Opportunities For The Navy To Reduce Its Requirements For Avionics Testing Stations

Department of Defense

Repairing the complex avionics of modern carrier aircraft requires costly testers. GAO reviewed the implementation of the Navy's Versatile Avionics Shop Test system and recommends ways to reduce requirements for additional test stations.

LCD-76-440

~~703721~~ JUNE 14, 1976

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

LOGISTICS AND COMMUNICATIONS
DIVISION

B-133118

The Honorable
The Secretary of Defense

Dear Mr. Secretary:

This report points out opportunities for the Navy to reduce its requirements for additional Versatile Avionics Shop Test stations.

This report contains recommendations to you which are set forth on pages 14, 16, and 21. As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions he has taken on our recommendations to the House and Senate Committees on Government Operations not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Director, Office of Management and Budget; the Secretary of the Navy; and the Chairmen and ranking minority members of the House and Senate Committees on Appropriations, Government Operations, and Armed Services.

Sincerely yours,

Fred J. Shafer
Director

Contents

ABBREVIATIONS

GAO	General Accounting Office
VAST	Versatile Avionics Shop Test

GENERAL ACCOUNTING OFFICE
REPORT TO THE
SECRETARY OF DEFENSE

OPPORTUNITIES FOR THE NAVY TO REDUCE ITS REQUIREMENTS FOR AVIONICS TESTING STATIONS
Department of Defense

D I G E S T

To cope with the ever increasing complexity of, space requirements for, and personnel training requirements to operate intermediate level avionics test equipment, the Navy developed the Versatile Avionics Shop Test system during the 1960s and early 1970s. This system is a fully automated, general purpose avionics tester used in repairing a large portion of the avionics of the E-2C, F-14A, and S-3A aircraft. It is also expected to be used to test avionics of future weapon systems, such as the F-18. (See pp. 1 to 5.)

At this time the Navy has procured 85 Versatile Avionics Shop Test system stations for operation at shore installations and aboard carriers. These systems cost about $750 million--nearly $500 million for the 85 test stations and about $250 million for computer test programs, connecting cables, interface devices, and technical data, needed to interface the avionics components with the test stations. (See p. 5.)

The system is still in the implementation stages. System stations are operating at shore installations, but not all stations are in place. Only 5 of 12 carriers have been outfitted. (See pp. 5 to 7.)

Despite some problems with the implementation of the system, it is working and appears to support the avionics programed for it. To alleviate most of the identified problems, the Navy has initiated corrective action which is expected to improve the system performance. (See pp. 9 to 12.)

GAO believes the Navy may buy more VAST stations than will be needed to support existing and future aircraft because the Naval Air Systems Command is not adequately considering the improved system processing capability expected from the intiated corrective action in determining requirements for additional system stations. (See pp. 12 to 14.)

In addition, GAO believes that there are too many system operator training sites operated and/or planned, tying up too many of the expensive system stations. (See pp. 15 to 17.) GAO also believes that consolidating geographically closely located system shops offers potential for reducing the number of system stations required and improving personnel utilization. (See pp. 19 to 21.)

RECOMMENDATIONS

GAO recommends that the Secretary of Defense:

--Reevaluate the requirements for additional system stations in support of existing and future aircraft to insure that requirements are based on current forecasts of system performance rather than on historical workload experience. (See p. 14.)

--Reduce the number of system operator training stations in use and being planned to the mimimum number required by initiating double shifting, conducting more than one class during single shifts to the extent possible, and consolidating training detachments based on training need and student load considerations rather than supporting training stations for each aircraft supported and/or service branch. (See p. 16.)

--Determine the extent to which it is feasible to consolidate system shops at geographically close shore installations. (See p. 21.)

CHAPTER 1

INTRODUCTION AND SCOPE OF REVIEW

Traditionally, avionic systems for each new aircraft required their own peculiar test equipment. As a result, the number of testers to maintain the avionics was almost as high as the number of avionic devices.

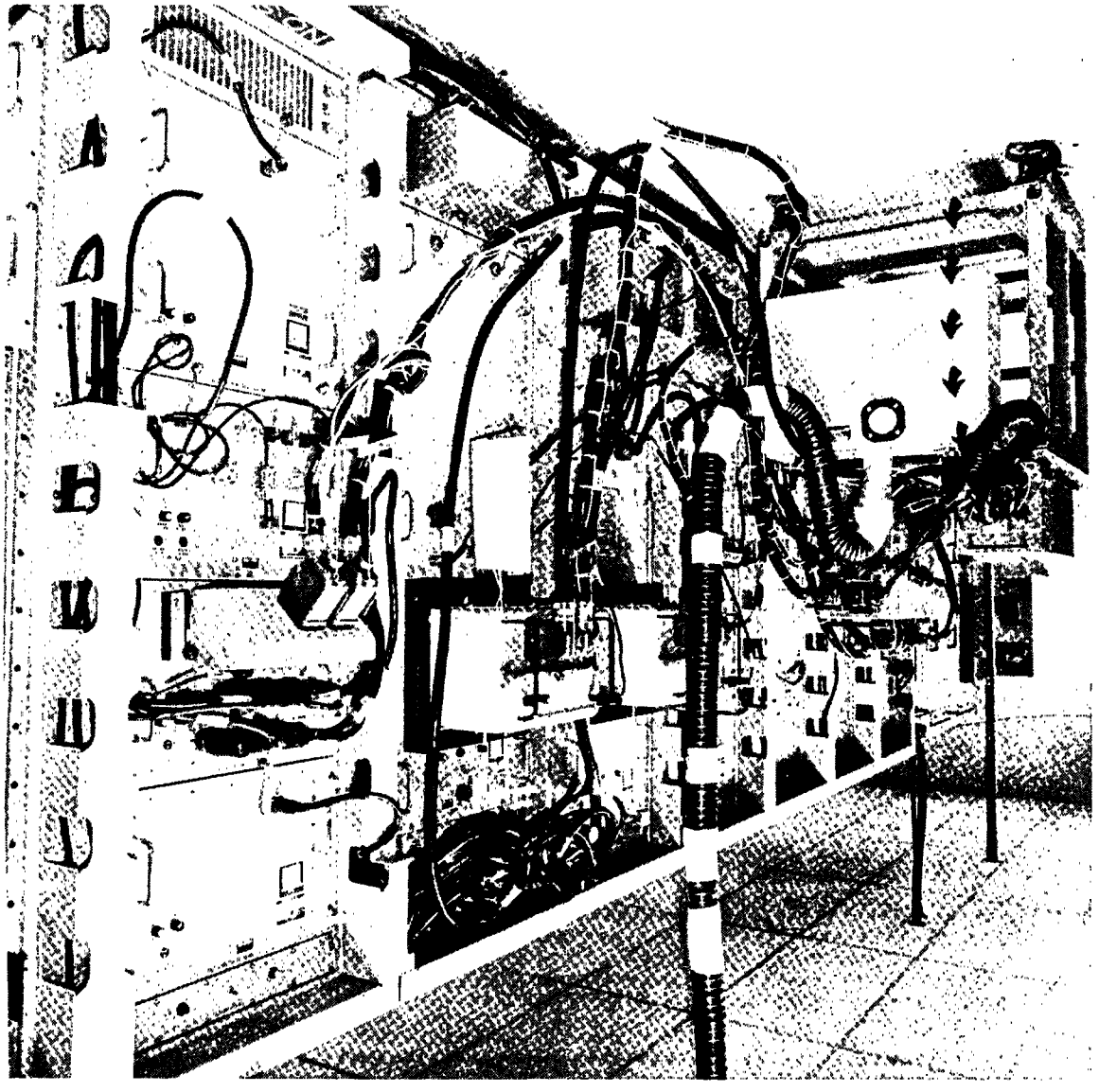
By the early 1960s the quantity, size, and complexity of avionics test equipment had increased to proportions causing problems concerning space, personnel, and training at the avionics shops aboard aircraft carriers and ashore. Because of the proliferation of avionics test equipment and resultant problems, the Navy decided to develop a general purpose, automated avionics test system, which eventually evolved into the current Versatile Avionics Shop Test (VAST) system.

VAST is an automated, general purpose, computer controlled network of avionics testing devices to be used primarily in intermediate maintenance shops aboard aircraft carriers and ashore. It is used to diagnose faults in avionic components which have been removed from aircraft.

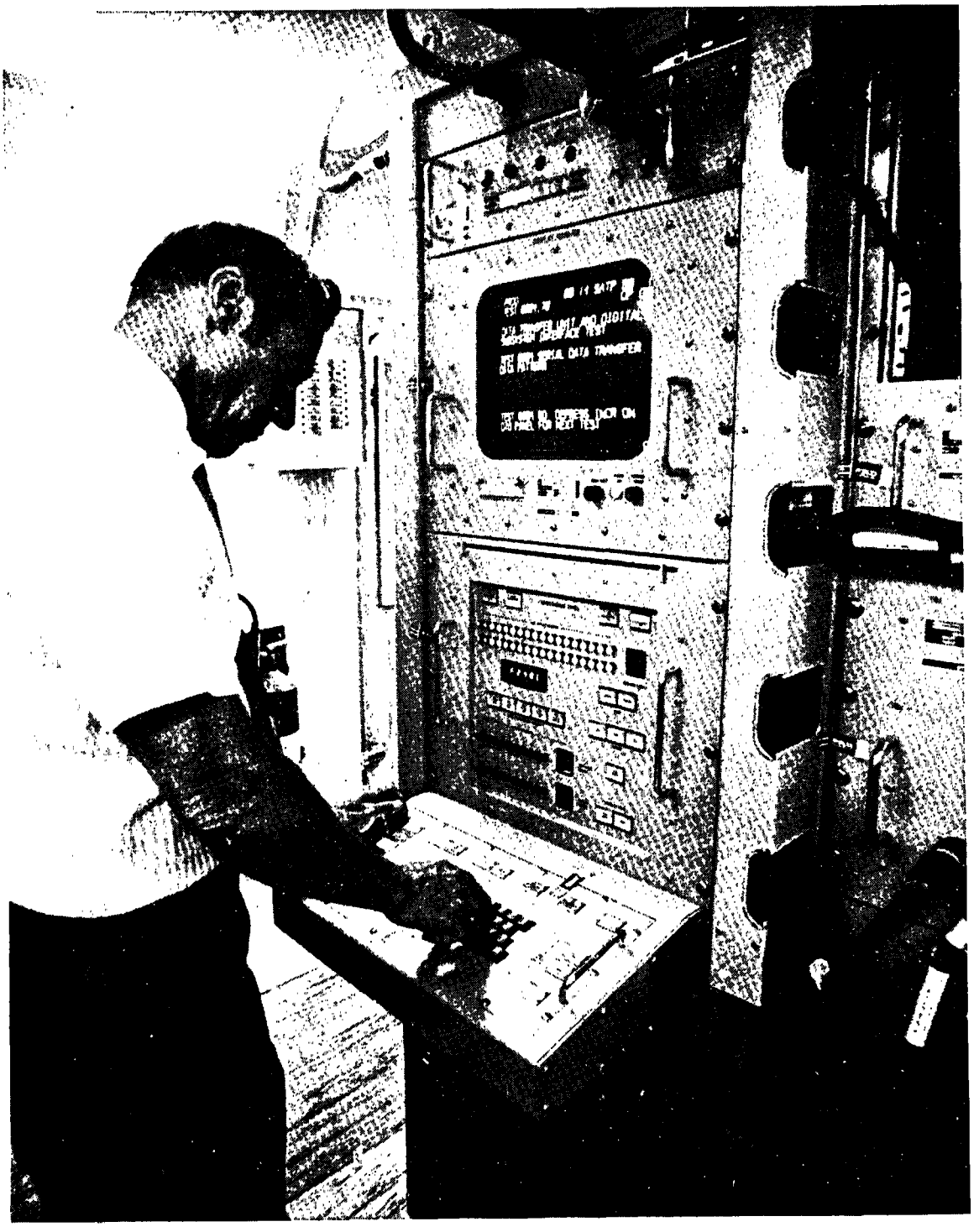
The system identifies faults to the next lower component. For example, if an avionic assembly is connected, VAST will identify the faulty module or groups of faulty modules. When a testable module is connected, VAST can determine if the module is faulty and, if so, identify the faulty lower subgroup.

Initially it was perceived that such a test system would be able to support most of the existing avionics in the carrier airwing along with new avionics to be developed for future aircraft systems. As the system evolved, it was recognized that it was not feasible to integrate then existing avionics into the tester.

Avionics systems are generally comprised of weapon replaceable assemblies which are removed from the aircraft to be fixed in avionics maintenance shops at the base or on the carrier. Shop replaceable assemblies, or modules, in turn, are subunits of weapon replaceable assemblies which can be exchanged in the avionics maintenance shops and repaired or shipped to the depot for repair.

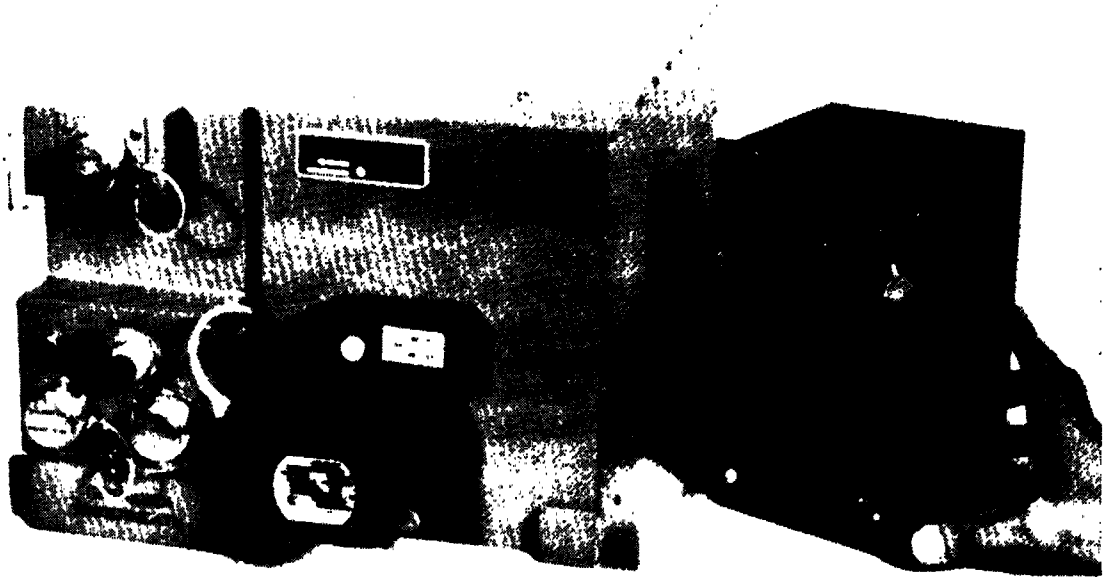


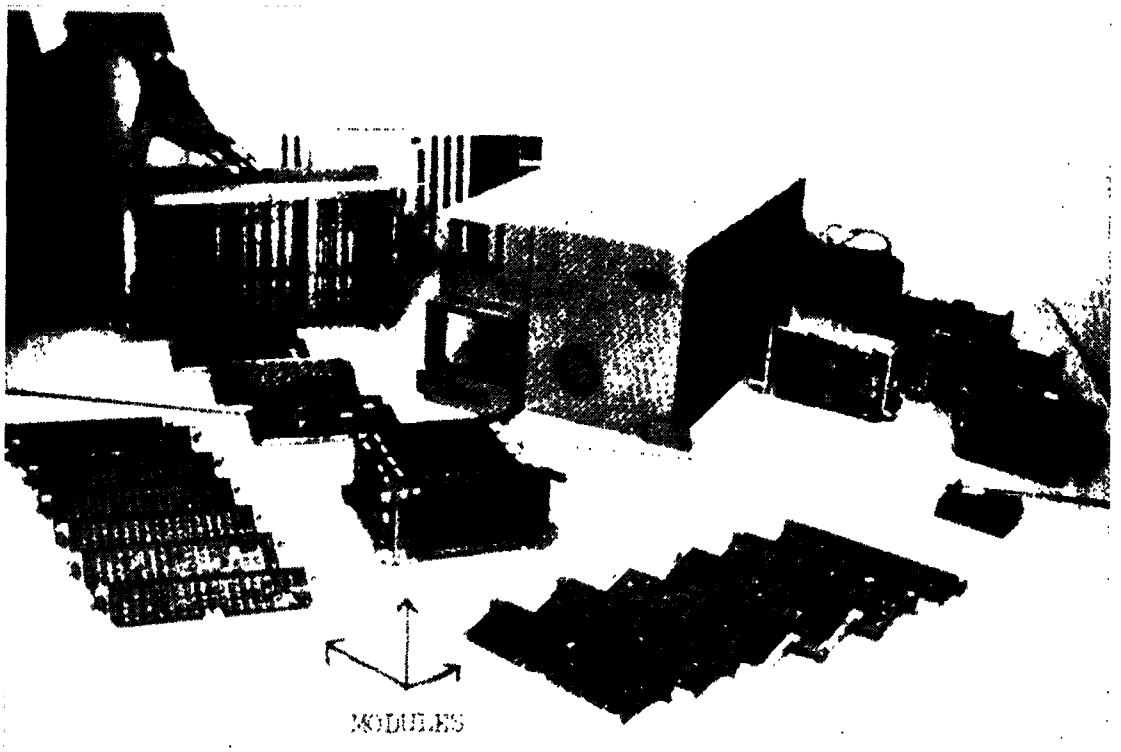
AN AVIONICS ASSEMBLY IS TESTED ON VAST. THE ITEM (LEFT SIDE) BEING TESTED IS ON THE CART; IT IS HOOKED TO THE INTERFACE DEVICE, WHICH IS CONNECTED TO THE HUGE VAST STATION BY EXTENSIVE CABLING.



COMMUNICATION BETWEEN OPERATOR AND VAST STATION

EXAMPLE OF AN AVIONICS ASSEMBLY





EXAMPLE OF ASSEMBLY MODULES

VAST is the principal testing support for a wide range of avionics on the F-14A, E-2C and S-3A aircraft. It supports about 150 avionic assemblies of the three aircraft and is also scheduled to support between 300 and 400 modules of the F-14A, E-2C, and S-3A avionic assemblies.

By Navy directive, the avionics of future aircraft are to be tested on VAST to the extent it is feasible to do so. Based on preliminary estimates VAST is expected to support an additional 39 assemblies of the future F-18 aircraft. In total, less than 50 percent of the avionic assembly support requirements of the four aircraft systems is tested on VAST.

A specially designed test program set is required to interface each avionic component with VAST. Test program sets include

--a tape containing the test routines,

--an interconnecting device and cables providing the interface connections, and

--instructions containing technical data to guide the VAST operator.

At the time of our survey, the Navy had invested about $750 million in the VAST system. The VAST hardware, consisting of 85 test stations, cost nearly $500 million. The test program sets needed to interface the various avionic components with VAST cost an additional $250 million. The software--test program--support costs can be expected to continue as long as the system is operational and will amount to millions of dollars in the future.

The Navy is planning to procure 28 additional VAST stations for an estimated $98 million to support present and future aircraft over the next 5 years. A VAST station, exclusive of the necessary test program sets, is estimated to cost about $3.5 million.

VAST stations operate with reasonable success at a number of shore installations and on aircraft carriers. (See p. 7.) During a recent deployment of the carrier USS John F. Kennedy, the VAST shop supported the avionics programed for VAST for the three different aircraft on the same carrier deck. This is not to say that VAST does not

have problems or that VAST has met all expectations, but it is encouraging that the system was able to test and make possible the repair of more than 80 percent of the major avionic assemblies inducted during the cruise.

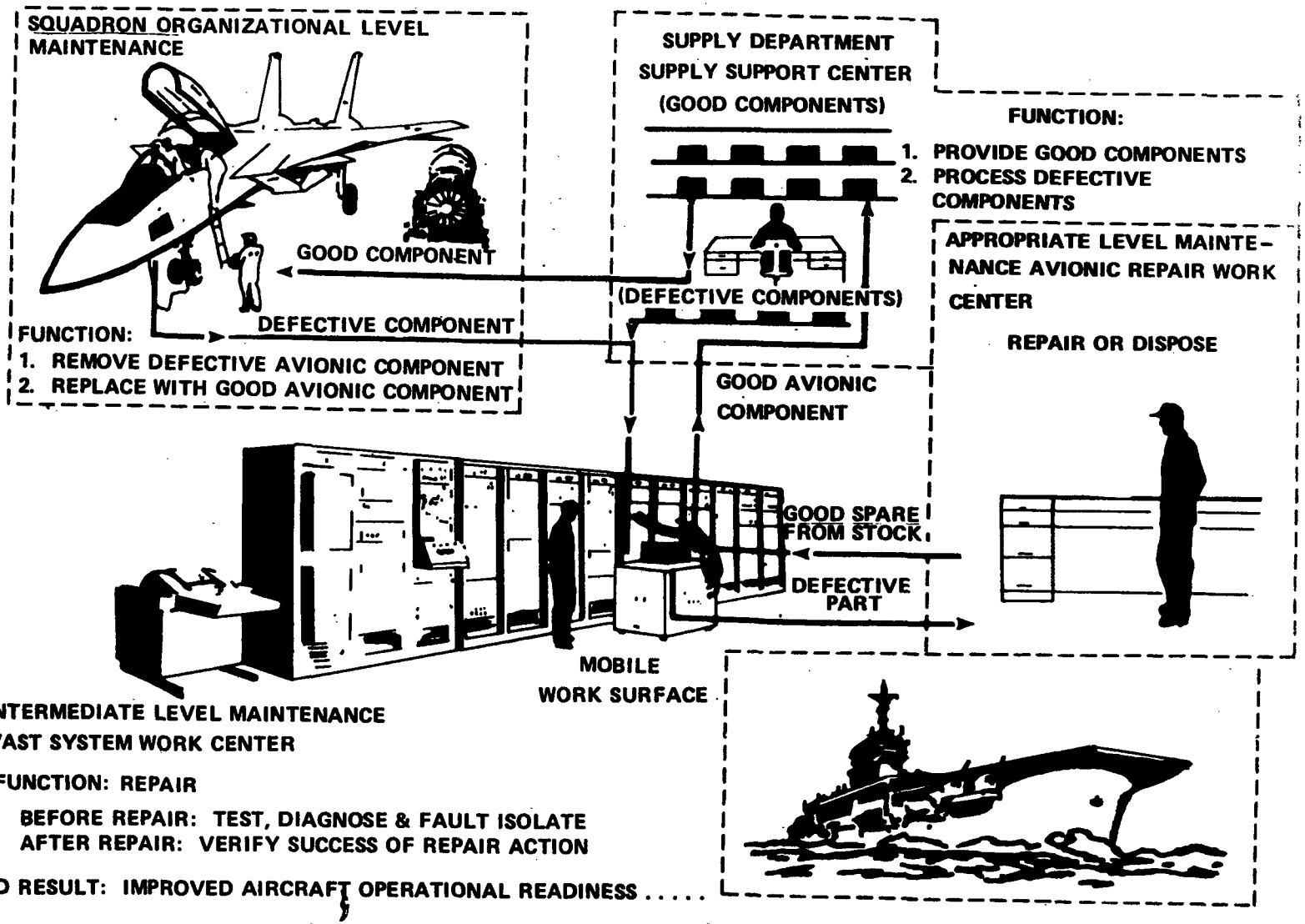
As depicted on page 8, malfunctioning avionic assemblies are removed from the aircraft and are replaced with functioning assemblies by the squadron's maintenance personnel. The malfunctioning assemblies are then forwarded, through the supply department, to the avionics shops for repair. The avionics repair shops are generally consolidated at the base level for shore installations and on carriers. These consolidated shops are referred to as intermediate level maintenance to distinguish them from the less complicated, routine maintenance performed at the squadron, known as organizational level maintenance, and the complex repairs and overhauls performed at the depot level maintenance.

SCOPE OF REVIEW

To determine the status of VAST implementation we contacted pertinent Navy activities, examined agency records, held discussions with responsible officials, and obtained copies of pertinent records and documents. Major review efforts were concentrated at the Naval Air Systems Command, Washington, D.C.; Commander, Naval Air Force, U.S. Atlantic Fleet, Norfolk, Virginia; Naval Air Station, Norfolk, Virginia; Naval Air Station, Oceana, Virginia; and USS John F. Kennedy (CV-67).

VAST STATION SITE PLAN FOR THE F-14A, E-2C, and S-3A

Location	Number of stations Planned		In place	
Intermediate maintenance:				
NAS Miramar (F-14A)	6		4	
NAS Oceana (F-14A)	5		4	
NAS Norfolk (E-2C)	2		2	
NAS North Island (S-3A)	5		5	
NAS Cecil Field (S-3A)	5		4	
Aircraft Carriers:				
Saratoga	4		4	
Enterprise	4		4	
Kennedy	4		4	
America	4		4	
Constellation	4		4	
Seven others	24		0	
		67		39
Depot maintenance:				
Norfolk, Virginia (F-14A)	2		2	
North Island, California (E-2C)	1		2	
Alameda, California (S-3A)	2		2	
		5		6
Training activities:				
NAS Miramar (F-14A)	1		1	
NAS Oceana (F-14A)	1		1	
NAS Norfolk (E-2C)	2		2	
NAS North Island (S-3A)	1		1	
		5		5
Contractors--for test program set development:				
Grumman Aerospace Corporation	2		13	
Lockheed California Company	1		6	
PRD Electronics Division of Harris Corp.	1		2	
		4		21
Other		4		3
Total		85		74



AIRCRAFT AVIONICS MAINTENANCE FLOW FOR VAST

CHAPTER 2

REQUIREMENTS FOR ADDITIONAL VAST STATIONS SHOULD BE BASED ON ANTICIPATED PERFORMANCE AND WORKLOAD

Navy officials generally agree that VAST will be able to support a larger volume of avionics than has been the case throughout the system implementation to date. They also point to improvements in processing as the result of actions being taken to correct identified shortcomings with VAST. However, in reevaluating requirements for VAST stations, expansion of existing VAST stations, and supplemental testers, Navy components are using VAST processing experience to date rather than the anticipated achievable workload factors.

PROBLEMS WITH VAST AND CORRECTIVE ACTIONS UNDERWAY

VAST is working, but the Navy is having a number of problems implementing the VAST system and is expending considerable resources to correct the shortcomings. VAST is not as efficient or effective as it could be because of (1) major flaws in some test program sets, and (2) relatively inexperienced operators. Also contributing to VAST system problems are (1) less than expected avionics reliability and (2) inadequate weapon system spares support. (See p. 10.) These shortcomings are well recognized within the Navy establishment and corrective actions are in progress for all of the above items.

Test program sets

The Navy is having problems with a number of test program sets. Some of the test program tapes have long run times and they are unable to isolate faults to specific modules if an assembly contains multiple faults. The Navy is contracting for the redesign of some test program sets for avionics to improve testability on VAST by shortening the test run times and making the tests more reliable.

For example, the fire control system on the F-14 uses excessive program run time because of required manual interventions. Unless each manual intervention is carried out within precise time intervals, the program has to be restarted. One of the assemblies of this particular system was one of the 10 most active items in the VAST shop during the recent USS John F. Kennedy deployment to the Mediterranean and required an average of 6 hours per unit to fix. The test

VAST SYSTEM PROBLEM AREAS

- **TEST PROGRAM SET (TPS) INADEQUACIES**

  - FAULT ISOLATION
  - ID, CABLE, CONNECTOR
  - COMPLEXITY
  - RUNTIME
  - CONFIGURATIONS
  - DELIVERY
  - DISTIBUTION
  - DOCUMENTATION

- **TRAINING INADEQUACIES**

  - CONTENT
  - SKILL LEVELS
  - DISCIPLINES

- **SPARES INSUFFICIENCIES**

  - MAINTENANCE ASSIST MODULES
  - AMBIGUITY GROUPS
  - EXPERIENCE

- **AVIONICS RELIABILITY**

program for this item is being revised to provide more entry points to obviate complete restarts each time the manual switching was not done timely.

As of late January 1976, test program set changes anticipated and in progress amounted to $11 million for the F-14 alone as a result of avionics changes and test program corrections. Although the effort is not as extensive, similar actions are underway for the other two VAST supported aircraft systems.

The Navy is also working on correcting interface device and connecting cable problems. Some of the complex interface devices and the fragile connecting cables for the S-3A are being redesigned.

Inexperienced operators

Another impediment to efficient VAST operations is the present qualification of VAST operators. Again, this problem is to be expected in the implementation phase of any new automated testing system. The operators have had formal training, but have not gained adequate experience in the operational environment. As the system becomes entrenched and more people have had extensive operating experience, VAST shop efficiency can be expected to improve considerably. In addition, the Navy has improved the advanced operator training course since it was implemented and is continuing to review the adequacy of the course. The improved training should eventually better VAST operations and improve the processing of avionics in the VAST shop.

Avionics reliability

VAST workload can be expected to decrease as avionics reliability of the supported aircraft improves. Avionics failure rates generally improve as the system ages and shortcomings are corrected, resulting in fewer numbers of assemblies to be tested. The avionics tested on VAST are generally new and have not necessarily reached final design. For example, the automatic flight control system on the F-14A requires a significant portion of available VAST station time. It was found that the blame is not to be placed on VAST or the test program tape, but rather on the avionics hardware, which is not reliable or VAST compatible. The Navy is planning to redesign the avionics system.

Spare support problems

Inadequate weapon system module spares availability is causing large backlogs in the repair of VAST supported assemblies. Coupled with nonspecific fault isolation, the lack of spares causes inordinate numbers of hookups and disconnects on VAST stations. Normally, assemblies are not disconnected from VAST when faulty modules are replaced because this is time consuming and frequent handling damages the extensive cabling.

While a test run may identify a faulty module, the module may not be in stock and will have to be ordered. In the meantime the assembly has to be disconnected and await the arrival of the spare. After the spare arrives, the assembly is reconnected and retested. Often another problem is identified during retest and the process repeats itself. For example, it took 77 days to repair an aircraft temperature control including 74 days to obtain spare parts. Parts were ordered on five different occasions because each retest identified another defect.

USE OF SUPPLEMENTAL TESTERS TO REDUCE VAST WORKLOAD

The VAST system is being relieved of a large portion of the programed module workload because other, less expensive testers needed to test assemblies beyond the capability of VAST are being bought. Since the new testers can test both the assemblies and their modules, the module test workload of VAST will be reduced. These testers will also be used to test other modules formerly scheduled for VAST support.

Future VAST workload may be reduced further if a family of module testers is developed. The Naval Air Systems Command is considering developing a family of testers capable of testing all types of modules and eliminating certain manual/semiautomatic testers from the Navy inventory. Over the next 5 years this effort could amount to as much as $50 million.

ADDITIONAL VAST STATIONS PLANNED TO SUPPORT EXISTING AIRCRAFT

The Naval Air Systems Command proposed to buy six additional VAST stations to expand existing intermediate maintenance activities at Naval Air Stations Cecil Field, Miramar, Norfolk, North Island, and Oceana at an estimated $21 million. Because of budget limitations all but the additional VAST station at Oceana were deleted from the 5-year defense plan.

Four of the five deleted VAST stations, however, are still considered to be valid long-term requirements as long as the number of VAST supported aircraft remains the same. The additional VAST station at Miramar is no longer needed because the anticipated E-2C increase did not materialize. These requirements are based on extrapolations of workload experiences to date coupled with the number of planes to be supported.

Since the Navy expects VAST system performance to improve, we believe it to be premature to justify additional VAST stations based on implementation experience to date. Also, the workload placed on VAST will be less than projected because many of the modules anticipated to be tested on the system will be transferred to module testers.

DETERMINING VAST REQUIREMENTS FOR FUTURE AIRCRAFT SYSTEMS

Requirements for the number of VAST stations needed to support the future F-18 are also based on extrapolations of VAST performance to date. As in the case of additional VAST stations needed to support existing aircraft, we believe such requirements would be more appropriately based on expected VAST system performance.

The Naval Air Systems Command estimates that 21 VAST stations will be needed for the shore support of the F-18 aircraft. An as yet undetermined number of additional VAST stations will be required when the attack variant of the F-18 enters the inventory in later years.

CONCLUSIONS

The VAST system performance, in terms of quality and volume, can be expected to improve as the system is fully implemented and actions to correct identified shortcomings take effect. Determinations of additional VAST station requirements to support existing and future aircraft systems should consider improvements in VAST performance and expected workload levels, rather than being based on workload experiences during the system's introductory phase. The present practice of basing additional requirements on the system's workload experience to date may result in procurement of an excessive number of VAST stations.

RECOMMENDATION

We recommend that the Secretary of Defense reevaluate the requirements for additional VAST stations in support of existing and future aircraft to insure that requirements are based on current forecasts of system performance rather than on historical workload experience.

CHAPTER 3

VAST OPERATOR TRAINING ACTIVITIES COULD BE REDUCED

The Navy has a VAST operator training site at three Naval Air Stations and opened another site at a fourth location in May 1976. A separate VAST operator training site is maintained for each of the aircraft systems supported by VAST.

Training sites are located at Naval Air Stations Miramar, California, for the F-14A; Norfolk, Virginia, for the E-2C; and North Island, California, for the S-3A. Each site has one VAST station. A second training site for VAST operators in support of the F-14A opened at Naval Air Station, Oceana, Virginia, in May 1976.

None of the VAST operator training stations is fully utilized. The VAST operator training station at Norfolk operates only one shift a day. Norfolk plans to conduct two classes during the same shift by scheduling the classroom work for one class while the other is doing laboratory work and vice versa.

The VAST operator training detachment at Miramar generally has operated a single shift per day, although double shifting has taken place twice since July 1975 for a total of 6 weeks. No attempts are made to teach two classes simultaneously by scheduling classroom and laboratory work in the manner planned at Norfolk. In addition, class size at Miramar since July 1975 has been only 50 percent of capacity for the advanced operator course and 75 percent of capacity for the basic operator course.

The VAST operator training detachment at North Island has operated on a two shift basis since about January 1975 and will run three shift operations for awhile. No attempts have been made to teach two training courses during a single shift as is planned at Norfolk. North Island personnel told us that the makeup of the courses would easily allow scheduling two courses during the same shift, and that doing so could reduce the number of instructors needed.

It is also noteworthy that the training sites are virtually collocated in the Norfolk, Virginia, and San Diego, California, areas. (See p. 18.) Consolidation of training sites into single facilities in each geographic area would not cause undue logistical problems, such as travel and temporary duty.

Further VAST operator training stations are planned in support of the F-18. The number of such sites along with the number of VAST stations has not yet been finalized, but present plans call for four sites with one VAST training station at each. Two of the stations are scheduled for the Marines; the other two are for the Navy.

CONCLUSIONS

The number of VAST operator training sites now operated could be reduced and make VAST stations available for other requirements, thereby reducing the number of future procurements. The VAST operator training site at Oceana in support of the F-14A is unnecessary and should not have been opened in view of the single shift operations taking place at Norfolk, which is only about 30 miles away. (See p. 18.) Also, the existing F-14A VAST operator training site at Miramar is not operated to capacity since class sizes have generally been below standard, and generally only single shift operations are conducted.

We believe that the Navy should evaluate the consolidation potential of the two training sites maintained in the San Diego, California, area. The Navy should also review its policy with respect to VAST operator training sites to insure that the mimimum number of the expensive VAST stations are tied up for training purposes. Furthermore, we believe that Navy and planned Marine Corps VAST operator training detachments should be consolidated based on training need and student load considerations, rather than supporting training stations for each aircraft supported and/or service branch.

RECOMMENDATIONS

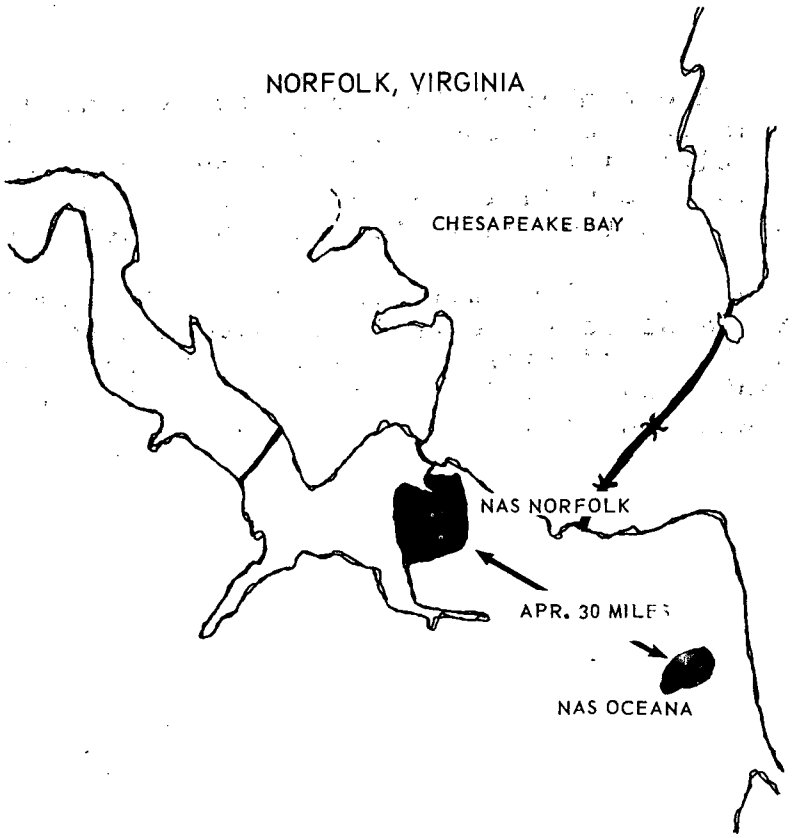
We recommend that the Secretary of Defense

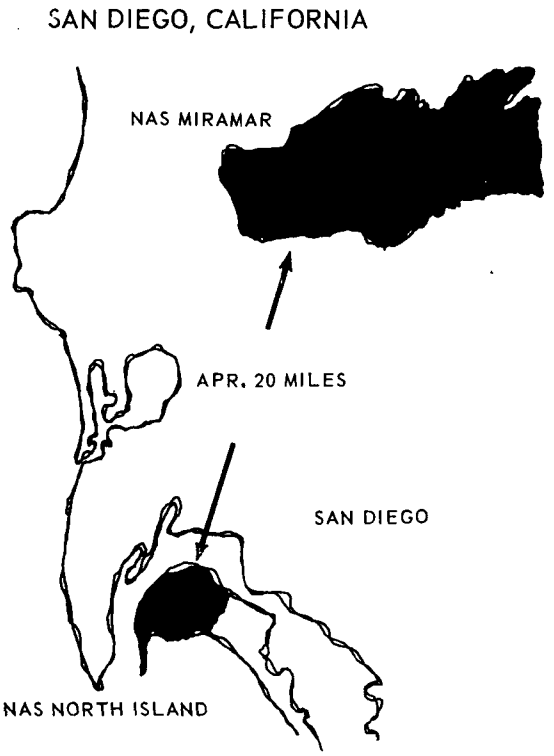
--close the additional VAST operator training site recently established at Oceana and operate the VAST training site at Norfolk on a two shift basis, if necessary;

--reduce the number of VAST operator training activities in the San Diego, California, area by instituting multishift training cycles and conducting more than one class during single shifts to the extent possible to free VAST stations for other uses; and

--review Navy policy with respect to VAST operator training sites and establish consolidated sites for total Navy and Marine Corps-wide training need and student load considerations to minimize the number of VAST stations required for training.

PROXIMITY OF LOCATIONS WITH **VAST** STATIONS





CHAPTER 4

POTENTIAL FOR ECONOMIES THROUGH CONSOLIDATION OF VAST SHOPS

The Navy has established separate intermediate maintenance VAST shops for each type of aircraft supported at each shore station irrespective of the closeness of the various installations. VAST shops at shore installations are concentrated in the Norfolk, Virginia, and San Diego, California, areas.

Excluding training and depot level repair activities, the Navy operates two VAST shops in the Norfolk, Virginia, area. The F-14A aircraft is stationed at Oceana. The VAST shop at this location has four VAST stations and is expected to eventually have five. Only about 30 miles away, at Norfolk the Navy has another VAST shop of two stations to support E-2C aircraft. (See p. 18.)

A similar situation exists in the San Diego, California, area. The F-14A is supported by a VAST shop of four stations at Miramar. This shop is scheduled for a total of six stations. The S-3A is supported by five VAST stations at North Island about 20 miles from Miramar. (See p. 18.)

VAST shops represent a considerable investment in sophisticated equipment and trained personnel. The current estimated cost of a VAST station alone amounts to about $3.5 million, placing the value of the VAST stations planned at the intermediate level maintenance in the Norfolk and San Diego areas at $24.5 million and $38.5 million, respectively.

Similarly, about 70 and 100 personnel will be required to operate these VAST shops in the Norfolk and San Diego areas, respectively. The operating personnel have generally received long, specialized training. Generally, the operators have completed the Navy's avionics school, had fleet experience in the maintenance of avionics, and completed specialized VAST training courses.

In our report on below-depot level maintenance 1/ we found that mechanics at the intermediate and organizational level were not used as productively as possible. We also found that equipment, skills and overhead personnel are needlessly duplicated and much equipment is underused within and between the services. We pointed out, and the Department of Defense generally agreed, that further consolidation of maintenance programs would result in better utilization of personnel and equipment. We believe that these principles apply to VAST shops once they are fully implemented.

The proliferation of VAST shops at shore installations will become even more severe with the eventual deployment of the F-18 now being developed. To support the new aircraft, further VAST shops are planned at Miramar and Oceana.

In evaluating the need for further VAST stations in any geographic area, existing slack capability among all installations should be considered. While the VAST stations may be fully utilized during the implementation phase, station availability should increase as experience is gained and the corrective actions underway discussed in chapter 2 take hold. Eventually it should be possible to accommodate temporary excess VAST workload at one installation by the slack in VAST use at another location. Similarly, as new aircraft, such as the F-18 are phased in at locations already having VAST shops, total VAST station requirements should be minimized by considering overall VAST assets available at the installation and other nearby locations.

Transporting avionics components to consolidated shore sites would not be an impediment. Avionics are now transported by truck between the unit level and base supply. Considering the current cost of about $3.5 million per VAST station, a more extensive avionics delivery schedule between maintenance levels could prove well worthwhile, if a VAST station can be eliminated in the process.

1/Productivity of Military Below-Depot Maintenance--Repairs Less Complex then Provided at Depots--Can Be Improved, LCD-75-422 dated July 19, 1975.

CONCLUSIONS

We believe that the intermediate level VAST shops in the same general geographic area should be considered from a total requirement and total capabilities point of view to make the best overall use of personnel and equipment. In our opinion, consolidation of VAST shops on the same air station and geographically close locations could lead toward minimizing the total number of VAST stations needed for shore support, along with overhead savings, and improving personnel utilization.

RECOMMENDATION

We recommend that the Secretary of Defense determine the extent to which it is feasible to consolidate VAST shops at geographically close shore installations to minimize VAST stations needed ashore and to improve personnel use.

APPENDIX I

PRINCIPAL OFFICIALS OF THE DEPARTMENTS OF DEFENSE AND NAVY RESPONSIBLE FOR THE ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
DEPARTMENT OF DEFENSE		
SECRETARY OF DEFENSE:		
Donald H. Rumsfeld	Nov. 1975	Present
James R. Schlesinger	July 1973	Nov. 1975
William P. Clements, Jr. (acting)	Apr. 1973	July 1973
Elliot L. Richardson	Jan. 1973	Apr. 1973
Melvin R. Laird	Jan. 1969	Jan. 1973
DEPUTY SECRETARY OF DEFENSE:		
William P. Clements, Jr.	Jan. 1973	Present
Kenneth Bush	Feb. 1972	Jan. 1973
Vacant	Jan. 1972	Feb. 1972
ASSISTANT SECRETARY OF DEFENSE (INSTALLATIONS AND LOGISTICS):		
Frank A. Shrontz	Feb. 1976	Present
John J. Bennett (acting)	Mar. 1975	Feb. 1976
Arthur I. Mendolia	June 1973	Mar. 1975
Hugh McCullough (acting)	Jan. 1973	June 1973
Barry J. Shillito	Jan. 1969	Jan. 1973
DEPARTMENT OF THE NAVY		
SECRETARY OF THE NAVY:		
J. William Middendorf II	June 1974	Present
J. William Middendorf II (acting)	Apr. 1974	June 1974
John W. Warner (acting)	May 1972	Apr. 1974
UNDER SECRETARY OF THE NAVY:		
David S. Potter	Aug. 1974	Present
Vacant	June 1974	Aug. 1974
J. William Middendorf II	June 1973	June 1974
Frank Sanders	May 1972	June 1973