BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

The Navy's Submarine Launched Ballistic Missile Force Is Highly Ready

The Navy maintains the submarine launched ballistic missile force in a high state of readiness because of its strategically important deterrent mission. The Navy achieves this favorable readiness posture through special emphasis on management, staffing, equipment, maintenance, and supply support. Costs to design, procure, operate, and maintain this system average over $4 billion annually.

This report presents information on the system's readiness condition, the reasons for its high readiness the costs of achieving and maintaining this readiness, and the Navy's efforts in relating costs to various readiness options. The report also provides GAO's observations for improved program management and issues which the Congress may want to pursue with the Navy.

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

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

This report addresses the factors which contribute to the Navy's favorable readiness posture for the submarine launched ballistic missile force, as well as measures which could be taken to improve these areas and the potential applicability to other Navy programs.

We made this review because of the strategically important deterrent mission of the submarine launched ballistic missile forces and the corresponding high costs to maintain this readiness. Also, this is the first time we have looked at the readiness of this program.

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

We are also sending copies of this report today to the Director, Office of Management and Budget, and the Secretaries of Defense and the Navy.

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

THE NAVY'S SUBMARINE LAUNCHED BALLISTIC MISSILE FORCE IS HIGHLY READY

D I G E S T

The Navy maintains the submarine launched ballistic missile force at a high level of readiness because of its strategically important deterrent mission and achieves this condition through special emphasis on management, staffing, equipment, maintenance, and supply support.

GAO was unable to verify force readiness in the usual manner because examination of submarine and missile operations at sea was not practical, access to specifically requested Navy reports was denied, significant delays were experienced in obtaining requested data, and interviews with top level Navy officials netted only general information on operations. (See p. 10.)

The readiness reports show a high level of readiness. GAO has observed areas for additional management improvements relating to:

--Utilizing effectively submarine off-crew personnel under the two-crew concept.

--Applying POLARIS/POSEIDON maintenance-program benefits to other weapons systems programs.

--Obtaining necessary ocean survey data to enhance the TRIDENT's follow-on capability and survivability.

--Ascertaining the effects of construction delays in the TRIDENT program on the POLARIS phase out.

Although the Navy continues to fund programs to improve reliability and maintainability of this force, it needs to expand its efforts to relate costs to various readiness options. Such information, if made available, would provide the Department of Defense (DOD) and the Congress with readiness/cost options for their consideration where none now exist.

Since the consequences of a strategic nuclear attack by an aggressor could be catastrophic, a powerful and ready strategic force able to respond with more severe retaliation than the potential aggressor is willing to bear is extremely important for deterrence. To this end, the U.S. strategic offensive force has three diversified elements--manned bombers, silo-land based missiles and submarine launched missiles. These elements are known collectively as TRIAD.

The submarine launched ballistic missile force is considered essentially invulnerable to attack, carries the greatest percentage of warheads, and is considered a key deterrent against strategic war.

The Navy invests over $4 billion annually to develop, acquire, operate, and maintain its submarine and missile systems at an acceptable degree of readiness. To operate, maintain, and staff existing forces alone costs over $1 billion a year.

Supporting these forces is expensive, yet because of their strategic importance the Navy normally receives the funds requested. In addition, the Navy devotes special attention to its missile system by employing several measures to achieve and maintain a high level of readiness on 41 nuclear-powered submarines. These measures include

--giving priority to personnel assignment to submarines,

--planning operation cycles with maintenance periods interspersed,

--using modular components and redundant systems, and

--establishing special management and material offices to ensure satisfactory performance and availability of spare parts and supplies.

Priority ONE manning (100 percent) is granted those activities whose mission is most critical to national defense, including the

ballistic missile submarine force. GAO's analysis showed that the submarines were manned at 99 percent of authorized strength. While some shortages existed in lower enlisted and petty officer grades, the Navy compensated for such shortages by assigning additional personnel from other pay grades.

The ballistic missile submarine program differs from most other Navy weapons systems in the way it is managed. The Strategic Systems Project Office is the project manager from acquisition throughout operation and has managed this program intensively for nearly 20 years. This has included continuous performance monitoring and redesign of unsatisfactory elements where cost was commensurate with gain.

Deciding whether or not to obtain a strategic weapon system rests on more than quantitative cost/effectiveness analyses. Ultimately these decisions depend on the value of redundancy and flexibility to the strategic force and on the political consequences of changing the national military posture. However, costs and effectiveness considerations must be a part of such decisions because of the large sums required for personnel, maintenance, supplies, training, and deployment in order to achieve optimum readiness.

Because of these readiness costs, GAO asked DOD and the Navy what alternatives had been considered for supporting this system more economically and effectively, without decreasing required effectiveness and found that efforts to date have been limited. Though Navy officials said that system design tradeoffs during development are monitored by management continuously, there are currently no studies attempting to relate readiness to varying cost options. DOD and the Congress therefore lack readiness/cost options for budgetary consideration.

In this respect, the Congress in fiscal year 1978 directed DOD to identify specific material readiness requirements for U.S. forces, to report on past readiness based on those requirements, and to project future readiness

relative to the funds requested. However, the Navy has not as yet developed a system which would provide varying degrees of readiness/cost options to enable DOD and the Congress to have a choice among the most viable alternatives presented.

Nevertheless, the Navy has developed alternatives which have led to more effective and efficient operations in the strategic program. It has monitored the potential life span of reactor cores, resulting in significant cost savings. It has extended submarine operating times by 3 years and maintenance costs have reportedly decreased. The Navy estimates that it will save over $300 million within the next 20 years in operation and maintenance costs. The Navy has produced other benefits, such as reduced maintenance for monitored systems and fewer inspections. However, the Navy does not have a program or system for passing these benefits on to its activities.

GAO observed several areas in the ballistic missile submarine program where possibilities for more efficient or economic alternatives exist. For example, in January 1971 GAO reported that crew assignment could be modified from the present concept of two crews for each submarine to that of five crews to three submarines. This would reduce the total crew manpower by 1,500 personnel and shorten off-crew training from 68 to 38 days without loss of optimum readiness. The Navy believed such a change would lower crew morale and hinder crew adjustment to different submarines, so it decided to leave the crew to submarine ratio at 2:1.

Neither the Navy nor GAO knows what the actual effect of the change would have on morale and crew familiarity with submarines. It is an alternative which, to GAO's knowledge, has not been analyzed indepth since the inception of the two-crew concept. The Navy should reconsider its decision.

RECOMMENDATIONS

The Secretary of Defense should direct the Navy to:

--Determine the feasibility of adopting ballistic missile submarine maintenance and supply program benefits to the less-ready Navy attack submarines and surface ships, and establish a system for communicating future benefits on a continuing basis.

--Develop and study alternatives to the two-crew concept.

--Explore alternatives to increase use of ballistic missile submarine off-crew personnel.

--Determine whether the TRIDENT deployment delays will necessitate deferring the planned retirement of POLARIS submarines to maintain an adequate readiness posture. If this is the case, plans should be undertaken promptly so that the Navy has the funds and other resources needed to carry out the costly maintenance and overhaul work which would be required to retain the POLARIS submarines until they are replaced by the TRIDENTs.

--Start developing a system which would relate costs and risks of varying degrees of readiness for the submarine launched ballistic missile system, and provide information to the Congress on acceptable risks involved and funding options.

AGENCY COMMENTS

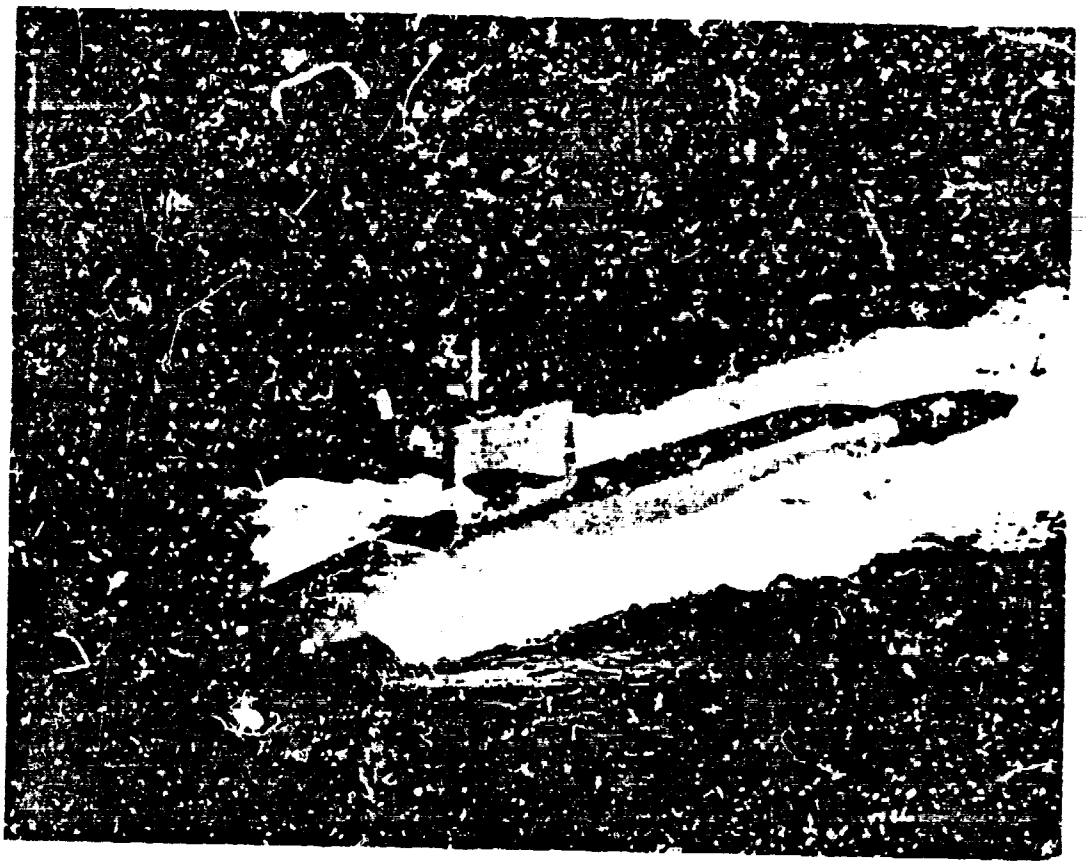
Representatives of DOD, Joint Chiefs of Staff, and the Department of the Navy responsible for the management and operations of the submarine launched ballistic missile program basically agreed with the report's conclusions and recommendations. Their comments indicate that they believe that adequate steps have been or are being taken in some of the areas, such as the two-crew concept and the application of POLARIS/POSEIDON maintenance and supply

program benefits, to satisfy our concerns. GAO evaluated their comments, and they are discussed throughout the report where appropriate. Although certain improvements have been made, GAO concludes that implementation of its recommendations will result in additional management improvements.

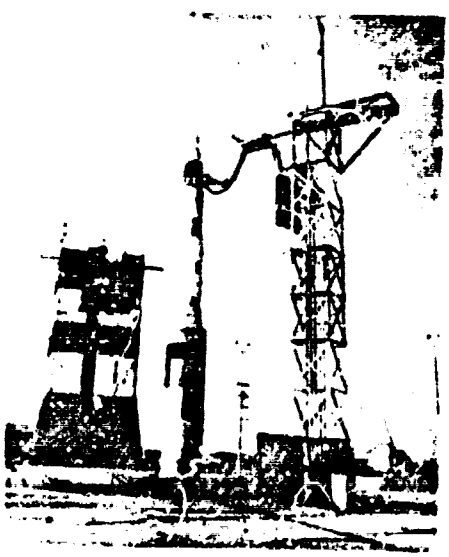
Contents

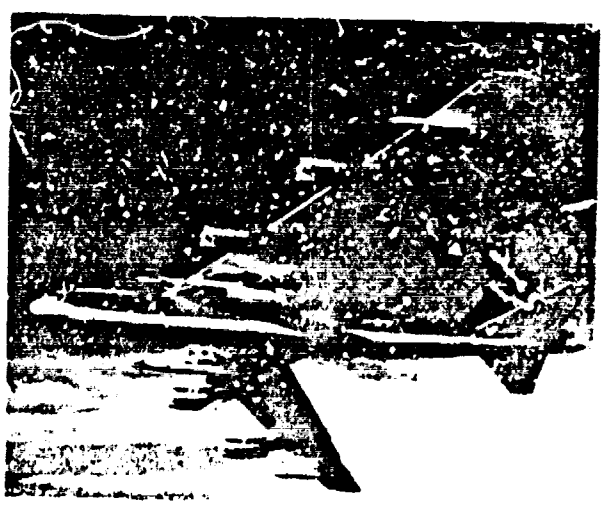
ABBREVIATIONS

DOD	Department of Defense
FBM	Fleet Ballistic Missile
GAO	General Accounting Office
ICBM	silo based intercontinental ballistic missiles
SLBM	submarine launched ballistic missile
SMMSO	Shipsystem Maintenance Monitoring and Support Office
SSBN	ballistic missile launching nuclear-powered submarine
SSPO	Strategic Systems Project Office



THE NUCLEAR TRIAD





CHAPTER 1

INTRODUCTION

The fundamental mission of U.S. nuclear forces is to deter aggression by threatening to respond with more severe retaliation than the potential aggressor is willing to bear. The United States held a monopoly on nuclear weapons at the outset of the nuclear era and for some time thereafter. Today, owing to massive growth in Soviet strategic nuclear capability, rough equivalence has resulted. According to the Secretary of Defense, each side has sufficient nuclear capability to inflict massive damage upon the other--but with the foreknowledge that such an attack will only bring about unacceptable damage.

According to the Department of Defense (DOD), this rough equivalence could have significant consequences for the coming years and supports the argument for arms limitation agreements that will contribute to greater stability. The Joint Chiefs of Staff have firmly supported efforts to achieve satisfactory arms limitation agreements and, in this context, reductions in strategic weaponry. However, since the consequences of a strategic nuclear attack by a potential aggressor could be catastrophic, DOD believes a powerful strategic force is extremely important in the deterrent role.

The U.S. strategic offensive force consists of three diversified delivery systems--the nuclear TRIAD and its manned bomber aircraft, silo based intercontinental ballistic missiles (ICBMs), and submarine launched ballistic missiles (SLBMs). A comparison of U.S. and Russia's estimated strategic offensive forces is included as appendix I. The TRIAD's objectives are to

--deter nuclear attacks against the United States and its foreign bases,

--deter nuclear or conventional attacks against U.S. allies and other nations whose security is deemed important to our security,

--deter forceful persuasion of the United States or its allies, and

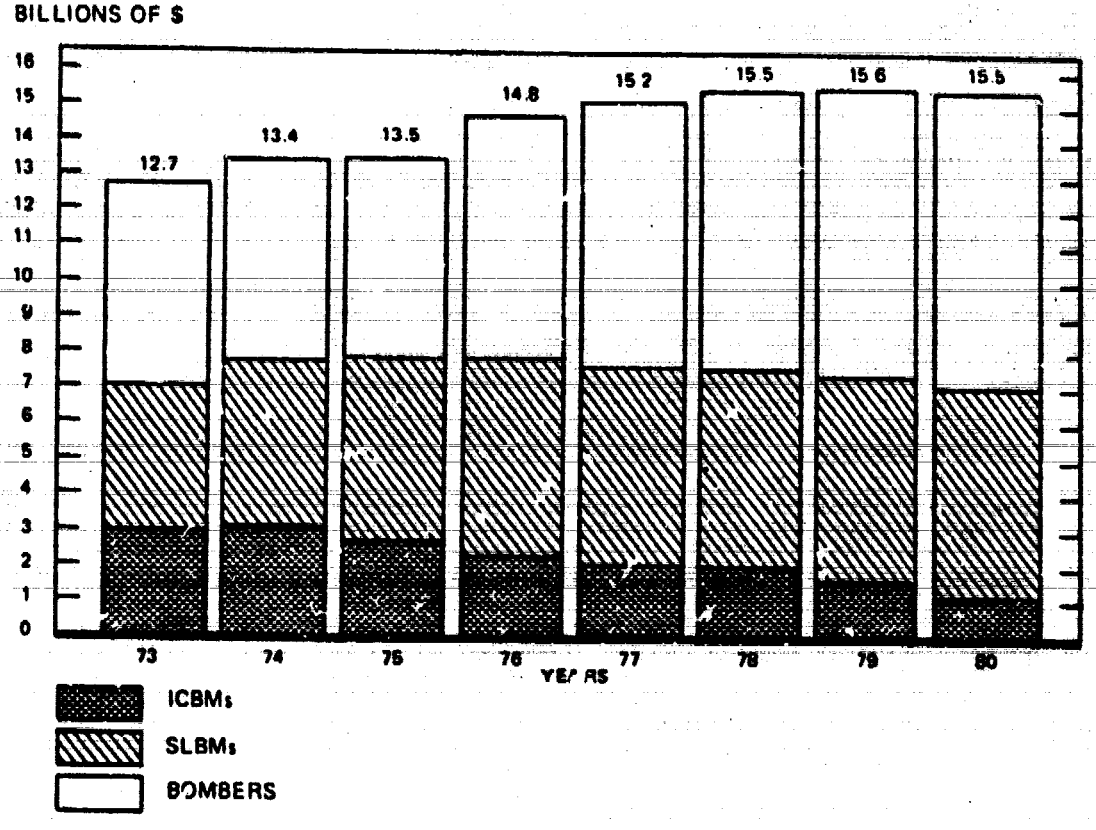
--provide responsive and effective fighting capabilities if a conflict occurs.

TRIAD DIVERSITY AND COSTS

DOD maintains the TRIAD--a mixed force of nuclear weapons--to hedge against the failure or destruction of one of its nuclear systems. By diversifying the force among three parts, each of which has different vulnerabilities, an enemy nuclear attack on U.S. nuclear forces--usually referred to as a "counterforce" attack--is made more difficult.

The Joint Strategic Target Planning Staff, under the Joint Chiefs of Staff, decides the targeting of all TRIAD nuclear weapons, including the SLBM force, in a series of coordinated attack options according to "executive" direction. The Staff formulates a targeting plan (the Single Integrated Operational Plan) using all the strategic weapons and relying on information such as intelligence data concerning Soviet targets, weapons system reliability and effectiveness, ability to deliver the weapons, and effects of simultaneous attacks. The Staff uses this data to plot the desired target coverage based on target importance to the United States. A description of missile firing and subsystem functions is included in appendix II.

We had a very difficult time obtaining cost data for the TRIAD. The following graph presents the only TRIAD cost data we were able to obtain. This data which projects the estimated costs of U.S. offensive strategic forces from fiscal years 1973 through 1980 was published in a March 1973 Brookings Institution report. We recognize that when the Brookings Institution prepared this cost data its estimates were based on certain assumptions which may have changed, such as the B-1 bomber and the MX missile. Though the individual costs for the TRIAD's components may actually vary, this graph is presented only as an indicator of the TRIAD's overall costs.



STRATEGIC IMPORTANCE OF SLBM FORCE

Of the strategic TRIAD, DOD considers the SLBM force at sea to be the least targetable by opposing strategic systems. By nature of the SLBM's strategically important mission of deterrence, it contributes to crisis stability and is operated and maintained under a wartime scenario. The submarines that carry the missiles--called ballistic missile-launching nuclear-powered submarines (SSBNs)--are considered essentially invulnerable to Soviet attack. A fleet of 41 SSBNs (31 POSEIDONs operating in the Atlantic Fleet and 10 POLARISs in the Pacific Fleet), each carrying 16 nuclear tipped missiles, partol the seas.

While the SLBM force comprises only [deleted] percent of the total deliverable megatonnage of the TRIAD, it has [deleted] percent of the warheads. Each SSBN is capable of carrying a total firepower greater than all the

bombs dropped in World War II. SSBNs assure a potential enemy that, should a nuclear attack be launched against the United States, a devastating blow would be received in response.

Currently, the POLARIS and POSEIDON SSBNs are the backbone of our strategic sea-based forces and will continue to be until the TRIDENT submarines reach the fleet in the 1980s. SLBM assets, projected to 1985, are as follows.

ASSETS OF SUBMARINE-LAUNCHED BALLISTIC MISSILE

DESCRIPTION	1978	1980	1985
SUBMARINES (SSBNs)	41		
MISSILE LAUNCHERS	656		
REENTRY BODIES/WARHEADS		deleted	
SLBM MEGATONNAGE			

a/ The number of reentry vehicles and their megatonnage are based on the assumption that Ohio-class SSBNs are armed with TRIDENT I SLBMs

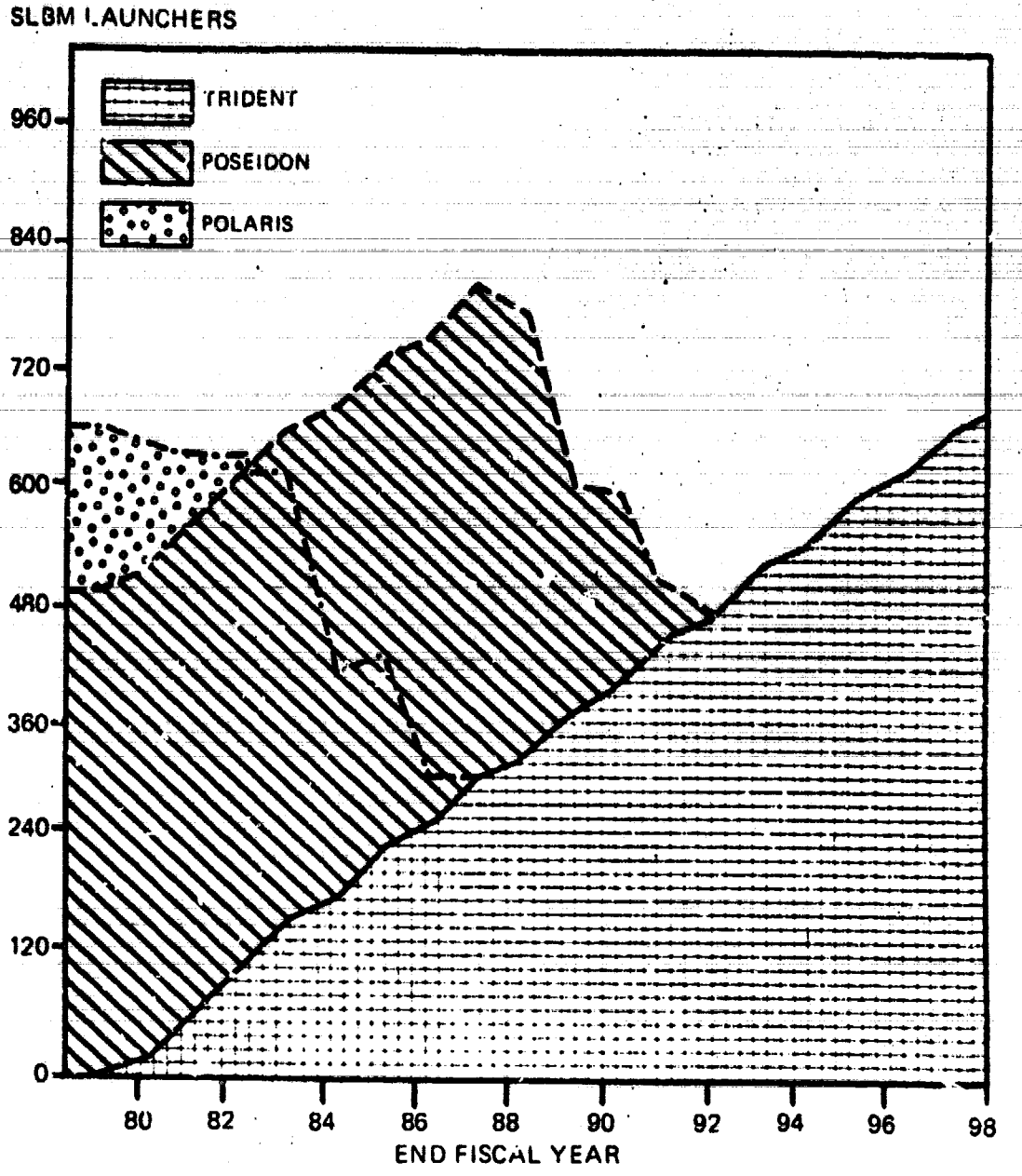
The above SLBM asset statistics include the planned phase in of the TRIDENT SSBN program and the phase out of the POLARIS program, as shown in the graph on the following page. However, the Navy currently projects a 19-month slippage in the TRIDENT construction schedule, which will delay the phase in of the TRIDENTs and may delay the phase out of the POLARIS submarines. In addition to new construction, 12 POSEIDONs will be modified to carry the TRIDENT I missiles.

The missile characteristics for SSBNs have also changed. The POLARIS missile can provide single target coverage with three nuclear warheads and has a range of 2,500 miles. The POSEIDON can employ up to 14 nuclear warheads per missile, aimed at separate targets, and also has a range of 2,500 miles. The TRIDENT I missile, though similar to the POSEIDON, will have significantly greater range and payload characteristics.

SSBN MAINTENANCE RESPONSIBILITY AND OPERATIONS

To provide for various readiness and maintenance requirements, a SSBN schedule is determined by a planned employment cycle, consisting of (1) the new construction phase, which

SLBM LAUNCHERS [a/]



[a/] Polaris and Poseidon submarines have 16 launch tubes per ship while the Tridents will have 24.

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occurs only once in the ship's life, (2) operational phases, (3) refit phases, and (4) a regular overhaul phase. Several operational and refit phases may occur during the employment cycle. A SSBN is considered not operationally ready during the new construction and overhaul phases. A ship can be operationally ready only when it can accomplish its basic mission as required by the general war plans.

The following three organizations have overall support responsibility for SSBN maintenance

--the Strategic Systems Project Office (SSPO) for the Strategic Weapons System comprised of the missile, launcher, fire control, navigation, missile checkout, and data recording subsystems;

--the Shipsystem Maintenance Monitoring and Support Office (SMMSO) for all ship auxiliary equipment in conjunction with the Submarine Logistics Division of the Naval Sea Systems Command; and

--the Directorate for Nuclear Propulsion, not under the cognizance of SSPO or the Naval Sea Systems Command for the nuclear reactor plant.

Major maintenance for SSBNs is accomplished at the depot level by shipyards. Intermediate maintenance is performed by submarine tenders.

The Navy relies heavily on preventive maintenance to sustain SSBN material readiness. Preventive maintenance is done at the organizational level by the SSBN crews at sea or, in the case of major propulsion machinery which must be non-operating for maintenance, when SSBNs are in port. Maintenance procedures are tailored to each SSBN's equipment configuration. Spare parts are maintained aboard SSBNs to satisfy maintenance requirements.

SSPO is responsible for the life-cycle support of the Strategic Weapons System. The Directorate for Nuclear Propulsion, SMMSO, and the Naval Sea Systems Command support the reactor plant and the ship's auxiliary equipment. These three responsible offices monitor, evaluate, plot trends, and make necessary changes to the two maintenance programs.

The Navy uses two basic preventive maintenance systems to sustain material readiness. The Preventive Maintenance Management Plan is under the responsibility of SSPO and includes the Strategic Weapons Systems. The Preventive

Maintenance System covers the reactor plant and the ship's auxiliary equipment and is under the direct responsibility of the Directorate for Nuclear Propulsion and SMMSO. The primary difference between the two maintenance programs is that the Plan's maintenance schedules are computer generated, while the System's schedules are prepared manually.

Both the Plan and System provide maintenance procedures tailored to each SSBN's equipment configuration. Both systems provide reference documents for preventive and corrective maintenance which include the tools and materials required, test equipment needed, and troubleshooting procedures for each maintenance action. Maintenance chiefs must verify that the work is done.

AUDIT SCOPE

We reviewed the readiness of the Navy's SLBM force because of the critical nature of its mission and the corresponding high cost to maintain this readiness. Also, this is the first time we have looked at the readiness of this program.

Our major objectives were to examine the reported readiness of the SLBM system and to determine Navy efforts in relating costs to the degree of readiness required. Due to the nature of the SLBM's mission and operations, we did not verify reported readiness in the usual sense as an onboard examination was not feasible. We relied on interviews and data prepared and reported upon patrol completion, such as Patrol Operational Reports, Material Section of Patrol Reports, Naval Force Status, and Fleet Readiness Reports, to determine consistency of information reported.

While we obtained some data on the overall TRIAD system, our detailed work involved the SLBM component of the TRIAD. We also concentrated on the readiness of the 31 POSEIDONs in the Atlantic Fleet. Our review included only general data on the POLARIS submarines in the Pacific Fleet. However, DOD reported little difference in readiness between the POSEIDON and POLARIS submarines, though the older POLARIS system requires more maintenance.

Many programs and concepts which contribute to the high degree of readiness of the SLBM system differ from those of other Navy programs. At this time, we do not know whether it is feasible to apply these programs and concepts to other

Navy programs, but we believe that the Congress should be aware of what these differences are and what they cost. We looked at alternatives and options the Navy has considered to accomplish the SLBM mission more efficiently and economically without impairing readiness. We have raised some questions and explored some alternatives which we felt would be of interest to the Congress.

In our review, we looked at readiness, factors contributing to this readiness, and the cost of the readiness. We realize that it is difficult to establish the correlation between these factors. Navy officials were unable to provide any studies or information showing the extent each of the factors contributes to the SSBN readiness posture, nor did we establish this relationship.

The information presented in this report is based on interviews with Navy and contractor officials and reviews of records provided by those officials.

Our fieldwork was done at the following offices

--Commander in Chief, U.S. Atlantic Fleet, Norfolk, Va.;

--Commander, Submarine Force, U.S. Atlantic Fleet, Norfolk, Va.;

--POLARIS Material Office Atlantic, Charleston, S.C.;

--Shipsystems Maintenance Monitoring and Support Office Washington, D.C.; and

--Strategic Systems Project Office, Washington, D.C.

We held several meetings and discussions with Washington officials from the offices of the Joint Chiefs of Staff and the Chief of Naval Operations.

AGENCY COMMENTS

We discussed this report with representatives from DOD, Joint Chiefs of Staff, and the Department of the Navy who are responsible for the management and operations of the SLBM program. Although they basically agreed with our conclusions and recommendations, their comments indicate that they believe that adequate steps have been or are being taken in some of the areas of concern, such as the two-crew concept and the application of POLARIS/POSEIDON maintenance and supply program benefits. We evaluated their comments and they are

discussed throughout the report where appropriate. We recognize that certain improvements have been made, but we believe that implementation of our recommendations will result in additional management improvements.

CHAPTER 2

THE SLBM FORCE'S HIGH READINESS: REASONS WHY

The Navy maintains the SLBM force at a high level of readiness due to its strategically important deterrent mission. In this respect, DOD reported that for nearly 20 years SSPO has given intensive management attention to making the total SLBM system highly reliable. This has involved continuous surveillance of performance and redesign of unsatisfactory elements. Both the POLARIS and POSEIDON missiles are reported to have a projected operational readiness in excess of [deleted] percent.

The Navy achieves this favorable readiness posture by emphasizing management, staffing, equipment, maintenance, and supply support. The factors enhancing SLBM system readiness include priority funding and personnel assignment, scheduled operating cycles with structured maintenance periods, use of modular components and redundant systems, and special offices to oversee proper maintenance and support of parts and supplies. This chapter discusses these factors in more detail.

READINESS ASSESSMENT-- GAO'S CONSTRAINED APPROACH

We were unable to verify POLARIS/POSEIDON system readiness in the usual sense because (1) onboard examination of submarine and missile operations at sea was not practical, (2) access to specifically requested Navy reports was denied, (3) delays in obtaining requested data were significant, and (4) interviews with top level Navy officials netted only general information on operations.

During the review, we were directed to SSPO and the Joint Chiefs of Staff to obtain supporting data on POLARIS/POSEIDON readiness and reliability. After about 6 weeks' delay, we were able to meet with SSPO officials and to obtain some general overall information on the SLBM program. However, evaluation access is very restricted. All requests for data must be in writing and be screened by top officials. These officials also handle responses; therefore, meetings are held only when all of these officials are available. During our reviews, we are normally given a liaison in an organization who coordinates our actions and allows us to discuss areas of interest with all applicable officials of that organization.

Our work was further complicated by the fact that several months' delay was experienced in obtaining readiness and reliability data from the Navy and the Joint Chiefs of Staff. For example, in September 1977 we asked the Navy for certain information, including system reliability data. We held several meetings with representatives of the Navy and the Office of Joint Chiefs of Staff to obtain this data. The Joint Chiefs of Staff finally released some of the requested information to us in June 1978, over 8 months after our initial request. However, we were still denied information regarding (1) procedures followed before missiles can be fired, (2) controls which preclude unauthorized release of missiles, and (3) survivability and vulnerability of submarines, especially in relation to electronic countermeasures.

Thus, we relied mostly on interviews with Navy officials, data screened by DOD officials, and data prepared from patrol operations to determine validity of reported information.

THE SLBM FORCE IS READY

The Navy considers the following two key evaluative elements in determining whether the SLBM program is ready or not:

--Is the weapon system, both the submarine and the missile firing components, available (are all systems go)?

--Once the fire command is executed, what are the predictable assurances that the payload will be delivered on target (reliability)?

We found that the POSEIDON force is extremely available [deleted] the Navy is apparently correcting the problems noted during the operational test firings.

Availability

To assess the availability of the submarine and its missile subsystems, we analyzed 42 reports for SSBN patrols for June 15, 1976, through May 31, 1977. As shown in the following table, these reports confirmed a high availability for the POSEIDON missile subsystems. The Navy reported similar availability for its submarines and missiles during fiscal years 1975 and 1976.

STRATEGIC WEAPON SYSTEM AVAILABILITY

SUBSYSTEMS	PERCENT OF TIME READY
NAVIGATION	deleted
FIRE CONTROL	
MISSILE	
LAUNCHER	
SHIP	

The Navy maintains a higher percentage of SSBNs in a "fully" or "substantially" ready status than it maintains for its other ships. The Navy's goal is to maintain 70 percent of its ships in a Command Operationally Ready status indefinitely without impairing material condition or the crews' morale. While the Navy reportedly met this goal for its 531 ships during fiscal year 1977, [deleted] percent of the ships were fully or substantially ready. The remainder were not ready or had major deficiencies which caused the loss of one primary mission area. The not ready category includes ships in scheduled maintenance activities, such as overhauls.

By contrast, over [deleted] percent of the Navy's POLARIS and POSEIDON submarines were fully or substantially ready. The following table compares the reported readiness condition by ship types.

RESOURCE READINESS CONDITION

SHIP		PERCENT OF READINESS				
TYPE	NUMBER	FULLY	SUBSTANTIALLY	MARGINALLY	SUBTOTAL	NOT READY
SSBNs	41	deleted				
SS & SSNs	75					
Carriers	13					
Cruisers	26					
Frigates-destroyers	158					
Amphibious	65					
Mobile Logistic Support Force	39					
Auxiliaries	75					
Miscellaneous	39					
TOTAL NAVY	531					

Our work verified the higher readiness condition of the SSBNs. Furthermore, we believe a greater disparity exists in readiness between submarines and surface ships, than shown above, because DOD's 1978 Military Readiness Report confirms that some masking of poor performance occurs in the readiness consolidation process, and a comparison of Navy Force Status Reports with other data suggests it to be somewhat optimistic for surface ships and apparently less biased for submarines.

Reliability

The Joint Strategic Target Planning Staff is responsible for proper targeting of all TRIAD nuclear weapons in a series of coordinated attack options according to "executive" direction. It formulates a targeting plan using all strategic weapons and relies on information such as intelligence data concerning Soviet targets, weapons system reliability and effectiveness, ability to deliver the weapons, and effects of simultaneous attacks. These data are used to plot the desired target coverage based on target importance to the United States and to improve reliability.

To determine SLBM weapon system reliability, the Navy combines three distinctly, measured aspects of system performance: launch from the submarine, missile in flight, and reentry body reliability. We found that for tests made in fiscal year 1977 the weapon system reliability rate was about [deleted] percent. For all tests conducted since August 1972, weapon system reliability averaged about [deleted] percent yearly.

Although the actual POSEIDON reliability is [deleted] [deleted] percent goal, Navy officials said the current, cumulative reliability rate is reasonable, considering the many sophisticated subsystems where problems could occur. While we did not evaluate all the Navy's efforts to improve reliability, we did note examples (one of which is described below) where improvements have been made.

The Navy uses weapon system reliability to measure, in relation to TRIAD's responsibilities, mission capability for SSBN planning, targeting, establishment of goals, etc.

The Navy and the Department of Energy reassess annually the reliability of the POSEIDON reentry body nuclear warheads. This reliability gives the probability of a nuclear detonation achieving an expected yield at the target, given adequate inputs to the reentry body. The two agencies evaluate separately the effects of hostile enemy action on reentry bodies.

We reviewed the results of the [deleted] POSEIDON operational tests conducted during the 1 year period starting in August 1976. The data extracted from the annual Poseidon Evaluation Report prepared by the Applied Physics Laboratory covered the latest available summary on operational testing.

According to the Poseidon Evaluation Report, the primary objective of operational testing is to determine valid reliability and accuracy factors under representative operational conditions. Operational testing involves all subsystem functions, including typical maintenance and readiness periods, and terminates with the delivery of the reentry bodies to the impact area. Operational testing also furnishes timely indications of any need for corrective actions, provides some evidence of the sources of trouble, and may suggest the required corrective action.

Missiles are randomly selected for operational testing from all candidates in order to provide the best statistical sample. Occasionally, missiles have been excluded as candidates because they were known to have deficiencies which were being corrected. For example, a problem was observed with a certain brand of insulator which was in POSEIDON second-stage motors. All missiles configured accordingly were temporarily removed from testing. A major modification was planned to correct this problem and subsequent operational tests with modified missiles verified the effectiveness of the modification.

In reviewing missile launch time for the deleted operational tests, we found that the missiles were launched within the established criteria after the SSBN's commanding officer received direction to fire. (See app. II for further discussion on missile firing criteria and procedures.)

CRITERIA FOR MEASURING READINESS

The readiness of a force, particularly the SLBM force, is clearly related to its capability to maintain the physical condition of individual submarines at an acceptable level of timely maintenance and regular overhaul. Joint Chiefs of Staff Publication 6 defines readiness as "The degree to which the organization is capable of performing the missions for which it was organized or designed."

The two levels of readiness measurement are unit readiness and composite readiness. Unit readiness is the degree to which an individual ship is able to perform its primary missions and it has two functions. First, it is the basic building block upon which further levels of composite readiness are developed. Secondly, it is the principal measure used by resource management in identifying deficiencies and indicates the qualitative and quantitative requirements to correct these deficiencies to achieve readiness improvement. A medium for analyzing unit readiness is the Naval Forces Status Report.

Composite readiness describes the ability of an organized force to carry out its responsibilities. Composite readiness can be described in terms of a geographic area--naval readiness in the Indian Ocean--or in terms of a force capability--readiness of the SLBM force. In the aggregate, the composite readiness of all units in the active force should give an accurate picture of the Navy's total force capability.

The National Command Authority, Joint Chiefs of Staff, and the unified Commanders (Atlantic, Pacific, and Europe) need this composite readiness for their operational and strategic decisionmaking. The medium for analyzing composite readiness is a recently developed command operational readiness reporting system called the Fleet Readiness Status Report.

The Joint Chief of Staff Readiness Reporting System established four C-ratings, which are standard for all services, for measuring the extent of deficiencies. Those ratings generally correspond to insignificant, minor, major, and mission precluding deficiencies. These overall C-ratings and their descriptive terms are:

C-1--Fully Ready. Capable of performing all assigned primary mission areas.

C-2--Substantially Ready. Minor deficiencies which are insufficient to cause the loss of any primary mission area.

C-3--Marginally Ready. Major deficiencies which cause the loss of no more than one primary mission area.

C-4--Not Ready. Mission precluding deficiencies which cause the loss of more than one primary mission area.

The unit readiness analysis system is the basis for the analysis of composite readiness which is reflected through the command operational readiness reporting system. In determining composite readiness, senior operating commanders are mainly interested in whether a ship is Command Operationally Ready or Command Not Operationally Ready. A ship is classified Command Operationally Ready when the reporting unit believes it can get underway in 96 hours or less and accomplish its basic mission as directed by the Fleet Commander in Chief. Ships are classified Command Not Operationally Ready when they cannot do the above two requirements. The latter can result from deficiencies in one or more of the three basic readiness factors: personnel manning, material condition, or training qualifications. Generally speaking, the overall C-1, C-2, and C-3 ratings correspond to Command Operationally Ready, and C-4 corresponds to Command Not Operationally Ready.

REASONS FOR THE HIGH READINESS

The Navy gives special attention to the SLBM system and; thus, has implemented several programs and concepts to achieve and maintain a high degree of readiness. These include priority personnel assignment, scheduled operating cycles with structured maintenance periods, use of modular components and redundant systems, and special offices to oversee proper support of parts and supplies.

Priority manning fulfills personnel requirements

The most important factor in combat readiness, often taken for granted in sophisticated equipment systems, is the people who operate and support the weapon systems. Personnel readiness is having enough people to operate the ships and support activities, qualified people to do the jobs necessary to operate and maintain the ship and its installed equipment, and experienced people to provide the necessary organizational leadership. The Navy is manning its POSEIDON submarines at authorized levels and maintaining more submarines at sea under the two-crew concept, referred to as Blue/Gold crews.

The Chief of Naval Operations has stressed that those activities whose mission is of the highest priority to national defense will be granted priority ONE for personnel assignment to help meet staffing requirements. The Navy has emphasized that, since such a decisio· usually results in undermanning other activities, priority assignment will be kept under strict control and will be granted only in cases considered essential to the national defense either by the Chief of Naval Operations or the Commander in Chief, U.S. Atlantic Fleet. Pacific Fleet procedures are similar. The Chief of Naval Operations has directed that SSBNs have priority ONE manning. A manning monitor is assigned to the Atlantic Fleet Submarine Force who oversees implementation of this directive.

The Atlantic Fleet Submarine Force has 100 percent of its authorized strength. As shown in the table on the following page, about 30 percent of the Force's personnel were assigned to SSBNs, which had 99 percent of their authorized allowance of 7,734 personnel.

ATLANTIC FLEET SUBMARINE FORCE MANNING STATUS AS OF 2-27-78

	AUTHORIZED	CURRENTLY ON BOARD	PERCENT OF AUTHORIZED	PERCENT OF PETTY OFFICER GRADES E-5 - E-9 ASSIGNED TO AUTHORIZED
Force totals	25,209	25,445	1	104
All submarines	12,797	12,736	100	114
SSBNs	7,734	7,622	99	114

As of February 27, 1978, the SSBN force was only 1 percent short of its authorized allowance of 7,734 personnel. A review of three submarine crews confirmed the high-manning levels.

Navy officials attributed proper SSBN-manning levels to a more successful first-term reenlistment ratio for submarines than experienced by Navy surface and air units. For example, in the Atlantic Fleet, 44 percent of eligible first-term submarine personnel reenlisted in fiscal year 1977 as compared to only 31 and 33 percent for surface and air unit personnel, respectively. Navy officials said that incentive pay and pride of the submarine force helped to obtain and retain the number of qualified people needed to man its submarines.

The flexibility permitted the Submarine Force in making priority personnel assignments to SSBNs also helped to achieve adequate SSBN-manning levels. For example, if a needed individual cannot be obtained through changes in orders, assignment from submarine school, or other immediate availability, the Force can directly transfer an individual from another submarine to fill the vacancy. However, such a transfer is made only as a last resort.

Navy criteria establishing the degree of personnel readiness are as follows:

READINESS CATEGORY	ASSIGNED PERSONNEL TO AUTHORIZED	PETTY OFFICER GRADES E-5 – E-9 ASSIGNED	DEGREE OF MISSION DEGRADATION
C1-fully ready	95 - 100%	95 - 100%	Insignificant
C2-substantially ready	85 - 94%	90 - 94%	Minor
C3-marginally ready	65 - 84%	75 - 89%	Major
C4-not ready	0 - 64%	0 - 74%	Loss of one or more mission areas

Our comparison of the Atlantic Fleet Submarine Force's onboard to authorized personnel ratio disclosed some shortages. However, the Navy compensated for such shortages in lower enlisted personnel and petty officer grades by assigning additional personnel in the other pay grades (see app. IV).

Our review of three SSBN patrol crews confirmed the Navy's reported manning of 99 percent of authorized personnel with only minor shortages existing in two of the three crews reviewed. The following shortages appeared in 3 of 21 rate groups involved.

RATE GROUP	NUMBER	
	AUTHORIZED	ACTUAL
NUCLEAR ELECTRICIAN	10	9
FIRE CONTROL TECHNICIAN	2	1
SEAMAN/FIREMAN	10	9

The Navy recognized that the actual personnel available for assignment to submarines might not meet all pay grade, rating, or specific skill requirements of the allowance and emphasized that distribution of available personnel should be made on an equitable basis. The minor shortages noted were evenly spread over the crews reviewed. The Submarine Force manning monitor told us that some shortages are typical. (We found that these shortages would not affect readiness.) Further, he said a submarine would not leave port if the Commanding Officer determined that personnel deficiencies would adversely affect mission performance, and that missions have not been canceled due to personnel problems since the beginning of SSBN operations in 1960.

The Navy attributes its SSBN personnel readiness to priority ONE personnel assignment, incentive pay, and pride in the submarine force. Also, Navy officials believe that submarine hazardous duty pay is an attractive incentive, though they were not certain how much these incentives have contributed to higher staffing levels.

Special management attention directed to monitoring and evaluating material requirements

On June 7, 1977, we issued a report ("Submarine Supply Support Costs Can Be Greatly Reduced Without Impairing Readiness," B-133058) on ways in which the Navy could save over $100 million in future investments of supplies without impairing submarine mission readiness. We stated that this could be done by (1) more promptly and accurately updating initial parts allowances, (2) adopting more stringent criteria establishing stock levels, (3) improving accuracy of usage data, and (4) using more realistic safety levels and order-ship times to compute stock requirements. DOD agreed with our findings and recommendations and initiated corrective action. Because of this report, we directed our work primarily to determining the extent that the Navy was meeting its supply system goals.

Navy policy states that the SLBM program, its highest priority operational weapons system, will be provided the highest degree of effort and resources at all Navy supply activities. The Navy established a goal of 95 percent for filling SSBN material replenishment needs from tender and supply system stocks. To help achieve this goal, the Navy established the Atlantic Fleet POLARIS Material Office, at the U.S. Naval Base, Charleston, South Carolina; and the Pacific Fleet POLARIS Material Office, at the Puget Sound Naval Shipyard, Bremerton, Washington.

These two offices are under the operating command of the Submarine Force Commanders in their respective Fleets. The offices provide a focal point through which the Submarine Force Commanders exercise assigned military material control and supply responsibilities for their complete (ship and missile) SLBM weapon systems. These material offices provide a supply system dedicated to ensuring the most effective supply support possible.

To provide the SSBNs with the necessary material to achieve the immediate supply responsiveness, the Navy uses three echelons of supply support. These echelons are the submarine itself, the submarine tender, and supply centers ashore.

The Coordinated Shipboard Allowance List provides the first level of support and constitutes the initial authorized allowance for each SSBN. The allowance list provides, based on available historical SSBN tailored usage rates, the range

and depth of repair parts, spares, and consumables required to insure optimum support during a patrol cycle. The list, which is subject to economic and space constraints, allows a 90 to 99.99 protection percentage against the probability of being out of stocked items for the SLBM weapons system and maintenance-related items. The higher protection percentage is based on the military essentiality of the items.

The submarine tender, the second level of support, provides the necessary replenishment material for SSBN support. The Navy has submarine tenders at the following SSBN replenishment sites.

REPLENISHMENT SITE	LOCATION
ONE	HOLY LOCH, SCOTLAND
TWO	ROTA, SPAIN
THREE	GUAM, MARIANAS ISLANDS
FOUR	CHARLESTON, SOUTH CAROLINA

The Navy plans to phase out replenishment Site Two by July 1979 and to move it stateside where the longer-range TRIDENT will operate. The tender at Site Three supports the 10 POLARIS SSBNs operating in the Pacific.

Navy supply centers make up the third echelon and replenish stocks in SSBNs and submarine tenders. A material availability goal of 95 percent has been established for material supplied during a SSBN refit period from a combination of the tender and stateside activities. The following table shows the percentage of all SSBN material supplied by tender and stateside activities during refit at the POSEIDON sites for the past 3 fiscal years.

SITE NUMBER	FISCAL YEAR 75	76	77
ONE	93%	94%	94%
TWO	93%	94%	94%
FOUR	90%	90%	94%

Our visit to Charleston, South Carolina, disclosed that the Atlantic Fleet POLARIS Material Office's effective performance contributed to successfully achieving a high degree of supply effectiveness--only 1 percent short of the effectiveness goal at all three replenishment sites during 1977.

To insure availability for the support of deployed SLBM fleet forces, the Material Office has implemented procedures and controls for the protection of material and critical items with SLBM application stocked at the Naval Supply Center, Charleston. The protection level is the established level of an SLBM applicable item to be stocked and controlled by the supply center, Charleston. When stocks are reduced to this level, restricted issue procedures are invoked. Protection levels are based on various inputs and SLBM applicability data. The supply center may not issue SLBM applicable items equal to or below the protection level to other than deployed SLBM units without a Material Office approval which requires exception processing.

In addition to exercising issue control over material within the SLBM protection level program, the Material Office exercises SLBM critical item program control over additional quantities of material and items as directed by SSPO, the Systems Commands of the Navy Department, Material Inventory Managers, and the Atlantic Fleet and Submarine Force Commanders. A manager identifies a critical item as being in short system supply, and it is subject to temporary issue restrictions.

Extended operating cycles and structured maintenance programs are the basis for a higher, stabilized level of deployed SSBNs

The Shipsystem Maintenance Monitoring and Support Office (SMMSO) was established in 1970 at the direction of the Chief of Naval Operations to study if the operating cycle of SSBNs should be extended to a time compatible with the new long-life reactor cores. On completion of the study, the extended operating cycle concept was adopted in 1974 for the 31 SSBNs carrying POSEIDON missiles, and the operating cycle was increased from 6 years to 9 years between overhauls. The purposes in extending the interval between overhauls were to achieve a higher, stabilized level of deployed POSEIDON SSBNs and maintain a high state of material readiness at a lower cost. The Navy estimates that the extended operating cycle concept will save over $300 million in SSBN operation and maintenance costs over the next 2 decades. Using the current projections of the reactor life core, the Navy is now considering extending the operating cycle from 9 to 12 years.

To sustain the extended operating cycle concept, the increased maintenance workload is accomplished during regular post-patrol refit periods and scheduled extended refit periods. During the extended operating cycle, routine maintenance is

done by SSBN and tender forces, technical representatives, and shipyard/contractor industrial support teams.

Two extended refit periods, lasting about 60 days each, are scheduled at 4-1/2 and 7-1/2 years out of overhaul. These special periods are required for maintenance that cannot be done during the normal tender refit periods. During these periods, drydocking facilities are made available to facilitate maintenance work.

SMMSO's monitoring and evaluation of SSBN shipsystems, in addition to increasing the operating cycle and availability of SSBNs, has resulted in a number of benefits to the program. For example, SMMSO reduced the maintenance time for specific equipment (i.e., the high pressure air compressors aboard the submarines). It also eliminated the need for some preventive maintenance inspections, thus, reducing maintenance hours. The Director of SMMSO told us that, while some benefits have been shared with other Navy commands, no formal effort has been made to insure that other Navy programs are notified of SMMSO efforts. In commenting on this report, Navy officials cited Naval Sea Systems Command Instruction 5400.13A which provides for the dissemination of maintenance benefits derived from the SSBN SMMSO. While we recognize the existence of this instruction, our concern is what is the Navy doing to implement it. During our review, none of the many Navy officials interviewed were aware of this instruction nor were they aware of an established program to implement its provisions. Furthermore, the instruction addresses only maintenance benefits which precludes the sharing of valuable benefits derived in other areas such as supply.

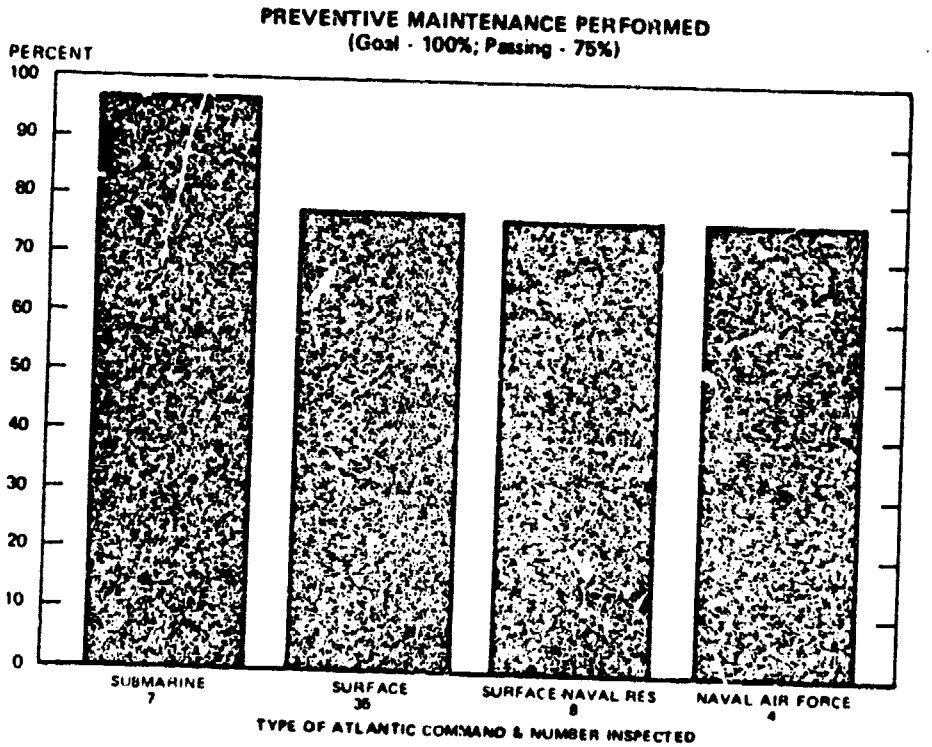
SSBN crews use the modular maintenance concept to reduce the amount of repair work required aboard ship. Equipment downtime is reduced and system availability improved. The modular maintenance concept allows SSBN crews to isolate an equipment problem down to the module causing that problem. The module is replaced and returned to the supply system for final disposition. The supply system may repair, store, or discard the defective module. SSBN crews normally use the modular concept in electronic systems (fire control, missile, sonar, communications, and navigation systems). Navy officials stated that the modular concept will be used more extensively on the TRIDENT submarines than it is now used on the POLARIS/POSEIDONs.

Redundant systems help maintain the SSBN's high state of readiness by providing a back-up system when one needs repair or parts. Redundant equipment or systems used on SSBNs include generators, Ships Inertial Navigation System, hydraulic, communications, and decoding machines.

The planned preventive maintenance program also contributes to the high SLBM readiness. This maintenance is done while the ship is at sea on patrol or, in the case of major propulsion machinery which must be nonoperating for maintenance, during periods of upkeep when the ship is in port. (For a more detailed discussion of preventive maintenance, see ch. 1.)

SSBN submarines presently operate on a 100-day cycle, although the crews work on a 200-day cycle. The ship cycle normally consists of about a 68-day patrol and a 32-day refit period for maintenance and replenishment of supplies after each patrol. Most maintenance work is performed during this 32-day refit period at the end of each patrol.

The percentage of preventive maintenance actions performed during the third quarter of fiscal year 1977, based on Navy inspections, disclosed that most of the required maintenance actions were performed on submarines in contrast to other ships as depicted in the table below.



A Navy official attributed the Force's higher performance of maintenance actions to better qualified and trained personnel, better parts support, and the fact that the crew feels the maintenance is essential for ship and personnel safety. During our visits aboard two submarines, ships' personnel informed us that the responsible maintenance support offices are very timely in correcting problems noted during maintenance work, such as a need to revise procedures for correcting a particular problem. The changes are usually made before the next patrol begins.

Navy officials we contacted were unable to specify the degree that the extended operating cycle, structured maintenance, modular and preventive maintenance, and redundant systems contributed to the high state of readiness of the SSBN force.

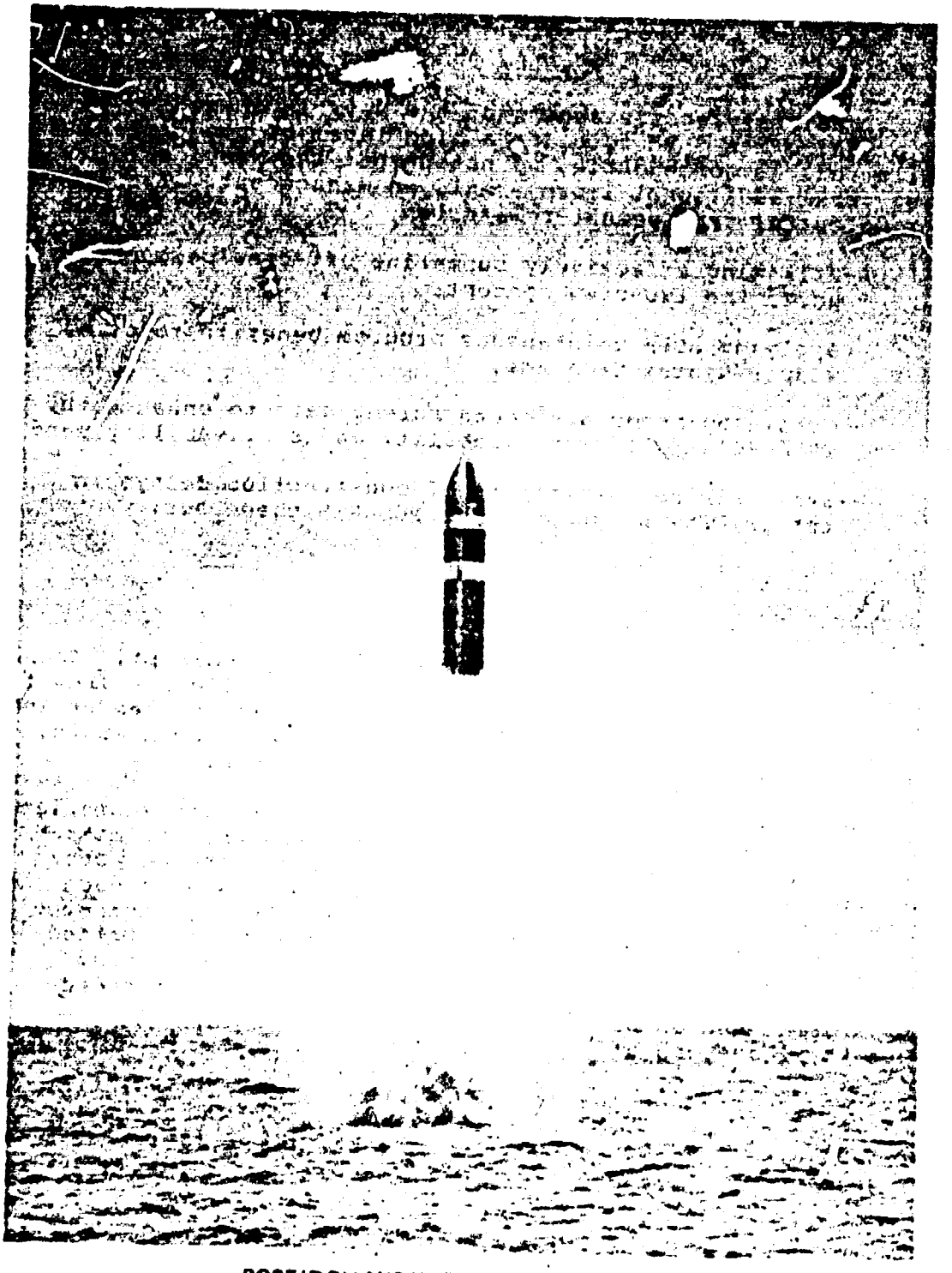
In examining the reported readiness of the SLBM system, we looked at alternatives and options the Navy has considered to accomplish the SSBN mission more efficiently and economically without impairing readiness. This process led us to make certain observations and raise questions which could possibly provide additional management improvements in the SSBN force. These observations and questions are discussed in chapter 3.

We also tried to compare the operational and support aspects of the Navy's surface ships to the SSBN force to determine what factors cause the SSBN force to be in a much higher degree of readiness than the surface ships. We tried to determine if the Navy had made any studies along this line. Our discussions with key Navy officials yielded generalities to our very specific questions. The most frequent responses were that they were not aware of any formal studies and that any internal office papers would not represent an official Navy position; therefore, these papers would not be available to us. We do not know if all of the programs and concepts which we identified as contributing to the high degree of readiness of the SSBN force could be used on surface ships, but we think that some could with benefits resulting in increased readiness.

We believe it is very important to identify the reasons contributing to this readiness, as well as addressing what accounts for the differences in the SSBN force readiness versus the surface ships' readiness. Is it the priority ONE designations for funding, personnel, supply support, maintenance practices, or better program management, etc.? Certainly good management approaches should be shared both

within the Navy and with other services. It may be more important for the Navy to spend the funds on improving the readiness of existing forces rather than expanding current facilities and forces. To convince the Congress not only of the need but that readiness will definitely improve by a certain percentage requires better and more extensive analyses than the Navy is currently making.

It is obvious from our analysis of SSBN forces that a ready force is attainable. With this and the above in mind, we discuss in chapter 4 our observations and the questions we believe should be answered by the Navy.



POSEIDON MISSILE TEST FIRED AT SEA

CHAPTER 3

OBSERVATIONS AND QUESTIONS ON SLBM PROGRAM

Readiness reports show that the Navy is operating and maintaining its SLBM force at a high level of readiness. While this is commendable, we noted that the Navy could possibly make additional improvements in management. The areas for potential improvement relate to

--utilizing effectively submarine off-crew personnel under the two-crew concept,

--applying SLBM maintenance program benefits to other weapon system programs,

--obtaining necessary ocean survey data to enhance the TRIDENT's follow-on capability and survivability, and

--ascertaining the effects of construction delays in the TRIDENT program on the POLARIS phase out.

SHOULD THE BLUE/GOLD CONCEPT BE MODIFIED TO INCREASE OFF-CREW UTILIZATION?

The SLBM force operates under a two-crew concept. Each submarine has both a Blue and a Gold crew. While one crew is on patrol, the other crew is in port undergoing refresher and advanced training, taking leave, training new crew members, and in general, getting ready to go back to sea.

By having an alternate crew to take over each submarine as it returns from patrol, the Navy has been able to make more patrols with fewer submarines than under the one crew for each submarine concept. Providing two crews for each SLBM submarine permits each crew to rotate between the same submarine and a shore installation within a 200-day period. During each 200-day cycle, the Blue and Gold crews spend 100 days each at the submarine's homeport for refit operations or at sea on patrol, and 100 days at the crew's homeport for leave and off-crew training.

We reported on the Blue/Gold crew concept in a letter report to the Secretary of Defense entitled, "Opportunities for Savings in Personnel Cost in the Fleet Ballistic Submarine Program" (B-171681, Jan. 27, 1971). While information developed

in our previous review indicated that the full off-crew training period was neither needed or used to maintain crew readiness, we suggested only that the Navy develop a program for effective utilization of the off-crew personnel. On the average, only half of the period designated for training could be accounted for by formal and informal training. Although some crew members were used for military or administrative duties, the Navy's records--or lack of records--indicated that Blue and Gold off-crew personnel actually were not used one-third of the time, or about 4 of each 12 months.

During the earlier review, we estimated that about 10 crews, or 1,500 men, could be made available to fill other Navy needs if 5 crews were assigned to 3 submarines, a modification of the two-crew concept. In this estimate, we assumed that 33 of the 41 SLBM submarines were either being refitted for patrol or on patrol at any given time.

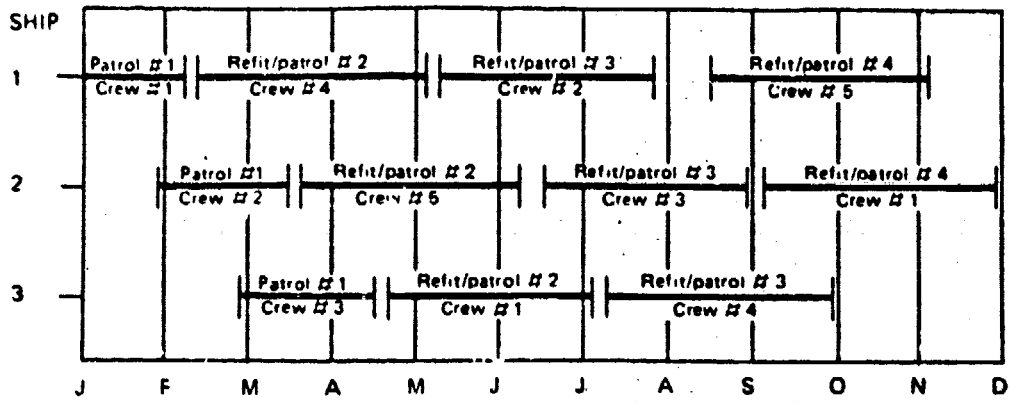
During our current survey, we again discussed the feasibility of modifying the Blue/Gold concept with Navy officials. The Atlantic Fleet submarine force presently has 57 SSBN crews for its 31 POSEIDON submarines. At the time of our audit, the Atlantic Fleet had five submarines in overhaul, and thus had only assigned one crew each. A reduction of 10 crews or about 1,500 personnel may still be possible through decreasing off-crew training time from the current 68 days to 38 days, and these personnel could be used to fill other essential positions. The submarine operating time and crew time at sea per patrol would not change. However, the crews would operate on a 170-day patrol cycle in lieu of a 200-day cycle, as projected below.

SUBMARINE AND CREW PATROL CYCLE (DAYS)

	SHIP CYCLE	CURRENT BLUE/ GOLD CREW CONCEPT	MODIFIED CONCEPT USING 5 CREWS FOR 3 SUBMARINES
PATROL TIME	68	68	68
LEAVE	--	32	32
TRAINING		68	38
REFIT PERIOD	32	32	32
TOTALS	100	200	170

The modified concept for the patrol and refit periods would work similarly to the matrix illustrated below.

MATRIX ILLUSTRATING PATROL CYCLE USING FIVE CREWS FOR THREE SUBMARINES



Navy officials said that, since the submarines were different in configuration, the crews would probably have a difficult time adjusting to different submarines. For example, personnel trained in nuclear power would be certified for a specific ship's power plant. Under current procedures, an individual's certification would expire if his service aboard the ship elapses for more than 6 months. Therefore, an individual assigned to three submarines would have to be certified before each patrol--a lengthy and expensive process. However, we found that the nuclear recertification process applies only to nuclear-trained personnel which is about 25 percent of the submarine's crew. Navy officials commented that the majority of the remainder of the crew who stand watch over the specific ship's watch station equipment also require certification. Ship safety requires that crew members be thoroughly familiar with their specific ship. Additionally, Navy officials stated that this requires initial training (i.e., strategic missile and navigation, sonar, torpedo fire control, MK 48 weapons handling, etc.) and also dedicated team training and recertification during each off-crew training period. (Underscoring supplied)

Since the Navy currently has provisions regarding training and recertification requirements during each off-crew training period, we believe it should seriously reconsider the option of having five crews for three submarines in lieu of two crews for every submarine.

Lastly, Navy officials said a decrease in shore time means an increase in sea time which may create a morale problem among submariners.

Navy officials commented that the 68 days represented only 8 calendar weeks of 5 days each, or 40 actual training days, and that weekends should not be included. Thus, Navy officials said the Navy could not shorten the training period appreciably and still maintain adequate readiness.

However, in two of three examples cited in the 1971 report as typical, both formal and informal training comprised only about 50 percent of the crew members' 40-hour, 5-day week. In addition, some informal training and military and administrative duties would be done after normal work hours or on weekends. Informal training consists of such activities as lectures, seminars, discussions, and self-study correspondence courses. Military and administrative duties include standing watch, personal and departmental administrative activities, and barracks cleaning details. Thus, we believe weekends should be considered as part of this training period. In any event, the Navy reported only half of the 40-hour week as being effectively utilized for formal and informal training, so 20 to 25 training days per crew during each cycle should suffice. Furthermore, in addressing the possible reduction of off-crew training time from 68 days to 38 days, Navy officials stated that 38 days equates to 5 weeks of 5 training days each and that these 25 training days could be sufficient for the required training.

Neither the Navy nor GAO knows what the actual effect a modification to the two-crew concept would have on morale and crew familiarity with submarines. It is an alternative which, to our knowledge, has not been analyzed indepth since the inception of the two-crew concept. Navy officials commented that they have reviewed the two-crew concept many times. However, we were unable to obtain any studies or analyses which would support that such reviews have been made. The information developed under our current work still supports the need for more effective utilization of off-crew personnel not engaged in training actually needed to maintain proficiency in their skills. An option which we believe warrants further consideration is to modify the present two-crew concept to five crews for three submarines.

CAN SLBM MAINTENANCE BENEFITS HELP OTHER PROGRAMS?

The Chief of Naval Operations established SMMSO to determine the feasibility of extending the SLBM submarine operating interval. SMMSO determined that extending the SLBM overhaul frequency of the 31 POSEIDON submarines from 6 to 9 years was feasible.

The Navy estimates that the extended operating cycle will save over $300 million in SLBM force operation and maintenance costs over the next 2 decades. One official said the Navy is now considering extending the operating cycle further, from 9 to 12 years, because current estimates of reactor core life have provided a greater life expectancy; thus, even greater savings in off-line time and maintenance dollars should be realized.

SMMSO was also tasked with the responsibility of supporting the extended cycle once implemented. Tangible benefits resulting from SMMSO's monitoring and analytical efforts have also included reductions in maintenance performed on specified equipment. For example, maintenance time for high pressure air compressors aboard ships has been significantly reduced. Before SMMSO began monitoring the system, the Navy spent 300 man-hours overhauling the compressors after every 1,000 hours of operation. SMMSO examined the compressors' failure rates and maintenance history and changed the overhaul cycle to every 3,000 hours, thus saving 600 maintenance hours per compressor. SMMSO is now studying whether it can feasibly increase the time between overhauls to 4,000 hours, based on the latest monitoring data. SMMSO has also instigated other beneficial changes, such as the elimination of unnecessary preventive maintenance inspections.

The Director of SMMSO said that while some beneficial results of the maintenance program are passed on to other Navy commands, the Navy does not have a system to ensure that maximum benefits are provided to other Navy programs.

WILL THE NAVY BE ABLE TO OBTAIN ESSENTIAL OCEAN SURVEY DATA TO ENHANCE TRIDENT OPERATIONS?

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The first 10 TRIDENT submarines are scheduled for operation in the Pacific Ocean using Bangor, Washington, as the initial base of operations.

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Justification for the TRIDENT submarine included the facts that it would be significantly quieter and more reliable than earlier SSBNs, would have a longer patrol period capability, and could use a much larger ocean patrol area because of the longer range TRIDENT missiles. (Underscoring supplied.) In addition, the justification stated that the longer-range missile greatly enhances submarine survivability and permits a deterrent capability from either the Atlantic or the Pacific Ocean.

However, deleted We issued a report to the Congress entitled, "Need for Improving Mapping, Charting, and Geodesy Support of the Strategic Ballistic Missile Submarine Force" (B-145099, July 25, 1978, Classified--SECRET/NOFORN). This report pointed out deleted greater increases in ballistic missile ranges, large operating areas, and the potential U.S. requirement for increased SSBN deployment and area coverage. We were informed that as of July 1977,

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Navy officials stated that the present ocean survey program data collection schedule will provide data through the planned operating area at the time of TRIDENT deployment. However, reasons provided for the lack of survey data included the poor material coordination of the survey ships and obsolete equipment. The question remains as to whether the Navy can update/replace its aging survey equipment and ships in sufficient time to maximize TRIDENT effectiveness and potential.

WILL TRIDENT CONSTRUCTION DELAYS AFFECT THE POLARIS PROGRAM?

The TRIDENT submarine construction contract gave an April 1979 delivery date for the first submarine; however, the contractor, Electric Boat, promised to use its best efforts to deliver the submarine as early as December 1977.

Since the construction contract was awarded in July 1974, Electric Boat has revised the delivery date of the first TRIDENT four times:

Date of revision	Revised delivery date
2/75	8/31/78
4/76	12/31/78
7/77	10/27/79
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CONCLUSIONS

Readiness of our forces involves costs, personnel and training, equipment on hand and its condition, and the support available to the forces and its positioning. The Navy is achieving its purpose of operating and maintaining the SLBM force in a high state of reliability and readiness. The cost to achieve the Navy's purpose now amounts to more than $1 billion annually.

Many programs and concepts which contribute to the high degree of readiness of the SLBM system differ from those of other Navy programs. At this time, we do not know whether it is feasible to apply these programs and concepts to other Navy programs, but we believe that the Congress should be aware of what these differences are and what they cost. We looked at alternatives and options the Navy has considered to accomplish the SLBM mission more efficiently and economically without impairing readiness.

As discussed in chapter 2, the Navy has implemented several measures to achieve a high level of readiness for its SLBM operations. These measures include priority manning for submarines, extended operating cycles with interspersed planned maintenance periods, use of modular components and redundant systems, special emphasis on attaining high supply system goals to enhance replenishment of spare parts and supplies, and special management organizations to oversee various operational aspects of the SLBM program.

While some beneficial results of the maintenance program have been passed on to other Navy commands, the Navy does not have a system to ensure that maximum benefits are provided to other Navy programs. Although the Navy has reported substantial benefits through its efforts in extending the operating time of SLBM submarines before overhaul from 6 to 9 years, we also believe that opportunities exist for the Navy to adopt more of the maintenance benefits, such as the extended operating cycle and decreased maintenance, to other Navy programs--attack submarines and surface ships. Program benefits could be made available to other activities by instituting the proper procedures and requiring their implementation where feasible.

Even though the Navy is achieving its objective of maintaining the SLBM force at sea by using two crews for each submarine, we believe that opportunities still exist for the Navy to modify the two-crew concept and improve off-crew personnel utilization, while retaining the same readiness levels.

Although the Navy is now projecting a contractor reported minimum slippage of 19 months in the TRIDENT construction schedule, Navy officials commented that the phase out of the POLARIS will remain on schedule. We did not look at the effect this slippage will have on the POLARIS program, but Navy officials said that additional POLARIS maintenance and overhaul work (now amounting to about $80 million per submarine) will not be necessary. However, based on the current

retirement schedule, which shows that some POLARIS submarines will not be retired until 1987, about half of the POLARIS fleet will have to be extended beyond their projected 20-year life and well beyond their 6-year operating cycle between overhauls. This means that some form of extensive maintenance may be required to maintain the POLARIS' effectiveness and capability. The Navy should be prepared to provide some assurance as to what these maintenance requirements may be, especially in the event of further slippages in the TRIDENT program.

RECOMMENDATIONS

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

--Determine the feasibility of adopting ballistic missile submarine maintenance and supply program benefits to the less-ready Navy attack submarines and surface ships, and establish a system for communicating future benefits on a continuing basis.

--Develop and study alternatives to the two-crew concept.

--Explore alternatives to increase use of ballistic missile submarine off-crew personnel.

--Determine whether the TRIDENT deployment delays will necessitate deferring the planned retirement of POLARIS submarines to maintain an adequate readiness posture. If this is the case, plans should be undertaken promptly so that the Navy has the funds and other resources needed to carry out the costly maintenance and overhaul work which would be required to retain the POLARIS submarines until they are replaced by TRIDENTs.

CHAPTER 4

THE NAVY COULD DO MORE IN RELATING COSTS TO READINESS OPTIONS

Although the Navy is continuing to fund programs to improve the SLBM's reliability and maintainability, it needs to expand its efforts in relating costs and various readiness options. Such information, if made available, would provide DOD and the Congress with readiness/cost options for their consideration, where none now exist.

Strategic nuclear weapons are expensive, but are considered a necessary part of this country's military forces even though their main purpose is to insure that they never have to be used. Deciding whether or not to obtain a particular strategic weapon rests on more than quantitative cost/effectiveness analyses. However, these must be considered. Ultimately, any decision affecting strategic force levels depends on policymakers' judgments of the value of redundancy and flexibility in the strategic force, and on their assessment of the political consequences of changing the Nation's military posture as it is perceived by allies and possible adversaries abroad.

THE NAVY'S TOP PRIORITY PROGRAM

The Navy handles the SLBM program separately from other Navy programs and designates it as the number one priority for funding purposes. Strategic programs normally receive the funds requested because of the critical nature of their mission. Costs to design, procure, operate, and maintain a technologically up-to-date SLBM force now average over $4 billion annually. This $4 billion excludes "Military Construction and Other Procurement, Navy" funds because we were unable to distinguish the SLBM force portion from all other Navy programs. Operation and maintenance and military personnel costs alone exceed $1 billion which represents a 38 percent increase since 1976.

As shown below, costs for developing, procuring, and operating the SLBM program are increasing. Since fiscal year 1976, costs have increased from $2.7 billion to $4.3 billion, exclusive of Military Construction and Other Procurement.

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FBM PROGRAM COSTS AND 3-YEAR COST GROWTH (000s OMITTED)

APPROPRIATION	ACTUAL 1976	ACTUAL TQ a/	ESTIMATED 1977	ESTIMATED 1978	PERCENT GROWTH
MILITARY PERSONNEL, NAVY (MPN)	$197,715	$52,081	$216,977	$223,036	13
OPERATION & MAINTENANCE, NAVY (O&MN)	591,008	193,537	853,223	862,681	46
SUBTOTAL	$788,723	$245,618	$1,070,200	$1,086,316	38
WEAPONS PROCUREMENT, NAVY (WPN)	268,100	100,200	649,300	685,800	156
SHIP BUILDING AND CONVERSION, NAVY (SCN)	646,500	264,300	794,400	1,703,200	163
RESEARCH & DEVELOPMENT, TEST & EVALUATION, NAVY (RDT&E)	981,848	238,190	914,954	813,928	(17)
TOTAL	$2,685,171	$838,308	$3,428,854	$4,289,244	60

a/ Transitional Quarter

The major increases from 1976 occurred in the Weapons Procurement and Ship Construction categories, and were caused by the phase in of TRIDENT submarines and missiles. Navy officials attributed the increases in military personnel and operation and maintenance primarily to (1) pay raises and (2) the transfer of funds for major repair parts to the operation and maintenance appropriation from other Navy appropriations.

The importance assigned to the SLBM program is demonstrated by the special management provided. SSPO is the designated POLARIS/POSEIDON project manager from inception throughout operation. Similarly, the TRIDENT Program Office is responsible for the TRIDENT system. In addition, special priorities are given to manning and to a number of specially

implemented maintenance and supply related programs and concepts. These priorities and programs help ennance readiness, but probably add significantly to the cost of the SLBM program.

THE CONGRESS HAS DIRECTED THAT READINESS BE BASED ON COSTS

In July 1977, the Congress enacted section 812 of the fiscal year 1978 Defense Authorization Act (Public Law 95-79), which requires DOD to (1) identify specific material readiness requirements for U.S. forces, (2) report on its past readiness status relative to those requirements, and (3) project future readiness in light of the funds requested. Recognizing some of the difficulties in such a large and complex undertaking, DOD launched a comprehensive attack on such problems as defining, measuring, and projecting force readiness. In November 1977 the Secretary of Defense established a DOD Readiness Management Steering Group to coordinate overall DOD efforts and improve DOD's ability to define, measure, analyze, and manage overall force readiness.

The steering group's charter states that the group is to identify, evaluate, and, where necessary, propose the development of new tools by which readiness could be managed more effectively within the existing DOD planning, programing, and budgeting process. The scope of the group's efforts includes readiness definition, measurement, reporting, analysis, and improvement. The steering group anticipates that several years will be required to define, evaluate, and implement the necessary changes to improve DOD's ability to manage readiness. However, an improved capability to measure readiness and relate it to changes in resource allocation should further improve DOD's ability to allocate its resources efficiently.

In response to section 812 requirements, DOD issued a Material Readiness Report in February 1978. The report statedly addressed the key elements of the reporting requirements and provided quantitative projections of material condition wherever the military had established methodologies for making such projections. In addition, DOD stated that each service gave its best qualitative estimate of the trends in key material condition indicators which were expected to result from the fiscal year 1979 budget request and the outyear defense program.

In the near future, we will review how DOD plans to satisfy the reporting requirements of section 812. In this review, we will focus on how valid, accurate, and meaningful DOD's reported data are, and whether the DOD Material Readiness Report satisfies the requirements of the act.

THE NAVY HAS DONE LIMITED WORK

We realize that it is difficult to establish the correlation between the contributing factors, the degree of impact each factor has on readiness, and the cost of each of these factors. However, because of the significant costs involved in operating and maintaining the SLBM system, we contacted officials of several Navy activities to determine their efforts in relating SLBM program costs to readiness achieved. These activities included the

--Office of the Chief of Naval Operations,

--Navy Comptroller,

--SSPO,

--SMMSO,

--Chief of Naval Personnel, and

--Naval Supply Systems Command.

We were also interested in learning if the Navy had (1) identified the risks involved, (2) studied ways to achieve essentially the same degree of equipment availability and reliability at less cost, and (3) determined alternative ways to manage maintenance, supply, and personnel programs more economically and efficiently without sacrificing required readiness. Also, we wanted to know what incentives exist for the Navy to minimize soaring costs of expensive DOD weapons systems, and if the better readiness posture of the SLBM force is simply a matter of more available funds because of its strategic mission.

For the most part, Navy officials informed us of a lack of official studies and research in the above areas. They said there are no official Navy studies currently in process assigning costs to various readiness options and risks. However, we discussed with them two past studies--a Navy and a GAO study--relating to economy of operations in SLBM maintenance and personnel programs. The Navy effort involved the SMMSO study which resulted in a number of cost-effective

changes. Our study involved the Blue/Gold concept. (Both of these studies were discussed previously in chapter 3 of this report.)

SSPO officials said that, while it is a continuous feature of their management process to appropriately allocate resources to various system elements, areas where quantitative estimates could be made in relating costs and readiness of a particular weapons system are very limited.

Officials said that readiness is tied to the availability of funds and, thus, to the budgetary process. For example, the Navy informally estimated what it would take to increase the TRIDENT reliability goal from [deleted] percent. The Navy determined that it would be substantially more expensive to increase reliability, so the Navy decided to retain the POSEIDON level of reliability, but at twice the range.

SSPO officials stated that other management decisions are made based on informal trade-offs at the earliest stages of design development. They said that program design interacts with system support issues; reliability goals are included in all development contracts and serve as the basis for design trade-offs. Such things as the degree of redundancy and the extent of computer diagnostics to be included (for example, in the fire control and guidance system) are considered based on costs and the need to achieve reliability goals.

An example of a system trade-off which reduced costs involved the Submarine Inertial Navigation System. The Navy initially planned to use three such systems on the POLARIS/POSEIDON submarines. But, due to improvements in technology, the Navy decided that only two systems were necessary to achieve the desired degree of subsystem capability. This action resulted in cost avoidance for the additional system, and use of available parts to minimize future purchases.

In another instance, the Navy, in relating design to operations, looked at reducing the number of authorized personnel and found that, by grouping equipment in certain strategically-located areas aboard ship, the number of personnel could be reduced. As a result of this and other considerations, the TRIDENT submarine, while much larger than the POSEIDON and carrying one-half again as many missiles, will have about the same crew size as the POSEIDON.

On the supply side, SSPO considered carrying no POSEIDON missile guidance system spares aboard the submarines and found that readiness would be lowered about 6 percent. SSPO concluded that the decreased effectiveness was not worth the reduction in costs, so no further action was taken.

CONCLUSIONS

The Navy is operating and maintaining the SLBM force at a high level of readiness and has implemented some cost efficient measures in-house based on its informal efforts. We recognize that section 812 of the fiscal year 1978 Defense Authorization Act directs DOD to (1) identify specific material readiness requirements for U.S. forces, (2) report on its past readiness status relative to those requirements, and (3) project future readiness in light of the specific amount of funds requested.

RECOMMENDATION

We recommend that the Secretary of Defense direct the Navy to start developing a system which would relate costs and risks of varying degrees of readiness for the SLBM system and provide information to the Congress on acceptable risks involved and funding options.

COMPARISON OF ESTIMATED U.S./U.S.S.R.

STRATEGIC OFFENSIVE FORCES

	FY 1976		FY 1980		FY 1985	
	U.S.	U.S.S.R.	U.S.	U.S.S.R.	U.S.	U.S.S.R.
Launchers:						
ICBM launchers	1,054					
SLBM launchers	656					
Bombers	396					
Total launchers	2,106					
Force loadings:						
SLBM-launched reentry vehicles						
ICBM-launched reentry vehicles						
Bomber weapons						
Total loadings						
Warhead megatonnage (MT):						
SLBM-launched MTs						
ICBM-launched MTs						
Bomber weapons MTs						
Total megatonnage						
SSBNs	41					

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APPENDIX I

MISSILE FIRING AND SUBSYSTEM FUNCTIONS

Once an order to fire is received from the Pentagon, the Navy can launch 16 missiles deleted from the time the message is transmitted. When the firing order is received,

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Navigation

For a successful missile launching, two positions--target and launcher--must be known. This puts great importance on FBM system navigation since the position of the ship is continuously changing. Several methods complement each other in the SSBN to provide a very high order of accuracy in determining a ship's position. The heart of the system is the Ship's Inertial Navigation System, a complex system of gyroscopes, accelerometers, and computers, which relate speed and movement of the ship in all directions to true north to give a continuous report of a ship's position.

Fire control

The fire control system is a large digital geoballistic computer which processes coordinated data (ship's location, local vertical, true north, target location, etc.). From this data, the computer determines the proper trajectory for each of the 16 missiles at any given moment. Because values change for much of this data as the ship moves about, the fire control computers can recompute all deleted deleted for transfer to the missile guidance computer "memories."

APPENDIX II

Missile guidance and launcher

The guidance system, composed of precise gyroscopes and accelerometers and their own computer, directs the missile toward a correct trajectory after launch, compensating for high winds and other effects, maintaining missile stability, and triggering reentry body separation. Separation of the missile occurs and the payload continues on the ballistic trajectory to the target.

An air ejection or a gas/steam generator system launches the POLARIS and POSEIDON missiles from the submarine. In the latter, a small, fixed rocket ignites which directs its exhaust through cooling water into the base of the launch tube which propels the missile to the surface. At that point, the missile's first stage rocket motor ignites and sends the missile on its way. The launching system takes advantage of the reliability and instantaneous ignition characteristics of solid propellant fuel used in POLARIS. The result is increased safety for submarine and crew. Each launch tube has its own launching system independent of the other tubes. Vital parts of each missile are accessible under controlled conditions for inspection and maintenance even when loaded in the launching tubes and while the submarine is underway at sea.

APPENDIX III

FLEET BALLISTIC MISSILE WEAPON SYSTEM

SUBMARINE CHARACTERISTICS

Characteristics	598 class (5 submarines)	608 class (5 submarines)	616 class (31 submarines)	726 class (TRIDENT submarines)
Length	382 feet	410 feet	425 feet	560 feet
Beam	33 feet	33 feet	33 feet	42 feet
Surface displacement	5,900 tons	6,900 tons	7,320 tons	16,600 tons
Submerged displacement	6,700 tons	7,900 tons	8,250 tons	18,700 tons
Propulsion	Steam turbine powered by water-cooled nuclear reactors	Same	Same	Same
Torpedos	6 bow torpedo tubes	4 bow torpedo tubes	4 bow torpedo tubes	4 bow torpedo tubes
Accommodations: Officer	13 berths	12 berths	14 berths	16 berths
Enlisted	127 berths	127 berths	133 berths	148 berths
Missiles	16 POLARIS A-3 Missiles	16 POLARIS A-3 Missiles	16 POSEIDON C-3 Missiles	24 TRIDENT-I (C-4) Missiles
Launch tubes	16 tubes located Midship	Same	Same	24 tubes located Midship
Launch control	Gas steam generator	Air ejection	Gas steam generator	Gas steam generator
Fire control system	MK 80	MK 80	MK 88	MK 98
Navigation system	3 MK 2 MOD SINS (Ships Inertial Navigation System) and Navy Navigational Satellite Receiver	2 MK 2 MOD 3 SINS and Satellite Receiver	2 MK 2 MOD 6 SINS Satellite Receiver	2 MK 2 MOD 7 SINS Electrostatically Supported Gyro Monitor Satellite Receiver
Air conditioning	Over 300-ton	Same	Same	Same

POLARIS/POSEIDON/TRIDENT MISSILES (A-3, C-3, C-4)

DESCRIPTIVE SUMMARY COMPARISON

	POLARIS A-3	POSEIDON C-3	TRIDENT C-4
Length	32'	34'	34'
Diameter	54"	74"	74"
Weight	35,700 lbs.	64,000 lbs.	65,000 lbs.
Powered stages	2	2	3
Motor case materials	1st Stage-- Glass fiber (note a) 2nd Stage-- Glass fiber (note a)	1st Stage-- Glass fiber 2nd Stage-- Glass fiber	Kevlar fiber
Nozzles	4, each stage	1, each stage	1, each stage
Controls	1st Stage-- rotating nozzles (note b) 2nd Stage-- fluid injection (note b)	Single moveable nozzle actuated by a gas generator	Single moveable nozzle actuated by a gas generator
Propellant	Solid 1st Stage-- Composite	Solid 1st Stage-- Composite	Solid
Guidance	All inertial	All inertial	Stellar and inertial
Range	2,500 NM (2880 SM)	2,500 NM (2880 SM)	4,000 NM (4600 SM)
Warhead	Nuclear	Nuclear	Nuclear

a/First large ballistic missile to use glass motor case for all stages.

b/Devised and first flown by the Navy in POLARIS development program. (Small Glass Fiber Motor Case had previously flown in Vanguard Program. POLARIS was first large Glass Fiber rocket motor case.)

APPENDIX V

ANALYSIS OF SUBLANT MANNING BY GRADE

(AS OF FEBRUARY 27, 1978)

Pay grade	Total SUBLANT Number authorized	Total SUBLANT Currently on board	Total SUBLANT Over/ (under)	Total SUBLANT Percent on board	All submarines Number authorized	All submarines Currently on board	All submarines Over/ (under)	All submarines Percent on board	SSBNs Number authorized	SSBNs Currently on board	SSBNs Over/ (under)	SSBNs Percent on board
Petty officers:												
E-9	230	196	(34)	85	107	82	(25)	77	60	41	(19)	68
E-8	732	535	(197)	73	401	278	(123)	69	241	187	(54)	78
E-7	1,920	2,109	181	109	1,197	1,160	(37)	97	722	704	(18)	98
E-6	4,922	4,673	(249)	95	2,555	2,611	56	102	1,332	1,550	218	116
E-5	6,351	7,184	833	113	3,573	4,796	1,223	134	2,285	2,804	519	123
Subtotal	14,163	14,697	534	104	7,833	8,927	1,094	114	4,640	5,286	646	114
Lower enlisted:												
E-4	6,229	4,452	(1,777)	71	3,502	2,238	(1,264)	64	2,254	1,365	(889)	61
E-3	4,817	6,296	1,479	131	1,462	1,571	109	107	848	971	131	116
Grand total	25,209	25,445	236	101	12,797	12,736	(61)	100	7,734	7,622	(112)	99

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