Harrier Movement Plan.

<u>From/to</u>	<u>Average days in transit (January to April 1975)</u>			
	<u>Movement plan</u>	<u>Commer- cial air (note a)</u>	<u>Defense trans system (note a)</u>	<u>Air par- cel post (note a)</u>
Cherry Point/London	3.0	5.2	11.1	13.1
London/Cherry Point	3.3	6.3	11.4	9.4
Cherry Point/Iwakuni, Japan	5.0	6.1	10.2	16.1
Iwakuni, Japan/ Cherry Point	4.0	5.1	10.0	14.0

a/Transit time based on surveys of past performance.

## CHAPTER 4

### CONCLUSIONS AND RECOMMENDATIONS

The Harrier is the first attempt by the United States to purchase major "off-the-shelf" weapons systems from a foreign ally. Consequently, it is not surprising to find unique problems which have seriously degraded the system's deployed readiness.

Operational readiness levels during 1974 and 1975 ranged from 22 to 43 percent, while the Navy has an established minimum goal of 60 percent for the Harrier when operating in a peacetime environment. Only in the early months of 1976--5 years after introduction into the operational fleet--has the Second Marine Aircraft Wing, which includes three of the four Harrier squadrons, experienced operational readiness levels more nearly approaching the established minimum goal.

The primary causes for Harrier aircraft readiness difficulties stem from inadequate integrated logistics support planning and a lack of specific guidance and experience in acquiring and supporting foreign-produced weapons systems. Introduction of the Harrier into the Marine Corps inventory did not follow the normal ILS planning process. Key ILS functions were compressed into a single phase of the acquisition cycle, rather than being completed in a timephased systematic approach normally envisioned for a weapon system acquisition. Because of this compression, maintenance engineering analyses were not performed, maintenance plans were not prepared, and other ILS functions were not timely. These difficulties contributed heavily to inadequate supply support and inability to establish adequate maintenance capability.

Other problems involved the different maintenance and supply support systems of the United States and the United Kingdom, inability of foreign vendors to provide necessary parts and supplies in a timely manner, inability of foreign contractors to supply all necessary support, and the transfer of support from a foreign contractor to the U.S. Marine Corps.

When the Navy realized it could not obtain the necessary maintenance support from the British contractors, it contracted with McDonnell-Douglas Aircraft to perform necessary maintenance support analyses and to develop a maintenance plan that would improve both maintenance capability and logistics support. This effort will further improve the readiness of the Harrier. The Navy has also been using

existing maintenance support programs as a further means of improving Harrier readiness.

In order that additional procurements, if any, of foreign developed systems will be less likely to encounter problems, such as those experienced on the Harrier, we recommend that the Secretary of Defense make certain that the following ILS functions are completed when any foreign-produced weapons system is procured.

- Timely performance of logistic support analyses (formerly maintenance engineering analyses) and development of maintenance plans for supporting the system.

- Provision for a contractor interim support period until the military activity which will have the operational system can develop complete support capability.

The experience gained on this first program to acquire a foreign-produced system also indicates a need for additional guidance to deal with the unique features of procuring a foreign-produced system that can adversely affect ILS for the system's life cycle. We recommend that as a minimum the Secretary of Defense require that existing ILS guidance be supplemented for a foreign-produced system to provide for:

- An early assessment of the compatibility of maintenance and supply support systems of the foreign producer and the intended user which identifies significant differences and their potential impact on providing support for the system.

- An early (1) identification of technical data requirements necessary to develop maintenance skills and support capability and (2) an assessment of accessibility to necessary technical data.

- An early assessment of the ability of foreign vendors to provide necessary parts and supplies in a timely manner.

- A determination of the likelihood of a foreign producer being able to provide supply support for the system until the intended user can establish an adequate support system.

--An early identification of problems which might be expected in transferring support of the system from a foreign contractor to the purchaser of the system.

In commenting on this recommendation, the Navy said it considers that existing Naval Material Command Instructions dated June 1975 fulfill our intent. The Navy agreed that the instructions do not specifically reference foreign-produced systems, but added that their purpose is to provide policy and guidance for all acquisition programs.

We believe the problems identified in this report were due, in part, to the lack of specific guidance in developing an ILS program to support a foreign-produced system. It is evident that existing ILS guidance was tailored after domestic acquisitions and further that there are unique characteristics associated with acquiring foreign-produced systems such as those identified in this report, which are not specifically addressed in the current guidance.

The Assistant Secretary of Defense (Installations and Logistics) agreed with this report and said the lessons learned from the AV-8A Harrier program will be passed on to all associated with system acquisitions. He did not, however, comment on whether the supplemental guidelines would be prepared.

We believe the Secretary of Defense should take the lead in providing the necessary guidance to deal specifically with ILS for foreign-produced systems.

## CHAPTER 5

### SCOPE OF REVIEW

Our review of the logistics and maintenance problems encountered by the U.S. Marine Corps in the support of the British-produced Harrier aircraft included:

- An examination of congressional hearings, Defense directives, and Navy instructions which explain integrated logistics support and contain policies and procedures.
- Discussions with officials connected with the Harrier aircraft and a review of documents at the Naval Air Systems Command.
- An analysis of readiness and maintenance statistics for Harriers at the U.S. Marine Corps Air Station, Cherry Point, North Carolina, and discussions with Marine aviation officials.
- Discussions with officials and a review of documents at the Naval Air Rework Facility.
- Discussions with officials and a review of documents at the Aviation Supply Office, Philadelphia, Pennsylvania.
- Review of contracts and discussions with officials of McDonnell-Douglas Aircraft.



OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE  
WASHINGTON, D. C. 20301

21 OCT 1976

INSTALLATIONS AND LOGISTICS

Mr. Fred J. Shafer, Director  
Logistics and Communications Division  
United States General Accounting Office  
Washington, D. C. 20548

Dear Mr. Shafer:

This is in reply to your letter of August 10, 1976 to Secretary Rumsfeld forwarding copies of your draft report, OSD Case No. 4430, "Problems with Providing Integrated Logistics Support to Foreign Produced Weapons Systems." We agree with your recommendations and consider that they would help alleviate like problems encountered in any acquisition of future foreign produced systems.

Department of Defense Directives are intended to apply to program management for foreign produced weapons systems as well as U.S. systems and delineate the responsibility of carrying out the integrated logistics support program as an integral part of the acquisition process. These management policies require a complete system approach for planning, analyzing, designing and managing the logistics support acquisition and include, timely performance of maintenance engineering analyses, provisions for interim contractor support and assessment of contractor performance in carrying out the logistic support approach. Further, we will assure that Service regulations and instructions are equally applicable to both foreign and domestic purchases to prevent future problems such as found in the Harrier acquisition.

The lessons learned from this program will be passed on to all associated with system acquisitions. In this way, future Program Office personnel may be made aware of the unique problems encountered in acquiring foreign produced systems. Upon receipt of the final report, we will assure that distribution is made throughout the Department of Defense for that purpose.

We have attached Navy comments for your consideration in finalizing this report.

Sincerely,

FRANK A SHRONTZ  
Assistant Secretary of Defense  
(Installations and Logistics)

Attachment  
Department of Navy  
Comments





DEPARTMENT OF THE NAVY  
OFFICE OF THE SECRETARY  
WASHINGTON, D. C. 20350

22 SEP 1976

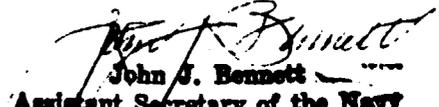
MEMORANDUM FOR THE ASSISTANT SECRETARY OF DEFENSE  
(INSTALLATIONS AND LOGISTICS)

Subj: GAO Draft Report, Problems with Providing Integrated  
Logistic Support for Foreign Produced Weapons Systems  
(OSD Case #4430)

Ref: (a) ASTSECDEF (COMPT) (A) memo of 17 Aug 1976

Encl: (1) Department of the Navy comments on subject  
Report

Enclosure (1) is forwarded in accordance with reference  
(a).

  
John J. Bennett  
Assistant Secretary of the Navy  
(Installations & Logistics)



**Department of the Navy Comments**

on

**GAO Draft Report of 10 August 1976**

on

**Problems with Providing Integrated Logistic****Support for Foreign Produced Weapons Systems, Code 947197****(OSD Case #4430)****I. GAO Findings and Conclusions**

The General Accounting Office (GAO) made an analysis of readiness and maintenance statistics for the Second Marine Aircraft Wing AV8A aircraft (the Harrier) at Marine Corps Air Station, Cherry Point, North Carolina. The GAO states that Second Marine Aircraft Wing AV8A aircraft operational readiness levels during 1974 and 1975 ranged from 22 to 43 percent while operating in a peace time environment. It wasn't until the early months of 1976, five years after the introduction of the AV8A into the operational units, that Second Marine Aircraft Wing Harriers experienced operational readiness levels more nearly approaching the established minimum goal.

GAO concludes the primary causes for the readiness difficulties stem from inadequate ILS planning and a lack of experience in acquiring and supporting foreign produced weapon systems. Further, the introduction of the AV8A into the Marine Corps did not follow the normal ILS planning process. Key ILS functions were compressed into the deployment and/or operational phase of the acquisition cycle. Because of this compression of ILS functions, maintenance engineering analyses and maintenance plans were not prepared. This contributed to the inadequate maintenance capability. Additional factors were the different maintenance and supply support systems of the United States and United Kingdom; the inability of foreign vendors to provide necessary parts and supplies in a timely manner; the problems associated with foreign contractors providing complete contractor support and the eventual transition of support from a foreign contractor to the military service operating the system.

GAO states that while the Navy did not foresee all the problems that have arisen, intensified management of these problems has improved the operational readiness, maintainability and logistic support of the aircraft.

## II. GAO Recommendations and Comments

GAO makes the following recommendations to SECDEF to take necessary action to ensure that additional procurements of foreign developed weapon systems, if any, will be less likely to encounter problems experienced by the AV8A.

Recommendation 1 - As a minimum, the following ILS functions must be completed when foreign procurement of a system is involved:

- (a) timely performance of maintenance engineering analyses with resultant maintenance plans for supporting the system.
- (b) provision for a contractor interim support period until such time as the military activity, which will have the operational system, can develop complete support capability.

Recommendation 2 - Existing ILS guidance be supplemented for a foreign produced system as follows:

- (a) an early assessment of the compatibility of maintenance and supply support systems between the foreign producer and intended user with identification of significant differences and potential impact on providing support for the system.
- (b) an early identification of technical data requirements necessary to develop maintenance skills and support capability with assessment of accessibility to necessary technical data.
- (c) an early assessment of the ability of foreign vendors to provide necessary parts and supplies in a timely manner.
- (d) a determination of the likelihood of a foreign producer being able to provide interim contractor supply support for the system until the user can establish an adequate support system.
- (e) an early identification of problems which might be expected in transitioning support of the system from a foreign contractor to the military service operating the system.

The Department of the Navy fully concurs with GAO recommendation 1 above. With regard to recommendation 2, we consider that existing Naval Material Command Instructions 4000.20B, "Integrated Logistic Support Planning Policy" and 4105.1A, "Contractor/Early Support for new weapons and equipment; utilization of" fulfill the GAO intent. While not specifically referencing either foreign or U. S. produced systems, their purpose is to provide policy and guidance for all acquisition programs independently of whether they be U. S., foreign, involve engineering development, or are "off-the-shelf."

It should be noted that the Maintenance Engineering Analysis process addressed under recommendation 1 has been superseded by the Logistic Support Analysis process described in Appendix D of NAVMAT Instruction 4000.20B.

With regard to foreign procurements by the U. S., including those on a government-to-government basis, all agreements should be sufficiently explicit to assure that DOD ILS requirements can, in fact, be fully realized and that differences between foreign and U. S. support practices will not become an impediment to a successful acquisition program.

The GAO analysis focused on the operational readiness of Second Marine Aircraft wing AV8A aircraft exclusively and did not address the operations of the AV8A squadron that has been deployed to the First Marine Aircraft Wing in WestPac since August 1974. This squadron sustained an average operationally ready rate of 70.7% during FY 1975 and 48.2% during FY 1976 while deployed. The readiness data for all Marine Corps AV8A aircraft operations are as follows:

	<u>OR</u>	<u>FSC</u>	<u>NORS</u>	<u>NORM</u>	<u>UTIL</u>
FY 75	42.0	33.9	38.7	19.6	19.7
FY 76	41.4	30.8	32.2	23.9	22.7
Jul 76	40.6	29.9	38.5	20.9	20.0

NOTE: OR - Operationally Ready (percent)  
 FSC - Full Systems Capability (percent)  
 NORS - Not Operationally Ready, Supply (percent)  
 NORM - Not Operationally Ready, Maintenance (percent)  
 UTIL - Utilization (average flight hours per aircraft assigned per month)

III. Discussion - The following comments apply to the pages and paragraphs of the report:

Page 2 (Digest), Para. (4)

Regarding inadequacy of provisioning approach apply:

Although maintenance plans were not available to the provisioning team, the varied types of data presented by the British contractors did not hamper the range selection for the Harrier items. As will be pointed out in later comments, some U. S. Navy provisioning actions preceded those of the RAF. In all cases, engineering assistance was provided by the JK prime vendors; therefore, the differences in the utilization of the aircraft by the RAF and USMC had little or no effect on the selection of repair parts. The absence of maintenance engineering analyses and maintenance plans did not significantly hinder the efforts of the provisioning team, and the item selection was consistent with existing USMC maintenance practices.

Pages 14, 15, and 16 - Maintenance levels for U. S. and British Weapons Systems

The chart should be revised to reflect the proper four levels of British maintenance as defined below:

Levels of Maintenance

The levels of maintenance for aircraft servicing in the Royal Air Force are first line through fourth line, with the first line representing the lowest echelon (organizational) for maintenance servicing/repair. Such four lines of servicing are as follows:

(1) First line servicing consists of those technical processes which must be carried out on an aircraft in use to maintain it fit for flight from day to day. The work comprises arming, disarming, flight servicing and scheduled servicing compatible with the servicing system in use, compliance with Special Technical Instructions (STI) and Servicing Instructions (SI) of a simple nature, diagnosis of random defects and rectification of those which are within the capacity of the limited technical resources provided. This work is accomplished by the skilled tradesman supported by a small nucleus of technicians, and such work does not normally require the use of costly test equipment or special working facilities to workshop standards.

(2) Second line servicing consists of those technical processes which must be carried out under qualified direction on aircraft which are temporarily out of use, to make them fit for use again. This line comprises minor and

major servicing weapon preparation, embodiment of prescribed modifications compliance with STIs and SIs and rectification of random defects beyond the capacity of First line servicing. The majority of this work is done by the advanced tradesman and requires the use of ground and special test equipment and facilities equivalent to the normal station workshop standards.

(3) Third line servicing consists of those technical processes which are normally beyond the resources of Second line servicing and comprises such specialized processes as salvage, repair on site, storage servicing, specified repair to components, calibration, test and embodiment of prescribed modifications.

(4) Fourth line servicing consists of those technical processes which require the facilities of a main base. Such servicing includes major repairs, reconditioning and general engineering. For economic reasons a proportion of this work is carried out by contractors.

NOTE: At the time of the U. S. Navy provisioning effort, the RAF had finalized provisioning determinations for first and second line servicing only.

It was therefore necessary, for most of the vendor systems/repairable items, to initially select the repair parts required for depot rework.

The Navy not only envisioned the differences in maintenance philosophy but provisioned in advance of the RAF to achieve support for the higher level of maintenance. This was accomplished by specialized provisioning teams conducting on-site, in depth item selections with the assistance and engineering guidance of the respective British Vendors.

The Ministry of Defense, Procurement Executive, UK and British contractors have been extremely positive in their attempts to correct the Marine Corps AV8A supply situation. The innate differences of the U. S. and U. K. aircraft production and support systems are the problems, not a specific lack of cooperation by the British personnel. The AV8A supply support situation is still not fully recovered and only by the requisite funds and extraordinary management actions will the AV8A supply support become totally satisfactory.

The AV8B acquisition and development program is more normally structured, with adequate funding and appropriate time for implementing complete ILS planning. This, in conjunction with a U. S. prime contractor (McDonnell-Douglas Corporation), will ensure that the introduction and operation of the AV8B will be supportable by established Navy procedures, although a significant portion of the aircraft systems will be subcontracted with the U. K.

PRINCIPAL OFFICIALS RESPONSIBLE FOR  
ACTIVITIES DISCUSSED IN THIS REPORT

	<u>Tenure of office</u>	
	<u>From</u>	<u>To</u>
<b>SECRETARY OF DEFENSE:</b>		
Donald H. Rumsfeld	Nov. 1975	Present
James R. Schlesinger	July 1973	Nov. 1975
William P. Clements, Jr. (acting)	Apr. 1973	July 1973
Elliott L. Richardson	Jan. 1973	Apr. 1973
Melvin R. Laird	Jan. 1969	Jan. 1973
<b>ASSISTANT SECRETARY OF DEFENSE (INSTALLATIONS AND LOGISTICS):</b>		
Frank A. Schrontz	Feb. 1976	Present
John J. Bennett (acting)	Mar. 1975	Feb. 1976
Arthur I. Mendolia	June 1973	Mar. 1975
Hugh McCullough (acting)	Jan. 1973	June 1973
Barry J. Shillito	Jan. 1969	Jan. 1973
<b>SECRETARY OF THE NAVY:</b>		
J. William Middendorf	June 1974	Present
J. William Middendorf (acting)	Apr. 1974	June 1974
John W. Warner	Apr. 1972	Apr. 1974
John H. Chafee	Jan. 1969	Apr. 1972
<b>COMMANDANT OF THE MARINE CORPS:</b>		
General Louis H. Wilson, Jr.	July 1975	Present
General Robert E. Cushman, Jr.	Jan. 1972	July 1975
General Leonard L. Chapman, Jr.	Jan. 1968	Jan. 1972