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Report to the Chairman, Committee on  
Armed Services, House of Representatives

November 1988

# NAVY STRATEGIC FORCES

## Trident II Proceeding Toward Deployment



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**National Security and  
International Affairs Division**

B-214336

November 21, 1988

The Honorable Les Aspin  
Chairman, Committee on Armed Services  
House of Representatives

Dear Mr. Chairman:

This report responds to your September 24, 1987, request, and subsequent discussions with your staff, to review the acquisition status of the Navy's Trident II system. The first Trident II submarine's initial operational capability (IOC) date is scheduled for December 1989. It will be armed with the D-5 missile, the Navy's newest and most deadly ballistic missile. The Trident II system will substantially increase the capability of the U.S. strategic submarine forces to destroy nuclear-hardened targets, including missile silos and command, control, and communications centers. Compared to the Trident I system, the Trident II system is designed to hit a target with improved accuracy and greater explosive power.

Our review, conducted from November 1987 through September 1988, focused on the status of each major Trident II acquisition element, including the work completed and the work remaining to deploy the Trident II. These acquisition elements consist of developing, testing, and producing the D-5 missile and its associated systems; constructing the Trident II submarines; and constructing and activating shore support facilities, including dredging waterway areas, at Kings Bay, Georgia. You also requested a management study of the Navy's Strategic Systems Programs (SSP) command and this work will be addressed in a later report. (See app. I for further information on the objectives, scope, and methodology of this review.)

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**Results in Brief**

At this time, the development of the Trident II system is proceeding on schedule. The acquisition program is still in development and early production, with many key milestones to be met before the December 1989 IOC, which was established in October 1981. Moreover, it will be necessary to continue testing the system long after IOC to obtain sufficient data to verify missile performance, particularly accuracy and reliability.

Several buildings at Kings Bay need to be finished and certified for use before IOC. Progress is being made in this area but more needs to be done prior to the submarine's arrival at Kings Bay. Lack of progress toward

timely completion of waterway dredging appeared to be a major concern to SSP only a few months ago. Recent progress in dredging the waterway has nearly eliminated this concern about meeting the schedule. Thirteen development missile flight tests remain—including 4 of 19 land-based launches and all 9 sea-launched tests—before IOC. Also, SSP plans to conduct two missile launches from the SSBN 734 during Demonstration and Shakedown Operations (DASO) before submarine deployment. The DASO is to verify the proper functioning and readiness of the Strategic Weapon System (SWS) and the submarine by the crew. Successful completion of these tests is critical if the Trident II is to meet IOC. Throughout our review, we observed SSP taking action to remedy known problems; that is, construction and dredging at Kings Bay, problems encountered during subsystem development, and missile flight testing. SSP officials indicated that they share our caution on program success since many major events are yet to be accomplished before the Trident II IOC.

The Department of Defense's (DOD's) December 31, 1987, estimated cost of the program was \$51.3 billion. This included research, development, and procurement of 843 missiles, procurement of 11 Trident II submarines, and general support facilities. DOD's December 31, 1982, estimated cost of the program was \$51.7 billion. At that time, the program included 740 missiles and 7 Trident II submarines. We estimate the total life-cycle acquisition and operations and support costs for the Trident II system (11 new Trident II and 8 modified Trident I submarines) at \$155 billion.

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## System Development Continues

Full-scale development of the SWS—the D-5 missile and supporting subsystems, including the navigation, fire control, launcher, guidance, and test instrumentation subsystems—began in October 1983. Work underway but not yet completed for this area includes installing and testing the shipboard missile subsystem, flight testing, and transitioning equipment from development and testing to production.

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## Installation and Testing the D-5 Missile Subsystems on the First Trident II Submarine

The first time the missile's subsystems are integrated, operated, and tested as one system is when they are installed on a submarine. SWS equipment for the first Trident II submarine—U.S.S. Tennessee, SSBN 734—has been installed and is being tested for the submarine's scheduled delivery to the Navy in December 1988.

Installation tests have revealed some problems with subsystem equipment and software, but SSP officials do not believe these problems will

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delay delivery of the SSBN 734. On the contrary, SSP officials believe that the progress being made may result in submarine delivery being as much as a month earlier than scheduled.

There were problems with the Gravity Sensor System (GSS). This system was to contribute more exact navigation information concerning submarine location. The problems involved an undependable component and inadequate diagnostic software. In July 1988, SSP officials canceled the GSS requirement. SSP stated that other equipment was performing above specification and the accuracy of the gravity maps was proving better than had been foreseen, thus compensating for accuracy improvements contributed by GSS.

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## Flight Test Progress

The flight test program, consisting of 19 missile tests from a land-based launch platform at Cape Canaveral, Florida, is about four-fifths complete. This program tests predominately the missile and the guidance subsystems of the weapon system. It began in January 1987 and is scheduled to be completed in January 1989. The overall performance results from the tests indicate that the missile is achieving its objectives for this phase of the program. Of the 15 tests conducted as of September 30, 1988, 11 were successful, 1 was partially successful, 2 were failures, and one was a "no-test." Although the majority of the tests were successful, each of the failures involved different problems and occurred at different stages of the missile flight. The most recent flight test (the 15th) was destroyed by command destruct early in its flight. According to SSP, the missile was performing normally at the time the decision was made to destruct; therefore, the flight was a no-test. (See fig. 1.)

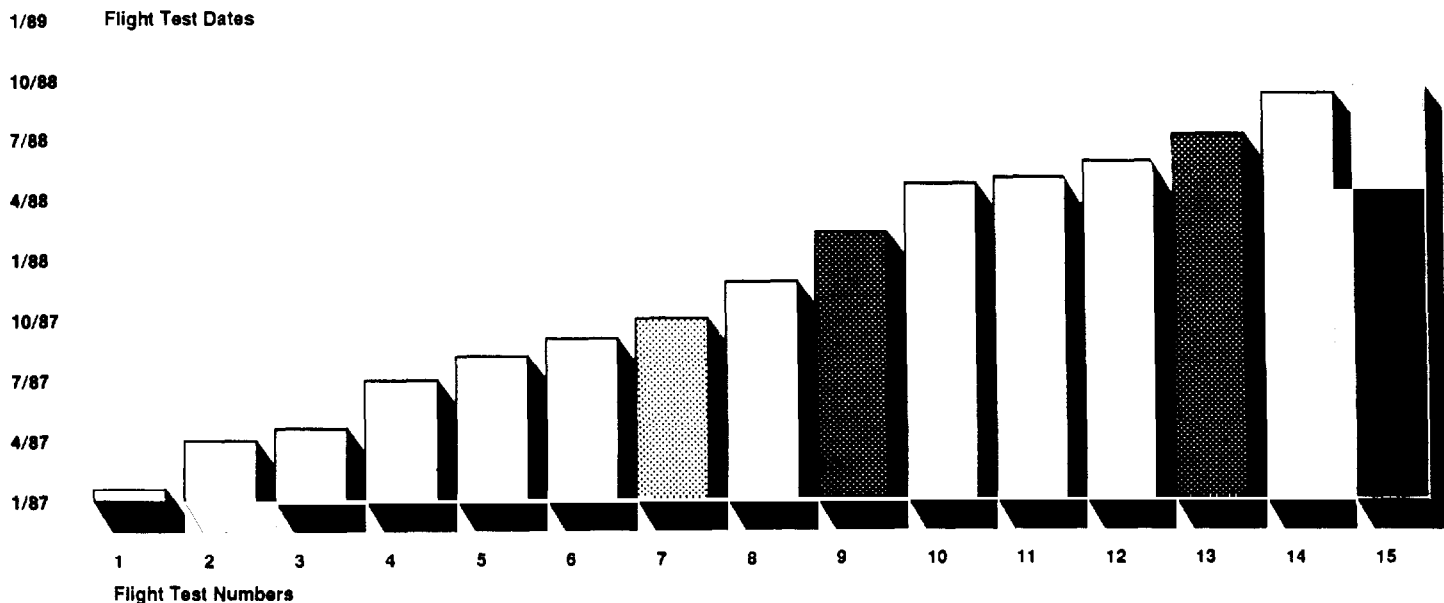
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## Partial Success - 7th Flight Test

The seventh flight test was a partial success because of a problem with the missile's Post Boost Control System. One of the valves in the system stuck closed during the flight, limiting the capability to maneuver the equipment platform that deploys the reentry bodies. There was a similar problem during the 11th flight. However, because that valve stuck at a later point in the flight, SSP scored it successful since there was negligible effect on the system's capability to steer and deploy reentry bodies. Engineering evaluations indicate that, in both cases, the valve stuck as a result of either overheating or contamination in the valves. Both SSP and the contractor are continuing their investigation of the problem.

SSP officials stated that neither occurrence of the valve problem prevented the missiles from completing their missions. Consequently, SSP

**Figure I: Trident II Development Flight Tests (Land-Launched)<sup>a</sup>**



<sup>a</sup> In addition, 4 remaining land-launched missile tests will be conducted through January 1989 and 9 sea-launched performance evaluation missile tests will be conducted from March 1989 through July 1989.

- Success
- Partial success
- Failures
- No test

decided to continue missile flight testing. They also stated that some valve sticking does not seriously affect the steering.

According to the SSP program manager, a software change was made to allow the valve to operate more frequently. This software change was made before the 13th development missile flight. Flight testing of this change was not possible, but if the software change does not solve the problem, changes to the system's gas generator, manifold, and/or valves may have to be made in order to fix the problem. If changes are necessary, SSP and the contractor plan to make them during the submarine-launched flight test program in 1989.

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**Failure - 9th Flight Test**

During the ninth flight test, a problem with a low voltage power supply in the missile's flight control electronics package caused the missile to veer off its course and self-destruct. The problem occurred during the flight's third stage; SSP classified this flight test as a failure. Investigation of this problem delayed the flight test program by about 2 months. According to SSP, the problem appears to have been resolved through minor changes in the flight control computer. These changes were incorporated in the missile, beginning with the 10th flight test. SSP officials are confident that the change has solved the problem. It has not reappeared in any of the five subsequent missile flight tests.

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**Failure - 13th Flight Test**

During the first stage of the 13th test, a problem developed in the thrust vector control subsystem. About 55 seconds into its flight, the missile went off course, out of control, and had to be destroyed for safety reasons. Both SSP and the missile contractor are investigating this problem.

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**At-Sea Submarine Tests**

In March 1989, SSP plans to begin a series of nine missile launch evaluations from the SSBN 734. These tests, scheduled for completion in July 1989, are intended to demonstrate the ability of the Trident II system to launch missiles from the submarine at sea to predetermined target areas. During the first 3 years of deployment, the Navy plans to continue operational testing of the Trident II from deployed Trident submarines.

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**Production of Subsystem Equipment**

Limited production of the subsystem equipment, except guidance, is on schedule. Manufacture of the two key elements of the guidance subsystem—the Inertial Measurement Units (IMUs) and the Electronic Assemblies (EAs)—are behind schedule. The production problems are attributed to late design deliveries to the contractors and difficulties producing the quantities needed of certain guidance components. IMU and EA production is improving. SSP officials said that although schedules remain tight, production will not delay the ongoing land-launched missile flight tests, the upcoming ship-launched missile tests, or IOC.

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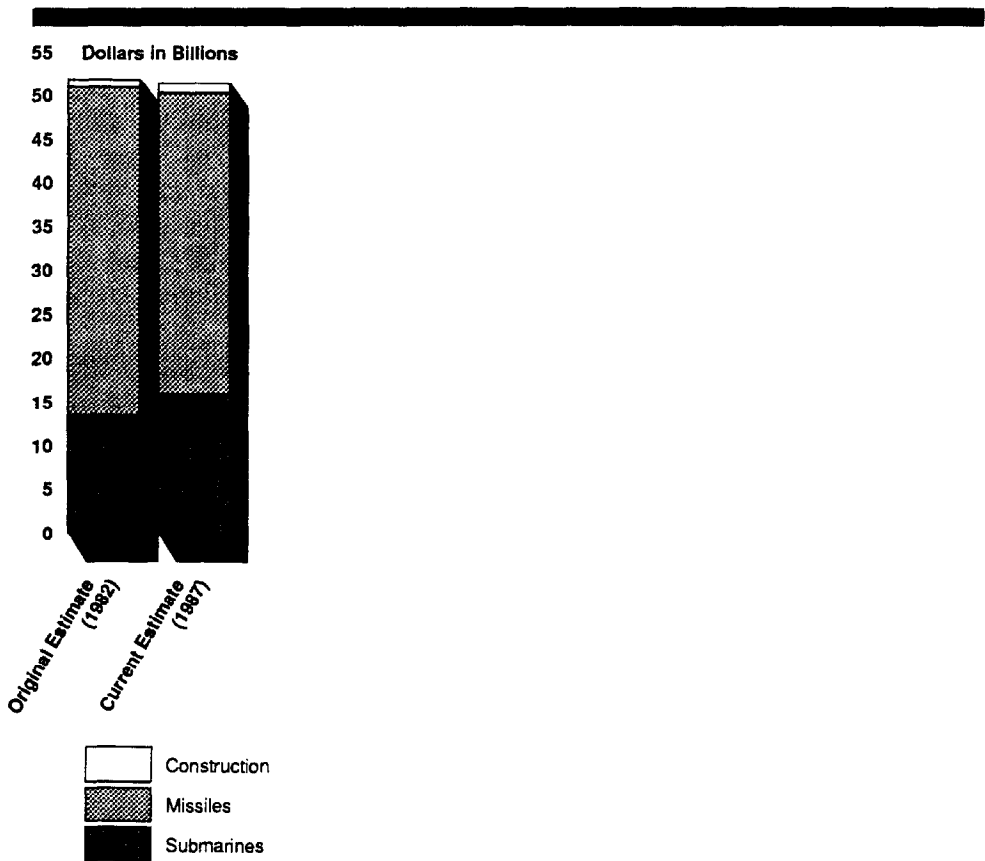
**Program Cost**

The most recent Selected Acquisition Reports (SARS) for the Trident II program, as of December 31, 1987, show approximately \$51 billion, in escalated dollars, as the cost for (1) research and development of the D-5 missile and its supporting subsystems, (2) procurement of 28 development and 815 production missiles, (3) procurement of 11

Trident II submarines, and (4) military facility construction and waterway dredging required for Trident II operations. The \$51 billion cost does not include the planned refitting of eight Trident I submarines in the 1990s to accommodate the D-5 missile or the Department of Energy's costs for the nuclear warheads.

Our analysis of Trident II SARS, beginning with the first report as of December 31, 1982, revealed that 4 Trident II submarines, 103 missiles, and general support facilities were added to the program estimate, but the total program acquisition cost estimate decreased by about \$400 million. These changes are reflected in the SARS. According to SSP, this lower acquisition estimate was mostly because of lower inflation indices and other estimating changes. (See fig. 2.)

Figure 2: Trident II Program Acquisition Costs Through 1999



Source: Selected Acquisition Reports for Ohio Class D-5 Capable Submarine and D-5 Missile, December 31, 1987



The eventual total acquisition cost of the Trident program is uncertain because DOD has not decided on the final Trident II force size. DOD says that a number of uncertainties have precluded establishing the ultimate Trident force size, that is, potential arms agreements and survivability issues. Consequently, the Navy now adds one submarine with associated missiles to the SAR each budget year.

Full-scale development contracts for the D-5 missile and its supporting subsystems total about \$9.3 billion. Some initial production of equipment is included in these contracts. As of April 30, 1988, three of the six contractors forecasted contract overruns of about \$89 million. The government share is estimated at about \$69 million. About \$65 million of this forecasted overrun is attributable to problems in developing equipment for the navigation subsystem and associated schedule delays. Two other contracts for the test instrumentation subsystem and the launcher subsystem are estimated to overrun by about \$16 million and \$8 million, respectively. The remaining three subsystem contracts—missile, fire control, and guidance (development only)—are forecasted to be within contract target dollar amounts.

Our estimate of the life-cycle cost for the Trident II system shows that the program, through fiscal year 2032 when the last submarines would be retired, will cost about \$155 billion in escalated dollars. SSP's life-cycle cost estimate of about \$100 billion relates only to the Trident II SWS and associated support programs. The major difference between the estimates is that we included construction costs for 19 submarines (11 new Trident II and 8 Trident I) and operational and support costs for 19 submarines. For additional information on Trident II program and contract costs, see appendix IV.

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## Base Construction and Waterway Dredging

Although much construction work needs to be completed at the Naval Submarine Base, Kings Bay, the Navy believes the work will be completed in time to support critical 1989 program milestones. These milestones include the arrival of the first Trident II submarine in January 1989, start of the at-sea testing of the submarine-launched missile in March 1989, and the Trident II IOC in December 1989. Officials representing SSP and the Naval Facilities Engineering Command predict that the base construction projects critical to meeting these milestones will be completed. (See app. III.)

SSP officials consider completion of work at several buildings in two critical base complexes—the Strategic Weapons Facility and the Trident

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Refit Facility—essential for supporting preparation of the submarine for the upcoming at-sea missile tests in March 1989 and meeting IOC in December 1989. Much of this work involves the installation of cranes, heating, ventilation, and air conditioning equipment in the buildings and the final preparation and certification of the buildings for use.

A dry dock is required to support the Trident II submarine maintenance and repair work. Construction of the dry dock at Kings Bay is about 60 percent complete and is scheduled to be available for use in November 1990. Dredging of waterway areas required for the Trident submarine to safely maneuver and operate as it transits from the Atlantic Ocean to Kings Bay waterfront facilities is nearly complete.

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## Remaining Milestones Leading to System Deployment

Several major milestones are scheduled in the time remaining before Trident II system IOC in December 1989.

- Completing installation and testing of D-5 missile supporting subsystems for the SSBN 734 delivery in December 1988.
- Successfully conducting SSBN 734 builder trials and delivering the Trident II submarine to the Navy in December 1988.
- Completing the 19 missile developmental flight test program from a land-based launch platform at Cape Canaveral in January 1989.
- Beginning in March 1989, conducting the at-sea submarine test program of nine missile launches. Tests are scheduled to end in July 1989.
- Completing and activating the facilities at Kings Bay submarine base, which are required to support the arrival of the first submarine, missile assembly and processing, D-5 missile and supporting subsystems testing, and preparations for deploying the Trident II. For a more comprehensive list of major program milestones, see appendix V.

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## Agency Comments

We obtained DOD's comments on a draft of this report. DOD concurred with our findings and conclusions. (See app. VI.)

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As arranged with your Office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from its issue date. At that time, we will send copies to interested committees and other Members of Congress, as well as to the Secretaries of Defense and the Navy. Copies will be made available to other parties upon request.

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The work for this report was performed under the direction of Donna Heivilin, Associate Director, National Security and International Affairs Division. Appendix VII provides the names of the contributors to this product.

Sincerely yours,

A handwritten signature in black ink that reads "Frank C. Conahan". The signature is written in a cursive style with a large, prominent "F" and "C".

Frank C. Conahan  
Assistant Comptroller General

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**Abbreviations**

DASO	Demonstration and Shakedown Operation
DOD	Department of Defense
DOE	Department of Energy
EA	Electronic Assembly
FY	Fiscal Year
GAO	General Accounting Office
GSS	Gravity Sensor System
IOC	Initial Operational Capability
IMU	Inertial Measurement Unit
PEM	Performance Evaluation Missile
OSDP	Operational Systems Development and Production
SAR	Selected Acquisition Report
SITP	Ship Installation and Test Program
SSBN	Ship, Submersible, Ballistic, Nuclear
SSP	Strategic Systems Programs
SWS	Strategic Weapon System

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# Objectives, Scope, and Methodology

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At the request of the Chairman, House Committee on Armed Services, we examined the status of acquiring the Trident II system as it nears the initial operational capability (IOC) date, December 1989. Specifically, the Chairman requested that we determine the "health" of current program efforts and the prospect for meeting IOC as scheduled. The program includes the development, test, and production of the Strategic Weapon System (SWS), the construction of Trident II submarines, and the dredging of waterways and construction of shore facilities required to activate a Trident II-dedicated submarine base at Kings Bay, Georgia. Our assessment focused on the following program aspects:

- Current development, test, and production status of the six subsystems of the SWS.
- Status of Trident II submarine construction.
- Progress of construction and dredging activities leading to activating the Naval Submarine Base, Kings Bay, Georgia.
- Estimated acquisition and life-cycle costs for the Trident II system, including status of contracts for development and initial production of the SWS.

Our evaluation, which was done from November 1987 through September 1988, was conducted in accordance with generally accepted government auditing standards. It was performed primarily at the Navy's Office of Strategic Systems Programs (SSP), which is responsible not only for the development, acquisition, and maintenance of the Navy's SWS, but also for acquiring both the Trident II submarines and the facilities at the Naval Submarine Base, Kings Bay. In reviewing the status of the SWS subsystem, we visited activities currently testing the SWS and most of the major contractors and plant representative offices. To review the construction at Kings Bay, we held discussions with Naval Facilities Engineering Command headquarters and Army Corps of Engineers officials and visited Navy command organizations at the Naval Submarine Base, Kings Bay.

We also reviewed the Department of Energy's (DOE's) warhead development and acquisition effort for the Trident II. The design and production responsibility and funding for the warhead belongs to the DOE and not to the Navy.

Our methodology included interviewing cognizant officials and analyzing pertinent plans, reports, program assessment documents, and SSP instructions. We also analyzed financial data related to program cost,

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sws subsystem contract cost performance reports, submarine construction, sws testing and production, and the Kings Bay submarine base construction and waterway dredging. We held frequent discussions with the SSP program manager and his immediate executive staff to obtain their views.

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## Organizations Contacted During Our Review

We contacted the following government and contractor organizations and facilities during our review.

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### United States Government

Office of the Assistant Chief of Naval Operations for Undersea Warfare, Washington, D.C.  
Strategic Systems Programs, Washington, D.C.  
Naval Sea Systems Command, Washington, D.C.  
Naval Submarine Base, Kings Bay, Georgia  
Strategic Weapons Facility, Atlantic, Kings Bay, Georgia  
Trident Refit Facility, Kings Bay, Georgia  
Trident Training Facility, Kings Bay, Georgia  
Polaris Missile Facility, Atlantic, Charleston, South Carolina  
Naval Ordnance Test Unit, Cape Canaveral, Florida  
Hunters Point Surface Launch Test Complex, San Francisco, California  
Naval Technical Representative, Detachment C, Great Neck, New York  
Naval Plant Representative Office, Sunnyvale, California  
Naval Plant Representative Office, Pittsfield, Massachusetts  
Supervisor of Shipbuilding, U.S. Navy, Groton, Connecticut; and Quonset, Rhode Island  
Naval Facilities Engineering Command, Alexandria, Virginia; and Atlanta, Georgia  
Officer in Charge of Construction, Trident, St. Mary's, Georgia  
Corps of Engineers, U.S. Army, Washington, D.C.; Jacksonville, Florida; and Savannah, Georgia  
Department of Energy, Germantown, Maryland; and Albuquerque, New Mexico

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### Contractors

Charles Stark Draper Laboratories, Inc., Cambridge, Massachusetts; and Cape Canaveral, Florida  
EG&G (Reticon), Sunnyvale, California  
General Dynamics Corp., Electric Boat Division, Groton, Connecticut;

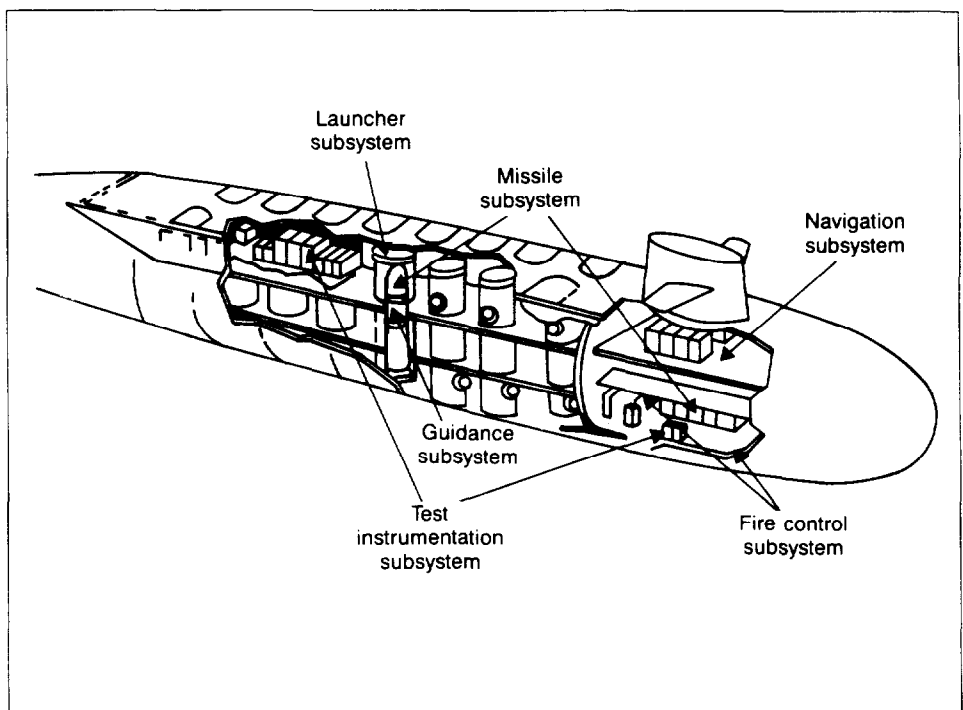
Quonset, Rhode Island; and Cape Canaveral, Florida  
General Electric Company, Ordnance Systems Division, Pittsfield, Massachusetts; and Cape Canaveral, Florida  
Interstate Electronics Corporation, Groton, Connecticut; and Cape Canaveral, Florida  
Johns Hopkins University/Applied Physics Laboratory, Laurel, Maryland; and Cape Canaveral, Florida  
Lockheed Missiles & Space Company, Inc., Sunnyvale, California; and Cape Canaveral, Florida  
Northrop Corporation, Electro-Mechanical Division, Cape Canaveral, Florida  
Palisades Geophysical Institute, Cape Canaveral, Florida  
Raytheon Company, Sudbury and Waltham, Massachusetts  
Rockwell International, Cape Canaveral, Florida  
Singer Company, Kearfott Guidance & Navigation Division, Little Falls, New Jersey  
United Technologies Corp., Chemical Systems Division, San Jose, California  
UNISYS Corporation, Shipboard & Ground Systems Group, Great Neck, New York; and Cape Canaveral, Florida  
Vitro Corporation, Silver Spring, Maryland; and Cape Canaveral, Florida  
Westinghouse Electric Corporation, Marine Division, Sunnyvale, California; and Cape Canaveral, Florida



# Acquisition Proceeding Toward Deployment

The Trident II sws is composed of the D-5 missile and five other subsystems: launcher, guidance, fire control, navigation, and test instrumentation. Figure II.1 shows the location of these subsystems on the Trident submarine. After successful advanced development, the Navy began full-scale development of the sws in October 1983. At that time, the Office of the Secretary of Defense approved limited production of the subsystem equipment needed to meet the deployment schedule. In April 1987, limited production of the missile and guidance subsystems was approved by the Secretary of Defense. The sws is transitioning from development and testing to production.

**Figure II.1: Location of the SWS Subsystems on the Trident Submarine**



Source: GAO

In developing the sws for the Trident II, the Navy sought to retain as much of the Trident I system equipment and components as possible. This evolutionary approach reduced the technical risks for the sws, reduced the development period, and allowed the use of Trident I expertise, documentation, and experience. According to an SSP official, the major Trident II sws technological challenges were developing improved electronics, rocket propulsion, and software to enhance capabilities of the sws.

Relatively minor changes to the Trident submarine were required to accommodate the new strategic weapon system. These included additional ventilation, air conditioning, power, water provisions, signal cabling, and foundations.

Development of the sws has proceeded on schedule and performance objectives are being met. The major program emphasis at this time are (1) testing the sws as an integrated system and (2) demonstrating the capability to produce the equipment within cost and schedule requirements.

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## Trident II Development Flight Tests

SSP is responsible for planning, coordinating, and conducting all testing, trials, and evaluations of the missiles. Its Naval Ordnance Test Unit, located at the Eastern Space and Missile Center, Cape Canaveral, Florida, contains the facilities to assemble, test, launch, and evaluate the weapon system during the development phase and to support operational tests after sws deployment. The 19 development flight tests, which are launched from a land-based platform, concentrate on the missile and guidance subsystems, but do not test the fire control, navigation, launcher, or submarine test instrumentation subsystems. The heavily instrumented missiles are flown at different trajectories and ranges to test the missile's ability to reliably and accurately deliver reentry bodies within a predetermined target area.

The development flight testing of the sws includes demonstrating the missile's capability to carry two alternate types of reentry bodies. In addition to the existing MK 4 reentry body, a new MK 5 reentry body with a significant explosive power increase over the MK 4 was developed for the Trident II missile. The MK 5 is designed to provide improved capability of destroying nuclear-hardened targets.

Development flight testing is a major means of verifying missile subsystem design, equipment, and support items. Land-based launches began in January 1987 and are planned to be completed in January 1989. As shown in table II.1, 15 flight tests were conducted as of September 30, 1988. Although one was partially successful, two were failures, and one was a "no test," the overall performance results from the tests indicate that the missile is achieving its objectives. To date, flight test results show that the guidance subsystem and the reentry bodies also are meeting their performance requirements. None of the flight problems or failures have been attributed to either the guidance subsystem or the missile's reentry bodies.

**Appendix II  
Acquisition Proceeding Toward Deployment**

**Table II.1: Summary of Trident II Development Flight Tests as of September 30, 1988**

<b>Flight test number</b>	<b>Reentry body type</b>	<b>Date of test</b>	<b>Summary of results<sup>a</sup></b>
1	MK 5	01/15/87	Successful
2	MK 5	03/17/87	Successful
3	MK 5	04/30/87	Successful
4	MK 5	06/12/87	Successful
5	MK 5	07/20/87	Successful
6	MK 4	09/08/87	Successful
7	MK 5	10/06/87	Partially successful; malfunction in Post Boost Control System and in electronics package
8	MK 5	12/11/87	Successful
9	MK 5	01/21/88	Failure; malfunction in flight control electronics
10	MK 5	04/07/88	Successful
11	MK 5	04/28/88	Successful
12	MK 4	05/26/88	Successful
13	MK 5	07/07/88	Failure; thrust vector control subsystem problem under investigation
14	MK 5	08/20/88	Successful
15	MK 5	09/19/88	No test

<sup>a</sup>SSP, with assistance from the missile subsystem contractor—Lockheed Missiles & Space Company—scores development flight tests as successful, partially successful, or a failure. A successful score indicates that the missile flew without incident, delivered reentry bodies in a predetermined target area, and met minimum test objectives. Partially successful is given if the missile experienced problems but still was able to transit and deliver reentry bodies to the predetermined target area and to meet minimum test objectives. A failure denotes a test in which the missile did not accomplish minimum test objectives, such as no reentry bodies being delivered to the target area or no, or minimal, data collected.

A problem encountered during the seventh flight requires a redesign of the Post Boost Control System. This system is used to maneuver and control the missile's equipment platform<sup>1</sup> during deployment of the reentry bodies. During the deployment phase of the seventh flight, one of the valves in the system, which controls the flow of hot gases through the system, remained closed and limited the system's steering capability. Engineering evaluations indicate there was overheating or contamination in the valve, causing it to stay closed. SSP officials stated that it may be necessary to change the system's gas generator, the manifold, and/or valves in order to correct the problem. The engineering analysis for the

<sup>1</sup>The equipment platform contains the missile's primary electronic equipment, the Post Boost Control System, the third stage motor, and the reentry subsystem. After third stage flight is completed, the third stage motor separates from the equipment platform. The Post Boost Control System, with commands from a flight control computer on the platform, moves and positions the equipment platform for deployment of reentry bodies.

redesign of the Post Boost Control System is continuing. SSP plans to have the redesigned unit incorporated sometime during the 1989 testing program.

During the ninth flight test, the missile lost control and went off course about 14 seconds into third stage flight, and self-destructed. Engineering verification of the failure indicated that a short in one of two 5-volt power supplies, which control the flight control computer, prevented the computer from providing the proper steering commands for the missile's third stage. According to SSP officials, beginning with the 10th flight, no further corrective actions have been necessary. The problem was solved through minor changes in the flight control computer. Also, there has been no reoccurrence of the problem in subsequent flight tests.

During the 13th flight, the missile encountered a problem with the thrust vector control subsystem<sup>2</sup> on its first stage, causing it to lose control and go off course about 55 seconds into flight. The missile was destroyed by the range safety officer for safety reasons. The problem is under investigation by SSP and Lockheed Missiles & Space Company.

During the 15th flight, the missile was destroyed by command destruct early in its flight. According to SSP, the missile was performing normally at the time the decision was made to destruct, thus resulting in a no test. A combination of events prompted the destruct action, including the specific trajectory selected to be flown, the prelaunch weather conditions, and the missile dynamics along the flight path, which resulted in the missile looking to the range safety officer as though it would cross the boundaries of the safety corridor.

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## Ship Installation and Test Program

The first time the sws subsystems are integrated, operated, and tested as one system is when installed on a submarine. Before installation, each subsystem is tested individually, with limited interface testing with other subsystems. During installation on the submarine, the sws undergoes a series of comprehensive and integrated tests referred to as the Ship Installation and Test Program (SITP). This program is intended to ensure that the sws equipment has been installed correctly and is operating properly.

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<sup>2</sup>The thrust vector control subsystem, one for each of the missile's three motor stages, provides steering by moving the thrust nozzles during flight.

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### Importance of SITP in Construction of Initial Trident II Submarines

In June 1982, the Secretary of Defense advised the Congress of the decision to accelerate installation of the Trident II sws into submarine construction. Although ship construction schedules were slightly lengthened for the initial Trident II submarines to accommodate this change, it resulted in a shorter time period to design, develop, and test sws equipment and deliver the equipment to the submarine contractor, Electric Boat. It also made installation of the sws the critical path<sup>3</sup> in constructing the first three Trident II submarines—SSBNs 734, 735, and 736. According to SSP officials, SITP schedules for these submarines are time constrained for accomplishing the necessary tests. Consequently, completion of SITP activities is a critical step in the construction and delivery of these submarines.

According to SSP officials, because the SSBN 734 is the first Trident II submarine to undergo SITP for the new sws, it is the most likely to experience problems. As these problems are addressed, SITP should have less affect on constructing the SSBN 735, SSBN 736, and subsequent submarines. Beginning with the SSBN 737, installing the sws will no longer be the controlling path for construction, and submarine construction will return to a traditional schedule.<sup>4</sup>

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### Status of SITP for the SSBN 734

Overall, the SITP testing for the SSBN 734 has been on schedule. Testing for the first five phases of SITP has been substantially completed for the SSBN 734. Although SITP has revealed some problems with subsystem equipment and software, none are expected by SSP officials to affect the submarine's delivery to the Navy. Experience obtained during SSBN 734 testing is being applied in the successive submarines. Phase six testing for the SSBN 734 is underway. According to SSP officials, SITP is progressing better than they expected it would and it is likely that these tests will be completed ahead of schedule, with the SSBN 734 being delivered to the Navy by mid-November 1988, 1 month early.

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### Concerns of Gravity Sensor System Availability

In the navigation subsystem, the SITP testing of the Gravity Sensor System (GSS) was delayed as a result of problems with the reliability of slip rings and the inadequate maturity of diagnostic software. Slip rings for

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<sup>3</sup>The longest critical path to delivery dictates the submarine's construction schedule since the events in this path must be completed prior to other key construction tasks.

<sup>4</sup>During a traditional construction schedule, the SWS equipment is installed with other submarine equipment during hull fabrication. However, for the SSBNs 734, 735, and 736 the submarine was essentially completed and the SWS was then installed during additional time provided in the construction schedules.

the GSS's Gravity Gradiometer Instrument had mean-time-between-failure rates well below specification. New slip ring configurations did not correct the problem. Officials indicated that the GSS did not contribute as much to the missile's accuracy as originally anticipated since other subsystem equipment, such as the Navigation Sonar System, are doing better than expected and are providing the location information required by the SWS to support missile launches. SSP decided to cancel the GSS because other weapon system equipment was performing above specification and the accuracy of their gravity maps had exceeded expectations.

The SITP testing of the Navigation Sonar System and other navigation subsystem equipment is on schedule.

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## Other SWS Subsystems

Initial tests of the launcher subsystem revealed seal leaks on 16 of 24 launch tubes. SSP officials said these failures could have affected the testing, but problems were averted when Westinghouse, the launcher contractor, devised a new repair procedure for the seals on the SSBN 734 and a new sealant to use on future submarines. All of the launch tubes on the SSBN 734 have been successfully tested and no further problems have been encountered in this area.

The fire control subsystem has experienced few problems during SITP. Although there continue to be some delays in deliveries of tactical software installments, SSP officials do not expect them to delay the SITP testing or the delivery of the SSBN 734. The missile subsystem also has encountered minor problems interfacing with the fire control subsystem during SITP. These were corrected without affecting the test schedules.

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## Phase Six Testing

Phase six operational sequence testing is conducted in two segments. The first tests, performed at the shipyard, verify the operability and performance of the system prior to beginning submarine builder trials. These tests include operating the SWS through a simulated missile preparation and launch. This is a crucial milestone in SITP because it is the first time the SWS subsystems are tested as an entire system. The first segment testing is proceeding ahead of schedule.

The second segment is being conducted at sea, during builder trials of the submarine. Builder trials for the SSBN 734 began on August 23, 1988, and will be completed by December 31, 1988. During this segment, the SWS will be tested under actual operating conditions. Additional tests

that cannot be conducted at the shipyard are run at this time, such as checks on the Navigation Sonar System's performance and demonstration of hovering and compensation capabilities of the ship after a missile is launched. Successful completion of phase six testing is a prerequisite for ship delivery and assurance that the SWS is ready to support Performance Evaluation Missile (PEM) and Demonstration and Shakedown Operation<sup>5</sup> (DASO) testing.

According to SSP officials, the first segment of phase six testing is progressing better than anticipated, and it is likely that these tests will be completed ahead of schedule. The SSP program manager predicted that the SSBN 734 could be delivered to the Navy as early as mid-November 1988. Six other Trident II submarines under various stages of construction are on schedule.

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## Some Guidance System Difficulties

Most Trident II SWS subsystems are in limited production. Because the initial Trident II submarines were under construction concurrently with SWS full-scale engineering development, it was necessary to build some navigation, launcher, and fire control subsystems while development tests were conducted. Limited production for the missile subsystem began in April 1987 and a full-production decision is expected in the fall of 1989. Limited production of the other SWS subsystems, except guidance, is currently on schedule.

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## Guidance Subsystem Production Concerns

Guidance subsystem contractors are currently producing development equipment—the Inertial Measurement Unit (IMU) and the Electronic Assembly (EA)—in support of the missile flight test programs. However, manufacturing is behind schedule as a result of late delivery of the design drawings to the contractors coupled with difficulty in producing some guidance components. Nevertheless, SSP officials stated that delivery schedules will support the development test programs and IOC.

Technical enhancement of the Trident I guidance subsystem was required for the Trident II to increase missile accuracy, particularly in its IMU. There were some technical difficulties in developing and manufacturing some of the guidance components for the IMU and the EA. SSP officials explained that production delays can be attributed largely to

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<sup>5</sup> A DASO is a test conducted before submarine deployment to verify the proper functioning and readiness of the SWS and the submarine by the crew. The first of two missile launch tests for the SSBN 734 is scheduled for August 1989.

the lateness of the component designs from Charles Stark Draper Laboratory, the design subcontractor, and deficiencies in those designs. The design flaws have been corrected and production is proceeding. However, production is somewhat behind schedule. In addition to the design problems, the contractors had problems manufacturing the numbers required for some components of the IMU and the EA, including the accelerometer, the charge coupled device for the stellar sensor, and several radiation hardened integrated circuits. The close tolerances of parts and intricate assembly procedures needed to manufacture the IMU make high quantity production difficult.

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## Status of the Nuclear Warhead Program

We also examined the status of DOE's program to provide nuclear warheads for the Trident II. DOE's program is on schedule, to support the Trident II program. Specific cost, schedule, and performance information on the nuclear warheads is classified; therefore, it is not included in this report.



# Base Construction and Waterway Dredging

The Kings Bay Naval Submarine Base is under construction near St. Mary's, Georgia, and is to accommodate personnel, industrial, and support activities for the Trident II submarines. (See fig. III.1 for base location.) The total cost of construction and waterway dredging for Kings Bay through completion in the late 1990s is estimated at \$1.4 billion in escalated dollars. Although much work needs to be done, the Navy believes that all critical construction work will be completed in time to meet the 1989 program milestones. These milestones include the arrival of the first submarine, the SSBN 734, in January 1989; evaluation testing of submarine-launched missiles during most of the year; and deploying the SSBN 734 in December 1989. SSP and Naval Facilities Engineering Command officials do not believe that any construction projects will delay the 1989 milestones.

## Status of Construction Activities

Construction of the facilities for the Trident II began in fiscal year 1982 and is planned to continue through the late 1990s. The Kings Bay facilities are designed to support Trident submarines and missiles, beginning in December 1989.<sup>1</sup> The 16,000 acre base now serves as a site for a Poseidon submarine squadron that carries the Trident I missile system.

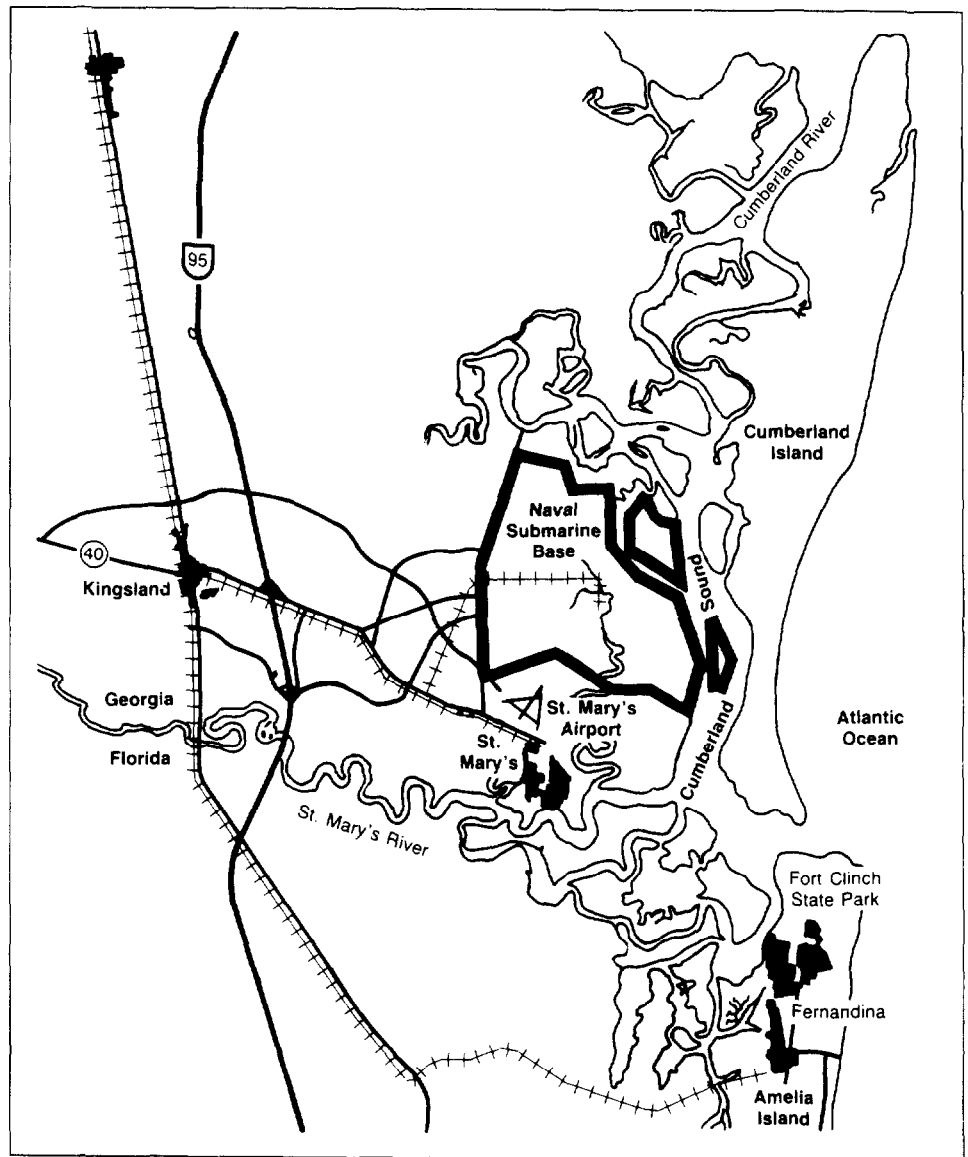
Remaining facility work involves installing cranes and ventilation, heating, and air-conditioning equipment into buildings as well as final preparation and certification<sup>2</sup> of the buildings for use. Although not all the facilities have to be completed in time to prepare for the arrival and IOC of the Trident II, SSP officials say that their completion is important to avoid disruptions of submarine maintenance or missile processing when operations begin to increase at Kings Bay. Examples of this work include correcting building deficiencies, installing communications equipment, and completing the submarine drydock facility.

Construction activities include building and outfitting facilities for the four major Trident support commands—Strategic Weapons Facility, Atlantic; Trident Refit Facility; Trident Training Facility; and Submarine Base, Kings Bay. The boundaries and layout of the base and general location of its facilities are shown in figure III.2.

<sup>1</sup>Beginning in the early 1990s, the facilities at the Trident submarine base, Bangor, Washington, will be modified to support Trident II submarines deployed on the U.S. Pacific coast. Currently, the base supports the eight Trident I submarines. These submarines carry the C-4 missile.

<sup>2</sup>Certification is the process in which the government verifies that a building or facility is complete and that all equipment and operating procedures are in place.

Figure III.1: Geographic Location of the Naval Submarine Base, Kings Bay

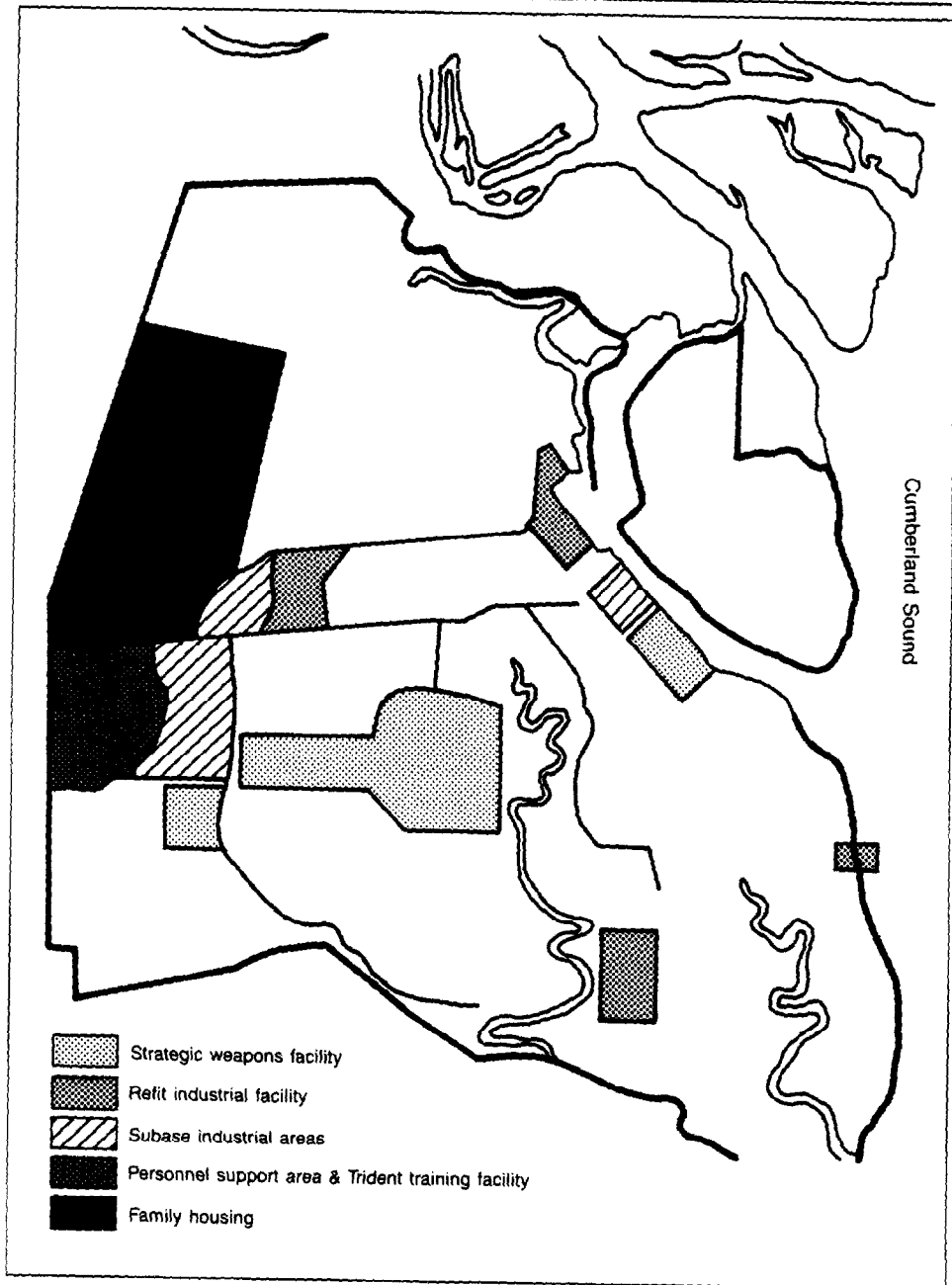


Source: U.S. Navy

### Strategic Weapon Facility

Completion of this facility is critical to missile testing and Trident II IOC. This facility will support missile assembly, maintenance, storage, and loading and off-loading the submarine.

Figure III.2: Physical Layout of the Naval Submarine Base, Kings Bay



Source: U.S. Navy

Although all of the buildings needed to support the mission are nearly complete, SSP officials are concerned about the work remaining in the

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Reentry Body Complex, Vertical Missile Packaging Building Number 1, Missile Assembly Building Number 1, the Motor Inspection Building, and the Explosive Handling Wharf.

The Reentry Body Complex will support processing and storing the reentry bodies. Several items at this complex are not yet finished; however, SSP believes solutions to the problems have been identified, and they are confident that all work will be completed in time to support receipt of reentry bodies.

Problems in controlling the humidity also remain in the Vertical Missile Packaging Building Number 1, the Missile Assembly Building Number 1, and the Motor Inspection Building. According to SSP officials, similar problems have been experienced in other buildings at Kings Bay. Solving the problem in these buildings is critical because excessive humidity could damage missile propellant.

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### Explosive Handling Wharf

The Explosive Handling Wharf is where missiles will be loaded and unloaded on and off of the submarines and two 120-ton bridge cranes have to be installed in this facility. Installation of the cranes is expected by SSP to be completed in October 1988. The bridges for both cranes were lifted into place in September 1988. The remaining crane installation and certification will be finished in October 1988.

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### Trident Refit Facility

The Trident Refit Facility will be used for Trident submarine maintenance, including the subs shipboard equipment. The problems with the Trident Refit Facility are similar to those experienced at the Strategic Weapons Facility, that is, crane installation and building deficiencies. The Refit Industrial Facility, the Refit Industrial Administration Building, and the Controlled Industrial Facility must be completed before the SSBN 734 arrives.

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### Status of Trident Dredging Program

To accommodate the large size and displacement of Trident submarines, it was necessary to dredge an access channel approximately 22 nautical miles long from the Atlantic Ocean into the Kings Bay submarine base. Completion of the entrance channel was essential before arrival of the first Trident submarine in January 1989, since channel depth was inadequate for safe passage. Trident II waterway dredging is estimated to cost about \$168.5 million.

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The widening and deepening of key waterways at Kings Bay is a multi-year military construction project that began in 1982. Figure III.3 shows the four key segments of these projects and status as of September 1988. Each dredging segment was performed under separate contract.

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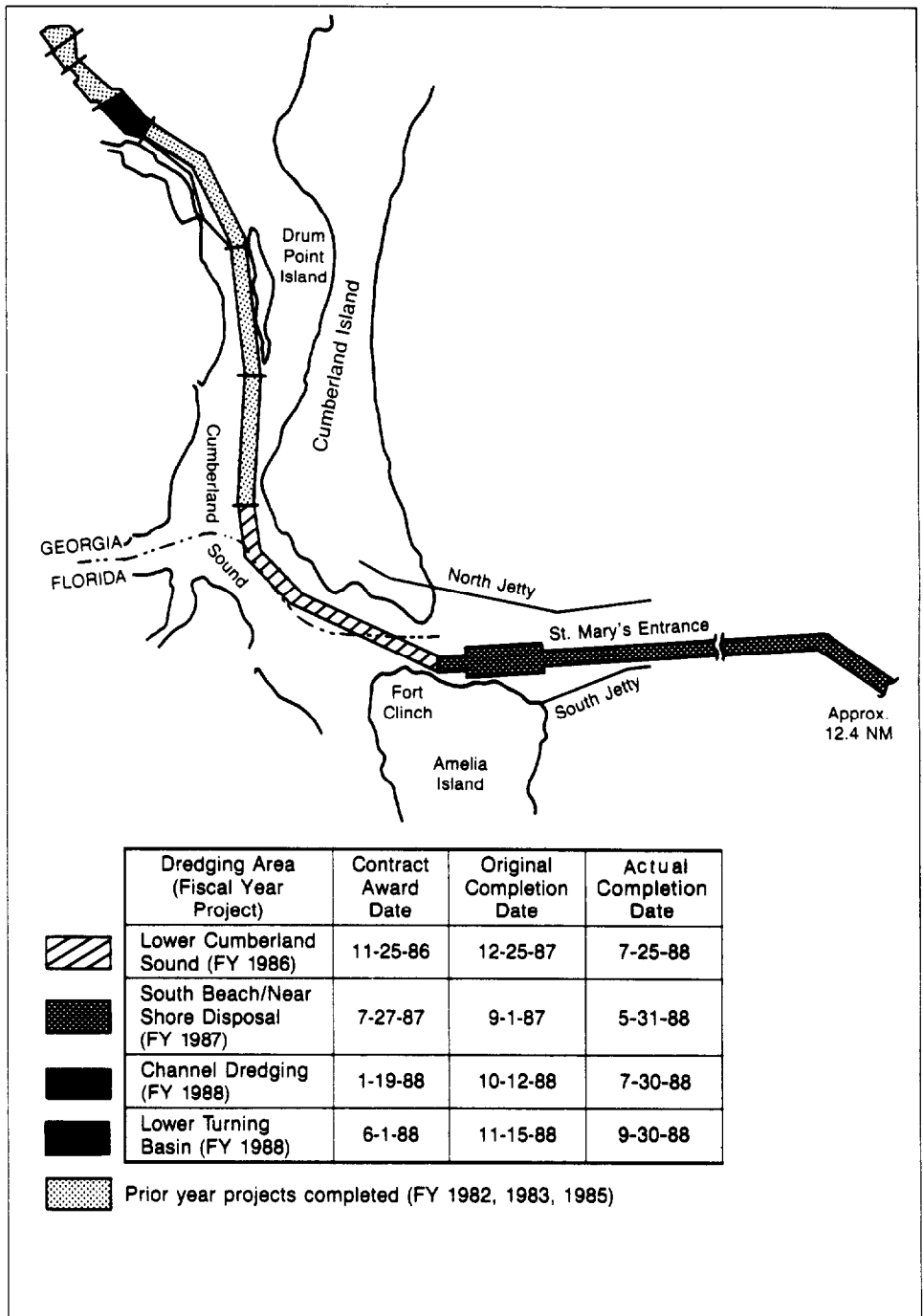
**Fiscal Year 1988 Dredging**

The two major dredging efforts in the fiscal year 1988 project involve dredging in Kings Bay a channel and a turning basin near the Explosive Handling Wharf. Both efforts were completed in September 1988.

The Explosive Handling Wharf turning basin dredging work involved expanding the basin by 150 feet. This expansion provides safe maneuvering room for the submarine to turn around in the bay.

**Appendix III  
Base Construction and Waterway Dredging**

**Figure III.3: Kings Bay Dredging—Status of Areas Critical to Arrival of SSBN 734 In January 1989**



Source: U.S. Navy

# Trident II Program Costs

The Trident II program is a large and costly U.S. defense program. According to the Navy's most recent acquisition cost estimate, the cost of acquiring a fleet of 11 Trident II submarines with missiles and shore support activities is projected through the year 1999 to be about \$51 billion (escalated dollars<sup>1</sup>). Our estimate of the total life-cycle cost for the acquisition, operations, and support of a 19 submarine program (includes refitting 8 Trident I submarines to Trident II in the 1990s) through their retirement in the year 2032 is about \$155 billion (escalated dollars). DOE's cost to support the Trident program with nuclear warheads is not included in either the acquisition or life-cycle costs. These DOE costs are classified for national security purposes.

As discussed earlier in this report, the Trident II missile and associated subsystems are in full-scale development, with some limited production taking place. Contracts for the sws subsystems are priced at about \$9.3 billion. As of April 30, 1988, cost overruns of about \$89 million were projected for three subsystem contracts. This represents an overrun of less than 1 percent of the total cost of the six subsystem contracts. The largest portion of this overrun—\$65 million—is attributed to the contract for developing the navigation subsystem. The other three contracts currently are reported to be within contract costs, including a \$2 million projected cost underrun on the development and initial production of the fire control subsystem.

## Acquisition Costs as Reported in Selected Acquisition Reports

Acquisition costs for the Trident II program are separated into two Selected Acquisition Reports (SARs)<sup>2</sup>: (1) Trident II Missile and (2) Trident II Submarine. According to the most recent SARs, as of December 31, 1987, the projected total acquisition cost for the Trident II through the year 1999 is \$51.3 billion in escalated dollars. This includes costs for the (1) total research and development of the sws and procurement of 28 development missiles, (2) research and development for Trident II submarines, (3) procurement of 815 production missiles, (4) construction of 11 Trident II submarines, and (5) military construction to support the Trident II. This acquisition figure has decreased by \$400 million since

<sup>1</sup>Dollars that include the effects of escalation reflecting the price levels expected to prevail when the expenditure is actually made.

<sup>2</sup>The SARs 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.

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the fiscal year 1982 SARS.<sup>3</sup> Estimated program cost reductions are attributed by the Navy to lower inflation indices and other changes. These reductions largely offset the cost of 4 Trident II submarines and 103 missiles added to the program since the 1982 SARS.

The \$51.3 billion acquisition cost does not include about \$2 billion for the planned conversion of eight Trident I submarines to Trident IIs. This conversion is planned to take place in the 1990s as part of the Trident I's scheduled overhaul program. Also, DOE's costs to research, develop, test, and produce nuclear warheads to support the Trident program are not included.

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## Trident II Life-Cycle Costs

As part of our review, we developed a life-cycle cost estimate for the Trident II program, excluding DOE's costs associated with the nuclear warheads. We prepared our cost estimate with assistance from SSP and other Navy officials.

As shown in table IV.1, our estimate of the total life-cycle cost of the Trident II submarines, weapon systems, and shore support facilities through the year 2032 is approximately \$155 billion in escalated dollars. This estimate assumes that the operation and support costs for Trident II submarines ends with retirement of the 19th submarine in 2030. Under this assumption, Navy officials indicated there would probably be some deactivation costs in the years 2031 and 2032, but they were not able to estimate these costs.

The \$51.3 billion acquisition cost, as reported in the SARS, is included in the \$114.2 billion life-cycle estimates shown in table IV.1.

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<sup>3</sup>The first SARs for the Trident II program were December 31, 1982, and indicated acquisition costs of \$51.7 billion in escalated dollars. These costs included 7 Trident II submarines, 30 development missiles, and 710 production missiles.



**Appendix IV  
Trident II Program Costs**

**Table IV.1: Estimated Life-Cycle Costs for Trident II Capability Through the Year 2032**

Dollars in billions

<b>Item</b>	<b>Cost</b>
<b>I. Estimated Trident II acquisition and military construction costs.</b>	
SWS research and development, procurement of 28 development and 815 production missiles. This figure includes operation and support costs for the SWS subsystems, conversion of 8 Trident I submarines to Trident II capability and military construction for the Strategic Weapons Facility at Kings Bay, and for Trident II portions of the Strategic Weapons Facility at Bangor, Washington.	\$99.3
Research and development required for incorporating the Trident II SWS on Trident submarines.	0.1
New construction of 11 Trident II submarines.	13.0
Military construction funds for non-SWS facilities and related construction activities at Naval Submarine Base, Kings Bay (excluding the Strategic Weapons Facility): Trident Training Facility; Trident Refit Facility; and Submarine Base.	1.0
Submarine-related and other non-SWS equipment required for Trident Training Facility, Trident Refit Facility, and Submarine Base facilities at Naval Submarine Base, Kings Bay.	0.8
<b>Subtotal</b>	<b>\$114.2</b>
<b>II. Estimated operating and support costs for Trident II submarines.</b>	
Operating and support costs for 19 Trident II submarines. This figure includes cost for submarine personnel, operations, and maintenance through the year 2032.	31.0
<b>Subtotal</b>	<b>\$31.0</b>
<b>III. Estimated acquisition and construction costs which were prerequisites to Trident II development.</b>	
Research and development for 8 Trident I submarines.	0.8
Construction of 8 Trident I submarines.	7.9
Military construction of the Naval Submarine Base, Bangor (excluding the Trident II portions of the Strategic Weapons Facility, Pacific).	0.7
<b>Subtotal</b>	<b>\$9.4</b>
<b>Total Estimated Life-Cycle Costs</b>	<b>\$154.6</b>

DOD has not set the force level objective, that is, the number of Trident II systems needed, and therefore the final total acquisition cost of the Trident program is uncertain. DOD has stated that an open-ended Trident program is undesirable for planning, programming, and budgeting purposes. However, uncertainties in ongoing Strategic Arms Limitations discussions and the threat to survivability of U.S. strategic forces have prevented DOD from deciding how many Trident II systems should be built. Consequently, the Navy adds one Trident II submarine and its associated costs each year to the previously approved program in the SARS.

## Operational Systems Development and Production Contracts

For development and initial production of the SWS, SSP used an Operational Systems Development and Production (OSDP) contract with its prime subsystem contractors. (Only the guidance subsystem is handled differently.) These long-term, cost plus-incentive fee contracts are incrementally funded each fiscal year and include incentives and penalties based on meeting contract requirements. For example, the final contract target fee or profit is based on the contractor's success in (1) developing equipment that meets or exceeds performance requirements and that can be efficiently and economically produced and (2) managing costs and maintaining the schedule. At the beginning of the full-scale development phase, an OSDP contract is negotiated and awarded for the design, development, and initial production of a subsystem within established requirements and cost estimates. The five OSDP contracts began in October 1983 and are of various lengths, with the last contract ending September 1993.

SSP has OSDP subsystem contracts with the following prime subsystem contractors:

- UNISYS Corporation for navigation,
- General Electric Company for fire control,
- Lockheed Missiles & Space Company for the missile,
- Westinghouse Electric Corporation for the launcher, and
- Interstate Electronics Corporation for test instrumentation.

In addition, SSP has a cost plus fixed-fee, full-scale development contract with Charles Stark Draper Laboratory, Inc., for the design and development of the guidance subsystem. The Laboratory, in turn, awarded separate contracts to a number of industrial contractors for supporting development efforts and manufacturing guidance components. SSP will award contracts to the industrial contractors and a technical support contract to the Laboratory for producing the tactical guidance components.

As of April 30, 1988, there was a total cost overrun of about \$89 million forecasted by the contractors on three of the six Trident II subsystem full-scale development contracts. The government's share is estimated at about \$69 million. (See table IV.2.) This overrun is less than 1 percent of the total amount for the Trident II SWS contracts. Of the three contracts, the UNISYS Corporation had the largest overrun, \$65.2 million, due to developmental problems and schedule delays with some navigation subsystem equipment. Interstate Electronics Corporation and Westinghouse Electric Corporation are reporting overruns of \$15.6 and \$8.2 million,

Appendix IV  
Trident II Program Costs

respectively. The other subsystem contractors--Lockheed Missiles & Space Company, Charles Stark Draper Laboratory, and General Electric Company—are within contract target amounts. (General Electric is projecting a \$2.1 million underrun on its contract.) Most of the work remaining on these contracts is for initial production of sws equipment. For the same period, the SSP projection for the three contracts reporting overruns is \$98 million.

Contracts for full-scale production of some subsystem equipment were awarded to various contractors in fiscal years 1986 and 1987. SSP officials say that full-scale production contracts are similar to OSDP contracts with multiple incentives for items such as reliability, cost, and quality. Initially these contracts are cost-plus incentive fee, and as the production program matures, SSP plans to use fixed-priced incentive contracts.

**Table IV.2: Summary of Trident II SWS Subsystem Full-Scale Development Contracts Through April 30, 1988**

Dollars in millions

Prime subsystem contractor/ subsystem <sup>a</sup> (contract period)	Target cost	Target fee	Target price (cost plus fee)	Contractor estimate overrun/ underrun at completion <sup>b</sup>		SSP estimate overrun/ underrun at completion <sup>b</sup>	
				Cost	Price <sup>c</sup>	Cost	Price <sup>c</sup>
UNISYS Corporation/ Navigation (10/83 to 9/93)	\$1,042.0	\$106.8	\$1,148.8	\$65.2	\$55.8	\$65.2	\$55.8
General Electric Company/Fire Control (10/83 to 9/92)	\$471.3	\$51.8	\$523.1	\$-2.1	\$-1.8	\$0.0	\$0.0
Lockheed Missiles & Space Company/Missile (10/83 to 3/90)	\$5,347.1	\$469.1	\$5,816.2	\$0.0	\$0.0	\$0.0	\$0.0
Interstate Electronics Corporation/ Test Instrumentation (10/83 to 9/89)	\$387.8	\$34.4	\$422.2	\$15.6	\$13.2	\$25.0	\$20.0
Westinghouse Electric Corporation/ Launcher (10/83 to 12/89)	\$427.4	\$37.9	\$465.3	\$8.2	\$1.8	\$8.2	\$1.8
Charles Stark Draper Laboratory, Inc./ Guidance (10/83 to 9/89)	\$914.9	\$40.0	\$954.9	\$0.0	\$0.0	\$0.0	\$0.0
<b>Total</b>	<b>\$8,590.5</b>	<b>\$740.0</b>	<b>\$9,330.5</b>	<b>\$86.9</b>	<b>\$69.0</b>	<b>\$98.4</b>	<b>\$77.6</b>

<sup>a</sup>Contracts, except guidance, include some initial production of equipment and components.

<sup>b</sup>Underruns are shown as negative numbers.

<sup>c</sup>Price overrun is the amount to be paid by the government based on the cost sharing terms of the contract.

# Significant Trident II Program Milestones

<b>Date</b>	<b>Milestone</b>
October 1977	Initiated concept definition for the Trident II SWS.
October 1980	Advanced development phase initiated for the Trident II SWS.
March 1981	Trident II SWS acquisition strategy was approved and submitted by Secretary of Defense to Chairmen of the House and Senate Committees on Armed Services.
October 1981	Secretary of Defense directed the Navy to proceed with development of the Trident II SWS.
January 1982	Production contract for the first Trident II submarine, SSBN 734, awarded to Electric Boat Division and construction begins.
June 1982	Secretary of Defense decided not to accelerate development of the Trident II SWS, but rather to rephase the introduction of the missile into the fleet with the ninth Trident submarine. This retained the 1989 IOC date.
October 1983	Program approved to begin full-scale development of the SWS.
January 1987	First development missile flight test from land-based launch platform at Cape Canaveral, Florida.
April 1987	Secretary of Defense approved commitment to full-scale missile production (milestone decision IIIa).
August 1988	Builder trials began on SSBN 734.
December 1988	Completion of SSBN 734 builder trials and delivery of the submarine to the Navy.
January 1989	Completion of the 19 development missile flight test program from a land-based launch platform at Cape Canaveral, Florida.
January 1989	Completion of Kings Bay waterway area dredging required for safe submarine transit from the Atlantic Ocean to base waterfront facilities.
	Arrival of SSBN 734 at Naval Submarine Base, Kings Bay, Georgia.
March 1989	Commence PEM test missile launches from SSBN 734 (nine missile tests).
July 1989	Completion of PEM testing.
August 1989	Delivery of SSBN 735 to the Navy.
	First DASO missile flight test launched from SSBN 734.
September 1989	Confirmation by Secretary of Defense for full-scale missile production.
December 1989	Trident II IOC.

# Comments From the Department of Defense



(S&TNF)

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

WASHINGTON, DC 20301-3010

3 4 001 1988

Mr. Frank C. Conahan  
Assistant Comptroller General  
National Security and International  
Affairs Division  
U.S. General Accounting Office  
Washington, DC 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "NAVY STRATEGIC FORCES: Trident II Proceeding Towards Deployment," dated September 29, 1988 (GAO Code 394238), OSD Case 7784.

The DoD has reviewed the report, concurs with the GAO findings and conclusions, and has no further comments. The Department appreciates the opportunity to comment on this draft report.

Sincerely,

A handwritten signature in cursive script, appearing to read "Robert C. Duncan".

Robert C. Duncan

Enclosure

# Major Contributors to This Report

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