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BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Logistics Concerns Over Navy's Guided Missile Frigate FFG-7 Class

The Navy has developed many new logistics strategies for the FFG-7 class ships, which differ significantly from traditional practices in the surface Navy. It wants to reduce the number of shipboard personnel needed and increase ship availability. Questions remain, however, as to whether this will provide adequate and economical logistics support for the FFG-7s.

This report raises a number of issues about the feasibility and economy of the new logistics strategies and recommends actions to improve support.



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

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

This report discusses the many potential obstacles which threaten the success of the Navy's new logistics strategies for FFG-7 class ships. We made this review in response to the growing congressional concern about the significant increases in operation and maintenance costs for Department of Defense weapon systems.

Current plans call for over 50 FFG-7 class ships to be built, resulting in significant logistics support costs. This report identifies ways in which logistics support for the FFG-7 class ships can be achieved more effectively and efficiently.

We are sending copies of this report to the Director, Office of Management and Budget; the Secretary of Defense; and the Secretary of the Navy.

A handwritten signature in black ink that reads "Milton J. Fowler".

Acting Comptroller General
of the United States

D I G E S T

This report evaluates integrated logistics support planning for the Navy's guided missile frigate--FFG-7 class. It also raises concerns about the feasibility and economy of certain logistics strategies and concludes that, while the planning is comprehensive, the adequacy of support provided is contingent upon the successful implementation of new logistics strategies. GAO points out several areas for improving logistics support planning, as well as logistics alternatives for improving the economy and operation of the FFG-7 class ships. (See p. 12.)

The FFG-7s are a new class of ocean escort ships designed to operate in areas of low enemy threat. Projected program costs exceed \$10 billion to build an estimated 51 ships.

Integrated logistics support planning for the FFG-7s was designed to reduce the number of shipboard personnel needed and to increase ship availability. To achieve these objectives, several new approaches to logistics support were developed, which were previously untested in the surface Navy. The planning process for developing these strategies has been comprehensive; however, it could have been improved by keeping logistics plans up to date, estimating costs of logistics support strategies, and applying analytical approaches to developing logistics support requirements earlier in the acquisition process. (See p. 9.)

MAINTENANCE PLAN

The FFG-7 class maintenance plan is centered around a new approach to maintenance for surface ships called progressive overhaul, which relies heavily on (1) the removal and replacement of certain equipment or components at predetermined intervals and (2) short and intensive periodic maintenance actions. The feasibility and economy of this approach are yet to be demonstrated; however, its success

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is strongly dependent on the effective implementation of various logistics strategies. (See p. 16.)

Life-cycle logistics costs were not developed for the FFG-7 class ships. In 1980 the Navy studied the comparative costs of conventional and FFG-7 class crewing and maintenance practices. The Navy study indicated only that the FFG-7 class strategies were not more costly and noted that actual costs experienced would depend largely on the Navy's ability to accomplish FFG-7 class strategies as planned. GAO has identified many potential obstacles which threaten the success of the FFG-7 class strategies, including lack of skilled personnel aboard the ships and at maintenance facilities, the inability to accurately forecast material requirements for planned maintenance actions, and the need for a timely and accurate system for accomplishing and monitoring the maintenance plan. The Navy plans to further evaluate the cost effectiveness of the maintenance approach before expanding it to other types of ships. (See p. 19.)

OPPORTUNITIES TO REDUCE FFG-7 CLASS LOGISTICS COSTS

The Navy has opportunities to reduce FFG-7 class maintenance costs by using reliability centered maintenance. The basic principle of reliability centered maintenance is to perform only those tasks needed to retain designated levels of safety and reliability and has resulted in reduced maintenance costs in the commercial aviation industry. The Navy is using this technique for FFG-7 organizational level shipboard maintenance, but it needs to determine whether use of the technique can reduce intermediate and depot maintenance costs. (See p. 21.)

In developing shipboard supply support allowances, the Navy has not considered that the FFG-7 class maintenance plan calls for the removal of certain items at predetermined intervals. If the Navy did consider the periodic removal of equipment or components, it might find that unneeded repair parts are being stocked aboard ship. Since over 200 maintenance tasks require the planned removal of one or multiple items, it is important that the Navy consider this when determining shipboard supply support. GAO also found that inventory

being stocked to support intermediate maintenance activities appears to be excessive. (See pp. 26 and 28.)

The number of personnel an FFG-7 class ship could initially accommodate was arbitrarily set to meet acquisition cost objectives. Since then, both accommodations and personnel requirements have increased significantly, and controversy still exists over the appropriate crew size for the FFG-7s. Even though increases have occurred, fewer crewmembers are required for the FFG-7 class ships than similar classes of Navy ships. Apparently, the Navy will still have difficulty providing properly skilled enlisted personnel to the ships because of existing personnel shortages. Although this situation is a problem Navy-wide, it is particularly critical to the effective operation of FFG-7s because they have smaller crews, and therefore, any shortages are more noticeable. (See p. 37.)

Shore intermediate maintenance activities will play a major role in maintaining the FFG-7s. Although the Navy began a \$156 million program in 1977 to upgrade these activities to accommodate increased workload from the FFG-7s and other classes of ships, it appears that skill shortages among enlisted personnel will exist. In addition to these shortages, personnel trained to maintain FFG-7 unique equipment will not be fully available at intermediate activities until fiscal year 1983. Consequently, the Navy may have difficulty accomplishing maintenance actions within planned time frames, thus reducing availability of the ships. (See p. 45.)

RECOMMENDATIONS

To help ensure adequate and economical support for the FFG-7 class and to improve integrated logistics support planning, GAO recommends that the Secretary of Defense direct the Secretary of the Navy to:

- Make greater use of reliability centered maintenance if it can reduce maintenance costs for the FFG-7 class ships at the intermediate and depot levels.
- Consider the replacement frequency of end equipment in determining FFG-7 class shipboard spare parts allowances.

- Reassess stockage of the same items in colocated geographic and corrective maintenance stocks to avoid unnecessary duplication.
- Revalidate FFG-7 class crew requirements after new logistics support strategies are implemented.
- Reconsider previously rejected cost-benefit decisions for ship design and equipment alternatives to reduce crew requirements.

Other recommendations are contained on pages 24, 32, and 42.

AGENCY COMMENTS AND
GAO'S EVALUATION

The Department of Defense (DOD) commented that the report is factual, comprehensive, and objective. According to DOD officials, they recognize the criticality of the new logistics strategies to the success of the FFG-7 class maintenance plan and consider the concerns raised generally valid.

DOD agreed with most of GAO's recommendations. It did not agree that there may be excessive inventories or that it should reevaluate cost-benefit decisions on ship and equipment design to reduce crew requirements. GAO has analyzed DOD's comments and believes the report's points are valid and should be reassessed by DOD.

DOD's specific comments (see app. III) on each of the recommendations have been incorporated in the report where appropriate.

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ABBREVIATIONS

COSAL	coordinated shipboard allowances list
DOD	Department of Defense
GAO	General Accounting Office
ILS	integrated logistics support
IMA	intermediate maintenance activity
IMAV	intermediate maintenance availability
LSA	logistics support analysis
OSI	operational support inventory
RCM	reliability centered maintenance
SHAPM	Ship Acquisition Project Management
SRA	selected restricted availability
SSIP	Ship Support Improvement Project

CHAPTER 1

INTRODUCTION

In 1970 the Chief of Naval Operations directed that a study be made for the development of a new class of ocean escorts to replace the Navy's World War II destroyers, thus initiating the Navy's \$10 billion FFG-7 guided missile frigate shipbuilding program. The FFG-7 frigate is a surface combatant ship to be used to protect convoys, amphibious forces, and underway replenishment groups against subsurface, air, and surface attack.

The FFG-7 program is in the "low" part of the overall Navy strategy referred to as "high-low mix." Generally, this strategy refers to the need for (1) highly capable and high-cost cruisers and destroyers to serve in areas of severe enemy threat and (2) less capable and less costly ships to operate in areas where the enemy threat is less intensive.

In fiscal year 1973, the Congress provided funds to build the first ship of the class. Since then, the Congress has approved funding for the construction of an additional 44 ships. As the following table shows, current plans include a request for six more ships.

FFG-7 Procurement Program

<u>Fiscal year</u>	<u>No. of ships authorized</u>
1973	1
1974	0
1975	3
1976	6
1977	8
1978	8
1979	8
1980	5
1981	6
<u>a/1982</u>	3
<u>a/1983</u>	<u>3</u>
Total	<u>a/51</u>

a/Planned as of April 1981.

The average program acquisition cost per ship is about \$202.4 million, with total program acquisition costs estimated to be \$10 billion. The ships are being built at Bath Iron Works, Bath, Maine, and at Todd Pacific Shipyards Corporation in Seattle, Washington, and in Los Angeles, California.

FFG-7 CLASS LOGISTICS STRATEGIES

Navy logistics planners have developed a number of logistics strategies, some of which were previously untested in the surface Navy, to ensure effective logistics support for the FFG-7 class and other classes of ships. Specific strategies which are discussed in this report include:

- Progressive overhaul maintenance - A maintenance approach which relies heavily on shore-based maintenance and the planned removal of equipment to improve ships' material condition and to avoid frequent overhauls.
- Mission criticality oriented shipboard allowances - An approach for determining shipboard supply which considers, among other things, an item's criticality to the accomplishment of the ship's mission.
- Operational support inventory - A level of inventory designed to improve supply responsiveness to Navy ships and other facilities.
- Minimal manning - An effort to reduce shipboard personnel requirements through labor saving ship and equipment design and maintenance techniques.
- Upgraded shore maintenance facilities - A program to upgrade shore facilities to accommodate increased maintenance workload resulting from changes to naval ship maintenance practices.

LEAD SHIP CONCEPT

One unique aspect of the program was the use of the lead ship concept. Under this concept, the Navy planned a 2-year gap between the first and subsequent ships' contracts to allow adequate time for incorporating system/subsystem testing results into subsequent ship production. The lead ship of the class-- FFG-7, the Oliver Hazard Perry--was delivered on November 30, 1977, and the delivery of subsequent ships (FFG-8, FFG-9, etc.) was started on November 19, 1979.

Navy officials explained that implementing all of the new logistics support strategies just for the lead ship would not have been economical. Therefore, plans for implementing the new strategies were scheduled to support the subsequent ships.

OBJECTIVES, SCOPE, AND METHODOLOGY

Our primary objectives were to examine FFG-7 class integrated logistics support (ILS) planning and resulting logistics strategies to determine (1) ways to improve the logistics support planning process, (2) whether the strategies will provide adequate support, and (3) whether logistics alternatives were available to improve the economy and operation of the FFG-7 class ships. Additionally, since several of the FFG-7 class logistics strategies were previously untested in the surface Navy, we evaluated the strategies' feasibility and economy. Our review was limited to analyzing logistics issues for the FFG-7 class ships and did not address the individual ILS plans for equipment or systems carried aboard the ships. Further, since many of the front-end logistics decisions for the ship class had been made, we concentrated on the logistics strategies developed to support the ship class during its operation.

Our approach was to first examine the overall ILS planning effort and to assess its adequacy. We then examined each of the various ILS elements from the viewpoint of our review objectives. On the basis of our analysis, we identified three specific logistics issues for detailed examination--maintenance planning and execution, supply support requirements, and personnel constraints. To do our review, we used various Department of Defense (DOD) and Navy guidance on logistics management and ILS planning and generally accepted logistics management practices and procedures. Specific references to these criteria are identified as appropriate in the report.

Our analysis of certain logistics strategies (for example, progressive overhaul) was constrained because they were in the developmental or early stages of implementation. Consequently, actual data upon which to measure the effectiveness and efficiency of the strategies was not always available. In those instances, we raised specific concerns about actions needed to ensure effective implementation of the strategies. Where actual data on logistics performance was available, we used it in our analysis.

We met with numerous DOD and Navy officials whose responsibilities included ship acquisition and ILS planning, development and implementation of supply and maintenance strategies, management and accomplishment of maintenance actions, ship construction and operation, maintenance facilities construction, and personnel assignments. We also reviewed pertinent DOD and Navy regulations and documents, memoranda and other data on the planning and implementation of the logistics strategies, and related GAO (see app. II), Defense Audit Service, and Naval Audit Service reports.

We did the fieldwork from June to October 1980. We visited the following DOD activities in the Washington, D.C., area:

- Office of the Secretary of Defense, Assistant Secretary (Manpower, Reserve Affairs and Logistics).
- Deputy Chief of Naval Operations (Logistics).
- Naval Sea Systems Command.
- Naval Military Personnel Command.
- Naval Supply Systems Command.
- Deputy Chief Naval Operations (Surface Warfare).

We also visited the following Navy field activities:

- Supervisor, Shipbuilding, Conversion, and Repair, Bath, Maine.
- Navy Ship Parts Control Center, Mechanicsburg, Pennsylvania.
- Headquarters, Naval Surface Forces, Atlantic, Norfolk, Virginia.
- Naval Air Station, Jacksonville, Florida.
- Supervisor, Shipbuilding, Conversion, and Repair, Mayport, Florida.
- Naval Station Mayport, Mayport, Florida.
- Naval Maintenance Support Office, Mechanicsburg, Pennsylvania.
- Office of Planning and Engineering for Repairs and Alterations (Cruisers and Destroyers), Philadelphia, Pennsylvania.
- Naval Ship Engineering Center, Mechanicsburg, Pennsylvania.



COURTESY OF U.S. NAVY

FFG-7, OLIVER HAZARD PERRY

CHAPTER 2

FFG-7 CLASS INTEGRATED LOGISTICS

SUPPORT PLANNING

ILS planning for the FFG-7 class has been extensive and calls for the implementation of several unique logistics strategies which were untested in the surface Navy. These strategies are designed to increase ship availability and reduce shipboard crew requirements. The adequacy of support provided by the plan is contingent upon the successful implementation of new supply, crewing, and maintenance strategies, but their effectiveness cannot yet be assessed.

Certain factors may adversely affect the effective implementation of the strategies, and more cost-effective alternative logistics strategies should be considered.

WHAT IS ILS PLANNING AND WHY IS IT NECESSARY?

ILS planning is the process which identifies, in an orderly manner, the functions which must be done to support the operation and maintenance of a system and the resources needed to accomplish these functions. The objective of ILS planning is to ensure that a system is provided effective and economical logistics support during its life cycle. Basic DOD and Navy guidance on ILS planning, set forth in DOD Directive 5000.39 and Naval Material Command Instruction 4000.20B, stresses that ILS planning is an inherent part of the acquisition process. A comprehensive ILS plan should address

- the maintenance plan;
- manpower and personnel;
- supply support (including initial provisioning);
- support and test equipment;
- training and training devices;
- technical data;
- computer resources support;
- packaging, handling, storage, and transportation; and
- facilities.

This guidance stresses that ILS planning should be initiated in the early stages of the acquisition process and should continue through the system's operational life. An ILS plan should be structured to meet program system readiness objectives, that is,

peacetime readiness and wartime employment, within established cost, schedule, performance, and logistics constraints. Early ILS planning is essential to ensure that logistics considerations and trade-offs are addressed during the equipment design.

A key ILS process is logistics support analysis (LSA) described in Military Standard 1388. LSA is the use of analytical tools and models throughout the acquisition cycle to evaluate trade-offs between system design and ILS elements and among the ILS elements to meet system readiness objectives at minimum costs. For example, a particular maintenance plan may not be feasible when supply support costs and personnel requirements are considered. As a logical extension of the LSA process, an LSA file should be developed. The file becomes a central data source for such logistics decisions as provisioning supply support, preparing technical publications, planning maintenance, distributing resources, determining personnel requirements, and identifying facilities requirements. The file is maintained throughout the system's life and should be updated as necessary to provide a single source of information for logistics managers.

LOGISTICS PLANNING RESPONSIBILITIES FOR THE FFG-7s

Logistics support planning for the FFG-7 class began in 1971 during the early stages of the acquisition process. The Naval Sea Systems Command's FFG-7 Ship Acquisition Project Management (SHAPM) Office developed the ILS plan and its logistics strategies. Currently, logistics support planning responsibilities for the FFG-7 class are divided between the SHAPM Office and the command's Ship Support Improvement Project (SSIP) Office. ^{1/} This was done because the Navy felt that many of the logistics strategies being developed were outside the scope of usual SHAPM Office logistics planning capabilities and resources.

Generally, the SHAPM Office plans logistics support on the ships, and the SSIP Office plans logistics support off the ships. The division of responsibilities has been set forth in a series of memoranda of agreements between the offices, and activities have been coordinated through formal and informal channels. The chart on page 8 shows major ILS milestones for the FFG-7 class.

^{1/}For more detailed information on the SSIP, see our report, "The Navy's Ship Support Improvement Project" (LCD-78-433, Sept. 12, 1978).

**MAJOR INTEGRATED LOGISTICS
SUPPORT MILESTONES -- FFG-7 CLASS**

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
SHIP DELIVERIES														
● FIRST DELIVERY					● ○									
● FINAL DELIVERY														● ○
MAINTENANCE PLANNING AND MANAGEMENT														
● SHIP MAINTENANCE PLAN COMPLETED					●		○							
● MAINTENANCE MANAGEMENT SYSTEM OPERATIONAL									○ ●					
SUPPLY SUPPORT														
● EQUIPMENT LOGISTICS SUPPORT ANALYSIS COMPLETE						●			○					
● OPERATIONAL SUPPORT INVENTORY IN PLACE									○ ●					
PERSONNEL AND TRAINING														
● SHIPBOARD REQUIREMENTS VALIDATED						●		○						
● TRAINING STARTED		● ○												
FACILITIES UPGRADE														
● INTERMEDIATE LEVEL COMPLETED										●			○	
● DEPOT REWORK COMPLETED									● ○					
TECHNICAL DOCUMENTATION														
● INTERMEDIATE AND DEPOT LEVEL									● ○					
● SHIPBOARD					● □									

- PLANNED (ORIGINAL)
- ACTUAL OR ANTICIPATED
- PARTIAL DELIVERY

ILS PLANNING IS COMPREHENSIVE,
BUT SOME IMPROVEMENT IS NEEDED

Whether the ILS plan for the FFG-7 class will result in adequate operational logistics support cannot yet be conclusively determined. However, logistics considerations clearly have influenced ship design and equipment selection, and extensive effort has been devoted to developing logistics support planning for the FFG-7 class. Although the SHAPM Office did not maintain specific cost data on logistics planning and support, the SSIP Office estimated that it will spend \$408 million on planning and providing FFG-7 class logistics support between fiscal years 1975 and 1985. Notwithstanding the above efforts, the ILS planning process could have been improved by

- keeping logistics plans up to date,
- introducing LSA earlier in the acquisition process, and
- identifying life-cycle costs of new operational support strategies.

Efforts to enhance
logistics support

Logistics planners for the FFG-7 class initiated numerous efforts during ship design to ensure that operational objectives were realized and logistics support was enhanced. Some of the more significant efforts were:

- Through a process referred to as "design criteria for logistics elements," efforts were made to ensure that the ship designer provided access for equipment maintenance and equipment removal for overhaul and repair. As a result, a document was developed which lists the equipment requiring accessibility and removability, showing weight dimensions and other pertinent factors. Clear vertical and horizontal paths for moving equipment have been established. Equipment removal instructions and route diagrams are provided to each ship and maintenance activity. (See app. I for an illustration of the planned removal routes.)
- To achieve standardization between the ships in the class, several efforts were taken. These included using validated drawings for the follow-on ships and standardizing major contractor-furnished equipment through mandatory procurement options.
- To reduce shipboard personnel requirements, the ship design includes a centralization of administrative offices, ship store, galley, and habitation areas. Additionally, automated equipment was included to reduce personnel in the

engineering and combat systems departments, and increased use was made of modular components to facilitate maintenance actions.

As the FFG-7 class ships are altered to add new weapon systems and increase accommodations, the initial design efforts to enhance logistics support must be maintained to ensure that the ships' full benefits are realized.

ILS plan should be updated

Naval Material Command Instruction 4000.20B requires that an ILS plan be developed for each weapon system acquisition. Management uses the ILS plan to ensure the timely accomplishment of the various ILS elements, to identify what tasks must be developed, and to assign responsibility for accomplishing these tasks. The plan should be kept current throughout the system's development, production, and deployment phases.

A 1980 Naval Audit Service report found, however, that the FFG-7 class ILS plan had not been updated since 1975. The report stated:

"Extensive changes in ship weapon systems configuration, manning requirements, training requirements, delivery schedules, and procurement quantities have not been incorporated. Consequently, the plan does not provide management a tool that can be used to assure timely and effective accomplishment of all assigned logistics tasks by responsible organizations."

In addition to these concerns, information on the plans and milestones for operational logistics support strategies being developed by the SSIP Office should also be updated to ensure their timely and effective implementation. Navy officials stated that the plan would be updated by June 1981.

LSA should be introduced earlier in the acquisition process

The LSA process, although required to be initiated early in the acquisition process, was not started until 1975 when the program was in the full-scale engineering development phase. Consequently, this process was of no value in making initial shipboard logistics decisions, such as

- determining personnel requirements,
- developing trade-off analyses between equipment design and logistics requirements,

- determining preventive maintenance requirements,
- establishing training requirements for crews,
- identifying technical manuals required for equipment maintenance,
- identifying support and test equipment requirements, and
- provisioning initial supply support.

Navy officials explained that the LSA process was not being widely used in the early 1970s when FFG-7 class logistics planning was implemented and pointed to the Navy's past efforts to consider logistics in ship design and construction. They pointed out that when they decided to develop LSA, its express purpose was to assist in effectively implementing the various logistics strategies to support the FFG-7 class during its operation. Originally, the LSAs were to be completed and approved by September 1978; however, a Navy official estimates that this process will not be completed until the latter part of 1981. Navy officials stated that delays in LSA were caused by increases in the number of equipments to be analyzed and late approval of LSAs. As discussed in chapters 3 and 4, the LSA data is a critical element in developing maintenance and supply requirements for the FFG-7 class, and its delay has contributed to problems in identifying material requirements for maintenance availabilities.

Once the LSA process is completed and the LSA file is fully operational, LSA should be a valuable tool to logistics managers by providing such information as

- frequencies for the planned removal of certain equipment,
- number and types of repair parts required during planned maintenance periods,
- support and test equipment requirements, and
- technical data required to perform maintenance actions.

Life-cycle costs should be identified

As previously mentioned, Navy planners have developed a number of new or unique logistics strategies for the FFG-7 class, such as:

- A maintenance strategy referred to as progressive overhaul.
- The establishment of protected levels of stocks at the retail level to improve supply support.

--A program to expedite the repair of depot level equipment.

--The establishment of a program for rotatable pools of spares.

These and other strategies are in various stages of implementation or development.

Implementing these strategies will cost a great deal of money. Navy regulation requires that cost data be developed for logistics support as part of the ILS process. However, Navy officials stated that they were not aware of efforts to determine life-cycle costs of these strategies.

Navy officials also stated that savings resulting from the reduced crew requirements would outweigh any increased cost resulting from implementing the other strategies. While this may or may not be true (see ch. 5), it does not negate the need to identify life-cycle support costs. Such an exercise may have shown a certain strategy to be particularly costly, and managers could have considered less costly alternatives which were consistent with personnel and operational goals.

FFG-7 CLASS LOGISTICS PROBLEMS AND ALTERNATIVES

The FFG-7 class ships represent a significant expenditure of defense dollars. To assure that maximum benefit is received from this investment, the ships must be adequately supported. As more ships are deployed, logistics support requirements will increase rapidly. If Navy logistics planners and managers address the following issues, the adequacy of FFG-7 logistics support should improve:

--The expanded use of reliability centered maintenance (RCM) may reduce maintenance costs for the class. The basic principle of RCM is to do only those tasks needed to retain designated levels of safety and reliability. RCM is currently being applied to shipboard maintenance. We believe its use at other levels of maintenance should reduce logistics costs. (See ch. 3.)

--The successful implementation of the progressive overhaul maintenance strategy depends upon the Navy's ability to (1) plan and monitor maintenance actions, (2) provide effective supply support, and (3) ensure that intermediate maintenance activities can accomplish required maintenance. Questions remain as to whether maintenance tasks will be accomplished as planned. Additionally, the cost of implementing the strategy should be closely monitored. (See ch. 3.)

- Supply support strategies for determining shipboard spares and repair parts do not appear to be consistent with the maintenance strategy and should be changed. Additionally, retail inventories to support the ships appear to be excessive. (See ch. 4.)
- Problems experienced in providing initial supply support to the ship class should be closely monitored. (See ch. 4.)
- To meet acquisition cost considerations, the FFG-7 class crew size was arbitrarily set below formal crew size estimates. Actual experience has shown, however, that additional crewmembers have been added, increasing estimated life-cycle crew costs by about \$828 million. About \$70 million more will be required to increase shipboard accommodations for the increased crew size. (See ch. 5.)
- Although the FFG-7 class was designed for minimum manning and requires a full crew in both quantity and quality to accomplish mission objectives and maintenance goals, Navy personnel resources are not sufficient to meet these requirements. Furthermore, shore facilities, which are vital to the FFG-7 class maintenance plan, will fall short of personnel quality requirements. (See chs. 5 and 6.)

CONCLUSIONS

Although some improvements could have been made in planning, life-cycle costing, and LSA, ILS planning for the FFG-7 class ships has been comprehensive and has resulted in the development of new and innovative logistics strategies. These strategies represent an effort to eliminate costly depot level overhauls, increase ship availability, reduce shipboard crew requirements, and maintain a more constant level of ship material condition. The Navy is to be commended for the innovative approach it has taken in developing logistics support plans for the FFG-7 class ships.

The adequacy of support provided by the logistics strategies in the plan cannot yet be conclusively determined. However, we believe the Navy should consider certain logistics concerns and alternatives to improve the ILS planning process, to help ensure adequate logistics support, and to reduce logistics support costs. Our recommendations are included in chapters 3, 4, and 5.

CHAPTER 3

FFG-7 CLASS MAINTENANCE PLAN:

CONCERNS AND ALTERNATIVES

The maintenance plan for any weapon system is a major factor in shaping the logistics requirements for the system. The principal objectives of the FFG-7 class maintenance plan are to (1) minimize shipboard maintenance, thereby reducing shipboard crew requirements, and (2) minimize the offline time for extensive depot maintenance, thereby increasing the at-sea availability of the FFG-7 class. The Chief of Naval Operations approved requirements and constraints for the class established a shipboard accommodations ceiling of 185, including a helicopter crew and a goal of 90 percent online availability. Our review of the FFG-7 class maintenance plan showed that:

- The plan's success is dependent on the effective implementation of various logistics strategies, and many questions remain regarding their feasibility and timely implementation.
- Initial Navy estimates show the approach to be less expensive than current practices; however, its cost should be monitored closely.
- RCM is being partially implemented; however, greater use of the technique may reduce maintenance costs.

FFG-7 CLASS MAINTENANCE PLAN:

A NEW APPROACH

By adopting the progressive overhaul strategy, the Navy is moving away from a traditional reliance on the ship's crew to accomplish maintenance and is eliminating the need for frequent and lengthy overhauls. By making these changes, the Navy hopes to reduce the number of shipboard personnel needed and increase online availability and, at the same time, maintain a more constant level of material condition for the ships.

Conventional maintenance practices

The three basic levels of maintenance for Navy ships are:

- Organizational - Maintenance which is the responsibility of the ship's crew.
- Intermediate - Maintenance which is performed by Navy personnel aboard tenders, repair ships, aircraft carriers, and at-shore intermediate maintenance facilities.

--Depot - Maintenance which is performed by industrial activities on materials requiring major overhaul or a complete rebuilding of parts, assemblies, subassemblies, and end-items, including the manufacturing of parts, modifications, testing, and reclamation, as required.

As a general policy, ship maintenance requirements for most Navy surface ships call for the ship's crew to perform all needed maintenance tasks within its capability. Those tasks which cannot be accomplished are deferred until regularly scheduled intermediate maintenance availabilities (IMAVs). Ships are normally scheduled for an IMAV every 6 months, which lasts 4 weeks. Depot maintenance for ships occurs at predetermined intervals, at which time, the entire ship is overhauled. The intervals between and length of overhauls differ between classes of ships; however, most ships are overhauled every 3 to 5 years, and the overhauls last about 1 year. Additionally, ships undergo periodic repairs referred to as either restricted or technical availabilities.

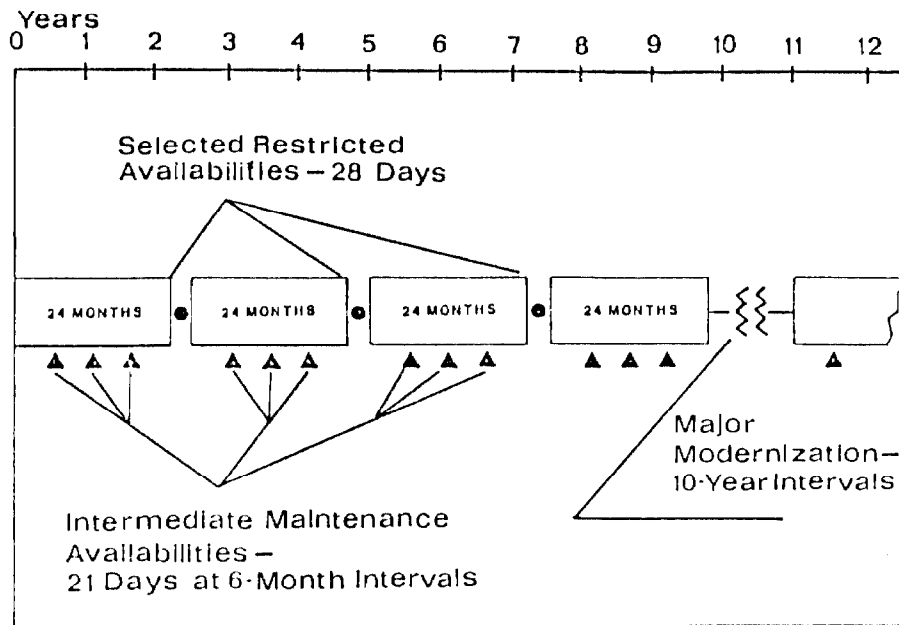
FFG-7 class uses progressive overhaul

The FFG-7 class maintenance plan calls for a portion of the organizational level maintenance burden to be shifted to intermediate and depot maintenance activities, and regular overhauls have been eliminated in favor of shorter, more frequent intermediate and depot level maintenance availabilities. The Navy refers to this strategy as progressive overhaul.

Under progressive overhaul, the ship and its equipment are undergoing continuous overhaul. A class maintenance plan, which is developed for each ship, sets out certain preplanned maintenance actions to be accomplished at 6-month intervals at intermediate and depot facilities. The planned maintenance actions call for certain equipment or components to be removed and replaced at predetermined intervals, as well as other routine maintenance actions. These actions represent about 30 percent of the workload at each availability. The other 70 percent is made up of corrective maintenance actions which are identified by the ship's crew in much the same manner as for a conventionally maintained ship. The ships are required to have an IMAV every 6 months which lasts 21 days, and a selected restricted availability (SRA) every 24 months, which lasts 28 days. SRAs are conducted at a depot level facility. At the end of 10 years, the ship will undergo a major modernization period at a depot level facility. The length of the modernization period has not yet been determined; however, it is expected to last about 1 year. The Navy anticipated that changes required to the ships by its fleet modernization program will be carried out during the IMAVs and SRAs; however, availabilities may be extended for more complex modernizations. The chart on the following page shows the progressive overhaul maintenance cycle.

FFG-7 Class Operating Cycles

Progressive Overhaul



CAN PROGRESSIVE OVERHAUL BE EFFECTIVELY IMPLEMENTED?

The successful execution of the FFG-7 class maintenance plan rests on the implementation of a number of interrelated logistics strategies. Although Navy planners and operators are confident that the strategies can be effectively implemented a number of questions remain concerning the strategies, feasibility and timely implementation. For example:

- Will planned supply support strategies be effective and economical?
- Will the required quantity of qualified shipboard personnel be available?
- Will intermediate maintenance facilities have the required skilled personnel to handle the projected workload increases?
- Will systems being designed provide the information needed to effectively and efficiently manage logistics support for the FFG-7s?

Supply support, shipboard personnel, and intermediate maintenance facilities are discussed in chapters 4, 5, and 6, respectively. Maintenance monitoring is discussed below.

Can effective maintenance management be achieved?

A key to the effective and efficient implementation of progressive overhaul is the ability of logistics managers to (1) identify which maintenance actions must be accomplished and which material is required during each maintenance availability, (2) track the extent to which maintenance actions are accomplished, and (3) determine whether initial estimates for the planned removal of equipment or components are accurate. To accomplish these tasks, logistics planners are developing a Maintenance Management System. However, this system is not yet fully developed, and past studies have shown that some of the data on which the system must rely has not been entirely accurate.

Generally, the Maintenance Management System is made up of three major components:

- A class maintenance monitoring system - Will capture logistics data on ships' equipment and, by comparing it to LSA data, will identify maintenance and support problems. This information will then be used to adjust the class maintenance plan, shipboard maintenance, and logistics support at all levels of maintenance as necessary.
- The class maintenance plan - Will identify the various planned maintenance actions.
- A repair maintenance management system - Will schedule maintenance tasks and produce material requirements.

Through the Maintenance Management System, adjustments will be made to the class maintenance plan, and the system will monitor the extent to which maintenance actions are being accomplished during availabilities. Also, on the basis of information from the system, adjustments will be made to the intervals for the planned removal of equipment. A Navy official estimated that the system will not be fully operational until October 1981. He explained that several key tasks are not yet complete. These include (1) identifying and developing formats for reports required to effectively monitor maintenance actions, (2) determining specific information which will be required from designated overhaul points and intermediate maintenance activities on the condition of equipment which is removed and replaced, and (3) establishing procedures to fully implement the automated exchange of information between the various elements of the system.

It is particularly important that the Maintenance Management System be implemented as quickly as possible to ensure the accuracy of planned replacement intervals for equipment. In preparing the class maintenance plan for the subsequent FFG-7s, the Navy

compared the plan previously developed for the first-delivered FFG-7 class ship to the LSA file and designated equipment replacement intervals on the basis of the shorter frequency shown. A Navy official told us that the Navy used this approach because both the FFG-7 data and the LSA file were based on separate engineering judgments, and the Navy had no way of knowing which was correct until it gathered data from operational experience.

Currently, since only the leadship--the Oliver Hazard Perry--has started the progressive overhaul maintenance cycle, the Navy, by using onsite inspection teams, is assessing the condition of equipment removed and replaced. At the time of our review, the Navy, on the basis of the onsite inspection team recommendations, was considering longer replacement intervals for several equipments. But, it decided to change the replacement frequency on only three equipments. Based on the increased frequency for replacement, material requirements for the three equipments would be reduced by about \$219,000 during the 10-year maintenance cycle for one FFG-7. Considering the large number of equipments which will be removed and replaced at preplanned intervals and considering that the Navy is planning to buy 51 ships, one can readily see the significant impact of replacing equipment too frequently. In fiscal year 1982, the number of FFG-7 class ships under the maintenance cycle will rapidly increase, making the use of onsite inspection teams impractical. Consequently, it is imperative that the Maintenance Management System be fully operational so equipment replacement intervals can be assessed.

We believe that Navy logistics planners need to ensure that a Maintenance Management System is developed and in place early in the ship's acquisition cycle so that it can be used to the fullest extent and can be relied upon as the single data source necessary for an effective logistics support plan.

Data must be accurate

The Maintenance Management System will receive information from a number of other Navy logistics reports and data systems, including Casualty Reports, Shipyard Departure Reports, reports from designated overhaul points, the Maintenance Materials Management System, the Ship's Alteration Management Information System, and the Fitting Out Management Information System. While we did not review these systems, prior GAO and Naval Audit Service reports have questioned the accuracy of data in three of these systems:

- An April 1980 Naval Audit Service report 1/ questioned the use of the Ship Alteration and Management Information System as a management tool because it lacked accurate data.
- In a 1978 report, 2/ we noted that, in some cases, shipyard departure reports were either not prepared or not accurate.
- In another 1978 report, 3/ we questioned the accuracy of data provided by the Maintenance Material Management System.

Navy officials said that the major source of needed feedback data for the Maintenance Management System is the Navy's Maintenance Material Management System. They acknowledged that the usefulness of prior Maintenance Material Management System data was limited because the system lacked accurate data and because data was reported only on selected items. To counter these prior weaknesses, a computerized shipboard data system has been developed for the FFG-7 class ships. However, we found that although this system has been installed on the first-delivered FFG-7, it has not yet been installed on the subsequent ships, such as the FFG-8 through FFG-15. We were informed that installation of the shipboard data system on those FFG-7s already delivered would begin in May 1981.

If the Maintenance Management System is to be an effective management tool, Navy logistics managers must carefully screen the data on which the system's operation depends to assure its accuracy.

DOES THE MAINTENANCE PLAN
PROVIDE OPPORTUNITIES TO
REDUCE LOGISTICS COSTS?

The FFG-7 maintenance plan may represent an opportunity to reduce logistics support costs when compared to conventional maintenance practices. This plan could be applied to other classes of ships; however, closer study is needed before this can be determined.

1/"Fleet Modernization Program At the Naval Sea Systems Command, (Audit Report C35239, Apr. 25, 1980).

2/"The Navy Overhaul Policy--A Costly Means of Insuring Readiness For Support Ships" (LCD-78-434, Dec. 27, 1978).

3/"The Navy's Ship Support Improvement Project" (LCD-78-433, Sept. 12, 1978).

In developing the FFG-7 maintenance plan and its related logistics strategies, Navy planners emphasized increasing ship availability and reducing shipboard crew requirements. Reducing logistics support costs was not a specific objective in the effort. The Navy did not estimate logistics life-cycle costs.

In December 1979 the Vice Chief of Naval Operations questioned whether the FFG-7 class crewing and maintenance plan was more or less expensive than conventional Navy practices. A study was made and the results were released in August 1980. An official Navy summary stated that following:

"Summing the three cost factors considered above [program management, maintenance, and personnel costs] provides a lower projected cost for the FFG-7 class of just under \$2 million per ship operating year. The many assumptions and generalizations which were made during the course of this comparison make the final dollar value significant only as an indicator that the Navy has not developed a maintenance philosophy which is much more costly than that of a conventional ship, and over the life of the ship class will probably be less costly. The actual costs experienced will to a great extent depend on the Navy's ability to execute the FFG-7 maintenance plan as established. The real value of the plan is a potential 11 percent increase in ship availability over that of the conventional cycle."

The projected savings identified in the study were attributed to the elimination of regular overhauls and reduced shipboard personnel.

Although we did not review the study in detail, we noted, as the Navy had pointed out, that the study contained many generalizations and assumptions. However, the study did indicate that the FFG-7 maintenance plan provided significant opportunities to reduce logistics support costs over conventional practices if maintenance and ship operational availability goals can be met. We were told that, because of plans to modify the first 26 ships of the class to increase accommodations and add weapon systems, projected increases in online availability would be reduced from 11 to about 6 percent over the 10-year operating cycle.

The Navy had similar concerns about the study's conclusions and what actual experience would show. Consequently, the Navy has directed that, before it considers extending the maintenance approach to other classes of ships, the Deputy Chief of Naval Logistics prepare a cost comparison between the FFG-7 and traditional maintenance approaches. The study will consider actual maintenance, personnel, and material costs. The Navy will evaluate actual cost experience for the first-delivered FFG-7 after it has completed SRA two (during 1983) and again after it has completed SRA three (during 1985). This approach should provide sufficient logistics data to analyze the cost effectiveness of the FFG-7 logistics strategies.

APPLYING RCM TO THE FFG-7s
AND OTHER SHIP CLASSES

Since 1974 the Office of the Secretary of Defense has directed the services to use RCM. As previously discussed, the technique's basic principle is to perform only those tasks necessary to retain designated levels of safety and reliability. Based on application of RCM, a preventive maintenance schedule is developed which calls for one of the following maintenance actions:

- Inspecting an item at specified intervals to find and correct potential failures, thereby preempting functional failures.
- Reworking (overhauling) an item at or before some specified operating age to reduce the frequency of functional failures.
- Discarding an item or one of its parts at or before some specified life limit to avoid functional failures or to reduce their frequency.
- Inspecting a hidden-function item at specified intervals to find and correct functional failures that have already occurred but were not evident to the operating crew.

RCM also recognizes that there are many items whose reliability cannot be improved by any of these tasks. Maintenance tasks for these items are performed through "on condition monitoring." The commercial aviation industry's use of RCM has shown that maintenance costs can be reduced without reducing equipment availability.

The Navy is in the early stages of implementing RCM for its surface ships. Although the Navy is using RCM logic to develop planned maintenance tasks for the FFG-7 class at the organizational level, it has not been used at the intermediate or depot levels.

RCM is being partially implemented

FFG-7 class maintenance at the intermediate and depot levels is based on the progressive overhaul strategy which does not consider RCM logic. The strategy requires that certain equipments or components be removed and replaced at planned intervals during IMAVs and SRAs. The intervals are based on engineering judgments and LSA results. It is through this process that ship equipment is progressively overhauled. To accommodate the progressive overhaul strategy, some equipment receives initial scheduled maintenance actions earlier than called for by the engineering estimates. We noted that of 225 remove and replace actions (involving 1 or multiple items), 94 were not done in accordance with initial estimates and that, on an average, items were removed about 14

months early. Navy officials explained that to start the progressive overhaul and to spread the workload among the series of availabilities, it is necessary to have initial actions on redundant equipment started early. After the initial leveling action has occurred, equipment will be removed more closely in accordance with estimated wear-out rates.

Planned maintenance for the FFG-7 class at the organizational level was initially developed using standard Navy procedures which rely heavily on scheduled maintenance actions. However, in December 1978 the Chief of Naval Operations directed that the Navy determine whether RCM could be applied to the FFG-7 class at the organizational level. This was done because of the general concern about the significant percentage of planned organizational maintenance tasks which were not being accomplished on ships throughout the fleet. Navy officials believed that RCM might help to reduce scheduled maintenance requirements. Navy officials told us that as of November 1980 about 40 percent of planned organizational level maintenance tasks for the FFG-7 class were based on RCM, and that by April 1981 all of these tasks will be based on RCM. They also told us that using RCM on a test basis had reduced maintenance staff-hours on one ship by about 35 percent.

As we pointed out in our 1978 report on Navy overhaul policy, RCM represents an alternative approach which can reduce maintenance efforts and costs. Navy officials told us that they are considering the use of RCM to reduce intermediate and depot-level maintenance on FFG-7 class ships; however, they have not yet developed specific plans.

Efforts to apply RCM to other ship classes

The Navy is beginning to apply RCM to other classes of ships. These efforts are in their early stages and include:

- Applying RCM to planned organizational maintenance requirements for the DD-963, DD-1052, LSD-41, and DD-993 classes.
- Identifying new ship construction programs where RCM can be integrated with the construction program.
- Identifying existing classes of ships for which RCM can be applied.

However, the Navy has not set forth a specific policy statement or directive regarding the use of, and procedures for, implementing RCM for surface ships and submarines. We believe it would be beneficial for the Navy to define to what extent it expects RCM to be applied at the various levels of maintenance and to ensure that RCM is an integral part of the ILS planning during system design.

CONCLUSIONS

The FFG-7 maintenance plan represents a change from past maintenance practices in the surface Navy, with the most significant change being the elimination of lengthy and costly overhauls in favor of short, well-planned, periodic maintenance availabilities. Navy planners believe that, if implemented effectively, the maintenance plan can result in reduced logistics support costs and increased ship availability. However, a Navy study to compare the cost effectiveness of the reduced crewing and the new maintenance plan to conventional crewing and maintenance practices was not conclusive. Since life-cycle cost data was not developed for the various FFG-7 class logistics strategies, it is unclear whether the maintenance plan will be more cost effective than past Navy practices. Also, projected increases in ship availability may not be realized if the supporting logistics strategies cannot be implemented effectively.

These unknowns strongly point to the need for the Navy to closely monitor FFG-7 class maintenance costs and ship availability so that it can assess the overall benefit of plan. By using this type of analysis, the Navy can best determine where improvements in the plan's economy and efficiency can be made and the extent to which the use of the approach should be expanded. Currently, the Navy is conducting such a study. However, because of the need for the first FFG-7 to go through several IMAVs and SRAs before adequate data is available to evaluate the concept, the study will not be completed until 1985.

Critical to the effective and efficient operation of the FFG-7 class maintenance plan is the automated Maintenance Management System, which is scheduled to be fully implemented in October 1981. However, much work remains to be done on the system, and the accuracy of certain key information supporting it is questionable. To avoid ineffective, inefficient maintenance planning and execution, the Navy must ensure that the system's implementation is timely and the data is accurate.

The commercial aviation industry has successfully used RCM to reduce maintenance costs. DOD has instructed that the services also apply this approach to maintenance of their equipment. The Navy is partially using RCM on the FFG-7 class ships. Further use may reduce maintenance costs for the ships. Also, the Navy has not set forth specific guidance on the use of RCM for surface ships. We believe such guidance is needed to facilitate the use of RCM in the surface Navy.

RECOMMENDATIONS

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

- Make greater use of RCM if it can reduce maintenance costs for the FFG-7 class ships at the intermediate and depot levels.
- Develop specific policies on using RCM in maintenance planning for future ship construction.

AGENCY COMMENTS

DOD agreed and said it had begun examining expansion of RCM to other than the organizational level for the FFG-7 class and other surface ships. It also said that it would review policies on using RCM in maintenance planning for future ship construction and initiate necessary changes before the end of fiscal year 1981.

CHAPTER 4

FFG-7 CLASS SUPPLY SUPPORT

COULD BE MORE EFFICIENT

Although the Navy is using LSA and is implementing new strategies and procedures to provide supply support for the FFG-7 class ships, it can obtain adequate supply support for the FFG-7s at less cost. The Navy could improve supply support and reduce costs by

- using LSA more effectively,
- modifying shipboard supply support allowances, and
- reducing retail inventory allowances.

Also, the Navy has experienced problems in providing initial supply support to the FFG-7 class ships. However, the Navy has recognized these problems and is taking corrective action.

FFG-7 CLASS SUPPLY SUPPORT STRATEGY

Supply support, designed to accommodate FFG-7 class maintenance is a major element of the ILS plan. The overall objective of the FFG-7 supply support program is to provide optimum support by ensuring the availability of supplies at the right time and place.

In developing the supply support strategy, the Navy recognized that shifting maintenance from the organizational to the intermediate and depot levels and removing and replacing equipment at periodic intervals rather than repairing them in place would require increased investment in supply system stock. The stringent time parameters for IMAVs and SRAs require that all necessary support material be readily available at the maintenance activity. To determine the supply support approach and to define requirements, the Navy is using an LSA process and has developed new strategies and procedures, including:

- Modifying shipboard inventory allowances.
- Authorizing additional levels of retail stock.
- Developing a class maintenance plan to assist in determining material requirements.

LSA IS NOT TOTALLY EFFECTIVE

A major purpose of LSA is to determine the maintenance and support approach for each equipment/system, including the logistics needed at each maintenance level for each FFG-7. However, LSA has not been totally effective in establishing supply

support requirements because it was not developed early enough in the FFG-7 class acquisition cycle.

Material requirements
are inaccurate

One function of LSA is to identify the planned maintenance requirements for the class maintenance plan. Using information from the plan, the Navy develops planned material requirements for each IMAV and SRA. However, all LSA data had not been reconciled with the class maintenance plan by the time the Navy developed initial material lists.

The initial listing of planned maintenance requirements was printed in February 1980 and showed that 803 equipments, valued at about \$2.9 million, were required for 25 IMAVs and 2 SRAs planned for fiscal year 1982. On the basis of a subsequent listing of requirements, printed in May 1980, the Navy deleted 241 equipments, valued at about \$1.1 million, and added 349 equipments valued at about \$1 million. According to Navy officials responsible for buying material, such instability of requirements can result in (1) overstated requirements, (2) procuring the wrong items, and (3) ineffective supply support when needed items are not available at the maintenance activity. For example, in another program which uses planned material requirements (the Destroyer Engineered Operating Cycle Program), ships' requirements fluctuated widely. In March 1980 Navy officials reported that instability in program requirements caused some \$10 million of known overstated requirements. However, a Navy official said that the instability in FFG-7 class requirements was not nearly as great as for the Destroyer Engineered Operating Cycle Program.

Although some changes to the class maintenance plan are inevitable, we believe the magnitude of changes experienced would not have been as great and potential for erroneous requirements would have been reduced if LSA had been started earlier in the acquisition cycle.

SHIPBOARD SUPPLY SUPPORT
CAN BE REDUCED

Current and planned methodologies for developing FFG-7 class shipboard supply support requirements do not consider the periodic removal of certain equipment.

The Navy provides newly constructed ships with supplies to support uninterrupted operations for 90 days. These allowances are called coordinated shipboard allowances list (COSAL) inventories. When completely delivered, the 51 ships of the FFG-7 class will be authorized hundreds of millions of dollars in inventories to sustain uninterrupted supply operations. The following table shows the authorized material allowances for the first six FFG-7s constructed.

<u>Ship</u>	<u>No. of items</u>	<u>Value</u>
FFG-7	12,468	\$ 3,301,935
FFG-8	11,499	3,606,599
FFG-9	11,749	3,458,614
FFG-10	11,487	3,422,492
FFG-11	11,809	3,722,322
FFG-12	12,574	<u>3,648,256</u>
Total		<u>\$21,160,218</u>

One significant variable in determining this support is the estimate of an item's expected failure rate. Failure rates are determined on the basis of fleetwide historical data. In Navy supply terminology, these failure rates are referred to as the application replacement or best replacement factor. The application replacement factor is based on the fleetwide expected failures of an item as it relates to a specific equipment application, as opposed to the best replacement factor which represents the expected failure rate across all equipment applications.

The FFG-7 class ships' allowances are determined by the application replacement factor. If the application replacement factor is not available, then the best replacement factor is used. We were told that only 177 items have application replacement factors. Therefore, the best replacement factor becomes the primary basis for determining the FFG-7s' allowances.

The FFG-7 class maintenance plan, unlike plans for conventionally maintained ships, is based in part upon replacing equipment before it wears out and overhauling equipment and components on shore to reduce the maintenance workload of shipboard personnel. However, the Navy does not consider the replacement period of the end equipment when determining shipboard allowances of repair parts. Thus, using a factor based on fleetwide failure rates to determine FFG-7 class shipboard supply support allowances could result in stocking items not expected to fail before the end equipment is replaced. For example, two components stocked to support major equipment had an expected life of about 4-1/2 and 2-1/2 years, respectively, while the equipment itself is scheduled to be replaced every 2 years. The cost of stocking unneeded spare parts could be significant considering each of the 51 ships will have over 200 end items periodically removed. A limited review of 50 repair parts applicable to 15 end equipments showed that 13 repair parts--costing \$22,000--had a longer expected life than the planned removal period for the end equipment they supported.

Maintenance criticality
oriented COSAL

The Navy is planning to implement a new strategy--the maintenance criticality oriented COSAL--to determine shipboard allowances of repair parts for the FFG-7 class. However, this new strategy does not consider the planned removal of certain equipment. In 1983, with the delivery of the FFG-36, shipboard allowances for the FFG-7 class ships will be determined by using the new strategy.

Under the new approach, each maintenance task is assigned a criticality code on the basis of (1) the importance of the task to maintenance of the equipment/system and (2) the importance of the equipment/system to the mission of the ship. A constraint in developing this strategy was that it not be more costly than the conventional method.

A Navy test showed that overall costs of the new allowances will be slightly less than under the conventional method and that the supply support effectiveness of mission critical equipment will be significantly improved. We agree that structuring shipboard allowances to emphasize support of mission essential equipment represents an opportunity to increase readiness without increased expenditures.

RETAIL SUPPLY SUPPORT INVENTORY
ALLOWANCES APPEAR EXCESSIVE

The Navy is establishing a new level of retail inventory 1/ referred to as operational support inventory (OSI). In part, justification for this inventory is to ensure availability of parts to support FFG-7 class intermediate maintenance availabilities. However, our analysis shows that OSI stocks appear to be excessive.

Operational support inventory

OSI provides responsive point of entry supply support to homeported ships and customer activities in a specific geographic area and ensures adequate material support for IMAVs for the FFG-7s and other classes of ships. OSI is divided into two levels:

- Intermediate level inventory, which is referred to as geographic stock. Geographic stock authorizations are based on the demands of homeported ships and customer activities in the geographic area.
- Consumer level stock which is divided into (1) corrective maintenance stock--a level of stock protected within the

1/Supplies/material held below the wholesale level.

geographic area whose authorizations are based on the actual or anticipated demands of intermediate maintenance activities in support of their maintenance missions, and (2) planned maintenance stock--a protected level of stock whose authorizations are based on material requirements identified in the class maintenance plans of destroyer engineered operating cycle and FFG-7 class ships.

The Navy was implementing OSI at the time of our review, so we limited our analysis to the initial OSI, which was being developed for the Mayport, Florida, area.

Inventories appear
to be excessive

The geographic and corrective maintenance stocks for the Mayport area are colocated at the Naval Air Station in Jacksonville, Florida. We compared the items authorized in each of these stock lists and found that 278 line items were authorized in both lists. The value of the duplicate items (a total of 1,073 items) in the corrective maintenance stock was about \$290,000. The duplication of corrective maintenance and geographic stocks could be significant since OSIs will be established at six additional geographic locations.

We analyzed the basis for computing the corrective maintenance and geographic stock levels and found that SIMA maintenance demand data is used in part to compute stock authorizations for both geographic and corrective maintenance stocks. Navy officials agreed that this was the case; however, they disagreed that the stocks are duplicative. We do not agree. (See p. 31.)

SUFFICIENT SPARE PARTS FOR
INITIAL SHIPS NOT AVAILABLE

Mission accomplishment for some of the first-delivered FFG-7s has been impaired because of insufficient spares to support critically needed equipment. As previously stated, newly constructed ships are supposed to deploy with enough spare parts to support uninterrupted operations for 90 days. The ships' COSAL is designed to provide this support. Thus, the Navy has established supply readiness objectives (Naval Material Command Instruction 4441.1B) for newly constructed ships' COSALs of 97 percent at delivery and 100 percent at completion of fitting out. ^{1/} for various categories of material. Any deviation of 5 percent or more from the objectives requires a waiver of the readiness objective.

^{1/}Fitting out refers to a specific period of time after a ship is delivered in which material on the ship's allowance list should be placed aboard.

The Navy has not met the supply readiness objectives on any of the ships delivered since the first-delivered FFG-7. The following table shows the supply readiness percentages of spare parts available at delivery and at end of fitting out through January 1981 for both contractor-furnished and Government-furnished materials.

Percentage of Spares Available (note a)

Ship	At delivery			At end of fitting out		
	Contractor-furnished (note b)	Government-furnished (note c)	Total	Contractor-furnished	Government-furnished	Total
FFG-8	87.1	79.5	81.7	98.4	94.4	95.6
FFG-9	78.2	85.2	83.2	93.9	95.3	94.9
FFG-10	85.2	84.4	84.7	94.2	90.0	91.1
FFG-11	95.9	86.9	89.2	97.8	89.4	91.7
FFG-12	95.8	91.3	92.5	97.9	94.9	95.0
FFG-13	97.1	86.9	89.7	98.6	91.8	93.7
FFG-15	98.1	87.2	90.3	98.9	94.4	95.5
FFG-16	97.9	87.9	90.2	99.3	94.2	95.4

a/Data provided by FFG-7 Ship Acquisition Project Management Office.

b/The number of contractor-furnished items averaged 4,448 items.

c/The number of Government-furnished items averaged 14,906 items.

The Navy recognizes these problems and has taken action to closely manage the provision of this material. The Navy identified the following areas as the primary reasons for the spare parts shortages:

- Late provisioning and technical documentation.
- Configuration changes.
- Late or delayed funding.
- Spares competing with hardware.
- Increased production leadtime.

The Navy expects to meet the supply readiness objectives for Government-furnished spare parts by December 1981.

CONCLUSIONS

New supply support strategies for the FFG-7 class ships have been developed to complement the progressive overhaul maintenance strategy. These strategies are designed to ensure that the right material is available at the right time and place so pre-planned maintenance actions can be performed effectively and efficiently. These strategies can be changed several ways to make them more economical and effective.

Initial difficulties have been experienced in accurately identifying specific material which should be procured to support planned maintenance actions at the periodic maintenance availabilities. If these problems are not corrected, the needed material may not be available and/or excesses of unneeded material stocks may develop.

The methods which will be used to determine shipboard supply allowances do not adequately consider certain major equipments which will be removed at periodic intervals. Consequently, unneeded repair parts may be stocked aboard the ships. While supply readiness objectives for some of the first-delivered FFG-7s have been impaired because of insufficient onboard spare parts, the Navy recognizes these problems and, by more closely managing provisioning, expects to meet readiness objectives by December 1981.

New levels of retail inventory, designed in part to support the FFG-7 class ships, contain similar items in both levels. We question whether these duplicate items are needed to provide effective supply support.

AGENCY COMMENTS AND OUR EVALUATION

DOD agreed with our recommendation regarding the need to improve the accuracy of planned material requirements for the FFG-7 class ships. DOD stated that this is a complex problem, but it has made progress and is continuing to emphasize this aspect of FFG-7 class support.

DOD also agreed with our recommendation to consider the periodic replacement of equipment in determining shipboard supply support allowances on the FFG-7s and said it had done this. However, DOD disagreed that the periodic removal and replacement of equipment before wearout would affect the repair parts needed aboard ship. DOD stated that repair parts are placed aboard ship to guard against random failures or untimely wearout. According to DOD, the periodic replacement of old equipment with new equipment would not affect shipboard spare parts requirements.

One of the objectives of progressive overhaul is to improve the material condition of the ship's equipment by periodically

replacing items before the wearout and to reduce the number of random failures. As pointed out in this chapter, FFG-7 class shipboard allowances are based on fleetwide failure data for equipment, which we believe will be different from that experienced by the FFG-7 class ships because of the different maintenance approach being employed. Consequently, we believe the Navy should reassess whether it should consider the effects of progressive overhaul when developing FFG-7 class shipboard allowances.

DOD disagreed with our suggestion to adjust methodologies for developing corrective maintenance and geographic stock authorizations to avoid duplication. DOD (and Navy officials in later discussions) explained that, although in some cases the same items are authorized in both the geographic and corrective maintenance stocks, they are not duplicative because the justification for the stock levels are based on different requirements. DOD stated that (1) the geographic stock is a demand-based stock required to provide supply support to authorized customers (homeported ships, intermediate maintenance activities, naval stations, etc.) in a geographic area and (2) the consumer level of inventory, which is in part demand-based, is required to accomplish the maintenance functions of a SIMA.

We agree that the material must be available if intermediate maintenance on the FFG-7 class ships and other ship classes is to be accomplished in a timely manner. However, in those cases where the geographic and corrective maintenance stocks are colocated (as they are at the Jacksonville Naval Air Station), we question whether all the items in this additional layer of stock are needed to provide effective support to the SIMA. We believe this is particularly true when the maintenance demands of the SIMA are considered in computing overall geographic stock authorizations. We recognize this may not be the case in all circumstances and have modified our suggestion to state that the Navy should reassess whether the stockage of the same items in colocated geographic and corrective maintenance stocks represents the most prudent use of scarce resources and is necessary for achieving effective supply support.

RECOMMENDATIONS

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

- Improve the accuracy of the system used to identify planned material requirements for the FFG-7s.
- Consider the replacement frequency of end equipment in determining FFG-7 class shipboard spare parts allowances.
- Reassess stockage of the same items in colocated geographic and corrective maintenance stocks to avoid unnecessary duplication.

CHAPTER 5

THE NAVY SHOULD RECONSIDER FFG-7

CLASS CREW REQUIREMENTS

The objective of FFG-7 class crew planning was to minimize crew size through innovative ship design, modern labor-saving equipment, consolidated watch stations, and a new maintenance plan. This objective has been achieved in part; however, actual crew requirements will significantly exceed initial estimates, thus increasing life-cycle crew costs and requiring additional accommodations to be added to the ships. Additionally, Navy-wide shortages of qualified personnel threaten the success of the class maintenance plan and mission objectives.

We believe the Navy should seek to reduce crew requirements and limit additional life-cycle costs.

INITIAL CREW REQUIREMENTS ESTIMATE WAS INACCURATE

Accurately estimating crew requirements for a ship class years before it is delivered and before major equipment and systems are fully developed is clearly a difficult task. Although crew planning for the FFG-7 class in 1970 faced numerous variables and incomplete data, the Navy had available a computer model and appropriate regulation for estimating crew requirements. However, the Navy disregarded these formal estimates and established an arbitrary personnel goal which has proven to be significantly less than actually required. Since the 1970 estimate, crew size for the FFG-7 class has increased, and the Navy is still debating the appropriate crew size.

Initial crew size was arbitrarily determined

In 1971 the Navy directed FFG-7 class ship crew size to be limited to 185 officer and enlisted accommodations. ^{1/} During our review, we found no formally developed methodology supporting this decision. Instead, we found that the accommodations decision was based on acquisition cost guidance.

Initial personnel planning for the FFG-7 class began as early as 1970, with early crew size estimates ranging from 220 to 256 personnel. However, in 1971, the Navy set a ship acquisition goal of \$45 million (in fiscal year 1973 dollars) which could not be met employing such a large crew. Consequently, the Navy directed that FFG-7 class ships not exceed 185 officer and enlisted accommodations.

^{1/}Accommodations are the sailors' living quarters aboard ships.

Standard Navy policy provides a 10-percent accommodation margin over the estimated billets ^{1/} to allow future crew size growth due to adding additional equipment or to modernization. The Chief of Naval Operations, however, authorized only a 5-percent accommodation margin for the FFG-7 class ships. Therefore, with an accommodation ceiling of 185, the crew size, including helicopter detachment, could not exceed 176 personnel.

With this guidance, the preliminary Ship Manpower Document, which was published in March 1976, established the following personnel requirements:

	<u>Officers</u>	<u>Enlisted</u>	<u>Total</u>
Ship	11	152	163
Helicopter	3	10	<u>13</u>
Total			<u><u>176</u></u>

Crew size problems were recognized early

The FFG-7 was delivered in November 1977. By early 1978, the Navy recognized that the initial crew size was too small to maintain and operate the ship. To meet this shortage, the Navy developed 16 training and qualifications billets, which included sonar technicians, gunners mates, and gas turbine technicians. These billets would provide additional personnel aboard ship and would also ensure that the absence of skilled personnel would not unduly reduce the ship's capabilities. In justifying this increase, a Navy official stated:

"* * * the FFG-7 class is acutely sensitive to unprogrammed personnel shortfalls in both quality and quantity. Consequently, 16 qualification/trainee billets * * * have been programmed for each FFG-7 Class ship."

The training and qualifications billets represented a 10-percent increase in billet size, already twice the directed growth margin.

From 1979 to 1980 the Navy carried out the validation process for FFG-7 class ship billets and developed a draft Ship Manpower Document which increased enlisted personnel requirements from 152 to 188. After further review, the Navy eliminated eight of these billets.

^{1/}Billets are the positions or assignments which may be filled by personnel.

The Ship Manpower Document, which was published in August 1980, reflected an 18.4-percent increase in enlisted crew size over the 1976 Preliminary Ship Manpower Document, as shown below. 1/

	<u>Officers</u>	<u>Enlisted</u>	<u>Total</u>
Ship Manpower Document	12	180	192
Preliminary Ship Manpower Document	<u>11</u>	<u>152</u>	<u>163</u>
Increase of personnel	+1	+28	+29

Projecting this 28-member enlisted increase, with an average yearly pay of \$19,328, over the U.S. FFG-7 fleet, we estimate total additional life-cycle cost to be \$828 million. 2/

This is not the only additional life-cycle cost. Since the first 26 FFG-7s are being built with 168 enlisted accommodations, bunks must be added to each ship for the additional crewmembers. Adding these accommodations will cost about \$2.4 million to back-fit already constructed ships and about \$0.3 million to alter plans for future construction. Altogether, this will cost about \$70 million.

Short-term accommodation shortages will exist

The first 26 FFG-7s will not have sufficient accommodations for both the required ships' crew and the helicopter detachment until the Navy installs additional accommodations. This, however, will not be completed on already constructed ships for as long as 3 years.

FFG-7 class ships are being crewed under the Special Navy Manning Plan which adjusts the "fair share" difference between preliminary and current Ship Manpower Document requirements. Until the additional bunks are added, however, a shortage of at least 10 bunks per ship will continue if the 10-member helicopter crew is embarked. As a result, FFG-7 commanders are required to develop a plan for sending personnel on leave or to training courses when their accommodations are needed for the helicopter

1/The Ship Manpower Document serves the same purpose as the preliminary Ship Manpower Document, except that it was developed using an actual ship and equipment, rather than estimating requirements from incomplete data.

2/Based on data from Manning Comparisons of Destroyer Type Ships, FFG-7 Ship Acquisition Project Management Office, dated Jan. 28, 1980. We based our computations on FY 1979 pay rates.

crew. That such a trade-off must be made raises questions about the operational capabilities of those ships.

Questions of crew size continue

The crew size issue has produced considerable controversy within the Navy. While Navy officials admit that additional personnel are needed, some strongly believe that 28 additional enlisted crewmembers is an unnecessarily large increase.

Navy officials pointed out that all elements of the maintenance support strategy, such as upgraded intermediate maintenance facilities and component replacement inventories, were not in place during crew validation of the FFG-7 class. Although the validation team took extensive steps to simulate the shore-based maintenance support, critics claim that until the entire support system is in place, any attempt to determine crew size will be exaggerated.

Navy officials also point out that the draft Ship Manpower Document called for an increase of 36 personnel, but this number was reduced to 28 during the validation review process. Further rigorous review, these officials claim, may identify additional unessential personnel.

Furthermore, the Naval Sea Systems Command has identified other billets which it considers to be unessential. These billets include

- two general maintenance welders,
- three food servicemen,
- one postal clerk, and
- three watch standers for the dead reckoning tracer (a navigation device).

Although the FFG-7 class was developed as a minimally manned ship, some opportunities for reducing crew requirements were considered but rejected to meet acquisition costs. For example, Navy planners considered

- a more completely integrated bridge to centrally monitor the entire ship's vital equipment,
- closed-circuit television to eliminate the need for roving patrols to inspect equipment, and
- greater consolidation of watch stations.

We did not analyze FFG-7 class crew requirements. However, we believe that the nontraditional maintenance approach under which this class will operate is likely to have a major effect

on both the FFG-7 class crew size and on future minimum manning. In addition, sufficient questions have been raised about crew requirements to warrant reconsideration. In light of the greatly increased crew life-cycle costs, we also believe that the Navy should reconsider ship design potential for reducing crew requirements, thereby reducing the crew life-cycle costs.

NAVY-WIDE PERSONNEL SHORTAGES
WILL ADVERSELY AFFECT THE
FFG-7 CLASS

When Navy planners developed the FFG-7 class Preliminary Ship Manpower Document in 1976, they assumed that full crew requirements would be met both in quantity and quality. Unless the minimum requirements were fully met, they warned, the FFG-7 class could not be expected to fulfill its mission. The Navy's current inability to meet those minimum requirements with available resources will very likely reduce both mission capability and material condition for the ships.

FFG-7 class crew problems cannot be fully understood except in the context of the overall Navy environment because the problems affect both ships and shore facilities.

Personnel shortages

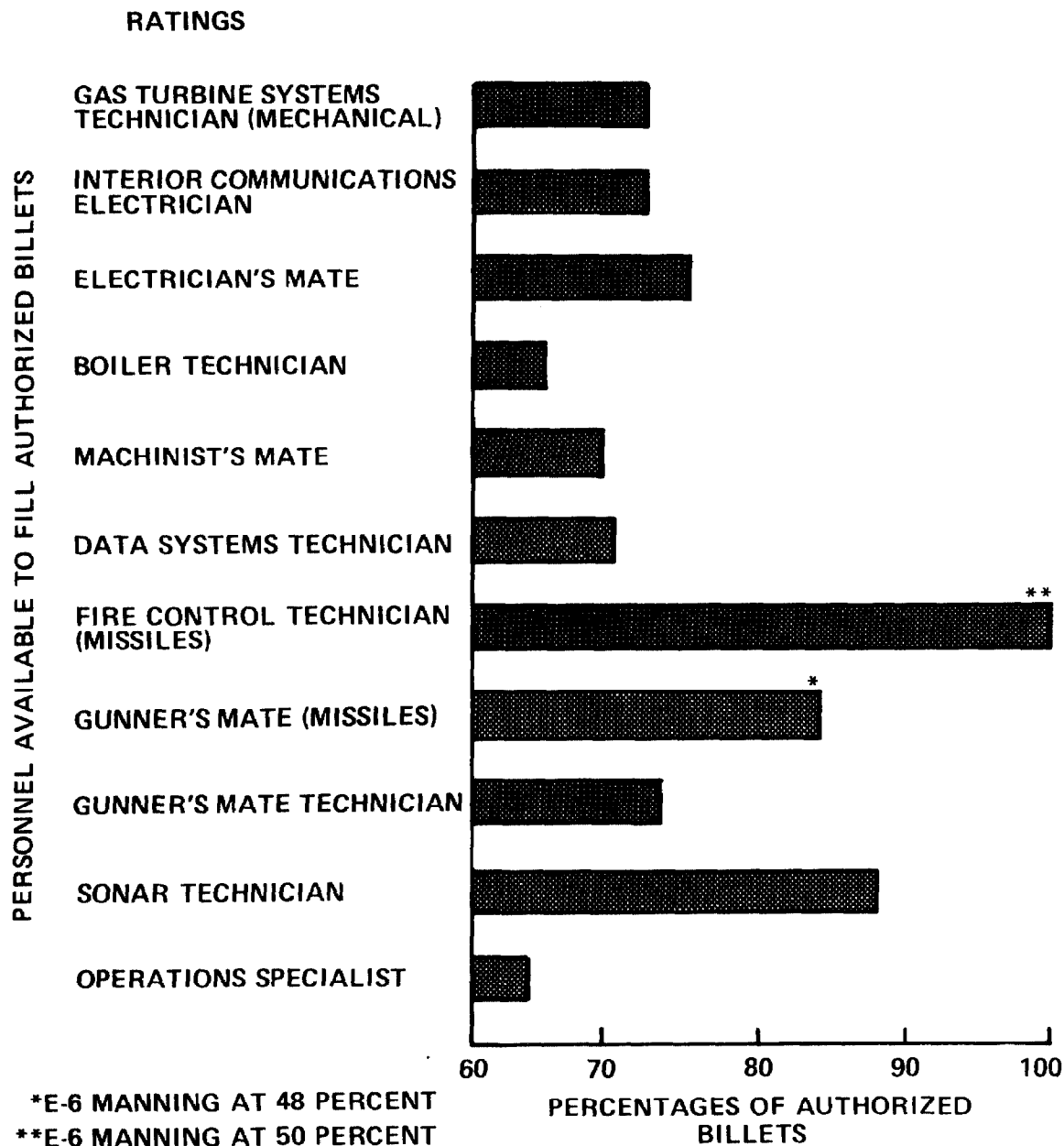
As the number of surface combatant ships increases, the competition for crews of the proper quality and quantity also increases. Unfortunately, competition is increasing at a time when the Navy's ability to meet those requirements is decreasing. Overall, the Navy is meeting its total personnel authorizations. The problem arises because of quality shortages. The Navy is short about 20,000 petty officers (ranks E-5 through E-9) compared to authorized billets. These petty officers represent the experienced, career-oriented personnel who provide the leadership and supervision necessary to accomplish both mission and maintenance objectives.

These senior enlisted personnel must obviously be "grown" from the lower E-1 through E-4 ranks, a level at which the Navy is almost fully staffed. Promoting these ranks to first class petty officers (E-6) requires at least one reenlistment. ^{1/} Navy personnel officials stated that with a 60-percent second-term reenlistment over the next several years, the petty officer shortfall could be largely eliminated in about 9 years. However, fiscal year 1980 second-term reenlistment rates are only about 50.5 percent. Furthermore, quality shortages among important ratings (identifying the particular skills in which a sailor has been trained) are also becoming serious. The following chart

^{1/}A sailor who has initially enlisted for 6 years can be promoted to petty officer during the first enlistment.

illustrates the current percentage of E-5 through E-9 resources available to the surface Navy in several important ratings.

**INVENTORY VS. BILLETS FOR E-5 THROUGH E-9
IN THE SURFACE NAVY (MAY 1980)**



Navy personnel management

Since personnel assets rarely match requirements, the Naval Military Personnel Command, which is responsible for assigning enlisted personnel to shore establishments and to the Atlantic and Pacific Fleets, has developed the Navy Manning Plan. Using this plan, the command can project the number of personnel available to fill authorized billets and the most equitable level of "fair sharing" those personnel assets.

The actual personnel level of a ship or activity is determined as either "normal" or "directed," meaning that the ship or facility will receive its normal fair share of personnel, or it is directed to receive other than its normal share. Furthermore, under directed manning, an activity can be manned to 100 percent, meaning that each billet is authorized to be filled. To actually place a sailor into a billet, however, is a function of stated priorities, meaning that one sailor would fill one of three empty billets based on the designated priority for that billet.

The FFG-7 class is normally manned. For example, an FFG-7 with a Ship Manpower Document enlisted billet requirement of 180 is only authorized to fill its fair share of those billets, meaning less than 180 sailors for 180 billets. Nineteen FFG-7 class billets were designated "selected priority" manned, meaning that they were to be manned to both quality and quantity to support essential personnel requirements. However, Navy officials stated that the Navy is not carrying out selected priority manning because of its personnel shortages.

What would be the result of FFG-7 class personnel shortages?

In light of the Navy's view that FFG-7 class ships are "acutely sensitive to unprogrammed personnel shortfalls in both quality and quantity," we believe that quality shortages aboard the currently commissioned FFG-7 class ships must be viewed as a potentially serious threat to both the ships' operational missions and maintenance capabilities.

By comparing authorized billets with shipboard personnel of commissioned FFG-7 class ships, we found that, as of April 3, 1981, quality shortages among E-5s through E-9s included the following:

FFG-7:	1 operations specialist
	1 data systems technician
	1 interior communications specialist
FFG-8:	1 engineman
	2 hull maintenance technicians

FFG-9: 3 operations specialists
3 missile fire control technicians
1 machinery repairman

FFG-10: 2 operations specialists
4 missile fire control technicians
1 radioman

FFG-11: 1 interior communications specialist
4 missile fire control technicians

FFG-12: 1 electronics warfare specialist
1 machinery repairman

FFG-13: 1 electronics mate
1 machinery repairman
4 missile fire control technicians

FFG-15: 1 operations specialist
2 electronics warfare specialists
4 missile fire control technicians

FFG-16: 1 operations specialist
1 hull maintenance technician
6 missile fire control technicians

While short-term shortages of qualified personnel will not necessarily result in the ships' immediate inability to meet either mission or shipboard maintenance responsibilities, we believe the logical results of long-term shortages on these ships are clear: as shipboard maintenance is either deferred or requires longer periods than planned to accomplish due to inexperienced personnel or lack of supervisors, IMAV and SRA workload will increase. The shore facilities, however, are facing their own personnel problems, as discussed in chapter 6. Maintenance workload would either cause needed maintenance to be deferred, or IMAV and SRA time to be extended. In the first case, material condition of the ships would worsen; in the second case, on-line time would decrease, thus defeating one of the major objectives of the FFG-7 class maintenance plan.

CONCLUSIONS

To meet acquisition cost goals, the Navy directed that total officer and enlisted shipboard accommodations be limited to 185. This estimate proved too low, requiring the current increase in crew size, and, in turn, requiring costly additional accommodations to be added to the class.

While most Navy officials agreed that a crew increase is necessary, several questioned the actual size of the increase. They pointed out that while the current requirement was being developed, the necessary shore maintenance support system was

not in place, unessential billets were included, and labor-saving design options were disregarded due to cost.

Because the FFG-7 class was designed to minimize crew requirements, Navy officials have pointed out that these ships are sensitive to shortages in either the quantity or quality of sailors needed to meet requirements. The Navy is currently facing serious personnel shortages in the E-5 through E-9 ranks. As a result, many of the FFG-7 class billets are not being filled as required, which poses a serious threat to the ships' operational and shipboard maintenance capabilities.

AGENCY COMMENTS AND OUR EVALUATION

DOD agreed that FFG-7 class crew requirements should be revalidated once the new logistics support strategies are implemented.

According to DOD, it agreed in principle with the need to develop an action plan to overcome personnel quality shortfalls aboard the FFG-7 class ships. However, it stated that this was a Navy-wide problem and could not be addressed in the context of one class of ships. While we recognize the Navy's overall personnel problems, we believe that if the Navy is to successfully implement the FFG-7 logistics strategies--or at least validate the feasibility and economy of minimum manning and the progressive overhaul maintenance strategy--it must take specific actions to address FFG-7 class shipboard personnel problems. We believe specific actions for the FFG-7 class are further warranted because the ships (1) will represent about 20 percent of the surface Navy and (2) are very sensitive to personnel shortages because they are minimally manned and require specific periodic maintenance actions. For example, the Navy could consider:

- Fully crewing to both quality and quantity a given number of FFG-7 class ships to compare the results of minimum manning with other FFG-7 class ships which operate with only their fair share of shortages.
- Develop alternatives to the IMAV and SRA maintenance schedules to reflect available shipboard personnel.
- Establish selected priority manning for the most critical quality shortages and fill those billets to quality and quantity.

DOD did not agree that it would be beneficial to reconsider ship design and equipment alternatives with a view toward reducing life-cycle crew costs. However, it stated that this should be considered in future alterations made to the ships. Because a

number of ships are yet to be built and because of the significantly increasing crew life-cycle costs that have been experienced, we do not believe it is unreasonable for DOD to determine where crew size can be reduced through equipment or design changes.

RECOMMENDATIONS

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

- Revalidate FFG-7 class crew requirements after new logistics support strategies are implemented.
- Develop an action plan for overcoming shipboard personnel quality shortages on FFG-7 class ships.
- Reconsider previously rejected cost-benefit decisions for ship design and equipment alternatives to reduce crew requirements.

CHAPTER 6

CAN INTERMEDIATE MAINTENANCE ACTIVITIES

ADEQUATELY SUPPORT THE FFG-7 CLASS?

One of the major goals of the FFG-7 class maintenance plan is to increase the FFG-7 class availability to the fleet over conventionally maintained ships. To accomplish this goal as well as to reduce crew size, the Navy will rely on extensively expanded shore and afloat intermediate level maintenance to carry out 21-day IMAVs. The key to this plan's success is an adequate intermediate level maintenance capability--both workforce and facilities. The intermediate level maintenance capability will be a major factor in the success or failure of the FFG-7 class maintenance plan.

In 1977 the Navy began a \$156 million program to upgrade its shore maintenance capacity and an additional \$53.6 million program to improve its afloat maintenance capacity. The Navy anticipated an increase in intermediate support functions and workload over the next 8 years. In addition to the introduction of the FFG-7 class into the fleet, reasons for this upgrade effort include:

- An increase in both type and total number of combat ships.
- The introduction of 105 cruiser-destroyer type ships into the engineered operating cycle maintenance strategy.
- Numerous modernization programs which will add substantial amounts of sophisticated equipment.
- The backlog of deferred intermediate level maintenance work, which is growing by at least 10 percent per year.

Even with this effort, the Navy recognized that its uniformed personnel would be insufficient to meet demand. The Navy, therefore, developed a contractor services program to supplement intermediate maintenance activities (IMAs) capabilities. 1/

During our review, we found that the shore and afloat IMA upgrades are well underway after a 1-year delay in congressional funding for the Mayport, Florida, facility. Facilities are being improved or added, equipment is being procured, and useful equipment is being retained in accordance with Navy regulations. Also, the contractor support program is well underway. However, we also found that

1/Intermediate maintenance activities are divided into shore IMAs, called SIMAs, and afloat IMAs, such as tenders and repair ships.

--shortages in qualified personnel at the SIMAs will pose an obstacle to successful maintenance capabilities and

--the commercial support program cannot always provide timely maintenance support.

THE IMA UPGRADE PROGRAM

Since the end of fiscal year 1971, the Navy's view of ship maintenance has changed drastically because new ships entering the fleet have become increasingly complex, requiring more sophisticated maintenance and repair.

As the material condition of the Navy declined in the early 1970s, the Navy developed a comprehensive program to reverse that trend. As a result of this decision, the SSIP Office was established. Among other programs, this Office is responsible for the IMA upgrade program, which is in part justified by increased workload resulting from the FFG-7 class maintenance plan. This new maintenance approach has shifted the maintenance focus from shipboard, crew-accomplished piece part repairs to an increased shore-based intermediate level maintenance capability.

Most SIMAs were established in 1972 as part of a program to provide meaningful shore billets for personnel who spend a disproportionate amount of time at sea. These personnel have skills which, for the most part, are needed aboard ships. The SIMAs allowed the sailors to maintain their skills while assigned to shore duty. Initially designed to assist ships in organizational level maintenance, the facilities quickly evolved into activities which largely duplicate the repair capabilities aboard tenders and repair ships.

While developing the maintenance plan for the FFG-7s, the Navy determined that available intermediate maintenance capabilities were inadequate. To address this problem, the Navy undertook a major upgrade of both its shore and afloat intermediate maintenance assets. For the shore establishments, this upgrade included building additional facilities where needed, purchasing new and refurbishing existing industrial plant equipment, and assigning additional personnel to meet the increasing intermediate level maintenance workload.

FFG-7 class ships will be homeported at SIMAs Mayport, Charleston, and San Diego. As of January 1981, the upgrade milestones for these SIMAs were generally on schedule. This included equipment procurement and installation, military construction, and occupancy dates.

Afloat IMAs, which are referred to as tenders, include (1) destroyer tenders and repair ships which service surface ships, and (2) submarine tenders, which service attack or missile submarines. These tenders are large ships often compared with floating cities. They usually contain over 50 repair shops, including electronics, calibration, machine, foundry, welding, pipe, optical, sheet metal, and weapons repair shops. In peacetime, except for training exercises and selective deployments, most tenders remain in their homeports. The mobility requirement is only for wartime deployments.

The purpose of the tender upgrade is to modernize selected ships to handle the intermediate maintenance requirements of the fleet through the 1980s. Modernization includes replacing obsolete equipment and improving management to increase overall efficiency and establishing new capabilities to support new ship classes. While most FFG-7 class IMAVs are scheduled at the SIMAs, the Navy plans to also conduct a number of deployed IMAVs with tenders.

PERSONNEL SHORTAGES AT SIMAS
COULD ADVERSELY AFFECT THE
FFG-7 CLASS MAINTENANCE PLAN

In chapter 5, we discussed the impact of personnel shortages aboard the FFG-7 class ships. Personnel shortages also threaten the long-term success of the SIMA upgrade, and in turn affect the success of the FFG-7 class maintenance plan. Navy officials underscored the importance of the upgrade during fiscal year 1979 hearings on military construction before the House Committee on Appropriations:

"* * * the Navy is fully committed to the new ship maintenance plans for the new ships such as the FFG-7 and the DD-963 class, and the Navy is fully committed to the extended intervals between overhauls for those ships going to our Engineered Operating Cycles (EOC). The existence of capable intermediate maintenance activities to accomplish the required IMA work is the key to those plans. Without capable SIMAs these maintenance plans will fail, and the material readiness of the fleet will suffer."

Although Navy officials said they were quite confident of providing the increased number of personnel needed at the SIMAs in each fiscal year, they also said that quality and skill shortages would almost surely occur. The table on the following page shows the projected steady increase in enlisted requirements at each of the FFG-7 homeports.

Projected SIMA Enlisted Personnel
(As of Dec. 1980)

	Fiscal years					
	<u>1980</u>	<u>1981</u>	<u>1982</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>
Mayport, Fla.	366	417	436	517	545	582
Charleston, S.C.	260	360	388	409	413	425
San Diego, Calif.	1,591	1,682	1,709	1,724	1,797	1,850

The following table identifies some of the current shortages among E-5 through E-9 personnel at SIMA Mayport.

E-5 through E-7 Shortages at
SIMA Mayport

<u>Skill</u>	<u>Personnel required</u>	<u>Personnel on hand (note a)</u>
Fire control technician	6	1
Electronics technician	28	21
Enginemen	18	15
Machinery repairmen	18	10
Gas turbine systems technician	4	1
Radiomen	4	1

a/As of January 19, 1981, or projected strength within 30 days.

While these shortages do not appear as serious as those aboard the FFG-7 class ships, they nevertheless represent significant shortages of skilled petty officers.

Most FFG-7 class unique skills-will not be available at SIMAs initially

In addition to these shortages, Navy officials said that most of the FFG-7 class unique skill codes which have been identified for the SIMAs will not be filled until late fiscal year 1983. While Navy officials expect to fill some of these billets in fiscal year 1981, they point out that the reason for this delay

is that sailors leaving FFG-7 class training courses are assigned to shipboard billets rather than shore billets. Navy policy requires crewing ships before shore facilities. Although the Navy has stated a goal of 3 years at sea and 3 years ashore, this goal is often not achieved. Sometimes, sea tours last as long as 5 years. Officers who assign Navy enlisted personnel pointed out that first-term sailors who spend the first year or more of their initial 6-year enlistments in FFG-7 class training schools, followed by 3 to 4 years aboard an FFG-7 at sea, would have only 1 to 2 years of their enlistment remaining during which they could be assigned to a SIMA. Further employment at the SIMA for these now experienced sailors would depend on whether they reenlisted. Even then, they could reenlist with the option of reassignment to another shore duty location or school.

Although the FFG-7 class unique billets are relatively few compared to the overall SIMA requirement (for example, in fiscal year 1981, 14 FFG-7 class unique billets are authorized for SIMA Mayport), these shortages will be more significant than their numbers indicate because they are uniquely necessary for maintaining this class of ships. These unique skills include gas turbine mechanics, radar and sonar maintenance personnel, electrical system maintenance personnel, auxiliary system technicians, and interior communications maintenance technicians.

COMMERCIAL INDUSTRIAL SERVICES PROGRAM

During the planning phase for the SIMA upgrade, the Navy recognized that its available personnel strength would be inadequate for the projected intermediate workload. To overcome this shortfall, the Navy implemented the Commercial Industrial Services Program in October 1979. Specifically, the program is designed to supplement the intermediate maintenance activity by using commercial industrial facilities, personnel, and equipment. Delays in implementing this program could adversely affect the FFG-7 class maintenance plan.

The program is expressly designed for the excessive workload which Navy personnel cannot accomplish. At each SIMA, an IMA coordinator projects the maintenance workload and when the workload exceeds the Navy's capacity, it is contracted from local commercial sources against previously negotiated contracts. Because the personnel strength, and therefore, work capacity of the SIMAs and afloat IMAs is a fixed quantity, the program can be viewed as a maintenance safety valve, to be turned on and off as the workload requires.

Although Navy officials we interviewed were uniformly in favor of the program, they also noted that contractor response is not always timely and could hinder maintenance planning and accomplishment. Navy officials pointed out that of the \$57 million funded to the program in fiscal year 1980, only \$48.6 million was obligated. This was primarily due to the inability

of local Navy Supervisors of Shipbuilding, Conversion, and Repair to prepare the necessary specifications against which contracts could be let. For example, of the 116 current contracts in force, 13 of these at Charleston and Mayport took anywhere from 1 to 18 months to contract, and 1 contract was still pending after 18 months. Officials said the reason for the backlog in preparing specifications was a lack of trained personnel and priority for the Commercial Industrial Services Program at the Supervisors of Shipbuilding, Conversion, and Repair to do the required contractual and administrative tasks.

Since 1978 the Navy has requested funding for 157 civilian personnel billets to prepare work specifications. Although the Congress has not yet provided funding, 157 additional billets have been authorized. Navy officials pointed out, however, that even with funding, they will need 12 to 18 months to fill the billets and train the new personnel.

Another obstacle is a lack of response from the commercial community. According to Mayport officials, the local area is not heavily populated with marine-related industries, and local businesses have often found it not in their best economic interests to bid on infrequent Navy maintenance contracts. Navy officials pointed out that as the total of ships increases, they expect a corresponding increase in commercial response.

CONCLUSIONS

The FFG-7 class represents the Navy's major experiment in minimum manning, modular repair, and nontraditional maintenance. Because this class is minimally manned it is heavily dependent on shore and afloat facilities for its intermediate maintenance support.

To meet its overall increasing maintenance requirements, including those of the FFG-7 ships, the Navy is conducting a major upgrade of its shore and afloat IMAs. These activities are not expected to meet the full maintenance demand. Rather, they will be supplemented by contractor personnel under the Commercial Industrial Services Program.

The Navy expects to meet the increasing personnel requirements for the shore facilities, but it also expects to fall short of quality requirements among petty officers. The Commercial Industrial Services Program, on the other hand, began in late 1978, and although its contribution cannot yet be determined, it has not always proven as timely as necessary.

With personnel shortages among the enlisted supervisory ranks and not always responsive commercial support, Type Commanders 1/ might be faced with a dilemma as the FFG-7 fleet increases. Should they concentrate available military and civilian resources to accomplish the FFG-7 class IMAVs, thereby decreasing personnel available to other ships? Or should they defer scheduled maintenance on FFG-7s?

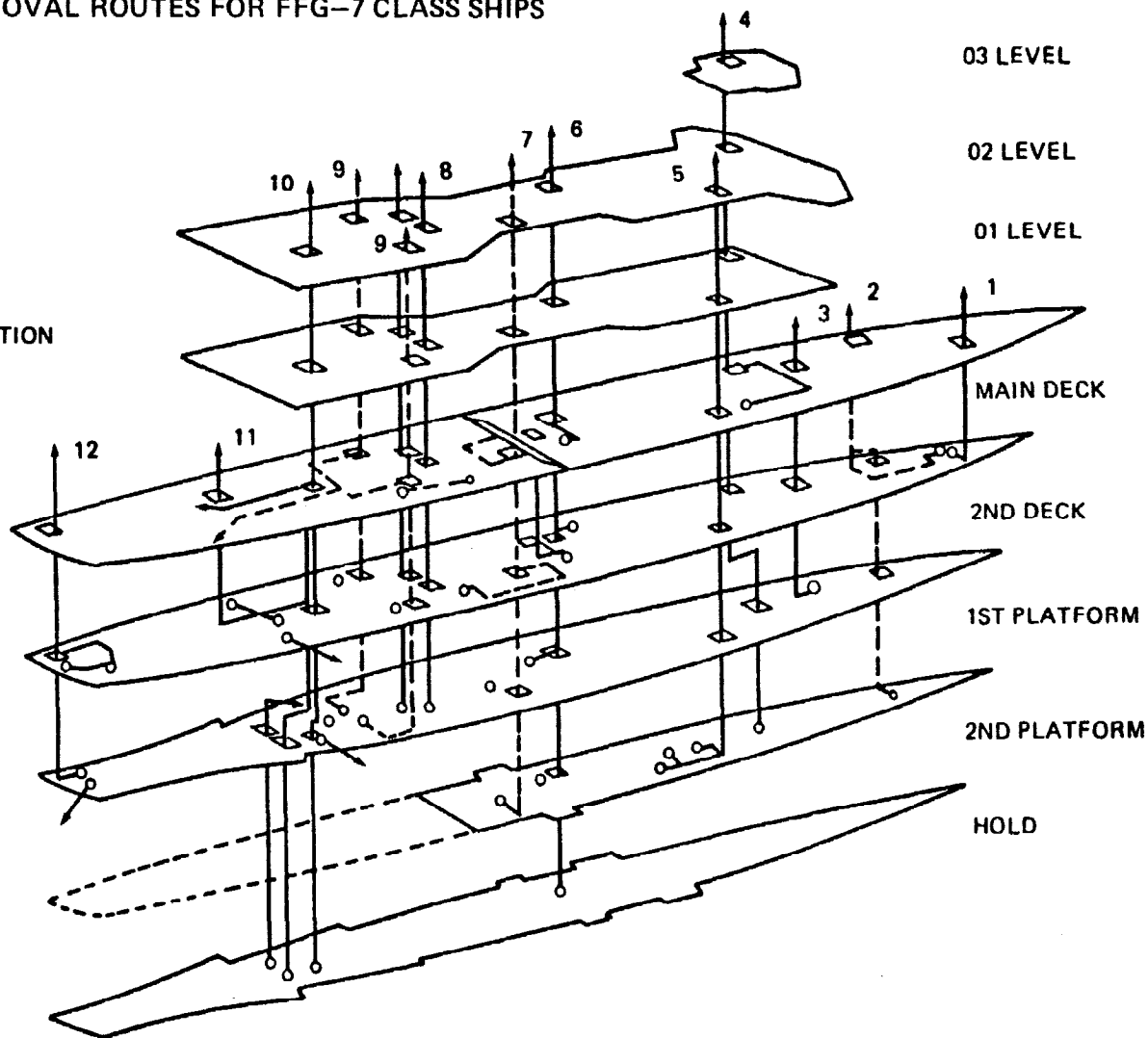
If this situation occurs, it is possible that the material condition of the ships will be degraded to the point where the ships would have to undergo a regular overhaul long before the planned 10-year modernization. Consequently, the initial operational objectives and estimated cost savings would not be achieved, and the purpose of the extensive and costly logistics efforts which are associated with the FFG-7 class would be negated.

1/Administrative Commands which provide tactical commands with the means of conducting tactical operations, such as administration of training, supply, and repair of fleet units.

EQUIPMENT REMOVAL ROUTES FOR FFG-7 CLASS SHIPS

LEGEND:

1. WINDLASS ROOM
2. SONAR COOLING EQUIP. ROOM
3. A/C MACHINERY ROOM
4. APU MACHINERY ROOM
5. LAUNDRY, FIRE PUMP, SEWAGE COLLECTION
6. AUXILIARY MACHINERY ROOM NO. 1
7. AUXILIARY MACHINERY ROOM NO. 2
8. GAS TURBINE
9. ENGINE ROOM
10. AUXILIARY MACHINERY ROOM NO. 3
11. SHOP
12. AFTER STEERING



GAO REPORTS RELATING TO FFG-7 CLASS LOGISTICSSTRATEGIES AND PROCUREMENT PROGRAM

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WASHINGTON, D. C. 20350

May 6, 1981

Mr. Donald J. Horan, Director
Procurement, Logistics, and Readiness Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Horan,

This is in reply to your letter of March 16, 1981 to the Secretary of Defense regarding "Guided Missile Frigate -- FFG 7: Are New Logistics Approaches Feasible and Economical?" (OSD Case #5665).

The logistic support procedures developed for the FFG-7 class ships represent a significant departure from standard Navy practices and incorporate a number of new logistic concepts to support reduced shipboard manning and increased operational availability. The GAO position as stated is that while the plan is comprehensive, the adequacy of support will be contingent upon the successful implementation of the new logistic concepts. GAO points out areas in which logistic support planning could be improved as well as recommending logistic alternatives for improving the economy and operation of these ships.

The Navy finds the report factual, comprehensive, and objective. The report is correct in pointing out that cost was not the major consideration in development of the logistic support concepts for this ship class. It correctly cautions that the Navy must closely monitor and evaluate operational experience and logistics costs for this class and investigate the applicability of other specific concepts which could provide additional economies. In general, the Department of Defense shares the concerns expressed and agrees with the recommendations made in the report.

Detailed comments are provided in the attached reply in regards to the recommendations contained in the body of the report.

Sincerely,

R. A. JONES
CAPT, SC, USN
PRICINPAL ASSISTANT LOGISTICS

Enclosure

1. Summary of GAO Findings and Recommendations

While the plan for logistic support of the FFG 7 class ships is comprehensive, the adequacy of support provided is contingent upon the successful implementation of new logistics concepts. There are several areas in which logistic support planning could be improved as well as logistic alternatives for improving the economy and operation of the FFG 7's. Additionally, the Navy should closely monitor and evaluate operational experience and logistics costs for this ship class.

2. Summary of the Department of Defense Comments

Overall, the report is factual, comprehensive, and objective. The criticality of the new logistics concepts to the success of the FFG 7 class maintenance philosophy is recognized and the concerns raised in the report are considered generally valid. The Navy plans to monitor the costs associated with this concept as recommended in the report and concurs with the majority of recommendations made by the GAO.

There are certain specific conclusions and resulting recommendations contained within the body of the report which indicate a possible misunderstanding of the subject in question, such as those which relate to stocking of spare parts, or result from the fact that the scope of the study is limited to FFG 7 while the problems being discussed are in fact much broader in scope, such as personnel shortages. Specific comments are provided in the following section on each major recommendation included in the study.

3. Specific Comments on the GAO Recommendations

a. GAO Recommendation: Determine, based on operational experience the cost effectiveness of the progressive overhaul concept and its related logistic strategies when compared to conventional Navy maintenance practices.

Navy Comment: Concur. The report discusses the study conducted in 1980 which indicated that the cost effectiveness of the concept will depend on the Navy's ability to execute the FFG 7 maintenance plan as defined. What was not mentioned was that in response to that study the Deputy Chief of Naval Operations (Logistics) was directed to track costs so that the study can be updated as experience is gained. (GAO note)

b. GAO Recommendation: Make greater use of Reliability Centered Maintenance if it can reduce maintenance costs for the FFG 7's at the intermediate and depot level.

Navy Comment: Concur that RCM should be examined for application at other than the organizational level. As noted in the report the Navy is proceeding with implementation of RCM

GAO note: Data added to body of report; recommendation deleted. See p. 20.

at the organizational level for both new construction and existing surface ship classes. This year the Navy has also begun examining the potential of an RCM type logic for use as a tool in defining surface ship overhaul work packages. Application of RCM to the engineered portion of work packages defined by a class maintenance plan would then follow as a next step.

c. GAO Recommendation: Develop specific policies regarding the use of the RCM concept in the development of maintenance planning for future ship construction.

Navy Comment: Concur. The Navy will conduct a review of applicable documentation and initiate necessary changes before the end of FY 1981.

d. GAO Recommendation: Consider the periodic replacement of equipments in determining shipboard supply support allowances on the FFG 7's.

Navy Comment: Concur. The Navy has considered the periodic replacement of equipment and other relevant factors in determining shipboard supply support allowances on the FFG-7 Class ships. The GAO recommends that the Navy should carry fewer shipboard repair parts applicable to an end-item equipment which is periodically replaced as part of the FFG-7 Class progressive overhaul concept because the parts should be required less frequently. Repair parts are placed on-board ship to ensure against degradation of mission performance in the event of random failure or untimely wearout failure. The fact that new equipments will periodically replace old equipments does not diminish to any extent this requirement, particularly the need to protect against random failures. Consider the example provided by GAO on page 39 of the Draft Report in which it was indicated that two stocked repair parts to support a major equipment had an expected life of about 4.5 and 2.5 years respectively, while the equipment itself is scheduled to be replaced every 2 years. With random failures, there is a 36% chance that the item with a 4.5 year expected life will have a random failure in two years and a 55% chance that the 2.5 year item will fail in 2 years. On the average if the part is not on-board there will be a two and one half week delay until that part will be available. Therefore, to the extent that the GAO is recommending a decreased number of on-board repair parts, the ship will have lower protection against random failures which will result in decreased operational readiness. Since approximately 95% of the current shipboard inventories are insurance items held in minimum quantities and a recent independent study indicated that the economic cost of shipboard allowances represents less than one half of one percent of life-cycle cost, the current level of investment in these allowances represent a prudent investment particularly for a program scheduled to grow from 15 ships in 1981 to 54 in 1988. In summary, the Navy is opposed to

recommendations that reduce shipboard spare parts inventories carried on-board to protect against random failures and to ensure that a ship will be able to carry out its mission in a combat environment.

e. GAO Recommendation: Avoid stocking duplicative items in support of corrective maintenance at intermediate maintenance activities.

Navy Comment: Do not concur. While the same stock number may be in both the geographical support and the corrective maintenance portions of Ship Operational Support Inventory (OSI), there is no duplication in the requirements determination process. In fact, the same stock number is computed and authorized to be in both levels in order to meet the unique purpose of each level.

(1) GEOGRAPHICAL SUPPORT INVENTORY: The geographical support OSI is a demand-based intermediate level of inventory, available to all authorized customers (ships, industrial activities, Naval Stations, etc.) in a geographical area. Geographical support OSI will respond to demands from consumer level inventory holders and compute levels authorized by DODI 4140.44, DODI 4140.45 and DODI 4140.46, namely, Order and Ship Time Level (OST), Operating Level (OL), Safety Level (SL) and, for repairables, Repair Cycle Level (RCL). Levels will be computed locally by Stock Points using standard inventory models, computer programs and parameters prescribed by the Inventory Control Point.

(2) CORRECTIVE MAINTENANCE INVENTORY: The corrective maintenance portion of OSI is a consumer level of inventory derived annually from maintenance plans using ship population data, usage rate data and configuration records at the Program Support Inventory Control Point to determine requirements. Only material used in support of intermediate level maintenance is eligible to be part of the Corrective Maintenance OSI. This level is broken into two parts:

(a) A 30-day operating level requirement which is reserved and protected for the "I" level maintenance activity.

(b) The remainder includes the OST, SL and RCL for this consumer level and is loaded as an NSO.

(3) In the stock replenishment programs, only the greater of the numeric stockage objective or the reorder point based upon actual demand recorded at the intermediate level, is used to initiate replenishment.

By determining requirements and replenishing stocks in this manner, the Navy has adjusted computational methodologies in order to minimize overall inventory levels as well as reducing inventory management cost while still providing the necessary level of mission support.

f. GAO Recommendation: Improve the accuracy of the system used to identify planned material requirements for the FFG 7's.

Navy Comment: Concur that the accuracy and stability of the material forecasts need to be improved. However, much of the fluctuation noted in material forecasts has been due to the learning curve associated with projecting material requirements for a planned intermediate and depot level maintenance program for the first time (FFG 7 and DDEOC programs were essentially developed simultaneously). This is an extremely complex problem, but the Navy has made progress in stabilizing requirements forecasts, and is continuing to emphasize this aspect of FFG 7 support.

g. GAO Recommendation: Revalidate FFG 7 crew requirements after new logistic support strategies are implemented.

Navy Comment: Concur, although major reductions in manpower requirements due to the implementation of the new logistics support strategies should not be anticipated. Based on the methods used in calculating manpower requirements, manpower savings would only occur through reduction of facilities and corrective maintenance requirements. Watchstanding and own unit support requirements, which generally represent about 80% of shipboard manpower requirements, would not be affected.

h. GAO Recommendation: Develop an action plan for overcoming personnel quality shortages on board FFG 7 class ships.

Navy Comment: Concur in principle. However, the Navy as a whole has a personnel quality shortfall. The FFG 7 must be approached as a part of the total problem, not as a separate entity.

i. GAO Recommendation: Reconsider cost benefit decisions previously rejected for ship design and equipment alternatives which can also reduce life cycle cost by reducing crew requirements.

Navy Comment: Do not concur. The Navy does not consider it beneficial to review design decisions made during ship design and construction such as the possibility of a more completely integrated bridge. Future decisions, however, must be tempered by the need to maintain or reduce crew size.

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