
BY THE U.S. GENERAL ACCOUNTING OFFICE

Report To The Secretary Of Defense

Trident II System: Status And Reporting

The Trident system consists of submarines, missiles and associated weapon equipment, and shore support facilities. Trident I missiles have been or are being installed on the first eight submarines. Trident II missiles will be installed on the ninth and subsequent submarines and will eventually replace the Trident I missiles on the first eight submarines. The Trident II is to provide submarine ballistic missile forces with improved accuracy and a capability to destroy hard targets.

The eventual cost of the Trident system is uncertain because the Department of Defense has not established the number of submarines and missiles to be acquired. GAO recommends that the department do so. GAO also recommends that the department change its reporting to the Congress as a means to better monitor costs and other aspects of the Trident system acquisition.



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

NATIONAL SECURITY AND
INTERNATIONAL AFFAIRS DIVISION

B-214336

The Honorable Caspar W. Weinberger
The Secretary of Defense

Dear Mr. Secretary:

This report provides our assessment of the Navy's efforts to develop and acquire the Trident II system, which consists of the submarines, missiles and associated weapon equipment, and shore support facilities. The Trident II system is a major part of the administration's modernization program for enhancing the characteristics of the Triad strategic forces. We made this review because of the significant strategic capabilities the Trident II system will provide the submarine launched ballistic missile forces and the increasing importance being placed on the sea-based leg of the Triad. Also, this is the first time we have looked at the Trident II acquisition program.

This report contains recommendations to you on page 15. As you know, 31 U.S.C. 720 requires the head of a federal agency to submit a written statement on actions taken on our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Operations not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report. We would appreciate receiving copies of these statements.

We are sending copies of this report to the chairmen of the four committees mentioned above as well as to the Chairmen of the House and Senate Committees on Armed Services. We are also sending copies of the report to the Director, Office of Management and Budget; and the Secretaries of Energy and the Navy.

Sincerely yours,

for 
Frank C. Conahan
Director

D I G E S T

A major part of the Department of Defense's strategic modernization program is to strengthen sea-based strategic forces by deploying the new Trident II strategic weapon system on board Trident submarines. The weapon system is composed of the navigation, fire control, launcher, missile, guidance, and test instrumentation subsystems. Submarines equipped with the Trident II weapon system will be capable of destroying a larger spectrum of targets, including hard targets such as Soviet intercontinental ballistic missile silos. (See pp. 1 and 2.)

At December 31, 1982, the Navy's estimate of the Trident system's (submarines, strategic weapon systems, and support facilities) acquisition cost for the approved Department of Defense program of 15 submarines was \$68.9 billion, in then-year dollars. The estimated Trident II strategic weapon system cost, including development, procurement, and military construction, was \$39.9 billion, or about 60 percent of the total cost. The Trident II strategic weapon system program entered full-scale engineering development in October 1983. (See p. 2.)

DECISION TO PLACE TRIDENT II STRATEGIC
WEAPON SYSTEM ON EARLIER SUBMARINES

Originally the Trident II strategic weapon system was to be introduced into the fleet by installing it on Trident submarines previously delivered with the Trident I system. The Trident II system was to have an initial operational capability in late 1989. (See p. 5.)

In response to congressional and Department of Defense requests, the Navy assessed the risks associated with accelerating Trident II's introduction 1 or 2 years. As a result of this assessment, in June 1982, the

Secretary of Defense advised the Congress of a more attractive alternative to accelerate Trident II development while retaining the 1989 initial operational capability. This alternative involved installing the Trident II system on board the fiscal year 1981 submarine, the ninth, already funded and under construction. (See pp. 5 and 6.)

The Department of Defense believes this decision resulted in a substantial cost avoidance in the program. It eliminated the need to replace the Trident I system with the Trident II for three Trident submarines, and thereby reduced the number of Trident I missiles and associated ship equipment. Another result of the decision is that the Trident II system will be introduced into the fleet at a slightly faster rate than originally planned. (See p. 5.)

The Department of Defense recognized that the decision would increase Trident submarine construction costs by about \$1 billion and would extend construction time by 12 months for each of the first three Trident II-configured submarines (9th, 10th, and 11th). This extended schedule is to accommodate delivering and installing the Trident II government-furnished equipment on board the submarine rather than installing the Trident I strategic weapon system. (See pp. 5 and 6.)

STATUS OF TRIDENT II FULL-SCALE DEVELOPMENT

The Trident II weapon system development is directed toward improving the accuracy of submarine launched ballistic missile systems. The Navy believes that accuracy goals are achievable. However, the Navy has stated that the Trident system's ultimate accuracy cannot be fully demonstrated until a sufficient number of operational missile tests are conducted from Trident II-configured submarines after weapon system deployment. The Navy expects the Trident II, at deployment, to have greater accuracy than the Trident I system and to realize its ultimate accuracy expectations within several years of deployment. (See pp. 17 and 18.)

A substantial amount of concurrency is planned among the development, testing, and production phases to achieve Trident II's initial deployment date. Planned concurrency is a management decision to combine certain sequential events during those phases to reduce the system's acquisition period. The Navy believes that the amount of concurrency in the Trident II is comparable to that in the successful Trident I program. Because of a number of actions to identify potential problem areas, the Navy believes that risks associated with concurrency are acceptable. (See pp. 18 to 20.)

TRIDENT PROGRAM FORCE LEVEL
OBJECTIVE NOT ESTABLISHED

The Navy estimated the Trident system acquisition cost to be \$68.9 billion, based on 15 submarines. The total acquisition cost, however, is uncertain because the Office of the Secretary of Defense has not established a force level objective for the program. A force level objective is the quantity of a weapon system necessary to carry out the mission as determined by specific military and/or political requirements. A number of indicators suggest that the force level objective is at least 20 submarines, which could increase program cost by \$15 billion. (See pp. 10 and 11.)

GAO believes that a force level objective is important for effective management, planning, and evaluation of the Trident program, as well as an assessment of Trident's role in the strategic modernization program. (See pp. 11 and 12.)

SELECTED ACQUISITION REPORTING
SPLIT FOR TRIDENT PROGRAM

The Navy reports costs for the Trident I and Trident II programs in three Selected Acquisition Reports (Trident I submarines and missiles, Trident II submarines, and Trident II missiles). This fragments the Trident program acquisition cost, particularly Trident II. A case could be made to report the Trident I and Trident II programs separately. In GAO's opinion, the Trident II Selected

Acquisition Reports should be combined. Thus, the Trident system would then be reported in only two Selected Acquisition Reports--one for the Trident I program and another for the Trident II program. (See pp. 12 to 14.)

RECOMMENDATIONS TO THE SECRETARY OF DEFENSE

GAO recommends that the Secretary of Defense establish the force level objective for the Trident program. GAO further recommends that the Secretary direct the Department of the Navy to report the Trident acquisition program in two Selected Acquisition Reports--Trident I and Trident II. (See p. 15.)

AGENCY COMMENTS AND GAO'S EVALUATION

The Departments of Defense and the Navy provided GAO with official comments on a draft of this report and they have been incorporated as appropriate.

Defense stated that various program uncertainties (i.e., strategic arms discussions and future threat) continue to prevent it from establishing a Trident force level objective. It did advise GAO that the issue would be studied this year, but no early action is expected. (See p. 12.)

Regarding Trident Selected Acquisition Reports, Defense believes that current reporting provides more visibility of the factors influencing the cost of the missile and the submarine and permits comparison to other Navy missile and ship programs. (See pp. 14 and 15.)

GAO believes that the Trident is a unique system because its missiles, submarines, and shore facilities collectively comprise the weapon system. Establishing a force level objective and reporting the Trident acquisition program in two Selected Acquisition Reports would better serve the informational needs of congressional decisionmakers for the Trident system. It also would assist the Congress and the administration in evaluating the strategic modernization program. (See p. 15.)

C o n t e n t s

		<u>Page</u>
DIGEST		i
CHAPTER		
1	INTRODUCTION	1
	Strengthening sea-based strategic forces	2
	Overview of the Trident II strategic weapon system	3
	Revised introduction of the Trident II strategic weapon system	5
	Trident II program management	7
	Objectives, scope, and methodology	7
2	A TRIDENT FORCE LEVEL OBJECTIVE AND IMPROVED PROGRAM REPORTING WOULD ENHANCE OVERSIGHT	9
	Force level objective needed	10
	Trident acquisition reporting needs improvement	12
	Conclusions	15
	Recommendations	15
	Agency comments	16
3	OBSERVATIONS ON THE TRIDENT II STRATEGIC WEAPON SYSTEM DEVELOPMENT EFFORT	17
	Improvements identified for achieving accuracy objectives	17
	Planned concurrency for meeting initial operational capability	18
	Trident I first-stage rocket motor failures raise some uncertainty	20
	Conclusions	20
	Agency comments	21
APPENDIX		
I	Trident system	22
II	Descriptions of the strategic weapon system subsystems	23
III	GAO reports on the Trident program	25

ABBREVIATIONS

DOD Department of Defense
GAO General Accounting Office
GFE government furnished equipment
SAR Selected Acquisition Report
SLBM submarine launched ballistic missile

GLOSSARY

Backfit	The industrial process of removing or modifying the shipboard equipment for the strategic weapon system and converting the submarine to carry a different ballistic missile.
Government-furnished equipment (GFE)	As used in this report, refers to government supplied strategic weapon system related parts, components, assemblies, and small tools and supplies required by the shipbuilder for installation on board the Trident submarine.
Hard target	A point or area protected to some significant degree against the blast, heat, and radiation effects of nuclear explosions of particular yields.
Poseidon	U.S. SSBN submarine that carries 16 ballistic missiles. Presently there are 31 Poseidon submarines: 19 carry the Poseidon missile system and 12 carry the Trident I missile system. These submarines are expected to be replaced by Trident submarines throughout the 1990s.
SSBN	Nuclear-powered ballistic missile submarine.
Strategic modernization program	A five-part Defense program designed to strengthen the land-based intercontinental ballistic missile force; modernize the strategic bomber force; bring hard target capability to the sea-based deterrent; enhance the air defenses of the United States; and improve the command, control, and communications system for controlling U.S. forces in time of peace and war.
Submarine launched ballistic missile (SLBM)	Any ballistic missile transported by and launched from a submarine; it may be short, medium, intermediate, or long range.
Triad	The three-way combination of land-based intercontinental ballistic missile, submarine launched ballistic missile, and manned bomber systems with which the U.S. strategic forces are equipped.

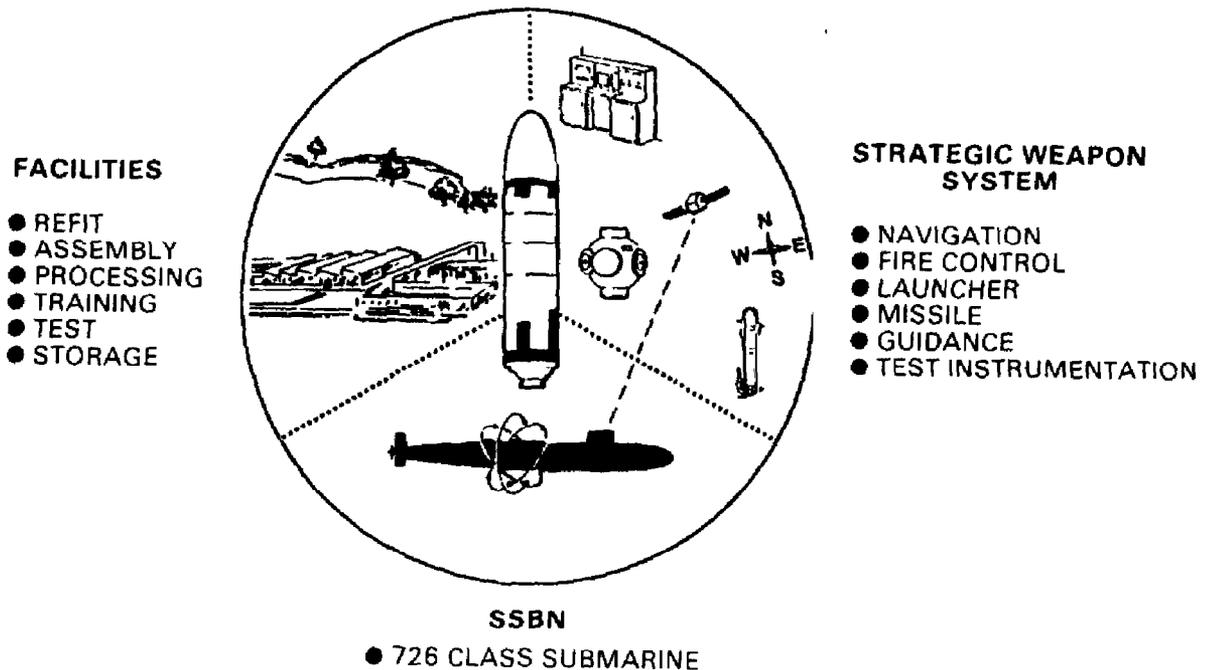
CHAPTER 1

INTRODUCTION

Trident is the popular name for the newest submarine launched ballistic missile (SLBM) system deployed in the sea-based leg of the strategic Triad. The Trident system consists of the strategic weapon system, the submarine, and dedicated shore support facilities (see figure 1). The Trident submarine is larger, faster, and quieter, and it carries more missiles than its predecessors. It will eventually replace the Poseidon ballistic missile submarine.

Figure 1

THE TRIDENT SYSTEM



The U.S. Navy has embarked on an effort to improve the Trident strategic weapon system. This improvement program primarily involves upgrading the currently deployed Trident I strategic weapon system (i.e., navigation, fire control, launcher, missile, guidance, and test instrumentation subsystems and nuclear warhead). The new Trident II strategic weapon system is to fully utilize the potential of the Trident submarine and is to provide increased accuracy and range/payload for SLBM forces. The Trident II-configured submarine is to have

at least as much range, operational area, and target coverage flexibility as the Trident I, but with an extended capability against a larger spectrum of targets, including hard targets such as Soviet intercontinental ballistic missile silos.

Trident II-equipped submarines will initially operate from the Kings Bay, Georgia, facility, which is now under construction, and then from the Bangor, Washington, base, after that facility is upgraded for the Trident II strategic weapon system. The Trident I-configured submarines currently operate out of the Bangor base.

Appendix I describes the three major elements comprising the Trident system.

The Trident system's acquisition cost, as of December 31, 1982, for the Department of Defense (DOD) program of 15 Trident submarines, was estimated by the Navy to be \$68.9 billion, in then-year dollars¹. The Navy has deployed two submarines, has accepted delivery of two others, and plans to complete deployment of the 15 submarines in the early 1990s. The estimated Trident II strategic weapon system cost, including development, procurement, and military construction, is \$39.9 billion of the total cost. The Trident II strategic weapon system program completed advanced development and entered full-scale engineering development in October 1983. The initial operational capability for the first Trident II-configured submarine is late 1989.

STRENGTHENING SEA-BASED STRATEGIC FORCES

DOD is committed to a strategic modernization program that will enhance the characteristics of the Triad forces. A major part of this modernization effort is directed toward strengthening sea-based strategic forces by deploying the Trident II strategic weapon system on board Trident submarines.

The Navy believes that the Trident II system will

- enhance submarine survivability by expanding the Trident submarine's total patrol area,
- minimize the total cost of a sea-based ballistic missile force by reducing the number of submarines,

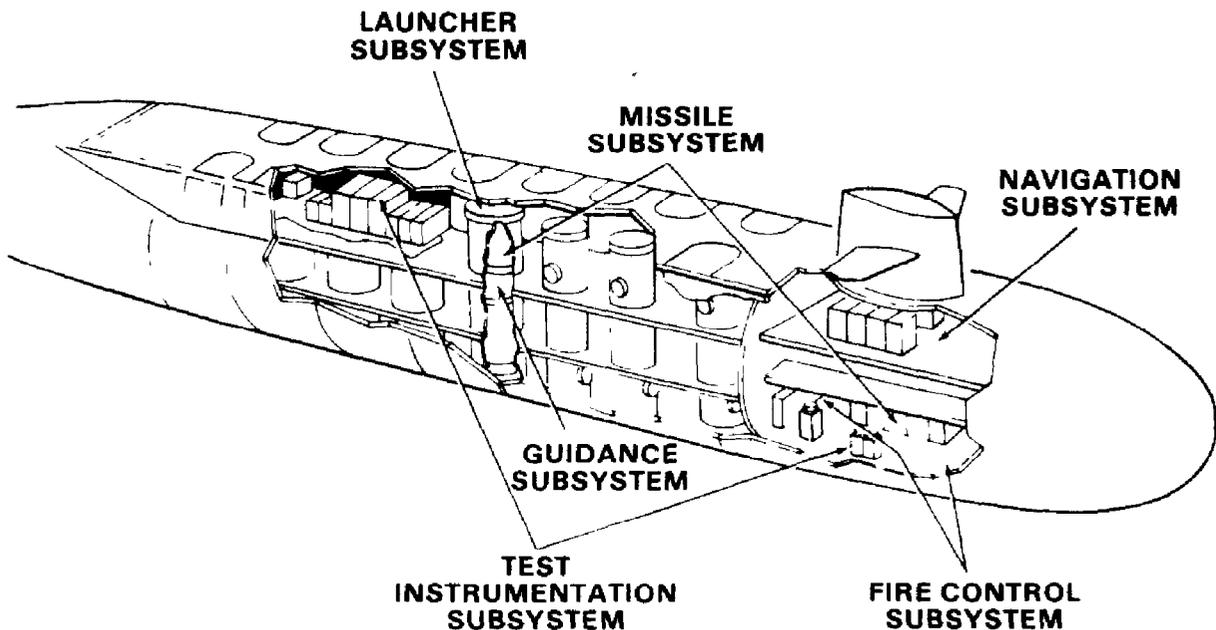
¹Dollars that include the effects of escalation and that reflect the price levels expected to prevail when the expenditure is actually made. Also, as of December 31, 1983, the Navy was reporting the Trident system's acquisition cost to be \$69.9 billion, in then-year dollars. This cost is based upon procurement of 16 Trident submarines with associated missiles and construction of dedicated shore support facilities. The 16th submarine is in the fiscal year 1985 DOD budget request.

- balance the capabilities of the Triad by adding hard-target capability to the sea-based force,
- restore margins of safety in the United States' strategic balance by offsetting Soviet capabilities, and
- open up opportunities for flexibility in arms control negotiations.

OVERVIEW OF THE TRIDENT II
STRATEGIC WEAPON SYSTEM

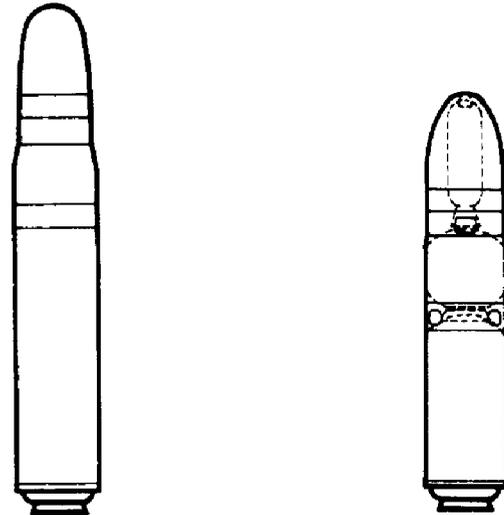
The Trident II strategic weapon system consists of six functional subsystems that program and launch missiles to targets and record system operations during test firings. These subsystems, shown in figure 2, are navigation, fire control, launcher, missile, guidance, and test instrumentation. A description of each subsystem is contained in appendix II.

**FIGURE 2
LOCATION OF STRATEGIC WEAPON SYSTEMS
SUBSYSTEMS**



The new Trident II missile (designated D-5) will be larger and heavier than the Trident I missile, C-4. The D-5 missile will utilize the total launch tube volume of the Trident 726 class submarine. A comparison of the Trident II and Trident I missiles is presented in figure 3.

Figure 3
COMPARISON OF TRIDENT II AND
TRIDENT I MISSILES^a



	TRIDENT II	TRIDENT I
RANGE	≥ 4,000 NM	4,000 NM
LENGTH	44 FT	34 FT
DIAMETER	83 IN	74 IN
WEIGHT	130,000 LBS	73,000 LBS
SUBMARINE PLATFORM	SSBN 726 CLASS	SSBN 726 CLASS POSEIDON CLASS

^a Missile figures drawn to scale

REVISED INTRODUCTION OF THE
TRIDENT II STRATEGIC WEAPON SYSTEM

The original Trident II program called for an initial operational capability in late 1989. This was to be accomplished by backfitting the Trident II system into Trident submarines previously delivered with the Trident I weapon system. The first Trident submarine configured with the Trident II system while under construction was to have been the fiscal year 1985 funded ship.

Early in 1982 the Navy, in response to congressional and DOD requests, assessed the accuracy, performance, schedule, and cost risks associated with accelerating Trident II's planned 1989 fleet introduction by 1 or 2 years. As a result of this assessment, on June 1, 1982, the Secretary of Defense advised the Congress of an alternative to accelerate Trident II development while retaining the 1989 initial operational capability. This alternative involved installing the Trident II system on board the fiscal year 1981 submarine, 9th (SSBN 734), already funded and under construction.

This alternative would eliminate (1) the procurement of Trident I missiles and associated ship equipment planned for the fiscal year 1981-84 funded submarines (9th, 10th, and 11th) and (2) the need to backfit the Trident II weapon system on board those three submarines. According to DOD, this is a substantial cost avoidance. It also would introduce the Trident II system into the fleet at a slightly faster rate than the original plan. However, DOD recognized that this alternative would increase Trident submarine construction costs and stretch the construction time frames for fiscal year 1981-84 funded submarines.

The first eight Trident submarines (SSBN 726-733) are to be reconfigured with the Trident II strategic weapon system during their first overhaul, beginning in the early 1990s.

Impact on submarine construction
cost and schedule

The Navy estimates the cost to deliver the 9th, 10th, and 11th Trident submarines with the Trident II strategic weapon system to be \$1,647 million, \$1,744.1 million, and \$1,848 million, respectively. This is an increase of about \$448.0 million, \$325.6 million, and \$223.2 million for the 9th, 10th, and 11th submarines, respectively, or a total of \$996.8 million over the cost of delivering the ships equipped with Trident I. Table 1 provides a breakout of the estimated additional construction costs for configuring the 9th, 10th, and 11th submarines with the Trident II strategic weapon system rather than with the Trident I.

Table 1

Estimated Additional Cost For Submarines Configured
With Trident II Strategic Weapon System

	Trident submarine			Total cost (by category)
	9th (SSBN 734)	10th (SSBN 735)	11th (SSBN 736)	
	----- (millions) -----			
Basic construction	\$ 55.7	\$ 61.8	\$ 61.6	\$ 179.1
Change orders	5.6	3.4	3.5	12.5
Escalation	44.6	41.0	35.4	121.0
Detail design (one time cost)	80.0	-0-	-0-	80.0
Strategic weapon system ^a	<u>262.1</u>	<u>219.4</u>	<u>122.7</u>	<u>604.2</u>
Total	\$ 448.0	\$ 325.6	\$ 223.2	\$ 996.8

^aTrident II strategic weapon system costs include launcher and handling, fire control, navigation, missile test and readiness equipment, system engineering, and support equipment and related services.

Installing the Trident II strategic weapon system on board these submarines will extend construction periods 12 months beyond the original delivery dates for those submarines. This is to accommodate the delivery and installation of shipboard government-furnished equipment (GFE) needed for the strategic weapon system. A summary of the Navy's schedule for delivery of Trident II-configured submarines is shown in table 2.

Table 2

The Navy's Trident II-Configured Submarine
Schedule Milestone Estimates As of April 1984

<u>Fiscal year</u>	<u>Trident submarine</u>	<u>Contract award</u>	<u>Construction start</u>	<u>Delivery</u>	<u>Months from contract award to delivery</u>
1981	9th (734)	01/82 ^a	01/82 ^a	12/88 ^b	83
1983	10th (735)	11/82 ^a	12/82 ^a	08/89 ^b	80
1984	11th (736)	11/83 ^a	01/84 ^a	04/90 ^b	77
1985	12th (737)	12/84	01/85	12/90	72
1986	13th (738)	12/85	01/86	08/91 ^c	68
1987	14th (739)	12/86	01/87	04/92 ^c	64
1988	15th (740)	12/87	01/88	12/93	72

^aActual.

^bDeliveries of strategic weapon system GFE primarily control the construction time frame of the 9th (SSBN 734), the first Trident II-configured submarine, through at least the 11th (SSBN 736).

^cThis estimate is based on a demonstrated capability to construct ships at the rate of three ships every 2 years and a shipbuilder's assessment that a 60-month total construction time is an achievable lower limit.

TRIDENT II PROGRAM MANAGEMENT

The Navy's Strategic Systems Project Office in Washington, D.C., is responsible for the technical and administrative management of development, production, and support of the Trident II strategic weapon system and the operational support requirements of the Trident system. This office, which reports to the Chief of Naval Material, performed similar roles in all previous SLBM programs. Individual branches within the office work in conjunction with private sector contractors to design, develop, and produce subsystem equipment and to devise operational support requirements for their respective subsystem.

The Trident Submarine Ship Acquisition Project, within the Naval Sea Systems Command, manages all technical, logistical, and business/financial aspects of submarine design and construction. Trident submarine design and construction is performed under Navy contracts by the Electric Boat Division, General Dynamics Corporation. Electric Boat's effort includes the installation of the shipboard strategic weapon system subsystems.

Under direction from the Strategic Systems Project Office, the Naval Facilities Engineering Command constructs facilities needed to support the Trident submarine and strategic weapon system.

Using requirements established by the Navy, the Department of Energy laboratories design, develop, and produce the nuclear warhead to be used with the Trident II missile. The warhead development program is now in progress.

OBJECTIVES, SCOPE, AND METHODOLOGY

Our objectives were to assess the (1) Navy's progress in developing the Trident II strategic weapon system, (2) adequacy of cost reporting¹ for the Trident program, and (3) impact of the strategic weapon system on Trident submarine cost, schedule, and future force level objectives. We have issued numerous reports on the Trident program, but this is our first review of the Trident II strategic weapon system. (See app. III for a list of our prior reports.)

We did not assess the rationale or implications of current U.S. nuclear strategy and policy nor did we question the need or role for the Trident II system. Also, we did not look at the Navy's strategic and logistics to support the Trident II system or the Navy's strategic force's command, control, and communications capabilities.

¹We looked at cost reporting for the entire Trident program because strategic weapon system costs, for budget purposes, were not reported as a separate line item.

Our review was made from February through September 1983 and was primarily conducted at the Navy's Strategic Systems Project Office.

In the course of our review, we

- examined DOD and Navy regulations and instructions;
- reviewed literature on the Trident program;
- obtained and reviewed DOD, Navy, Department of Energy, and private sector studies and reports;
- interviewed DOD, Navy, and Department of Energy officials;
- reviewed government files and records; and
- visited and interviewed selected contractor officials involved in the Trident II strategic weapon system and Trident submarine programs.

Our review was made in accordance with generally accepted government audit standards.

CHAPTER 2

A TRIDENT FORCE LEVEL OBJECTIVE AND IMPROVED PROGRAM REPORTING WOULD ENHANCE OVERSIGHT

The Trident system acquisition cost, including SSBN 726 class submarines, strategic weapon systems (Trident I and Trident II), and Trident facilities, is estimated by the Navy to be \$68.9 billion, excluding \$1.4 billion to backfit eight Trident I submarines with the Trident II system. This estimate is based on a DOD plan to build 15 submarines with associated missiles and support facilities. The Navy plans to add one submarine with associated missiles to its previously approved program plan each budget year. The eventual total acquisition cost is uncertain since DOD has not established the force level objective for Trident submarines and missiles. A number of indicators suggest that the force level goal is at least 20 submarines, which could increase the program cost by \$15 billion.

Since 1977 we have, on different occasions, reported on and have made recommendations regarding the absence of a Trident submarine force level objective. DOD agreed that a force level objective is desirable from the point of view of presenting an overall program and associated costs as well as force level planning. However, other factors and uncertainties have precluded it from establishing the ultimate Trident force size.

The Navy reports the Trident system--Trident I and Trident II--in three Selected Acquisition Reports (SARs).¹ The Trident I program is presented in one SAR--the Trident I submarines with associated missiles and dedicated shore facilities--as it has been since the beginning. However, the Trident II program, which was placed on the SAR for the first time in December 1982, is reported in two SARs--the Trident II submarines (and ship-related dedicated shore facilities) and the Trident II missiles (and missile-related dedicated shore facilities). In our opinion, the Trident II SARs should be combined and the Trident system should be reported in only two SARs--one for the Trident I program, as now being reported, and another for the Trident II program.

¹SARs are standard, comprehensive status reports submitted to the Congress on selected DOD acquisition programs. A SAR summarizes a program's technical aspects, current estimates of schedule, and total quantity and cost, and identifies changes since the previous SAR submission.

FORCE LEVEL OBJECTIVE NEEDED

Trident acquisition cost will depend on the ultimate number of submarines with associated missiles required to support future SLBM forces, but DOD has not established a force level objective. A force level objective refers to the quantities of a weapon system necessary to carry out the objectives of a mission as determined by specific military and/or political requirements. In the absence of a force level objective, the SARs, which DOD submits to the Congress, show Trident program quantities and costs based on the currently approved Five Year Defense Program plan. This plan reflects a yearly authorized procurement quantity of one Trident submarine a year for the next 5 years. As the plan is revised each year, one Trident submarine with related costs will be added. The Extended Defense Plan, which extends 10 years beyond the 5 year plan, indicates that the quantity of Trident submarines with associated missiles will continue to increase.

The Trident program plan as reported in the December 31, 1982 SARs, shows an acquisition cost of \$68.9 billion, in then-year dollars, for a total Trident force of 15 submarines with associated missiles. This amount excludes about \$1.4 billion needed to backfit eight Trident I submarines with the Trident II strategic weapon system. The Navy advised us that the cost category for the backfit has not yet been decided, but it may be a ship operational and maintenance cost rather than an acquisition cost.

Force level could be 20 Trident submarines

DOD and Navy officials advised us that a larger quantity than the 15 submarines with associated missiles reported in the December 1982 SARs is likely to be procured. DOD has indicated that a force level of 20 Trident submarines could eventually be established. For example:

--During fiscal year 1983 appropriations hearings before the House Committee on Appropriations, Subcommittee on Defense, the Deputy Undersecretary of Defense for Research and Engineering stated that the ultimate Trident force level would be 20.

--Trident support facilities at Bangor and at Kings Bay are being planned to accommodate a 20 Trident submarine force.

We believe that if 20 Trident submarines with associated missiles are procured, the total Trident acquisition cost could be about \$85 billion, in then-year dollars. This figure is based on the costs reported in the December 1982 SARs, plus

an additional cost of five Tridents with associated missiles (computed on the unit costs shown in the SARs).

A force level objective would
improve cost and schedule information

Establishing a goal for the total Trident submarine and missile quantities to be procured is important for providing the Congress with complete costs and schedule essential for monitoring the Trident program. We believe this information will also

--improve DOD's strategic Triad force level planning, utilization, and budgeting efforts; and

--provide a basis for comparing and evaluating Trident program costs and forces with other strategic modernization efforts.

In our opinion, the Trident force level question is becoming increasingly important to strategic planning because the Trident system is a vital element in the strategic modernization program. In introducing the fiscal year 1984 program for research, development, and acquisition, the Under Secretary of Defense, Research and Engineering, stated that the modernization program:

"...must not be viewed as a collection of separate elements but rather as an integrated and interrelated effort to deter the Soviet Union from acquiring nuclear superiority and to ensure the margin of safety necessary for our security and to form the foundation upon which viable arms control agreements can rest."

As discussed in chapter 1, the Trident II weapon system will provide, for the first time, SLBM forces the ability to strike and destroy hard targets such as Soviet intercontinental ballistic missile silos.

Previous GAO reports

Since 1977 we have made recommendations in three reports¹ regarding the absence of a Trident submarine force level objective. In each report we concluded that a force level objective would provide DOD a more effective framework for managing and controlling the Trident program and a basis for comparing it to other programs. We recommended that the Office

¹The Trident and SSN-688 Submarine Construction Programs-- Status and Issues, PSAD-79-18, Feb. 9, 1979, (Classified); The Navy's Trident Fleet--Some Success but Several Major Problems, PSAD-78-31, Apr. 7, 1978; Status of the Trident Submarine and Missile Programs, PSAD-77-34, Mar. 8, 1977.

of the Secretary of Defense provide the Congress with the best cost estimate for the ultimate Trident force level being considered.

The Office of the Secretary of Defense agreed that an open-ended Trident program is undesirable generally from the point of view of presenting an overall program and associated costs as well as force level planning. However, for various reasons (i.e., potential Strategic Arms Limitations Agreements and uncertainties in the threat to survivability of U.S. strategic forces), DOD has chosen not to establish the Trident force level objective. Since our first review, the number of Trident submarines approved for construction has increased from 11 to 15.

Agency comments regarding a Trident force level objective and our evaluation

DOD officials providing official oral comments basically restated the same reasons (i.e., potential Strategic Arms Limitations Agreements and uncertainties in the threat) given in the past for not establishing the force level objective. The officials advised us, however, that the issue will be closely studied this year, but no early announcement of a Trident force level is expected.

As mentioned previously, in our opinion, the absence of a Trident force level plan makes congressional monitoring of the Trident program difficult. A force level plan would enhance evaluation of the administration's strategic modernization program. This is more critical now because the Trident II capability places the SLBM leg of the Triad on a level with the Minuteman and the Peacekeeper intercontinental ballistic missile forces.

TRIDENT ACQUISITION REPORTING NEEDS IMPROVEMENT

For acquisition reporting purposes, the Navy reports the program cost, schedule, and performance aspects of the Trident system--Trident I and Trident II--in three SARs. The Trident I program is reported in a single SAR--Trident I submarine with associated missiles and dedicated shore facilities.¹ However, the Trident II program, introduced into the SAR system in December 1982, is divided between two SARs--Trident II submarine (including ship-related shore facilities) and Trident II missile (including missile-related shore facilities).

¹Strategic weapon system costs (e.g., fire control, launcher, navigation) are not broken out separately in the Trident SARs. Also, the costs for the dedicated shore facilities contained in the Trident I SAR are only for Bangor, Washington.

To determine the overall impact on the Trident program cost associated with introducing the Trident II into the SAR system, we analyzed the September and December 1982 SARs. Our analysis indicated that the overall increase to the Trident system acquisition cost, combining the three SARs, is \$40.4 billion (see table 1).

Table 1

Program Cost Changes Due To Introduction
Of The Trident II Strategic Weapon System
(Then-Year Rounded Billion Dollars)

Trident Program SAR Submissions	September 1982 (Single SAR) Cost(Quantity)	December 1982 (Three SARs) Cost(Quantity)	Program Cost Changes
Trident I Submarines	\$20.5 (15)	\$ 9.6 (8)	- \$10.9
Missiles	7.9 (327)	7.5 (291)	- 0.4
Trident II Submarines	a	\$14.1 (7)	+ \$14.1
Trident II Missiles	a	\$37.6 (740)	+ \$37.6
TOTAL	\$28.4	\$68.9^b	+ \$40.4

^aTrident II related program costs were not reported before the December 1982 SAR submission.

^bDoes not add due to rounding.

By reporting the Trident system--Trident I and Trident II--in three SARs, DOD has fragmented the Trident program acquisition reporting, particularly the Trident II. In our opinion, the Trident II SARs should be combined to bring together the total Trident II cost, schedule, and technical performance in a single SAR. For example, costs reported in the Trident II missile SAR include the missile structure and the guidance subsystem. The remaining strategic weapon system costs, such as navigation, are included in the submarine cost appearing in the Trident II submarine SAR. Also, construction costs for the Trident II system are split between the Trident II SARs according to their relationship to the missile and submarine.

Our approach to acquisition reporting would present the Trident system in only two SARs--one for the Trident I program and another for the Trident II program. This would serve two basic purposes: (1) continue to show the unique relationship of the major elements--submarine, strategic weapon system, and dedicated shore facilities--making up each Trident system (I or

II) and (2) clearly separate the two Trident programs in relation to their position in the acquisition process.

Agency comments regarding Trident SAR reporting and our evaluation

DOD, in its comments on this section, disagreed that the Trident system be limited to two SARs. DOD believes its present reporting is appropriate for the following reasons:

- The cost of the Trident II system is available by simply adding the Trident II missile and submarine SARs together, and separation provides more visibility of the factors that influence the cost of the missile and submarine.
- The missile is funded by Weapons Procurement Navy and the submarine is funded by Ship Construction Navy appropriations, and separation into two Trident II SARs permits a comparison of those programs to other Navy missile and shipbuilding programs.
- The Trident I program is approaching 90 percent completion status (86 percent obligation on submarine and 75 percent on missiles) and this SAR should be terminated in the near future.

We believe that the Navy recognized the premise for our position when it initially established the Trident I SAR (i.e., the uniqueness of the relationship of the three elements making up the Trident system--strategic weapon system, dedicated shore facilities, and the submarine--and the placement of them in a single report). The same unique relationship exists for the Trident II system acquisition as it did for Trident I. In our opinion, incorporating the major elements of the Trident II acquisition in a single SAR shows the integral balance of cost, schedule, and technical performance of each of the elements needed to acquire the Trident system. We agree with DOD that the information is available in each of the SARs as currently reported. We do not agree, however, that it is now and will continue to be an easy matter to determine the status of the acquisition. In this regard, the idea of the SAR is to provide DOD, the military services, and the congressional decisionmakers with a summary document analyzing the progress toward acquiring a major weapon system. We believe this can best be accomplished by providing decisionmakers the acquisition status of the Trident II system in one SAR.

DOD also commented that the current SAR breakout for Trident II is more in line with acquisition reporting of other missile systems and ships, which allows for a meaningful comparison. Missile systems referred to as examples were the Harpoon, Sidewinder, Sparrow, and Phoenix. We note that most of

the missile systems mentioned are reported in separate SARs and have multiple aircraft (platform) capabilities. Also, the ships are generally multiple platforms which carry a number of different weapon systems. The Trident, however, is a unique system because its missiles, submarines, and shore facilities collectively comprise the weapon system.

We believe that our approach to Trident acquisition reporting also would serve as a device to compare the improved Trident weapon system with other Triad systems (i.e., Peacekeeper and Minuteman intercontinental ballistic missile programs). This ties in with our earlier view that a Trident force level objective would be meaningful in analyzing the administration's strategic modernization program.

CONCLUSIONS

For the past several years, we have recommended that DOD establish a Trident force level objective to provide the Congress with the cost estimate for the ultimate Trident acquisition. While DOD has stated that an open-ended program is undesirable for program cost reporting purposes and for Trident force planning and utilization, it has been reluctant to establish a force level objective due to various program uncertainties. We continue to believe that establishing a program objective is essential for effective management, planning, and evaluation of the Trident program, as well as an assessment of Trident's role in the strategic modernization program.

In our opinion, by reporting the Trident system--Trident I and Trident II--in three SARs, DOD has fragmented the total Trident program acquisition reporting, particularly Trident II. We believe that previous reporting of the Trident program in one SAR provided the Congress and DOD the means to better monitor cost and other aspects of the Trident acquisition program. However, since there is now a distinction between the two Trident systems--Trident I and Trident II--a case could be made to report the programs separately. In effect, the Trident I report structure would remain unchanged and the Trident II SARs would be combined--reporting on the submarine, strategic weapon system, and facilities.

RECOMMENDATIONS TO THE SECRETARY OF DEFENSE

We recommend that the Secretary of Defense establish the force level objective for the Trident program. We further recommend that the Secretary direct the Department of the Navy to report the Trident acquisition program in two SARs--Trident I and Trident II.

AGENCY COMMENTS

DOD provided official comments on a draft of this report. Its comments on establishing a Trident force level objective and reporting the Trident program in two SARs have been previously presented in this chapter.

CHAPTER 3

OBSERVATIONS ON THE TRIDENT II STRATEGIC

WEAPON SYSTEM DEVELOPMENT EFFORT

The Trident II strategic weapon system development effort is directed toward improving the accuracy of SLBM systems. The Navy has identified critical factors that limited the accuracy of previous SLBM systems and is applying the lessons learned toward developing the Trident II. While the Navy believes the accuracy improvements for the Trident II strategic weapon system are achievable, it recognizes that the system's ultimate high accuracy performance expectations cannot be fully demonstrated until a sufficient number of operational missile tests have been conducted from Trident II-configured submarines following weapon system deployment. The Navy expects the Trident II weapon system at deployment to have greater accuracy than the Trident I system and to realize its ultimate accuracy expectations within several years of deployment.

A substantial amount of concurrency among Trident II development, testing, and production phases is planned during full-scale engineering development to achieve deployment in late 1989. However, the Navy indicated that the amount of concurrency in this program is comparable to the successful Trident I program. The Navy has identified and is resolving key technological risks that may hinder program accomplishment and is also monitoring the GFE process to help minimize any adverse impact on ship construction and delivery schedules. Because of these efforts, the Navy believes that any risks resulting from concurrency are acceptable.

IMPROVEMENTS IDENTIFIED FOR ACHIEVING ACCURACY OBJECTIVES

SLBM development programs prior to Trident II did not establish high accuracy as a specific requirement. Rather, moderate accuracy objectives were set within the state of the art. No overriding emphasis was placed on quantifying the limits of SLBM weapon system performance or the measurement for identifying the specific causes of target miss.

The Trident II development effort, however, is directed toward improving the accuracy of SLBM systems. In this regard, the Navy began the Improved Accuracy Program in fiscal year 1975 to identify factors limiting SLBM accuracy in four major strategic weapon system subsystems--navigation, fire control, missile, and guidance. The program, completed in fiscal year 1982, included a comprehensive evaluation of concepts and methods for improving the overall weapon system accuracy. The

most significant changes needed to obtain greater accuracy involved the navigation and guidance subsystems.

The Trident II advanced development program, conducted from fiscal years 1981 through 1983, determined the design and operational feasibility of accuracy improvements, identified in the Improved Accuracy Program, that could be made to the four subsystems of the Trident I strategic weapon system. In addition, upgrading performance of the launcher and test instrumentation subsystems were examined. These subsystems do not influence weapon system accuracy. The results of the Improved Accuracy Program and the advanced development program established the performance objectives that the Navy believes are achievable for the Trident II strategic weapon system.

System enters full-scale engineering development

The Navy has stated that advanced development efforts for Trident II were successful in achieving program objectives. On September 26, 1983, a Defense Systems Acquisition Review Council, a high level program review conducted by the Office of the Secretary of Defense, met to determine if the Trident II strategic weapon system was ready to enter full-scale engineering development. During full-scale development, engineering models are constructed, development tests are conducted, and production of the subsystems is begun. The council concluded that no major problems existed which would preclude beginning this phase of development. Trident II entered full-scale engineering development in October 1983.

Demonstration of overall accuracy performance

Tests conducted for advanced technology subsystem units have demonstrated performance capabilities within ranges required to meet weapon system objectives. However, the Navy has indicated that the system's ultimate high accuracy performance expectations cannot be fully demonstrated until a sufficient number of operational missile tests have been conducted from Trident II-configured submarines following weapon system deployment. The Navy expects the Trident II weapon system at deployment to have greater accuracy than the Trident I system and to realize its ultimate accuracy expectations within several years of deployment.

PLANNED CONCURRENCY FOR MEETING INITIAL OPERATIONAL CAPABILITY

Some full-scale development work was started during the Trident II advanced development program, but each of the six subsystems is still under a tight schedule to meet the late 1989 initial operational capability on board the Trident submarine.

According to the Navy, the time constraint necessitates substantial planned concurrency among development, testing, and production phases throughout the full-scale engineering development program. The Navy has indicated that the amount of concurrency is comparable to the successful Trident I program.

Planned concurrency is a management decision to combine certain sequential development, testing, and production events in order to reduce the acquisition period for a weapon system. The Navy plans to minimize the risk associated with concurrency in the Trident II full-scale development program by fully using Trident I technology, expertise, documentation, facilities, and equipment. The overall management of the program will be by the Strategic Systems Project Office, with existing Navy and contractor development teams. The Navy has identified, during the Improved Accuracy Program and the advance development program, and is presently resolving key technological risks that may hinder accomplishing full-scale development objectives. Because of these efforts to minimize the impact of concurrency, the Navy believes any risks resulting from concurrency are acceptable and program objectives and milestones are achievable.

Timely delivery of GFE is essential
for maintaining schedules

Delivery of the first and subsequent Trident II-configured submarines is dependent on meeting a sequence of construction events. These events depend heavily on the Navy's timely delivery of strategic weapon system GFE to the submarine contractor, Electric Boat. The Navy and Electric Boat have directed considerable attention to developing a schedule for delivery of strategic weapon system GFE to support the 9th and 10th submarine construction schedules.

Subsequent to the June and July meetings of the Trident II Strategic Weapon System Introduction Working Group,¹ the Navy reevaluated its Trident II GFE delivery dates and identified 14 GFE items that did not support established delivery dates. The problem was resolved by the Navy's adjusting some late GFE delivery dates and Electric Boat's working around those dates. These compromise dates have not yet been contractually invoked on the shipbuilder. However, all GFE delivery dates needed at this point have been agreed to.

¹The Navy formed a Trident II Strategic Weapon System Introduction Working Group after the Secretary of Defense's June 1, 1982, decision. The group, consisting of Navy program officials and Trident II ship and strategic weapon system contractors, met during June and July 1982 to develop a schedule and method for delivery and installation of weapon system GFE.

Some risk for two launcher GFE items

The Navy and Electric Boat recently resolved late shipyard delivery dates for two launcher GFE items required for the 9th Trident submarine. The new delivery dates are 2 months earlier than those originally proposed by the Navy and will result in the units being delivered before full qualification testing is completed. Although the Navy plans to complete full qualification testing for these units approximately 2 years before delivery of the ship, the earlier dates introduce some risk that the units will not meet performance expectations and could require modification prior to the ship's delivery. The Strategic Systems Project Office officials expressed concern about the risk induced with the earlier dates, but stated it was acceptable in order to not delay submarine construction. They believe that an acceptable amount of test data will be obtained for the units before delivery.

TRIDENT I FIRST-STAGE ROCKET MOTOR FAILURES RAISE SOME UNCERTAINTY

As of October 1983, some first-stage rocket motor failures had occurred in Trident I test missiles as the result of quality control and reliability problems. The Navy believes it has resolved the quality control problems. However, the reliability problems were not fully understood as of January 1984. The symptoms of the observed failures have been duplicated in ground tests, but a complete analytical and physical explanation of the causes has not been obtained. Process and design changes were incorporated in later production units, based on failure symptoms, but corrective action for earlier production units has not yet been developed. Several test firings have been conducted since the last first-stage motor failure occurred in April 1983. Of the tests, only one failed and the failure was not attributed to a first-stage motor problem.

The Trident II missile will use casting and propellant techniques similar to the Trident I. However, design margins and development testing for Trident II have been modified as a result of the Trident I's experience. Because of Trident II's evolutionary relationship to Trident I, the failures raise some uncertainty as to Trident II rocket motors' performance. The Navy is, consequently, devoting full attention to identifying and correcting first-stage motor problems so as to not affect Trident II program efforts.

CONCLUSIONS

The Trident II weapon system underwent considerable research and development before it entered full-scale engineering development. The Navy has identified strategic weapon system subsystem changes to improve SLBM accuracy and has taken action to resolve technological risks. Because the Trident II

full-scale development program is tightly scheduled with substantial planned concurrency, the Navy is closely monitoring program progress to ensure that an acceptable balance is maintained between schedule and performance objectives. The Navy and Electric Boat will continue to devote attention to weapon system GFE to minimize its impact on ship construction and delivery schedules.

AGENCY COMMENTS

The Navy generally concurred with the facts and findings presented in this chapter. Its comments have been incorporated where appropriate.

TRIDENT SYSTEMSTRATEGIC WEAPON SYSTEM

Subsystems: Navigation, fire control, launcher, missile, guidance, and test instrumentation

Description: Subsystems work in conjunction to program and launch missiles to selected targets and to record system operations during test firings.

Trident I strategic weapon system is deployed.
Trident II strategic weapon system is in full-scale engineering development with deployment beginning in late 1989.

SUBMARINE

Description: This vehicle houses the weapon system and provides a mobile launch platform for the missiles, an operating environment for the crew and equipment, and the required electrical, hydraulic, and pneumatic power for the strategic weapon system.

Trident SSBN 726 class submarine - The first eight will be configured with the Trident I and eventually will be reconfigured with Trident II; newly constructed submarines, beginning with the 9th, will be Trident II configured.
Poseidon class submarine (backfitted) - Currently there are 12 backfitted Poseidon submarines that carry the Trident I; they will not carry the upgraded Trident II system.

SHORE SUPPORT FACILITIES

Missile assembly and support facilities, refit facilities, crew training facilities, and missile test range

Description: Dedicated U.S. shorebases provide support for the submarine, crews, and the weapon system following each submarine patrol. During early program phases, flight tests are conducted at the test range.

Shorebases:

Bangor, Washington - Currently supports Trident 726 Class submarines configured with Trident I; it will be restructured to support Trident submarines configured with Trident II in the mid-1990s.

Kings Bay, Georgia - Facilities support Poseidon submarines backfitted with Trident I; major construction of facilities to support Trident II-configured submarines will begin in 1985. Trident II-configured submarines will initially be deployed from Kings Bay.

DESCRIPTIONS OF THE STRATEGICWEAPON SYSTEM SUBSYSTEMS

The strategic weapon system for Trident II consists of the navigation, fire control, guidance, missile, launcher, and test instrumentation subsystems. These subsystems program and launch missiles to predetermined targets and record system operations during test firings. A description of each subsystem follows.

NAVIGATION SUBSYSTEM¹

Its primary mission will be to provide the fire control subsystem with continuous, highly accurate navigation data, including ship's velocity, position, heading, tilt, and time. The weapon navigation data will be used to support the submarine's own navigation system.

FIRE CONTROL SUBSYSTEM¹

Fire control brings the other weapon subsystems together by collecting, analyzing, and disseminating data necessary for the successful launch and flight of the missile.

MISSILE SUBSYSTEM¹

The missile is an inertially guided vehicle, consisting of solid propellant rocket motors and flight controls, that delivers reentry bodies to points in space where, when released from the equipment platform, they will free-fall to predetermined targets.

GUIDANCE SUBSYSTEM¹

This subsystem is a self-contained, computer operated stellar inertial guidance system carried within each missile. Programmed by the fire control subsystem prior to launch, the guidance subsystem calculates adjustments to flight control commands and directs the missile's flight up to release of each reentry body.

¹Factors in these four subsystems were identified by the Navy's Improved Accuracy Program as limiting the accuracy of existing SLBM weapon systems. Trident II development concentrated on changing these subsystems to improve the overall weapon system accuracy. Launcher and test instrumentation subsystems do not influence weapon system accuracy.

LAUNCHER SUBSYSTEM

This subsystem provides the housing and protection for each of the 24 missiles on board the Trident submarine. Under command from the fire control subsystem, it prepares the tubes for launch, controls and monitors launch tube functions, and ejects the missile.

TEST INSTRUMENTATION SUBSYSTEM

Test instrumentation consists of the nontactical equipment for the strategic weapon system that collects test data from the subsystems to support evaluation of the performance and reliability of the overall weapon system.

GAO REPORTS ON THE TRIDENT PROGRAM

- GAO Staff Study, Trident System (Mar. 1973, Classified).
- Selection of a West Coast Site for the Navy's Proposed Trident Support Complex (B-178056, Nov. 14, 1973).
- Review of Production Schedules for SSN-688 and Trident Submarines at Electric Boat Division, General Dynamics Corporation, Groton, Connecticut (PSAD-75-47, Jan. 21, 1975).
- GAO Staff Study, Trident Submarine and Missile Systems (PSAD-76-123, Mar. 26, 1976, Classified).
- Status of the Trident Submarine and Missile Programs (PSAD-77-34, Mar. 8, 1977).
- Planning Federal Assistance to Communities Affected by the Trident Submarine Base, Washington State (LCD-77-320, June 8, 1977).
- Review of the Navy's Fiscal Year 1978 Appropriation Request for Trident Support Facilities Construction Program (LCD-77-350, June 22, 1977).
- Analysis of the Need for Additional Family Housing at the Navy's Trident Submarine Base (CED-78-49, Feb. 9, 1978).
- The Navy's Trident Fleet--Some Success but Several Major Problems (PSAD-78-31, Apr. 7, 1978).
- Review of Navy's Fiscal Year 1979 Appropriation Request for Funds to Construct Trident Base Support Facilities and for Community Impact Assistance (LCD-78-328, June 14, 1978).
- The Navy's Submarine Launched Ballistic Missile Force Is Highly Ready (LCD-78-429, Dec. 21, 1978, Classified).
- The Trident and SSN-688 Submarine Construction Programs--Status and Issues (PSAD-79-18, Feb. 9, 1979, Classified).
- Alternatives to Consider in Planning Integrated Logistics Support for the Trident Submarine (LCD-79-415, Sept. 28, 1979).
- Cost Growth and Delivery Delays in Submarine Construction at Electric Boat are Likely to Continue (MASAD-82-29, Apr. 19, 1982.)

Information Regarding Trident II (D-5) Missile Configured Trident
Submarine Costs and Schedule (GAO/MASAD-82-47, Sept. 3, 1982).

Status of Trident and SSN-688 Submarine Construction at the
Electric Boat Division of General Dynamics Corporation
(GAO/MASAD-83-10, Feb. 28, 1983).