

PROTEUS FACT SHEET

Mission..... Especially re-outfitted as the nations first tender to service and repair nuclear powered fleet ballistic missile submarines and their Polaris missiles.

Original Builder..... Moore Shipbuilding and Drydeck Company of Oakland, California

Keel Laid..... 15 September 1941

Commissioned..... 31 January 1944

Decommissioned ..... 26 September 1947 - New London, Conn.

Conversion..... Placed in drydock 8 June 1959 at Charleston Naval Shipyard, Charleston, S.C.

Recommissioned..... 6 July 1960

Length..... 573 feet 6 inches (Includes 44 feet added amidships)

Beam..... 73 feet 4 inches

Displacement..... 18,500 tons

Draft..... 23 feet 6 inches

Trial Speed..... 15.4 knots

Personnel Assigned..... 980 Officers and men

World War II..... As flagship of Submarine Squadron 20, PROTEUS tended submarines at advanced based in Pearl Harbor, Midway and Guam. Later, as a participant in the surrender and occupation of the Japanese home island, she berthed at Yokosuka and was given the mission of supervising demilitarization of all Japanese submarines, human torpedoes, torpedo carrying-suicide boats at Yokosuka and other locations in the Sagami Wan-Tokyo Bay areas.

Post War..... PROTEUS served as flagship of Submarine Squadron EIGHT, berthed at New London, until decommissioning.

(more)

**Re-Construction.....**At the Charleston Naval Shipyard the Proteus was cut in half amidships. The after section, with most machinery, was made water tight. The dock and the forward section were flooded and the after section was floated 44 feet down the ways, where it was re-positioned in alignment with the fixed forward section. On July 22, mass welding joined the two sections with sub-assemblies which formed the base of a reconstructed, six-deck high, 500 ton mid-section.

**Special Characteristics...**A 34 by 20 foot repair center on the after port side of the main deck of Proteus has been designed by Sperry Gyroscope Company to handle navigational repairs and replacements at sea of the missile-like guidance-navigation system of the Polaris submarine. The repair center houses a working navigational system (to check against those on the submarines) with almost all of the instruments used in the submarine together with simulation equipment, test panels, and ovens to store the temperature-critical inertial elements.

Proteus has support facilities for the nuclear propulsion plants on fleet ballistic missile submarines.

Proteus has the capacity to store and maintain Polaris missiles.

## HISTORY OF SHIPS NAMED PROTEUS

USS PROTEUS (AS 19) is the third ship of the Fleet named for a prophetic Sea God in the service of Neptune. When seized he would assume different shapes to escape prophesying.

The first PROTEUS was a wooden screw steamer purchased at New York from William P. Williams on 5 October 1863. She was rigged as a schooner and had a length of 203 feet; beam 36 feet; draft of 13 feet 9 inches; and a maximum speed of 11 knots. She was armed with one 100-pounder Parrott rifle; two 30-pounder Parrott rifles; six 32-pounders; and two 12-pounder rifles.

PROTEUS was commissioned in the New York Navy Yard on 15 March 1864, Commander Robert W. Shufeldt in command. She received a crew of 94 men and 6 boys.

The second PROTEUS was a fuel ship built for the Navy Collier Service by the Newport News Shipbuilding Company of Newport News, Virginia. Her keel was laid 31 October 1911 and she was launched 14 September 1912, under the sponsorship of Miss Lucy Day Martin, daughter of United States Senator Thomas S. Martin of Virginia. The fuel ship was placed in commission in the Norfolk Navy Yard on 9 July 1913 and turned over the command of Master Robert J. Easton of the Naval Auxiliary Service.

PROTEUS had an overall length of 522 feet; extreme beam, 63 feet; depth in hold of 36 feet, 9 inches; full load displacement, 19,080 tons; mean draft, 27 feet, 8 inches; speed, 15 knots; and a complement of eleven officers and 147 men. She had a cargo capacity of 10,500 tons for coal and could carry 3,081 tons of oil. After the United States entered World War I she was armed with four 4-inch .50 caliber guns.

The third PROTEUS (AS-19) was built by the Moore Shipbuilding and Dry Dock Company of Oakland, California. Her keel was laid 15 September 1941 and she was launched on 12 November 1942, under the sponsorship of Mrs. Charles M. Cooke, Jr., wife of Captain Cooke who was in command of the battleship PENNSYLVANIA. The submarine tender was commissioned in the Hunter's Point U.S. Naval Drydock at San Francisco on 31 January 1944, Captain Robert W. Berry, USN, in command.

PROTEUS had an overall length of 529 feet 6 inches; extreme beam, 73 feet 4 inches; standard displacement, 18,000 tons; mean draft 23 feet 6 inches; trial speed, 15.4 knots; and accommodations for 84 officers and 1,555 men. She was armed with four 5-inch .38 caliber guns and four twin 40-mm anti-aircraft mounts.

PROTEUS left the yard for her first trial run in San Francisco Bay on 11 February and began shakedown training in local waters out of San Diego on the 17<sup>th</sup>. This duty included running the measured mile, maneuvering in formation; anti-aircraft firing, simulated attack by submarine, damage control problems, night illumination battle practice, firing at surface targets, and the repelling of simulated attacks of dive and torpedo bombers.



She passed her final inspection on 29 February and underwent alterations while taking on supplies and submarine spare parts in the Mare Island Navy Yard. She became flagship of the newly formed Submarine Squadron TWENTY on 2 March and stood out of San Francisco Bay on 19 March. PROTEUS moored in berth 20 of the Pearl Harbor Submarine Base on 25 March 1944 to tend the submarines of Submarine Squadron TWENTY. In the following weeks she refitted submarines ASPRO (SS 309), BATFISH (SS 310), and gave voyage repairs to submarine PINTADO (SS 387).

On 29 April 1944 PROTEUS got underway from Pearl Harbor and moved in a specified safety land under the escort of PC-485 for Midway Atoll where she arrived on 3 May. Her operations at this base until 1 December 1944 included the completion of 51 voyage repairs and 14 refits for submarines. During this time she also gave voyage repairs to two patrol yachts, a submarine chaser, a minesweeper, and refitted patrol yacht AZURLITE (PY 22). Among the forty-four different submarines tended during this duty were such famous names of the silent service as SKATE, SEAHORSE, GATO, SWORDFISH, SNOOK, SCAMP, SARGO, and SUNFISH.

PROTEUS cleared Midway on 1 December 1944 and reached Pearl Harbor on the 4<sup>th</sup> for voyage repairs. She took time out to give a modified refit to CHARR (SS 328), then completed refits to LAGARTO and GROUPER. On 5 February 1945 she got underway for Guam, Marianas Islands. Steaming in company with two merchant ships, she was escorted by ocean escorts THADDEUS PARKER (DD 369) and DOHERTY (DE 14). Eniwetok Atoll came in sight on 13 February 1945 and PROTEUS entered Apra Harbor, Guam, on the 16<sup>th</sup> to moor in berth 20. She had completed four voyage repairs and twenty-four refits by 7 August. QUILLBACK (SS 424) and GUNNEL (SS 253) shared honors for the last refit accomplished at Guam (24 July-7 August 1945). As each undersea warrior returned from patrol PROTEUS gave them every attention. Fresh fruit, ice cream, and mail were taken on board immediately. Medical and dental care was arranged for all men. All their laundry was promptly done and the men were given immediate transportation to a rest and recuperation camp while PROTEUS and the relief crews thoroughly cleaned their submarine, refueling and stocking provisions, and in every way, getting them ready again for sea.

On 15 August 1945, the Commander Submarine Force, U.S. Pacific Fleet, Vice Admiral Charles A. Lockwood, Jr., U.S. Navy ordered PROTEUS and Commander Submarine Squadron TWENTY to proceed to Japan for participation in the invasion, surrender and occupation of the Japanese home islands. She got underway from Apra Harbor the next day, steaming in company with submarine rescue vessel GREENLET (ASR 10) and under the escort of USS DALE (DE 353). PROTEUS carried additional experienced submariners from units in Guam in order to make available the maximum number of prize crews to man enemy submarines which might be captured on the high seas or seized in Japan proper. She made rendezvous with units of the THIRD FLEET and became the flagship of a 26-ship support group which steamed off the coast of Honshu until 26 August when four Tank Landing Ships of LST Group Eight-Six joined the formation. That

night orders were received to proceed to an assigned anchorage in Sagami Wan, off Honshu, Japan, preparatory to entering Tokyo Bay. At high noon the next day PROTEUS intercepted a dispatch to Commander THIRD FLEET which gave information of an aircraft contact with Japanese submarine I-400 flying the designated surrender colors at latitude 38°-40' North; longitude 143°-12' West. Meanwhile plane contact was made on a second Japanese submarine, I-14, flying surrender colors at 37°-42' North and longitude 144°-52' East. Two of the twelve previously formed prize crews, each consisting of four officers and forty men, made ready for departure. Commander Hiram H. Cassidy, formerly of the submarine TIGRONE (SS 419) was given command of the first prized crew which was transferred to ocean escort WEAVER (DE 741) for transportation to the captured submarine I-400, largest submarine in the world at that time. Commander Clyde Stevens, former commanding officer of PLAICE (SS 309) took his crew aboard the BANGUST (DE 739) for transportation to the captured I-14.

PROTEUS anchored in Sagami Wan, Honshu, Japan, the late afternoon of 28 August 1945 and three demilitarization units immediately went ashore to occupy the Yokosuka Submarine Base. Shortly after daybreak on 29 August, the captured I-14 and I-400 moored alongside to port. These submarines accompanied PROTEUS to her new anchorage within the breakwater of the Yokosuka Naval Base on the 31st. Here the group was joined by Japanese Submarine I-401 who had been intercepted on the high seas by USS SEGUNDO (SS 398) and forced into port. Submarine Squadron TWENTY on board PROTEUS was given the mission of demilitarizing all submarines, human torpedoes, torpedo carrying boats, and suicide boats at Yokosuka and other locations in the Sagami Wan-Tokyo Bay areas. PROTEUS was given the immediate assignment of service as issue ship for food-stuffs, clothing, ships stores, and special items for repatriate prisoners of war. Nested alongside her for tending and repairs were the PILOTFISH (SS 386), TIGRONE (SS 419), HAKE (SS 256), ARCHERFISH (SS 311), MUSKALLUNGE (SS 262), CAVALLA (SS 244), RAZORBACK (SS 395), HADDO (SS 555), and SEGUNDO (SS 398).

Vice Admiral Charles A. Lockwood, Jr., U.S. Navy, took quarters on board PROTEUS on 30 August, having been designated to represent the U.S. Naval submarine forces at the formal signing of the surrender documents on 2 September on board the mighty battleship MISSOURI (BB 63). His flag was raised on the Japanese submarine I-400 during the signing of the surrender ceremonies and remained flying there for several hours. He left PROTEUS and the area the next morning.

All twelve American Submarines got underway from alongside on 3 September and PROTEUS spent the next ten days converting the three Japanese submarines into American standard of cleanliness and repairs. On 13 September 1945 these submarines commenced the first of a series of surface trials and on the 29th. Vice Admiral John H. Towers came on board for an informal inspection of the captured submarines. Meanwhile the diving activities of PROTEUS' officers and men included inspection of 33 Japanese midget submarines, underwater inspection of mooring buoys for cruiser SAN DIEGO (CL 53) and numerous smaller ships in the harbor; underwater inspection of the sunken Japanese cargo submarines for intelligence purposes, in water ranging from 30 to 150 feet in depth.

PROTEUS was homeward bound from Yokosuka on 1 November 1945, fueling at Guam from YO-108 and undergoing brief voyage repairs at Pearl Harbor before transit of the Panama Canal on 6 December 1945. She put 154 enlisted men ashore at Norfolk for separation from the Naval Service, and reached the Submarine Base of New London, Connecticut, on 16 December 1945. Moored to the State Pier of New London she tended various submarines and often served as temporary flagship for Commander of Submarine Squadron EIGHT. She took time out for overhaul in the Portsmouth Navy Yard (14 March-23 July 1946) and departed New London on 4 August with men on board for passage to St. Thomas, Virgin Islands, thence to Balboa where she debarked men for duty on submarines based at that port of the Canal Zone.

PROTEUS returned to New London on 9 August 1946 when Captain Edwin A. Swinburne came aboard and hoisted the flag of Commander Submarine Squadron EIGHT. She continued as his flagship, tending submarines at New London, and steaming from the base on 4 November 1946 for duty with submarines of the squadron at the Naval Operating Base of Argentia, Newfoundland. She cleared the last named port on 21 November 1946 and resumed tending operations at New London on the 25<sup>th</sup>. While engaged in this duty on 23 June 1947, Captain Edwin A. Swinburne hauled down his personal pennant as Submarine Squadron EIGHT and was detached to duty in Washington, D.C. Three days later she unshackled from her tending buoy and stood up the Thames River for assignment to the New London Group of the U.S. Atlantic Reserve Fleet. She was decommissioned on 26 September 1947. That same day she was placed in the service of the New London Submarine Base. She continued to give vital service for that command until 15 January 1959 when she arrived in the Charleston Naval Shipyard.

Selection of the Fulton-class submarine tender for conversion to the space age role resulted from a 1958 Lockheed Aircraft Corp. proposal for missile handling aboard various classes of submarine tenders, prepared at the request of the Navy Special Projects Office, in charge of Polaris weapons system development. She arrived on 15 January 1959 in the Charleston Naval Shipyard for conversion to the first tender for fleet ballistic missile submarines.

Placed in drydock the ship was cut in half amidships. The re-outfitting of the PROTEUS was without precedent in Naval annals. The job presented drydocking and engineering problems which the Charleston Naval Shipyard overcame with novel but highly satisfactorily solutions. Simple conversion of an existing tender wasn't enough. More space was needed. Specifications called for a six-deck high addition at midships weighing 500 tons, 44 feet long, and 73 feet at the beam. The solution to the problem was achieved by cutting the ship in drydock, sealing the after end which contained mostly machinery, flooding the forward end, floating the after end into position 44 feet down ways and building the 44 foot section in place in the drydock. In the unexpected short time of two days and on 8 June 1959 she was in half amid-ships. On 22 July 1959 mass welding work was completed and the work proceeding from that point became mere routine.



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Builder's trials were held at sea on 19 April 1960. The Navy acceptance trials were held 5, 6 and 7 July 1960 with the PROTEUS making her second sea run since her conversion on the 6th. She returned as a ship of the fleet on 8 July 1960. Recommissioning ceremonies were held on board at the Charleston Naval Shipyard.

PROTEUS departed Charleston on 8 August 1960 for shakedown and refresher training at Guantanamo Bay, Cuba. Upon completion she returned to Charleston on 28 August 1960 to complete post shakedown availability. On 16 November PROTEUS got underway for Norfolk, Virginia where she was depermed. Upon returning to Charleston on 22 November PROTEUS remained on a Restricted Availability status. PROTEUS departed Charleston on 16 January 1961 and arrived at New London, Connecticut on 18 January 1961. She remained there until 21 February at which time she proceeded to Scotland for the refitting of POLARIS submarines at Holy Loch in the Firth of Clyde. PROTEUS arrived on 3 March as the first unit of the POLARIS submarine replenishment anchorage.

PROTEUS was not awarded engagement stars for operations during World War II but she gave vital service to fleet submarines who sent hundreds of enemy ships to the bottom of the Pacific. The highest score achieved among the submarines she tended was by SEAHORSE, officially credited with sinking twenty (20) ships during her career. PROTEUS earned the Navy Occupation Service Medal (ASIA) for the period 2 September - 31 October 1945. She is also authorized to display, painted upon an appropriate location, replicas of the American Campaign Ribbon, Asiatic-Pacific Campaign Ribbon, and the Navy Occupation Service Ribbon (ASIA).

#### LIST OF COMMANDING OFFICERS

Captain Robert W. BERRY, USN:	31 JAN 1944 - 12 SEP 1944
Captain Charles N. DAY, USN:	12 SEP 1944 - 4 SEP 1945
Captain James A. JORDAN, USN:	4 SEP 1945 - 27 APR 1947
Captain Richard C. LAKE, USN:	27 APR 1947 - 26 SEP 1947
Captain Richard B. LANING, USN:	8 JUL 1960 -

USS PROTEUS (AS-19)  
c/o Fleet Post Office  
New York, N.Y.

THE REPLENISHMENT ANCHORAGE CONCEPT

Holy Loch has been selected as the replenishment anchorage for the first Polaris submarine squadron which currently is composed of the depot ship (tender in the U. S. Navy) PROTEUS and four fleet ballistic missile submarines; USS GEORGE WASHINGTON (SSB(N)-598), USS PATRICK HENRY (SSB(N)-599), USS ROBERT E. LEE (SSB(N)-601) and the USS THEODORE ROOSEVELT (SSB(N)-600). These ships comprise Commander Submarine Refitting Group, Clyde which will be built up within the next year and a half to ten FBM submarines and a floating drydock. The submarines will be supported from Holy Loch where they will appear periodically for repairs and maintenance, stores and provisions re-supply, and crew exchanges. The PROTEUS will be at the center of this activity in Holy Loch where she will perform the combined missions of a hotel, a modest shopping center, and a minor naval industrial activity.

In the capacity of providing hotel facilities the PROTEUS is equipped:

a. To provide berthing accommodations for about 1200 persons including sufficient accommodations for two off-ship submarine crews.

b. With messing facilities consisting of a galley, two cafeteria mess lines, a butcher shop, a bakery, and auxiliary facilities to prepare vegetables, wash mess gear, etc.

c. To provide all required services that are normally available in a small community. Examples of these are:

(1) Barber Shop.

(2) Ship's Store for sundries, necessities for shipboard living, and low cost luxury items.

(3) Soda Fountain for ice cream and soft drinks.

(4) Small Stores for articles of uniform.

(5) Cobbler Shop.

(6) Tailor Shop.

(7) Dry Cleaning and Laundry plants.

(8) Post Office.

d. To provide all the necessary utilities such as heat, light, electrical power, water (fresh water evaporated from sea water), compressed air, gases (oxygen and nitrogen manufactured on board).

e. To provide necessary medical and dental care which includes a well equipped operating room, sick-bay, X-Ray, prosthetics laboratory, pharmacy and so forth.



The PROTEUS is provisioned as a small Navy supply depot. In her holds and storerooms she stocks many thousands of items including food for herself and the submarines tended, lubricants of every nature, repair parts ranging in value from a few cents to many thousands of dollars each, common issue items such as paper, paint, industrial gases, etc. To illustrate the scope and complexity of supplies carried by the PROTEUS, her stocks are capitalized at approximately four million dollars which represents 65,000 distinct kinds of items for issue that in turn represents an uncountable number of individual items numbering in the millions. To keep up-to-date an accurate account of all materials stocked on board, an electrical accounting machine (EAM) installation has been provided. This facility keeps track of all accounts, issues, receipts, and controls re-ordering.

Finally the PROTEUS is equipped as a small industrial activity. She has the well equipped shops found on any submarine tender (depot ship) of which are:

Gyro Shop	Electrical Shop
Foundry	Shipfitters Shop
Inside and Outside Machine Shops	Carpenter Shop
Pattern Shop	Printing Shop
Photographic Shop	Pipe Shop
Welding Shop	Battery Shop
Torpedo Shop	Electronic Shop
Optical Shop	Watch Repair Shop
Typewriter Repair Shop	Rubber and Plastics Shop
Engraving Shop	Instrument Repair Shop

In addition to the normal repair capabilities illustrated by the above listing of shop facilities, the PROTEUS is further equipped with unique capabilities associated with Polaris missiles and nuclear propulsion systems. These additional capabilities include shops and test equipment to monitor, check-out, and repair missiles, missile components, supporting subsystems, and repair parts. The nuclear reactor plant serving capability includes specially designed clean areas, decontamination facilities, liquid and solid radioactive waste storage facilities, health physics laboratory, and instrumentation calibration equipment.

To serve all shops involved in precision work electronic, electrical, and mechanical standards laboratories have been recently expanded.

Later in the year the PROTEUS will be joined by a large floating drydock (AFDB) which will provide the replenishment anchorage at Holy Loch with the ability to repair Polaris submarines' underwater body, hull fittings and appurtenances. The drydock will have a complement of approximately 150 officers and men assigned to maintain and operate the dock; although, most repair work on the submarines will be accomplished by the PROTEUS' repair forces.

The replenishment anchorage complex will be re-supplied from continental United States, primarily, by the monthly arrival of a U.S. Navy cargo ship except for critical high cost technical items which will be delivered by Military Air Transport Service (MATS) at Prestwick, Scotland.

In conclusion, the Polaris system must depend upon the technical competence of the officers and men assigned. The PROTEUS has on board nearly 1000 men who all contribute. Many have received very special training representing up to several years of schooling at premium costs. To mention a few of the added requirements of the Polaris tender, men have been specially trained in digital and analog computers, instrument calibration, special quality control and inspection techniques, optical alignment, and systems analysis. PROTEUS personnel receive approximately one hundred thousand dollars a month in pay which does not include their savings or family allotments. These men comprise nearly every rate in the Navy today and even include a Marine Corps detachment which is unique in that PROTEUS and large combatant ships alone have Marine assigned to the ship's company. The mission of all these men is to maintain the submarines invulnerable and ever-ready at sea.

## THE POLARIS FLEET BALLISTIC MISSILE

### WEAPON SYSTEM FACT SHEET

#### The Status

The U. S. Navy's fleet ballistic missile (FBM) weapon system, became an operational reality on November 15, 1960, when the nuclear-powered submarine USS GEORGE WASHINGTON (SSB(N) 598) left Charleston, S.C., to go on patrol with a full load of tactical POLARIS missiles. Near the end of 1960 she was joined in her silent domain by the USS PATRICK HENRY (SSB(N) 599) also fully loaded with POLARIS ballistic missiles.

#### The System

Besides the missile itself, the fleet ballistic missile weapon system includes nuclear powered missile launching submarines, support facilities, and personnel. The system became operational more than two years ahead of the original schedule. All phases of the program were brought along in parallel and through inter-locking channels designed to have each component ready at the target date.

The first launching of a POLARIS test vehicle from a submerged submarine took place on July 20, 1960, about 30 miles at sea off Cape Canaveral, Florida, at 12:39 p.m. EST. Less than three hours later, at 3:32p.m. EST, GEORGE WASHINGTON fired a second POLARIS.

The POLARIS weapon system development is being managed for the Navy by the Director of the Special Projects Office, Vice Admiral William F. RABORN, Jr. Assisting him is an imposing team of Navy missile experts, major industrial firms, and scientific leaders.

Operational ballistic missile submarines are under the control of the Commander in Chief, U. S. Atlantic Command who exercises his authority through the Commander in Chief, U. S. Atlantic Fleet and Commander, Submarine Force, U. S. Atlantic Fleet.

The Special Projects Office will continue to manage the research and development programs for longer range versions of POLARIS missiles, advanced versions of POLARIS firing submarines and associated equipment.

#### The Concept

With almost unlimited cruising range and with endurance limited only by the crew, the FBM nuclear submarine is capable of extended submerged operation in the international waters of the world which comprise about 70 percent of the earth's surface. Free of the need to surface or extend a snorkel above the surface for continuous operation, FBM nuclear submarines will remain hidden by an oceanic curtain, their locations unknown to any potential enemy. The POLARIS



missiles, powered by solid propellant, will be ready for launch within minutes of receiving the command without the need for long countdown. Mobile, hidden, ready for instant action (or carefully considered delayed action), the FBM system will provide a powerful deterrent to those who might start a global war.

### The Missile

POLARIS, named for the North Star, is a two stage ballistic missile about 28 feet long, about four and one-half feet in diameter and weighs about 30,000 pounds. It is powered by solid fuel rocket motors and guided by a self-contained inertial guidance system independent of external commands or control. Propellant is basically a polyurethane compound with light metal additives for higher specific impulse. Each motor exerts thrust through four nozzles in the motor base. Thrust vector (direction control) is exercised by devices called jetavators. Range of the missile is 1200 nautical miles (1380 statute miles). Future development will give the missile a range of 1500 nautical miles by 1962 and later a range of about 2500 nautical miles.

### Missile Guidance

The inertial guidance system used in POLARIS is a refinement of earlier inertial systems and is the smallest in use in U. S. ballistic missiles. Using extremely precise gyroscopes, accelerometers and its own electronic computer, the guidance system puts the missile on correct course at the time of launch. Should the missile be moved off course by high winds or other effects, the guidance system automatically computes a new correct course and puts the missile on it. The guidance system also maintains the stability of the missile in pitch, yaw and roll planes. At the precise instant required, the guidance system shuts off the rocket motors and triggers separation of the re-entry body from the missile. The re-entry body then follows a ballistic trajectory to the target.

### The FBM Submarine

FBM Submarine of the GEORGE WASHINGTON class are about 380 feet long with a beam of about 33 feet and displacement of about 5900 tons. ETHAN ALLEN class submarines will be about 410 feet long and displace about 6900 tons. Both classes are driven by steam turbines powered by water-cooled nuclear reactors. Both classes carry 16 POLARIS missiles stowed in eight pairs of vertical launching tubes in the space immediately behind the sail. Each submarine has a 300 ton capacity air-conditioning plant. FBM submarines are also equipped with air scrubbers and precipitators to remove irritants from the air and maintain the proper balance of oxygen, nitrogen and other atmospheric elements. Electrolytic oxygen generators under development will permit the submarine to manufacture its own oxygen from sea water.

## Navigation

Two positions must be known for success in missile launching: Target and launcher. In the FBM system this puts great importance on navigation since the position of the launcher is the position of the ship and is continuously changing. Several methods complement each other in the FBM submarine to provide a very high order of accuracy in determining ship's position. Heart of the system is the Ship's Inertial Navigation System (SINS), a complex system of gyroscopes and accelerometers which relates movement of the ship in all directions, ship speed through the water and over the ground, and true north to give a continuous report of the ship position.

Each submarine has three SINS, each checking on the other. Systems similar to the SINS used in FBM submarines guided the NAUTILUS and SKATE on their historic voyages beneath the polar ice in 1958 and, more recently, TRITON on her 84 day underwater cruise around the world. The converted Mariner class cargo ship, USS COMPASS ISLAND (EAG 153), serving as navigation test ship has steamed well over 100,000 miles in development tests of the submarine navigation system. A number of equipments are included in the submarine navigation system to provide an all weather capability of checking on the accuracy of SINS. These include both optical and electronic devices. All are highly automated.

## Fire Control

The fire control system feeds coordinated information to the missile guidance system as to ship location, local vertical, true north, target location and trajectory to be flown. Corrections are supplied until the instant of fire. The fire control mechanism can prepare for launch at the rate of about one per minute.

## Communications

Radio communications with submerged submarines has been possible for a number of years. The systems used have been devised with special care to protect the location of the submarine and leave the advantage of concealment unimpaired. Recent tests have again demonstrated that the Navy's world-wide communication system has the power and coverage necessary to exercise command of the always-submerged FBM submarines.

## Launching

POLARIS missiles are launched by an air ejection system which forces the missile from its launching tube and propels it up through the water to a point above the surface. At that point the rocket motor ignites and sends the missile on its way. The system takes advantage of the reliability and instantaneous ignition characteristics of solid propellant fuel used in POLARIS. The result is increased safety for submarine and crew. Each launching tube has its own air supply and is independent of the other 15 tubes. Vital parts of each missile are accessible for inspection and maintenance even when loaded in the launching tubes and while the submarine is underway at sea.

## Personnel

Each FBM submarine has two crews, called Blue and Gold, of about 100 men and officers. The crews will alternate on the long patrols with the off-duty crew employed in training ashore at specially designed team training simulators.

## Training

The average pre-commissioning training period for FBM personnel is about eight to twelve months. Initially training was conducted by the factories supplying the equipment but the Navy now has its own training facilities. After pre-training in transistor theory, digital computing theory, Boolean logic, and electronic circuitry, FBM personnel get an intensive and extensive equipment training course. Maintenance instruction culminates in a course devoted to the functioning of the entire weapon system.

## Supporting Facilities

Support facilities include missile testing sites, Naval Shipyards, submarine tenders, an experimental test firing ship and a navigational test ship.

Chief testing site is the Atlantic Missile Range, Cape Canaveral, Florida. The Navy complex includes three launching pads, a missile assembly building, missile check-out building, engineering building and associated supply and maintenance buildings and shops. Two of the launching pads are conventional flat pads and the third is the unique ship motion simulator which mounts a submarine type launching tube in a 200 ton hydraulic device which can simulate all the motions of a ship at sea.

USS OBSERVATION ISLAND (EAG 154) experimental missile test firing ship is based at Port Canaveral. The ship, a post World War II Mariner class cargo ship modified extensively to serve as a firing test ship, has a complete submarine type fire control, navigation and launching system. The ship serves as both a floating launch complex for missile flight testing and as a working example of the kind of installation which could be placed aboard surface ships. OBSERVATION ISLAND has served the additional role as floating school for training FBM submarine crews and will be the seagoing link between the Atlantic Missile Range and FBM submarines when they visit the Cape for training with live test vehicles.

Flight tests of POLARIS are conducted at Cape Canaveral. Other tests on various parts of the missile have been conducted at Point Mugu, Sacramento, San Francisco, and China Lake in California, at San Clemente Is. off the California coast, and in Carderock and Cumberland, Maryland.

Among naval shipyards being equipped to meet the special requirements of the FBM submarines are Portsmouth, New Hampshire and Charleston, South Carolina.



A Naval Weapons Annex at the Naval Ammunition Depot, Charleston, has been commissioned to serve as a missile assembly and loading point. Here completed sections and subsystems of the missile, including motors, controls, guidance, etc., are being received from contractor plants, assembled, checked out and stored or loaded aboard FBM submarines.

The submarine tender, USS PROTEUS (AS-19) has been fitted out and deployed to provide supplies, service and all but major repairs to the FBM submarines. This includes supplying missiles and loading them into submarines. A second tender is under construction.

## Chronological Development of the Fleet Ballistic Missile System Program

- 28 Nov 1955 Navy stated long range objective to develop a solid propelled ballistic missile for use in submarines.
- 20 Mar 1956 OSD Ballistic Missile Committee approved Navy's solid propellant program for component development to determine weapon system feasibility.
- Mar 1956 Authorization received for a navigation development program, a weapon system test and development program, an FBM surface combatant development program, and an FBM submarine development program.
- Dec 1957 SECDEF authorized acceleration of the POLARIS program to achieve completion of the first POLARIS Submarine weapon system in 1960.
- Jan 1958 Navy Proposed that program be further accelerated and augmented.
- 11 Jan 1958 First FBM test flight, Pt. Mugu, California.
- 24 Sept 1958 First POLARIS AK test vehicle flight, Cape Canaveral, Florida
- 9 Jun 1959 First FBM submarine, USS GEORGE WASHINGTON, launched, Groton, Connecticut.
- 14 Aug 1959 First air-eject launched test flight, Cape Canaveral, Florida
- 27 Aug 1959 First seaborne launch of a large solid propellant ballistic missile (USS OBSERVATION ISLAND at sea off Cape Canaveral, Florida).
- 21 Sep 1959 First POLARIS ALX test vehicle flight, Cape Canaveral, Florida
- 30 Dec 1959 First FBM submarine, USS GEORGE WASHINGTON, commissioned, Groton, Connecticut.
- 7 Jan 1960 First inertially guided POLARIS test vehicle flight, Cape Canaveral, Florida.
- 29 Mar 1960 First fully integrated FBM system test. (ALX test vehicle launched from USS OBSERVATION ISLAND. Submarine type navigation, fire control and launching equipment used. Missile inertially guided).

- x-355001
- 14 Apr 1960 First successful underwater launch of a large solid propellant ballistic missile, San Clemente Island, California. (POLARIS flight test vehicle using reduced quantity of propellant to produce planned 23 second flight. Launched from static underwater launcher.)
- 25 Apr 1960 First 1000 nautical mile POLARIS test vehicle flight.
- 20 Jul 1960 First launch of POLARIS test vehicle from submerged nuclear FBM submarine (USS GEORGE WASHINGTON) at sea off Cape Canaveral, Florida. (Second POLARIS launch, same date, two hours and fifty-three minutes after first.)
- 15-18 Oct 1960 USS PATRICK HENRY successfully fired four POLARIS test vehicles 500 miles at sea under operational rather than test conditions.
- 10 Nov 1960 First test vehicle in the second generation 1500 nautical mile range POLARIS A-2 was successfully launched at Cape Canaveral, Florida. Missile went over 1400 nautical miles.
- 15 Nov 1960 USS GEORGE WASHINGTON (SSB(N) 598) departed Charleston, South Carolina to go on operational patrol.
- 30 Dec 1960 USS PATRICK HENRY (SSB(N) 599) departed Charleston, South Carolina on operational patrol.
- 3 Mar 1961 USS PROTEUS (AS 19) arrived Holy Loch, Scotland and established the overseas replenishment anchorage.



## Ship Building

Fourteen Fleet Ballistic Missile Submarines were authorized as of 25 July 1960. Two were in commission, three were launched, four were under construction, and authorization to start construction on five more had been granted. They are listed below with significant dates, builder, sponsor and Commanding Officer(s). In addition, authority to procure long lead items on five more has been granted, making a total of nineteen.

### USS GEORGE WASHINGTON (SSBN 598)

Keel laid	(See note below) 1 November 1957
Launched	9 June 1959
Commissioned	30 December 1959
Builder	Electric Boat Division, General Dynamics Corp.
Sponsor	Mrs. Robert B. ANDERSON
Commanding Officer	CDR James B. OSBORN (Blue Crew) CDR John L. FROM, Jr. (Gold Crew)

NOTE: USS GEORGE WASHINGTON, laid down as USS SCORPION, was later cut in two and had a 130 foot missile section inserted to convert the hull to the first FBM submarine.

### USS PATRICK HENRY (SSBN 599)

Keel laid	27 May 1958
Launched	22 September 1959
Commissioned	9 April 1960
Builder	Electric Boat Division, General Dynamics Corp.
Sponsor	Mrs. Leslie C. ARENDS
Commanding Officer	CDR Harold E. SHEAR (Blue Crew) CDR Robert L. J. LONG (Gold Crew)

### USS THEODORE ROOSEVELT (SSBN 600)

Keel laid	20 May 1958
Launched	3 October 1959
Commissioned	13 February 1961
Builder	Mare Island Naval Shipyard
Sponsor	Mrs. Alice Roosevelt Longworth
Commanding Officer	CDR William E. SIMS (Blue Crew) CDR Oliver H. PERRY (Gold Crew)

### USS ROBERT E. LEE (SSBN 601)

Keel laid	25 August 1958
Launched	18 December 1959
Commissioned	16 September 1960
Builder	Newport News Shipbuilding & Drydock Co.
Sponsor	Mrs. Hanson E. ELY
Commanding Officer	CDR Reuben F. WOODALL (Blue Crew) CDR Joseph WILLIAMS, Jr. (Gold Crew)

USS ABRAHAM LINCOLN (SSBN 602)

Keel laid 1 November 1958  
Launched 14 May 1960  
Commissioned 11 March 1961  
Builder Portsmouth Naval Shipyard, New Hampshire  
Sponsor Mrs. Mary Lincoln BECKWITH  
Commanding Officer CDR Leonard ERB (Blue Crew)  
CDR Donald M. MILLER (Gold Crew)

USS ETHAN ALLEN (SSBN 608)

Keel laid 14 September 1959  
Launched 22 November 1960  
Commissioned  
Builder Electric Boat Division, General Dynamics Corp.  
Sponsor Mrs. Robert H. HOPKINS  
Commanding Officer CDR Paul L. LACY, Jr. (Blue Crew)  
CDR William W. BEHRENS, Jr. (Gold Crew)

USS SAM HOUSTON (SSBN 609)

Keel laid 28 December 1959  
Launched 3 March 1961  
Commissioned  
Builder Newport News Shipbuilding & Drydock Co.  
Commanding Officer CDR W. WILLIS (Blue Crew)  
CDR J. H. HANKINS (Gold Crew)

USS THOMAS A. EDISON (SSBN 610)

Keel laid 15 March 1960  
Builder Electric Boat Division, General Dynamics Corp.  
Commanding Officer CDR C. YOUNG (Blue Crew)  
CDR W. DEHRICK (Gold Crew)

USS JOHN MARSHALL (SSBN 611)

Keel laid 4 April 1960  
Builder Newport News Shipbuilding & Drydock Co.  
Commanding Officer CDR R. STECHER (Blue Crew)  
CDR D. DONAVON (Gold Crew)

USS LAFAYETTE (SSBN 616)

Builder Electric Boat Division, General Dynamics Corp.

**USS ALEXANDER HAMILTON (SSBN 617)**

**Builder** Electric Boat Division, General Dynamics Corp.

**USS THOMAS JEFFERSON (SSBN 618)**

**Builder** Newport News Shipbuilding & Drydock Co.

**USS \_\_\_\_\_ (SSBN 619)**

**Builder** Mare Island Naval Shipyard

**USS \_\_\_\_\_ (SSBN 620)**

**Builder** Portsmouth Naval Shipyard, New Hampshire



## Major Contractors and Government Agencies

More than 6,900 contractors and government agencies are engaged in work on the POLARIS FBM system. Some major contractors and government agencies are listed below.

<b>FBM Submarines</b>	Electric Boat Division, General Dynamics, Corp., Groton, Connecticut
	Newport News Shipbuilding & Drydock Co., Newport News, Virginia
	Mare Island Naval Shipyard, Vallejo, California
	Portsmouth Naval Shipyard, Portsmouth, New Hampshire
<b>Submarine Propulsion</b>	Westinghouse Electric Corp., Pittsburgh, Pennsylvania
<b>Navigation</b>	Autonetics Division, North American Aviation Inc., Downey, California
	Sperry Gyroscope Co., Division of Sperry Rand Inc., Great Neck, Long Island, New York
<b>Communications</b>	Sylvania Electric Products Co., Buffalo, New York
	Princeton Laboratories, RCA, Princeton, New Jersey
	Bell Telephone Labs., Whippany, New Jersey
	International Telephone and Telegraph Labs., Nutley, New Jersey
<b>Fire Control</b>	Ordnance Department, General Electric Co., Pittsfield, Massachusetts
<b>Missile Checkout</b>	Nortronics Division, Northrop Corp., Anaheim, California
<b>Launching</b>	Westinghouse Electric Corp., Sunnyvale, California
<b>Missile System Manager</b>	Lockheed Missiled and Space Division, Lockheed Aircraft, Inc., Sunnyvale, California

**Missile Propulsion**

Aerojet-General Corp., Sacramento,  
California

Hercules Powder Co., Wilmington, Delaware

**Missile Guidance**

Massachusetts Institute of Technology,  
Cambridge, Massachusetts

Ordnance Department, General Electric Co.,  
Pittsfield, Massachusetts

Hughes Aircraft Corp., Culver City,  
California

**Warhead**

Livermore Laboratories, Atomic Energy  
Commission, Livermore, California

**Instrumentation**

Interstate Electronics, Inc., Anaheim,  
California