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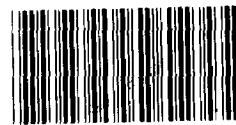
BY THE U.S. GENERAL ACCOUNTING OFFICE

Report To The Secretary Of The Navy

Navy Missile Maintenance Can Be Done Cheaper By Improving Productivity

The Navy has not tailored its intermediate missile maintenance resources to effectively meet its needs.

This report shows that the Navy's intermediate missile maintenance facilities capacity is more than needed. Also, the Navy does not have an effective work measurement system at its maintenance facilities. Without an effective system, the Navy's ability to measure missile production costs is limited.



112041



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LCD-80-43
APRIL 9, 1980



B-197995

The Honorable Edward Hidalgo
The Secretary of the Navy

Dear Mr. Secretary:


This report shows that the Navy could reduce anticipated facility modernization costs, improve worker efficiency, and increase facility use by reducing its intermediate missile maintenance resources. The report also shows that the Navy does not have an effective work measurement system at its weapons stations to evaluate maintenance performance.

We discussed this report with Navy officials and included their comments where appropriate.

The report contains recommendations to you on pages 17, 18, 22, and 33. 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 taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs 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 Chairmen, Senate and House Committees on Appropriations and on Armed Services, Senate Committee on Governmental Affairs, and House Committee on Government Operations; the Director, Office of Management and Budget; and the Secretary of Defense.

Sincerely yours,


R. W. Gutmann
Director





D I G E S T

The Navy could reduce anticipated facility modernization costs, improve worker efficiency, and increase facility use by reducing its intermediate missile maintenance resources. Intermediate missile maintenance consists mainly of testing the missile and its components to ensure readiness.

✓ To achieve an effective and economic match of maintenance resources with its needs, the Navy must be able to compare the facilities' capacity with projected requirements. However, the Navy has neither determined its facilities' capacity nor the private sector's capacity to meet its missile maintenance requirements.

✓ Navy officials recognize that its missile maintenance resources are greater than needed, but they do not know to what extent. ~~GAO's~~ analysis indicates that the Navy's missile maintenance capacity should be reduced. ~~because:~~

- Existing resources were greatly underused in fiscal year 1978 (see p. 7).
- Mobilization requirements will not exceed present capacities (see p. 10).
- Peacetime requirements through fiscal year 1983 will not increase much beyond fiscal year 1978 requirements (see p. 10).
- Future events, such as extending missile expiration firing dates, may decrease maintenance requirements (see p. 11).

✓ Weapons stations are not using their work force efficiently because of fluctuating or insufficient workloads. As a result, there is excessive idle time and skilled workers are assigned to nonskilled jobs (see p. 13).

Although the Navy recognizes that existing resources exceed present and future requirements, it continues to operate with unneeded maintenance capacity. The Navy plans to spend over \$8 million during the next 4 years for modernization purposes, and in some cases, for new capacity, even though such improvements or increases are questionable (see p. 19).

The underused missile maintenance capacity is costing millions of dollars annually, but this information has not been provided to the Secretary of Defense. Furthermore, the customers of the maintenance facilities are paying for the underused capacity (see p. 12).

The Navy lacks assurance that missile maintenance production is accomplished efficiently because the maintenance facilities are without effective work measurement systems. Consequently, actual performance cannot be evaluated or compared to performance standards or to other work at similar facilities (see p. 23).

RECOMMENDATIONS

GAO recommends that the Secretary of the Navy:

- Determine the private sector's and the Navy's capacity available for intermediate maintenance of air and surface launched missiles (see p. 17).
- Properly size the Navy's maintenance capacity to meet the air and surface launched missile requirements (see p. 18).
- Develop and implement a plan to systematically eliminate unneeded capacity (see p. 18).
- Report to the Secretary of Defense costs to retain or sustain unused or underused maintenance facilities in a readiness-for-mobilization position (see p. 18).

- Delay planned facility improvements that will not adversely affect mission effectiveness until capacity determinations have been completed and the improvements can be justified (see p. 22).
- Provide greater management support and reinforcement of work measurement concepts and principles at all management levels (see p. 33).
- Critically examine workloads at each maintenance facility to determine on which tasks labor standards should be developed (see p. 33).
- Direct missile maintenance managers to compare operating costs among facilities as a tool to increase missile maintenance productivity (see p. 33).
- Closely monitor the above actions and establish a realistic target date for estimating labor requirements based on labor standards rather than on historical data. (See p. 33).

AGENCY COMMENTS

In a January 10, 1980, letter, GAO asked the Secretary of Defense to comment on this report within 30 days. Although written comments were not received, GAO and Navy officials met on February 8 and February 27, 1980, and discussed Navy comments to the report. While Navy officials disagreed with some sections of the report, they generally concurred with GAO's conclusions and recommendations. Their comments are included in this report where appropriate.

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ABBREVIATIONS

GAO	General Accounting Office
IPG	industrial processing guide
MEFD	missile expiration firing date
MMMU-1	Mobile Missile Maintenance Unit-ONE
NAVAIR	Naval Air Systems Command
NAVSEA	Naval Sea Systems Command
PSP	Performance Standards Program

CHAPTER 1

INTRODUCTION

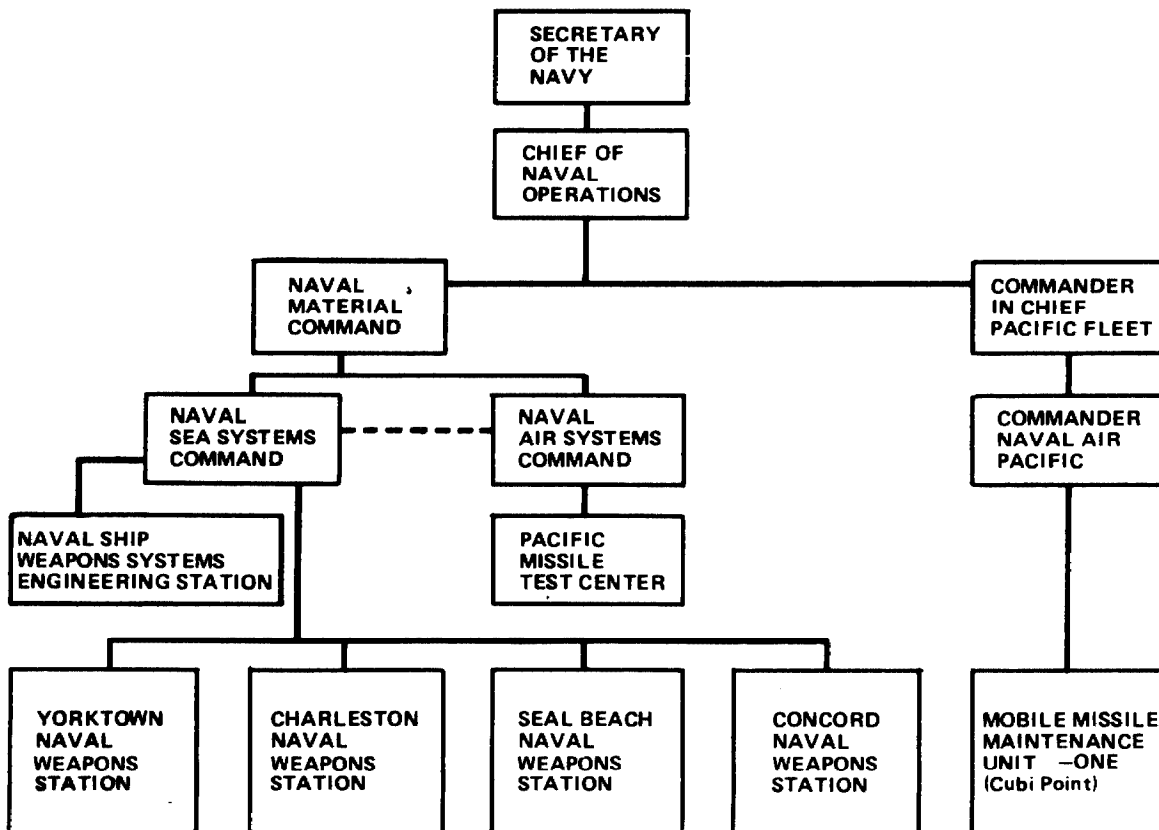
Tactical missiles are a key element of our national defense. These missiles must be kept in a serviceable, ready-for-issue condition to perform their missions. Essential in maintaining this readiness posture is the intermediate level maintenance function.

Intermediate level maintenance consists mainly of testing missiles and their components to ensure serviceability and readiness. Any actual repair is generally limited to (1) replacing nonserviceable components and (2) performing exterior appearance work, such as sanding and painting surfaces and repairing nicked fins.

The Navy's intermediate level maintenance costs for tactical air and surface launched missiles are about \$14 million annually. (See app. I for a listing of air and surface tactical missiles and their missions.)

MAINTENANCE ORGANIZATION

The following organization chart shows the Navy commands involved in managing missile maintenance.



Regarding intermediate missile maintenance:

- The Naval Ships Weapons Systems Engineering Station, Port Hueneme, California, is responsible for surface missile industrial engineering support. This support includes establishing and maintaining uniform production standards, equipment and facility use, logistics information, and workload and inventory management functions.
- The Pacific Missile Test Center, Point Mugu, California, an agent for Naval Air Systems Command (NAVAIR), is responsible for developing air launched missile maintenance requirements.
- The Naval Weapons Stations, Yorktown, Virginia, Seal Beach and Concord, California, perform intermediate maintenance on both surface and air launched missiles.
- The Naval Weapons Station, Charleston, South Carolina, performs intermediate maintenance on surface launched missiles only.
- The Mobile Missile Maintenance Unit-ONE (MMMU-1), Cubi Point, the Philippines, performs intermediate maintenance on air launched missiles only. MMMU-1 is a separate entity and its maintenance capability for air launched missiles is not considered part of the Naval Sea Systems Command's (NAVSEA's) capability to perform similar maintenance functions.

The following map shows the locations of the four weapons stations and one mobile missile maintenance unit performing intermediate maintenance on tactical missiles.



3

CUBI POINT
MMMU-12/



1/ NAVAL WEAPONS STATION

2/ MOBILE MISSILE MAINTENANCE UNIT -ONE

These activities perform maintenance on similar missiles as illustrated in the following matrix.

<u>Missile</u>	<u>Yorktown</u>	<u>Charleston</u>	<u>Seal Beach</u>	<u>Concord</u>	<u>Cubi Point</u>
Surface launch:					
Terrier	X	X	X	X	
Tartar	X	X	X	X	
Standard, ER	X	X	X	X	
Standard, MR	X	X	X	X	
Standard (SM-2)	(a)	(a)	X	(a)	
Air launch:					
Sparrow	X		X	X	X
Sidewinder	X		X	X	X
Shrike	X		X	X	X
Walleye	X		X	X	X
Phoenix	X		X		
Standard ARM			X		X
Harpoon	X			X	
HARM				(a)	

a/Planned capability.

SCOPE OF REVIEW

Naval weapons stations receive, renovate, maintain, store, and issue ammunition, explosives, expendable ordnance items and/or weapons and technical ordnance material, and perform additional tasks as directed by NAVSEA. We reviewed only the management of intermediate maintenance of tactical air and surface launched missiles. We used the Standard and Sparrow missiles to analyze and evaluate the weapons stations' facility capacities and missile maintenance management because in fiscal year 1978 these missiles represented 76 and 35 per cent of the surface and air launched missile workloads.

We made our review at the following locations:

- Naval Sea Systems Command.
- Naval Air Systems Command.
- Naval Ships Weapons Systems Engineering Center.
- Pacific Missile Test Center.
- Yorktown Naval Weapons Station.

--Charleston Naval Weapons Station.

--Seal Beach Naval Weapons Station.

--Seal Beach Naval Weapons Station (Fallbrook Annex).

--Concord Naval Weapons Station.

We obtained information concerning MMMU-1's capacity and production through formal correspondence.

CHAPTER 2

INTERMEDIATE MISSILE MAINTENANCE

RESOURCES ARE UNDERUSED

The Navy's intermediate missile maintenance capacity is more than needed to satisfy both peacetime and mobilization needs. The underused maintenance capacity is costing millions of dollars annually. For example, the underused capacity at the two west coast facilities cost the Navy about \$1.7 million in fiscal year 1978. Further, fluctuating and insufficient workloads at the maintenance facilities have caused labor inefficiencies, such as excessive idle time and the assignment of skilled workers to nonskilled jobs.

NEED TO MATCH REQUIREMENTS WITH RESOURCES

The Navy needs to ensure that there is sufficient industrial capacity and capability so its missions can be effectively accomplished. To ensure that missiles are prepared for emergency or war contingencies while minimizing costs, the Navy must effectively match requirements and resources. Requirements for both peacetime and wartime must be valid for developing an effective and economical industrial base.

REQUIREMENTS AND RESOURCES HAVE NOT BEEN EFFECTIVELY MATCHED

The Navy has not tailored its intermediate missile maintenance resources to effectively meet its needs. Although Navy officials recognize that missile maintenance resources are greater than needed, the amount of unneeded capacity is unknown because they do not know how much intermediate missile maintenance capacity exists.

Three potential sources of intermediate maintenance are naval weapons stations, commercial contractors, and MMMU-1. Navy officials said they did not know the maintenance capacity at the weapons stations, but they did know the capacity of MMMU-1. Navy officials also said they had some knowledge of private industry's maintenance capabilities and capacity primarily because they had used private industry as a maintenance source

recently. They said, however, that in the future more maintenance would probably be done by commercial contractors.

NAVY MISSILE MAINTENANCE
CAPACITY SHOULD BE REDUCED

The Navy's missile maintenance capacity should be reduced because

- it was greatly underused in fiscal year 1978;
- mobilization requirements will not exceed existing capacities;
- peacetime requirements through fiscal year 1983 will not increase much beyond fiscal year 1978 requirements; and
- future events, such as extending missile expiration firing dates (MEFD), may decrease maintenance requirements.

Maintenance capacity underused
in fiscal year 1978

Lacking precise missile maintenance capacity data for naval weapons stations, we devised several approaches which would provide some indication of the Navy's missile maintenance capacity. We compared our capacity figures to the fiscal year 1978 workload, and in all cases the capacity greatly exceeded the workload. Our study recognized four methods for determining the facility usage at the weapons stations: missile test set capacity, labor hours capacity, mobilization personnel requirements, and an air launched workloading comparison. These methods are not exact capacity determinations, but taken together, they do demonstrate that the Navy has more missile maintenance capacity than needed. The missile test set capacity method is discussed below. The other three methods are presented in appendix II.

Missile test set capacities

Underused missile maintenance capacity can be identified by determining the maximum number of missiles that can be tested daily. Although some Navy officials believe that maintenance production is limited by the missile workload mix, most officials agree that test set time is the

limiting factor on capacity. Thus, comparing the maximum number of missiles that could be tested daily to the number of missiles actually produced would indicate facility usage, as shown below.

Use of Maintenance Facilities
Based on Test Times
Fiscal Year 1978

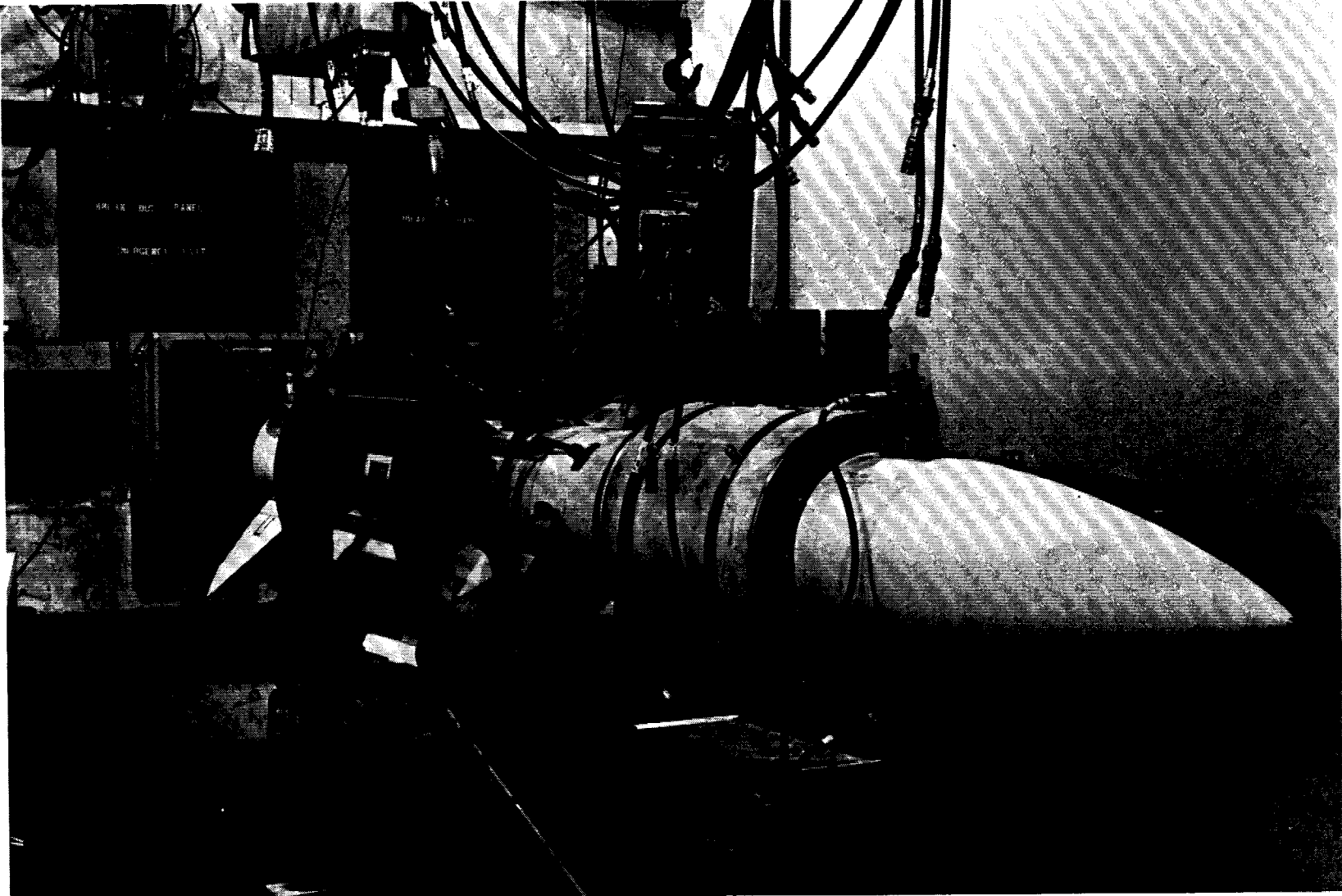
<u>Missile/ category</u>	<u>York- town</u>	<u>Charleston</u>	<u>Seal Beach</u>	<u>Concord</u>	<u>Cubi Point (note a)</u>
Standard:					
Capacity	1,287	1,287	1,287	1,287	-
Produced (note b)	1,070	789	534	638	-
Percent used	83	61	41	50	-
Sparrow:					
Capacity	3,213	-	3,213	3,213	3,000
Produced	970	-	437	531	357
Percent used	30	-	14	17	12

a/Capacity figures were provided by the Navy and are not based upon test set time.

b/Includes missiles for foreign military sales and depot acceptance program.

To simplify these determinations, the Sparrow and Standard missiles were selected. The maximum missiles that could be processed were determined by using the test times and support data contained in the Navy's surface missile processing description (Standard) and industrial processing guide (Sparrow). These test times were adjusted to recognize missile test failure rates.

A photograph of the Standard missile being tested is shown on page 9.



Source: U.S. Navy

STANDARD MISSILE BEING TESTED AT THE SEAL BEACH NAVAL WEAPONS STATION

Fiscal year 1978 missile workload
exceeds mobilization requirements

According to the Navy, mobilization requirements will consist of (1) repairing, assembling, testing, and packaging unserviceable assets in the system and (2) assembling, testing, and packaging anticipated procurements. NAVSEA, NAVAIR, and weapons stations officials said no missiles requiring maintenance would be returned from the fleet during mobilization because the fleet missiles would be fired.

Navy officials said that during mobilization sufficient maintenance capacity must exist to repair all unserviceable assets within 90 days. An April 1979 Navy study identified missile maintenance requirements during the first 6 months of mobilization. Our analysis showed that the surface missile requirements are less than half of the fiscal year 1978 production. Our analysis further showed that with existing capacities the Navy could satisfy its surface missile maintenance mobilization requirements within 65 days while working 1 shift, 8 hours, 5 days a week. Also, using existing capacities, the Sparrow missile maintenance mobilization requirements could be satisfied within 47 days while working 1 shift, 8 hours, 5 days a week. These maintenance time frames could be reduced to the extent the Navy decides to use multiple shifts to cover mobilization surges.

The Navy recently completed a study which supports the fact that missile maintenance requirements for mobilization can be accomplished within 90 days. This study, however, identifies other restraints at the weapons stations that could impede the Navy from meeting its overall mobilization requirements.

Peacetime requirements through
1983 will remain at 1978 levels

Future missile maintenance requirements depend, in part, on the size of the Navy's missile inventory between now and fiscal year 1983. If the Navy is able to satisfy its requirements, the existing missile maintenance capacity will still be underused.

NAVSEA's and NAVAIR's missile maintenance commands developed and provided missile maintenance requirements through 1983. The following table compares each station's percent of facility use in fiscal year 1978 with each station's highest expected use through 1983.

<u>Station</u>	<u>Standard</u>		<u>Sparrow</u>	
	<u>Fiscal</u> <u>year</u> <u>1978</u>	<u>Projected</u> <u>through</u> <u>1983</u>	<u>Fiscal</u> <u>year</u> <u>1978</u>	<u>Projected</u> <u>through</u> <u>1983</u>
	----- (percent) -----			
Charleston	61	60	-	-
Yorktown	83	95	30	31
Concord	50	45	15	20
Seal Beach	41	47	14	16

These results show that the facility use will not significantly improve.

Navy officials said that a comparison of capacity with 1985 requirements would be more meaningful. We therefore compared the projected 1985 requirements for the Standard missile to existing capacity and found that the average daily missile maintenance requirements would be about 11. The current test set capacity for the Standard missile is about 20 missiles a day. Further, we compared the 1985 requirements for the Sparrow missile to existing capacity and found that the average daily missile maintenance requirements would be about 21. The current test set capacity for the Sparrow missile, exclusive of MMMU-1, is about 36 missiles a day.

Future events may reduce missile maintenance requirements

Missile maintenance requirements may decrease because the Navy may extend the MEFD.

To ensure missile reliability, the Navy establishes an MEFD for each missile type. The MEFD--the primary cause for a maintenance action--indicates how often a missile should be tested; that is, if a missile type has a 2-year MEFD, half of the missile inventory should be tested each year to ensure that it is reliable and in a ready-for-issue condition. As missile reliability is established through a continuing analysis of missile firings and tests, the MEFD may be extended. When MEFDs are extended maintenance requirements decrease.

The Navy is considering extending the MEFD for some surface and air launched missiles. For example, the

Standard's MEFD may be extended from 3 to 4 years. According to the surface missile manager, this extension would reduce maintenance requirements by about 8 to 10 percent. The Navy is also considering extending the Sparrow's MEFD, which would also reduce maintenance requirements. The practice of extending MEFD is not new. For example, the Shrike's MEFD was changed from 6 to 12 to 18 months and is currently 24 months.

UNDERUSED CAPACITY COSTS ARE
SUBSTANTIAL BUT NOT REPORTED

The underused missile maintenance capacity is costing millions of dollars annually, but this information has not been reported to the Secretary of Defense. Furthermore, the weapons stations, through their budget systems, charge the costs of underused capacity to customers.

Defense Instruction 7410.4 states:

"The agency or command having management responsibility for an industrial fund activity shall budget and pay for the costs of maintaining unutilized or underutilized plant and facilities. The retention of such facilities must be specifically approved by departmental headquarters as essential in support of mobilization readiness."

Navy Comptroller Manual 038055 states:

"Costs applicable to maintaining unutilized and underutilized capacity will be determined and, where significant, will be made the subject of separate reimbursement."

In March 1974 we reported to the Secretary of Defense that the costs of maintaining unused and underused capacity were substantial; however, the costs were not being adequately identified, reported, or separately funded. We stated the impact of this shortfall was:

--The Congress and Defense are not fully aware of the costs of maintaining unused and underused plant and equipment for mobilization purposes.

--Industrial fund managers and their commands are not able to evaluate actual costs of providing customers with products and services requested.

--Industrial fund customers are not receiving accurate billings, thus inflating the costs of their operating programs and, possibly, adversely affecting their decisions regarding selection of Government versus commercial supply sources.

The conditions at the naval weapons stations today are similar to those we reported in 1974.

Concord's and Seal Beach's underused plant capacity reports, submitted to NAVSEA, concluded that the underuse of surface and air launched missile maintenance facilities cost the Navy about \$1.7 million in fiscal year 1978. In addition, the surface launched missile maintenance manager estimated that the underused surface missile maintenance capacity cost between \$300 and \$400 per missile or between \$1 million and \$1.3 million each year for the four weapons stations.

Each weapons station is recovering the cost of underused capacity through its overhead rate, which is not in accordance with Defense and Navy guidance. This procedure does not provide Defense nor the Congress visibility over such costs and does not allow them the opportunity to challenge the Navy's need for the underused capacity.

Recently, Navy officials recognized the need to identify and report excess capacity costs. For example, for fiscal year 1980 the Navy asked the Congress for \$11.8 million to maintain underused waterfront operations at two weapons stations. In future years, the Navy plans to update the data to identify the underused costs of all ordnance functions, including missile maintenance. In this regard, a NAVSEA instruction dated November 1979 requires the weapons stations to report the cost of maintaining underused plant and facility capacity. However, it does not guarantee that all costs will be identified and reported to Defense or to the Congress.

STAFF PRODUCTIVITY CAN
BE INCREASED

Weapons stations are not using their present work force efficiently because of fluctuating and insufficient

workloads which cause the underuse of the maintenance work force and the assignment of skilled workers to nonskilled jobs.

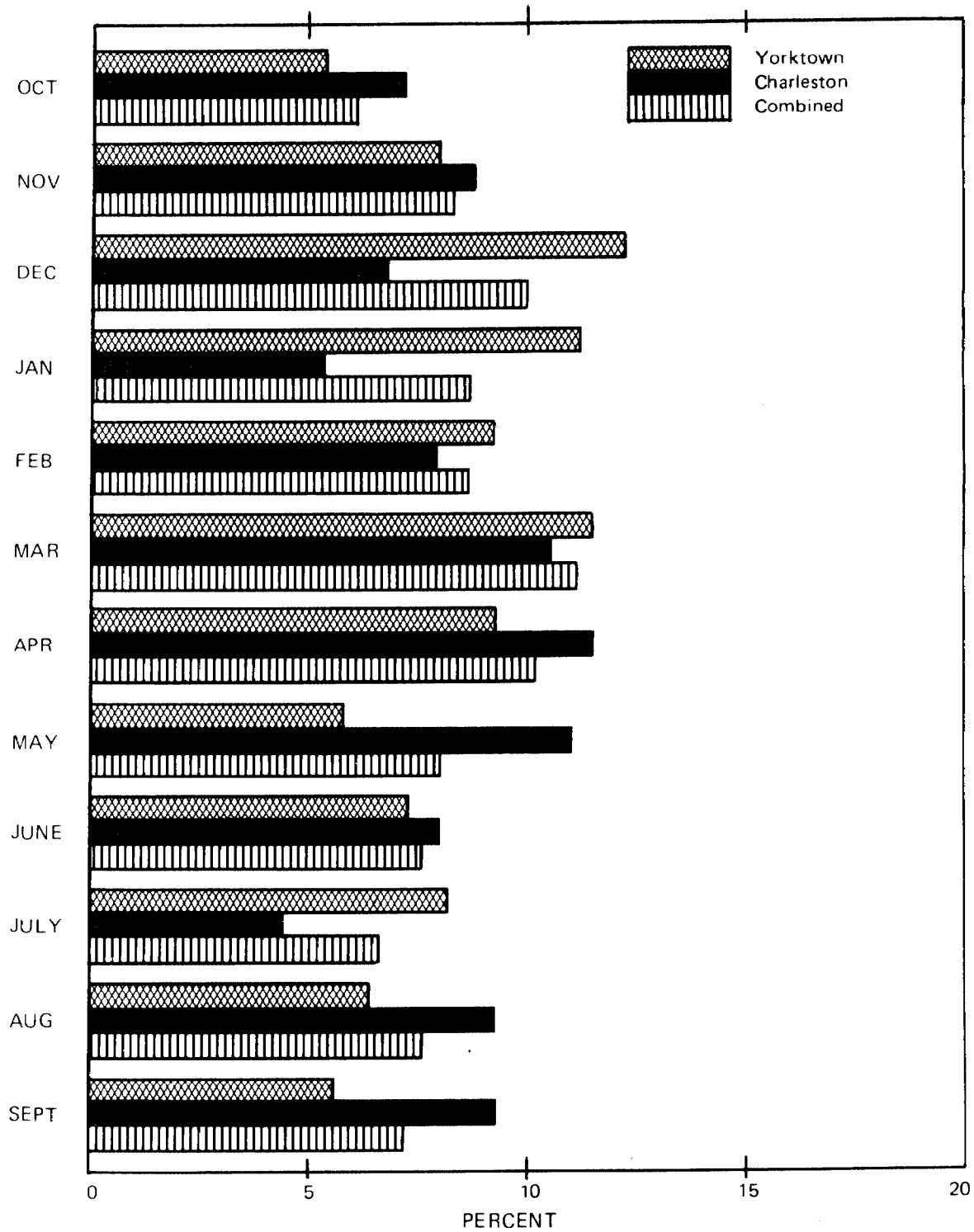
The surface missile maintenance manager stated that weapons stations must meet ship loadout requirements, but they lack the assets to do so. Therefore, the demand on the missile maintenance work force varies significantly. For example, when missiles are not available for maintenance, the work force performs nonrelated maintenance functions. However, to meet ship loadout requirements, the work force occasionally works overtime.

The Standard missile production in fiscal year 1978 fluctuated from month to month, between stations, and between the east and west coasts. The graphs on pages 15 and 16 show that each station's workload could be significantly mitigated by consolidating the entire workload into one station on each coast.

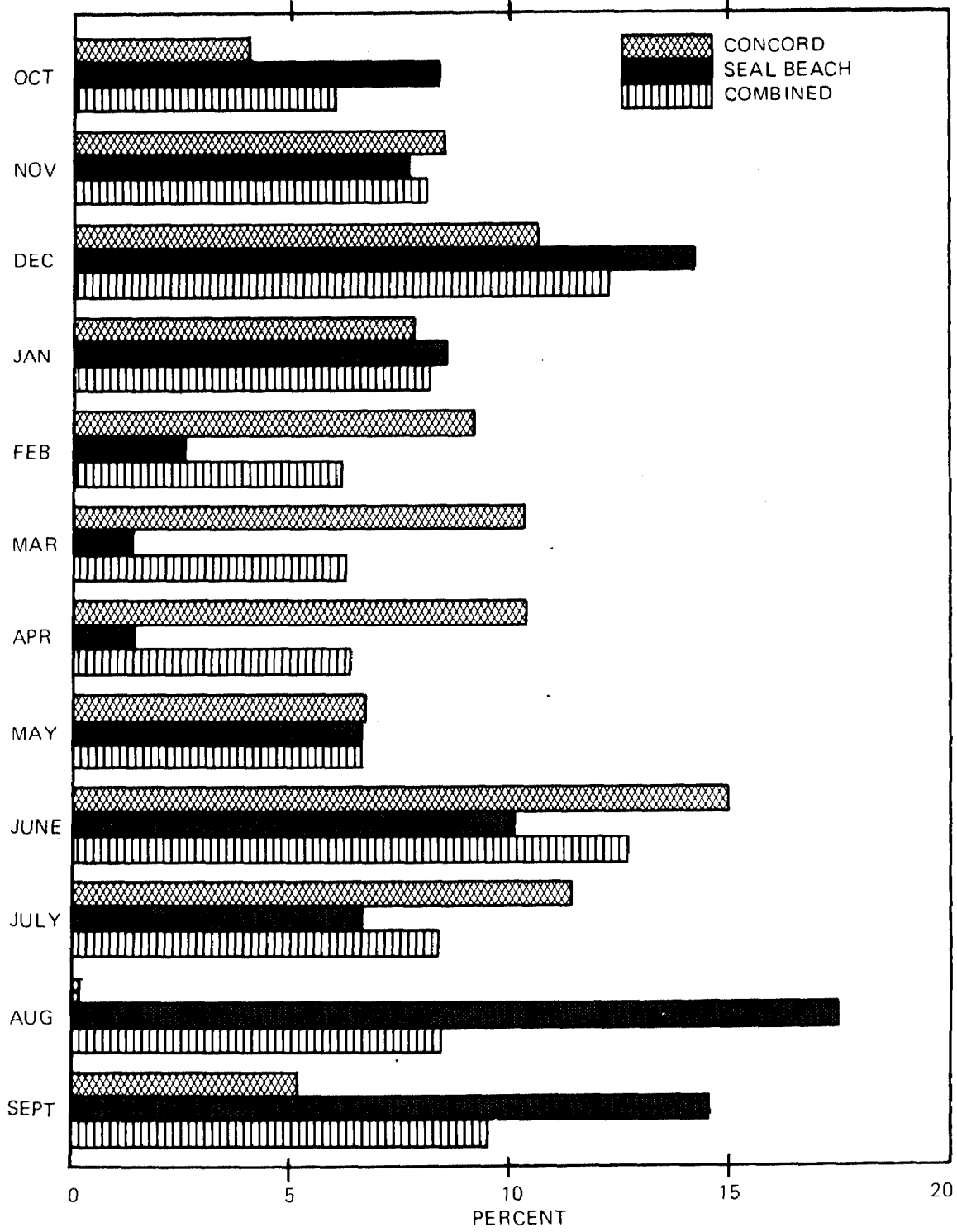
The surface missile maintenance manager agreed that a more efficient use of labor would be obtained by consolidating all surface missile maintenance requirements at one station on each coast. However, he believed the increased transportation cost would outweigh the benefits of a more efficient labor usage. Contrary to his belief, Charleston weapons station officials stated that the savings in production costs would exceed the transportation costs.

Future forecasts of Sparrow missile production levels show that the stations have insufficient workloads to be efficiently productive. In April 1979 the Surveys and Investigations Staff of the House Committee on Appropriations reported on maintenance concepts and procedures for air launched missiles of the Air Force and Navy. The report showed that the number of Navy air launched missiles scheduled for maintenance in fiscal years 1977-80 will average about 5,460 missiles per year, including 1,895 Sparrows. Each of the three Sparrow maintenance facilities can expect a workload of about 630 missiles. An annual Sparrow workload of 630 missiles for 1 shift, 8 hours, 5 days a week, would represent less than three missiles a day. At best, each station's daily production requirement for all air launched missiles, based on workload forecasts from the Committee's staff report, will be about seven missiles a day. This rate is well below the production capability of the available staff and/or the test cells.

PERCENT OF ANNUAL WORKLOAD BY MONTHS
 EAST COAST STANDARD MISSILE MAINTENANCE
 FISCAL YEAR 1978



PERCENT OF ANNUAL WORKLOAD BY MONTHS
 WEST COAST STANDARD MISSILE MAINTENANCE
 FISCAL YEAR 1978



Seal Beach officials stated insufficient air launched missile requirements result in a significantly inefficient use of air launched missile maintenance workers. They explained that these workers, because of insufficient maintenance requirements, spend an inordinate amount of time sweeping and cleaning the facilities. As a result, they are producing fewer units at a higher cost because overhead must be spread over a smaller production level.

NAVAIR is aware that there is insufficient workload to adequately support two weapons stations on the west coast. This problem was discussed at a June 1979 air launched missile workload planning conference. NAVAIR's proposed solution is to consolidate the air launched missile workload at Seal Beach. NAVSEA plans to conduct a detailed study before taking appropriate action.

CONCLUSIONS

Since Navy officials do not know how much missile maintenance capacity exists at Navy facilities or within the private sector, they cannot accurately match requirements to capacity. Thus, they do not have a sound basis for sizing their missile maintenance capacity.

The Navy's missile maintenance capacity should be reduced because it is more than needed to satisfy both peacetime and mobilization needs.

The underused missile maintenance capacity is costing millions of dollars annually, but this information has not been reported to Defense. Furthermore, the weapons stations have charged the costs of the underused capacity to their customers.

Weapons stations may not be using their present work force efficiently because of insufficient and fluctuating workloads which cause the underuse of the maintenance work force and the assignment of skilled workers to nonskilled jobs.

RECOMMENDATIONS

We recommend that the Secretary of the Navy:

- Determine the private sector's and the Navy's capacity available for intermediate maintenance of air and surface launched missiles.

- Properly size the Navy's maintenance capacity to meet the air and surface launched missile requirements.
- Develop and implement a plan to systematically eliminate unneeded capacity.
- Report to the Secretary of Defense costs to retain or sustain unused or underused missile maintenance facilities in a readiness-for-mobilization position.

CHAPTER 3

THE NAVY CONTINUES TO HAVE EXCESS

MAINTENANCE CAPACITY AND FORGOES

OPPORTUNITIES FOR CONSOLIDATION

Two recent Navy studies identified ways to consolidate intermediate missile maintenance. The Navy's response to the recommendations of these studies and a planned modernization indicates that it does not plan to reduce capacity. To illustrate:

- A 1977 study recommending surface missile maintenance consolidation was not implemented.
- Modifications to the Standard missile test capability are planned for all four weapons stations.
- A 1978 survey recommending maintenance for the HARM missile be located at Seal Beach was rejected.

SURFACE MISSILE MAINTENANCE CONSOLIDATION STUDY

The 1977 Naval Ships Weapons Systems Engineering Station study recommended consolidating surface missile maintenance at one station on each coast.

Consolidation would occur by placing all Tartar/Terrier missile workloads at Charleston and Concord and all Standard missile workloads at Yorktown and Seal Beach. This proposal would have eventually eliminated Charleston and Concord from surface missile work since the older Tartar/Terrier missiles are scheduled to be phased out of the Navy's weapons inventory.

Since Charleston does only intermediate maintenance for surface launched missiles, the consolidation would have eliminated Charleston as a maintenance facility.

Charleston officials did not agree with the study's conclusion of placing the Standard missile's workload at Yorktown. They believed their assembly and test production capabilities were superior to Yorktown's and that they could process all east coast Standard missiles at a cost savings of \$1.3 million.

Although NAVSEA planned to begin the consolidation in fiscal year 1977, no action has been taken. However, in February 1980, NAVSEA officials said that they plan to restudy the feasibility of consolidating surface missile maintenance.

INCREASED STANDARD MISSILE MAINTENANCE
CAPABILITY PLANNED FOR ALL STATIONS

Despite the 1977 study concluding that the Standard missile workload be consolidated at Yorktown and Seal Beach, the Navy plans for all stations to have maintenance capability for the new Standard SM-1 Block 6 missiles, although the frequency and duration of the tests have not been finalized.

To perform maintenance on the Block 6 missiles, which will enter the inventory in 1981, the Standard missile test set at each station will be modified at an estimated cost of \$900,000. The costs associated with the Block 6 missiles will be about \$300,000. Modifications to provide more reliable capability for Block 4 and Block 5 missiles will cost about \$600,000. In addition, the Navy proposes to spend \$390,000 to modify Concord's surface missile test cell for the Standard SM-1 and SM-2 missiles. Modifications for the Standard SM-1 will cost the Navy about \$4 million.

Further increases in maintenance capability are anticipated when the Standard SM-2 enters the active missile inventory in 1984. Although NAVSEA is evaluating future maintenance requirements for the Standard SM-2, it may install the test set capability at all four stations. The Standard SM-2 test sets will cost between \$1.5 and \$2 million each and will have the capability to perform the test requirements of all Standard SM-1 missiles. The Navy has Standard SM-2 capability currently available at Seal Beach for its depot acceptance program.

HARM MISSILE MAINTENANCE
CAPABILITY PLACEMENT SURVEY

In 1978 NAVAIR undertook what it considered to be an unbiased survey to determine which weapons station should be designated as the west coast maintenance activity for the HARM missile. The survey team proposed that the HARM maintenance capability be established at Seal Beach (Fallbrook Annex) for the following reasons:

- The testing of two missiles at one time would increase efficiency.
- Colocation with the production activity (supplier) would improve coordination and communication.
- Colocation of the air launched missile with the lead Weapons Quality and Engineering Center would increase reliability.
- The handling of larger and heavier HARM missiles would improve because Fallbrook Annex magazines have wider doors.

Despite all of the advantages suggested by NAVAIR for placing the HARM's maintenance capability at Seal Beach, NAVSEA decided to locate the capability at Concord because:

- Concord's workload is much less than Seal Beach's and placement of the HARM at Concord would reduce this imbalance.
- Concord has adequate maintenance facilities available.
- Concord is required to load ammunition support ships and aircraft carriers.

NAVSEA's decision to select Concord does not refute NAVAIR's justification. Both weapons stations have adequate facilities available and can load similar vessels.

CONCLUSION

The Navy has been slow in acting on recommendations to consolidate existing maintenance facilities to achieve more efficient and economical operations. Also, the Navy is spending or plans to spend over \$8 million during the next 4 years for modernization purposes, and in some cases, for new capacity, even though such improvements or increases in capacity are questionable.

Since the Navy has not determined its maintenance requirements for either the Standard SM-1 Block 6 or the SM-2 missiles, modifications to existing SM-1 test sets and the planned installation of additional SM-2

test sets seem premature, especially since the existing SM-2 test set is capable of testing the SM-1 Block 6 missiles.

RECOMMENDATION

We recommend that the Secretary of the Navy delay planned facility improvements that will not adversely affect mission effectiveness until the capacity determinations recommended in chapter 2 have been completed and the improvements can be justified.

CHAPTER 4

MISSILE MAINTENANCE MANAGEMENT CAN BE IMPROVED

The Navy's Productivity Program included in Defense's manpower requirements report for fiscal year 1980 emphasizes improving labor productivity at industrial activities where the potential payoff is significant. The Navy's productivity proposals for fiscal year 1980 include increasing the use of labor standards and considering the impact of productivity changes on labor hour requirements. The Office of Management and Budget, Defense, and Navy instructions require the use of work measurement systems, and we have repeatedly recommended 1/ that Defense implement these systems at other maintenance activities.

Despite these recognitions, naval weapons stations are without adequate work measurement systems for missile maintenance because NAVSEA failed to require the development and use of work measurement techniques to manage maintenance operations. Consequently, cost-saving opportunities could be lost because the Navy has no assurance that missile maintenance is accomplished efficiently. Additionally, the absence of an effective work measurement system has impaired the Navy's development of a realistic missile maintenance budget.

CURRENT SYSTEM OF CONTROL

The Navy currently uses a system which controls overall expenditures, but it does not control the cost of individual workload accomplishments. This type of system was identified in a 1973 joint (Civil Service Commission, U.S. General Accounting Office, and Office of Management and Budget) study 2/ as a fund control system as contrasted

1/"Improvements Needed in Defense's Effort to Use Work Measurement" (LCD-76-401, Aug. 31, 1976). "Naval Shipyards-- Better Definition of Mobilization Requirements and Improved Peacetime Operations are Needed" (LCD-77-450, Mar. 31, 1978).

2/Special Report #3, Special Studies of Measurement Problems. Volume 2, Improving Work Measurement Systems in the Federal Sector, Oct. 1973.

to a cost control system. According to the study, organizations that use the fund control system make little use of work measurement standards to analyze budget performance. This study also pointed out that a fund control system makes it extremely difficult to maintain tight control of expenditures or to detect problems and identify their source.

In contrast, a cost control system focuses on the unit cost of specific workloads. The unit cost reflects the ratio of resources used to the output produced. A cost control system has several advantages over a fund control system, as shown below:

- Baselines are established against which actual performance can be measured.
- Budgets are more easily formulated and supported for specific workloads.
- Comparisons between fiscal years' performances and among similar activities are facilitated.

The joint study identified quality work measurement standards as the foundation for effective cost control. Such standards also provide the basis for measuring the performance productivity of a facility.

NAVY WORK MEASUREMENT SYSTEM IS INEFFECTIVE

In October 1975 NAVSEA promulgated the Performance Standards Program (PSP) to increase productivity, reduce costs, and use time standards for performance measurement. NAVSEA established three performance standards categories--engineered (category I), estimated (category II), and labor hour allowances (category III). Engineered standards are developed using a recognized technique, such as timestudy, work sampling, or standard data. Estimated standards provide the time estimated to accomplish a given task or operation and are based on good work practices. Labor hour allowances are standards for work performed by support personnel (including military) whose positions are not dependent upon a quantitative measure of the volume of production.

Engineered standards are more reliable than estimated standards and are usually more precise, but they are also

more expensive to develop and maintain. Consequently, engineered standards should be developed with emphasis on high volume or repetitive jobs or jobs which need tight control.

NAVSEA and the Naval Ammunition Production Engineering Center, the administering activity for NAVSEA, are responsible for PSP. Neither NAVSEA nor the Center has ensured that the coordinating, monitoring, evaluating, and assisting functions are being done.

NAVSEA officials agree that the PSP has received little emphasis but attribute this condition to staff reductions since the end of the Vietnam conflict. For example, both NAVSEA and the Center have only one person involved in the program.

The May 1979 NAVSEA study 1/ concluded that PSP has been deemphasized and is unsatisfactory. Specific problems were identified:

- The quality and quantity of labor standards continue to decrease. Reports indicate that 52 percent of the personnel at these activities are not subject to any type of work measurement. Labor hour allowances standards cover 37 percent of the personnel, estimated standards cover 8 percent, and engineered time standards techniques cover only 3 percent.
- Measurement of labor efficiency using time standards varies by activity from 0 to 9 percent of total personnel.
- Personnel assigned to develop and implement work measurement have been reduced to less than 1 per 900 persons on board. (NAVSEA requires 1 per 150 persons.)

Weapons stations need to implement PSP

The weapons stations have not assigned adequate resources to standards development. Consequently, standards generally have not been developed. For example:

1/Activities included in the review were the five naval weapons stations plus units from Crane and Indian Head.

--Three of the four stations have not developed work measurement standards for the Standard missile. The fourth station had established standards, but the Production Planning and Control personnel did not believe they were accurate and therefore did not use them.

--Two of the four stations developed standards for the Sparrow missile but, like the Standard missile, the standards were not used.

Despite NAVSEA's staffing requirements of an industrial engineer, an industrial engineering technician, and a management analysis staff of 1 for every 150 station personnel, Seal Beach and Concord were understaffed, as shown below:

<u>Staffing</u>	<u>Concord</u>	<u>Seal Beach</u>
1978 year end	1,129	1,273
PSP requirement	7.5	8.5
PSP personnel	4.0	3.0
Percent of required staff	53	35

Weapons stations officials are not adequately emphasizing and supporting PSP. For example, officials at two stations said standards were not needed. One official stated that PSP was essentially a waste of time and that his technician's services would be better used to work on other engineering problems. The following situation illustrates the lack of management support for PSP and its effect on the quality of standards produced.

After we began our review at Yorktown, an engineering technician was tasked with preparing standards for surface launched missile maintenance. The technician was not formally trained for the job and there were no specific guidelines for him to follow in identifying or obtaining the necessary data to compute the standards. The technician said he prepared the draft standards and submitted them to the production division and Production Planning and Control for their review. The standards were established at labor hour levels which substantially exceeded the previous year's actual labor hours expended, as shown below:

<u>Surface missile</u>	<u>Labor hours</u>		<u>Percent above actual</u>
	<u>Proposed standard</u>	<u>1978 actual</u>	
Terrier, BT	85.5	64.3	33
Terrier, HT	96.5	43.8	120
Tartar, ITR	84.8	50.6	68
Standard, MR	46.7	60.5	-23

Although the labor hours were apparently excessive, both divisions reviewed the draft and returned them without change to the engineering technician. We attempted to determine the basis for the standards but supporting data had been destroyed. The technician said he used old standard operating procedures manuals, the current surface missile maintenance manuals, and his personal experience to develop the standards. He said he did not review actual production figures for past years and was not aware that they were available.

Our examination of the labor standards computation revealed two errors which substantially increased the total labor hours per unit. A nonrepetitive operation had been included in the testing time for each missile, and a reduction in the number of personnel had not been considered for three of the four missiles. The technician stated that the standards would have to be recomputed and resubmitted for review.

Standards needed to support maintenance budgets

An effective PSP at the weapons stations would provide a sound basis for missile maintenance budgets.

Navy instructions require that each station submit an annual operating budget based on workload requirements. The budget is to be constructed from cost estimates based on work measurement standards, and all supporting documents are to be kept.

Contrary to this requirement, the stations do not base budgeted amounts on work standards combined with projected workloads. None of the stations retained the supporting information necessary for validating their estimates or budget submissions. Without valid work standards and specific guidelines, the stations developed budgets using methods which varied among the stations and even among operations at a station.

Seal Beach, for example, based its surface missile budget on labor hour ceilings. Charleston and Yorktown also used the labor hours required to support the number of persons employed in producing missiles to determine their cost estimates for surface missile maintenance. To illustrate the effect of this practice, Charleston's records show that a decrease in the projected workload simply results in an increase in costs and labor hours per unit. The fiscal year 1979 estimates for surface missile maintenance exceeded fiscal year 1978 average actual costs by as much as 136 percent. Station officials attributed this increased cost to a decrease in the projected workload from 946 to 727 missiles (23 percent). The following table compares the figures by surface missile type:

Comparison of Resources Per Unit
Fiscal Year 1978 Actual Versus 1979 Estimate
Charleston Naval Weapons Station

Missile type	1978 actual			1979 estimate			Percent change		
	Qty.	Labor hours	Unit cost	Qty.	Labor hours	Unit cost	Qty.	Labor hours	Unit cost
Terrier, BT	54	86	\$1,833	37	120	\$3,041	-31	40	66
Terrier, HTR	35	64	1,460	23	93	2,575	-34	45	76
Standard, ER	347	63	1,461	270	81	2,240	-22	29	53
Tartar, ITR	68	74	1,323	57	81	2,233	-16	9	69
Standard, MR	208	44	1,025	100	87	2,414	-52	98	136
Standard, MR (note a)	<u>234</u>	39	893	<u>240</u>	61	1,674	<u>3</u>	56	87
Total	<u>946</u>			<u>727</u>			<u>-23</u>		

a/Depot acceptance program.

COST COMPARISONS CANNOT
BE PERFORMED

Navy management is unable to make valid comparisons of maintenance costs because the work content (scope of maintenance) of specific jobs is not consistent among the weapons stations, work standards have not been developed, and costs for maintaining ancillary equipment are combined with the cost of missile maintenance.

NAVSEA Instruction 7600.1 directs weapons stations to enter into fixed price agreements with customers to the maximum extent practicable on all work performed through the Navy Industrial Fund. The purpose of a fixed price is to provide both the stations and their customers with advantages and incentives for efficiency and economy

by creating and recognizing a buyer-seller relationship. This buyer-seller relationship allows the customer to compare prices and to have the maintenance performed at the most economical location. NAVAIR has air missile maintenance performed on a fixed price basis, but it does not compare prices. On the other hand, NAVSEA has surface missile maintenance performed on a cost reimbursement basis and does not compare weapons station costs.

Air launched missiles

According to the NAVSEA instruction, the customer should participate in determining the final cost through negotiations. The Pacific Missile Test Center at Point Mugu, California, the air missile maintenance manager for NAVAIR, is responsible for allocating the workload. The Test Center did not request pricing support for determining the scope of maintenance included in fixed price offers. The Test Center's air missile maintenance manager stated that maintenance costs are not a factor in workload allocation. He explained that the missiles are generally assigned to the weapons stations closest to the ship's home port.

The scope of maintenance included in the fixed price offers varies significantly. A comparison between Concord's and Seal Beach's offer demonstrates the lack of consistency needed for making a valid comparison of maintenance costs. For example, Concord's fiscal year 1979 fixed price offer for an all-up-round missile 1/ includes disassembling, replacing components, assembling, testing, and packaging, whereas Seal Beach's price includes assembling, testing, and packaging only. Seal Beach has additional fixed prices that pertain to removing and replacing components. To illustrate, consider the comparison made by the following two cases:

- A Sparrow 7E fleet return missile with MEFD is tested and found to be in a ready-for-issue condition. Seal Beach's maintenance charge is \$319 compared to Concord's price of \$709.

- A Sparrow 7E fleet return missile with MEFD needs to have the warhead, rocket motor, and guidance and control sections removed and replaced. Seal Beach's price for this work is \$894, whereas Concord's charge is still \$709.

1/Complete missile minus wings and fins.

The Seal Beach air missile planner stated that the Test Center has always accepted its fixed price offer. The Test Center has not questioned or tried to negotiate fixed prices, except for one minor downward pricing adjustment on a Yorktown proposal for repairing some wings and fins sets. Consequently, the objective of providing incentives for efficiency and economy through a buyer-seller relationship is not being achieved.

NAVAIR's absence of price negotiations is further evidenced by the weapons stations' significant gains over costs. The stations are to determine the cost of specific operations and provide the services a fixed price for the fiscal year. A variance account was established to record any difference between fixed prices and the station's cost with the objective of breaking even. For example, while Yorktown could not show how the fiscal year 1978 prices were set, the fiscal year 1979 prices were determined primarily by increasing fiscal year 1978's prices by 10 percent. Yorktown increased prices, although in 1978 it had fixed price gains of over \$600,000. NAVAIR accepted Yorktown's 1979 prices without obtaining supporting data for the increases.

Surface missile system

NAVSEA Instruction 4850.3 requires the weapons stations to develop complete and valid cost estimating data and to use a standard and systematic approach for preparing and submitting customer order estimates. However, we found customer order estimates to be

- comparable to the budgeted costs, which were based on labor hours authorized (staff ceilings) and not on the labor hours required; and
- impractical to evaluate because the maintenance of major components (containers and handling and test equipment) is included in producing an all-up-round missile.

Surface missile customers are billed for the actual labor hours used and not the estimated hours.

Because missile maintenance costs at weapons stations have reflected personnel on board rather than the labor hours actually needed and valid work standards have not been established, the "should-take" time and cost to produce missiles are virtually unknown. This is evidenced by the

extreme fluctuation in labor hours per missile among the weapons stations. For example, in fiscal year 1978 the labor hours to produce a Standard MR missile were 36 hours at Charleston and 59 hours at Concord--a 63-percent difference.

Missile type	Fiscal Year 1978			
	<u>Labor Hours Per Unit (note a)</u>			
	<u>Charleston</u>	<u>Yorktown</u>	<u>Concord</u>	<u>Seal Beach</u>
Terrier, BT	80	106	128	81
Terrier, HTR	59	54	69	48
Tartar, ITR	68	66	97	82
Standard, ER	46	51	58	41
Standard, MR	36	58	59	56

a/This data was compiled by the Naval Ship Weapons Systems Engineering Station and was not verified. The figures include only missile and boosters, not ancillary equipment maintenance, because the types and quantities vary and greatly distort the unit cost. Ancillary equipment includes containers, cradles, handling bands, dollies, etc.

Seal Beach officials cited NAVSEA's practice of grouping maintenance repairs for surface missile components, such as rocket motors and guidance and control sections, as a major obstacle to developing accurate customer order and budget estimates.

Also, NAVSEA does not require separate costing for test equipment, containers, or handling equipment common to more than one missile system. The allocation of costs common to more than one missile type affects accurate missile maintenance cost projections. For example, many surface missiles tend to use the same type of containers. Therefore, the cost of container maintenance is allocated proportionately to the various missile systems.

Consolidating common charges under one missile type limits identifying and developing accurate maintenance cost projections. It also limits the effectiveness of cost comparisons among weapons stations.

Navy officials acknowledged that evaluating maintenance efficiency on a cost-per-missile basis was abandoned

because there was no standard reporting system and because of distortions in unit costs caused by including varying quantities of ancillary equipment and their associated maintenance costs. Officials have also acknowledged that efficiency at the weapons stations is not measured. NAVSEA officials repeated that the current practice is to have missile maintenance performed nearest to the location where the receiving ship is to be loaded, usually the ship's home port. They assumed this practice is most cost effective because transportation costs would exceed any amount saved by performing the maintenance at the lowest cost station.

Nevertheless, NAVAIR is not fully supporting the practice of having the missile maintenance performed nearest the offloading location. For example, on the east coast all air launched missiles are maintained at Yorktown. On the west coast, all Phoenix, Sea Sparrow, and Standard ARMS are maintained at Seal Beach, while all Harpoon missiles are maintained at Concord.

CONCLUSIONS

The Navy does not have an effective work measurement system at its weapons stations to evaluate maintenance performance. The system is ineffective because the Navy has neither supported nor emphasized the need for the system. The Navy attributed this failure to the lack of qualified staffing to develop, monitor, or enforce work measurement system standards. Without labor standards at the weapons stations, management lacks one of its most basic tools for controlling productivity.

The weapons stations' maintenance budgets are based on projected staffing. Consequently, the Navy has no assurance that the weapons stations are operating their missile maintenance programs in the most efficient manner.

Finally, Navy management loses opportunities to reduce operating costs because it cannot compare missile production costs among the weapons stations. The workload is not allocated to the weapons stations to obtain the maximum productivity from the limited missile maintenance funds. Establishing valid job standards and properly identifying the workload would allow NAVSEA and NAVAIR to make cost comparisons among the weapons stations.

RECOMMENDATIONS

To overcome existing inadequacies in the labor standards, and especially in the work measurement system, we recommend that the Secretary of the Navy

- provide greater management support and reinforcement of work measurement concepts and principles at all management levels,
- critically examine workloads at each maintenance facility to determine on which tasks labor standards should be developed,
- direct missile maintenance managers to compare operating costs among facilities as a tool to increase missile maintenance productivity, and
- closely monitor the above actions and establish a realistic target date for estimating labor requirements based on labor standards rather than on historical data.

AGENCY COMMENTS

The Navy agreed with our conclusions and recommendations. NAVAIR, however, said that some improvements were made for fiscal year 1980. Specifically, NAVAIR began using the standard labor hours included in an industrial processing guide (IPG) for calculating the time required for missile maintenance. NAVAIR calculated standard prices by multiplying IPG standard hours times the stabilized rates. These prices were used to negotiate fixed price contracts with the weapons stations with the objective of establishing prices in line with NAVAIR's calculated prices. The analysis of standard prices in relation to the stations' bids will be useful in identifying cost variances and associated causes.

Although the use of the IPG has improved NAVAIR's ability to negotiate with individual weapons stations, it is not a viable substitute for a work measurement system at the weapons stations. Our analysis of the fiscal year 1980 prices showed that the weapons stations have not accepted the IPG standards. For example, the prices at two stations varied significantly from NAVAIR's calculated prices, and the prices for identical work continues to vary among the weapons stations.

AIR AND SURFACE TACTICAL MISSILES
AND THEIR MISSIONS

A description of the Navy's air and surface launched missiles included in our review follows:

AIR LAUNCHED MISSILES

Sidewinder--A short-range, 200-pound, air-to-air missile using a passive infrared seeker.

Sparrow--A medium-range, 500-pound, air-to-air missile guided by a semiactive radar seeker.

Phoenix--A long-range, 980-pound, air-to-air missile using both semiactive and active radar seekers.

Shrike--An air-to-ground, anti-radiation missile that homes on emitted radar energy. This missile is designed to detect, identify, and disable enemy radar capability.

Standard ARM--An air-to-ground, anti-radiation missile with a mission similar to the Shrike.

HARM--A high-speed, anti-radiation missile with greater range to replace the Shrike and Standard ARM.

Walleye--A short-range, air-to-ground, 500- to 1,000-pound bomb. These bombs have a television guidance unit and attached fins which provide them with glide capability when launched from an aircraft.

Harpoon--An air launched, radar-guided missile extending offensive capability to satisfy the Navy's sea control mission. It is primarily an anti-ship offensive weapon. Alternate versions have been adapted for surface and submarine launch.

SURFACE LAUNCHED MISSILES

Standard--Surface-to-air missile. It is the mainstay of the surface Navy's anti-airwarfare effort. The missile has two principal versions:

Standard SM-1 (medium-range)--Surface-to-air missile system with a low altitude capability against high performance aircraft. It was installed as primary anti-aircraft battery on destroyers and secondary battery on heavy cruisers.

Standard SM-2 (extended-range)--Anti-aircraft, surface-to-air guided missile installed as primary anti-aircraft battery in cruisers, carriers, and frigates.

METHODS FOR DETERMINING MISSILE MAINTENANCEFACILITY USAGE AT NAVAL WEAPONS STATIONSFACILITIES LABOR HOURS
AVAILABLE TO PERFORM MAINTENANCE

Prior to September 1977 each weapons station submitted an underused plant capacity report to NAVSEA. Although reporting of costs of maintaining underused facility capacity was no longer required, the two west coast stations-- Seal Beach and Concord--submitted the reports for fiscal year 1978. By using data from these reports, along with each station's fiscal year 1978 production data, we determined how much of each station's missile production capacity in labor hours was used.

A comparison of the surface and air launched missile labor hours that were available in fiscal year 1978, with maximum facility use, to the labor hours actually used at each station clearly demonstrated that current capacities were greatly underused in fiscal year 1978.

<u>Missile system/ station</u>	<u>Capacity</u>	<u>Used</u>	<u>Percent used</u>
Surface missile:			
Seal Beach	117,769	30,951	26.3
Concord	107,895	41,102	38.1
Air missile:			
Seal Beach	136,544	50,142	36.7
Concord	74,747	53,437	72.3

MOBILIZATION MAINTENANCE CAPACITY

As part of an April 1979 NAVSEA study, the stations were asked to determine how many missiles could be produced during mobilization (3 shifts, 8 hours a day, 5 days a week). According to NAVSEA, these mobilization production rates could be adjusted to reflect peacetime rates. In the schedule below, we compared the adjusted mobilization rates to the 1978 production rates.

Missile system/ station	Total missiles produced in 1978 (note a)	Adjusted mobilization maintenance capacity	Percent of maintenance capacity used
Surface missiles:			
Concord	877	(b)	(b)
Seal Beach	805	2,800	29
Charleston	946	3,660	26
Yorktown	<u>1,294</u>	<u>5,400</u>	<u>24</u>
Total	<u>3,922</u>	(b)	(b)
Air missiles:			
Concord	1,271	7,200	18
Seal Beach	1,364	12,000	11
Yorktown	<u>3,067</u>	<u>4,175</u>	<u>74</u>
Total	<u>5,702</u>	<u>23,375</u>	27

a/Excluding MMMU-1.

b/Figures were not provided by the Navy.

WORKLOADING--EAST COAST
COMPARED TO WEST COAST

A comparison of air launched missiles produced in fiscal year 1978 between Yorktown and the two west coast stations substantiates the existence of excess capacity on the west coast. The air launched missile maintenance manager considers Seal Beach and Yorktown comparable maintenance facilities. Assuming Yorktown is operating at 100-percent capacity, Concord's and Seal Beach's production for the same period was only 41 and 44 percent, respectively. Yorktown produced 12 air launched missiles a day compared to Concord's 5 and Seal Beach's 5. Of course, any underuse at Yorktown, which is likely, would further magnify the excess capacity on the west coast. This underuse is probable because all three stations have equal Sparrow test cell capacity--a limiting production factor--and Yorktown used only 30 percent of its Sparrow missile test cell capacity in fiscal year 1978.



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