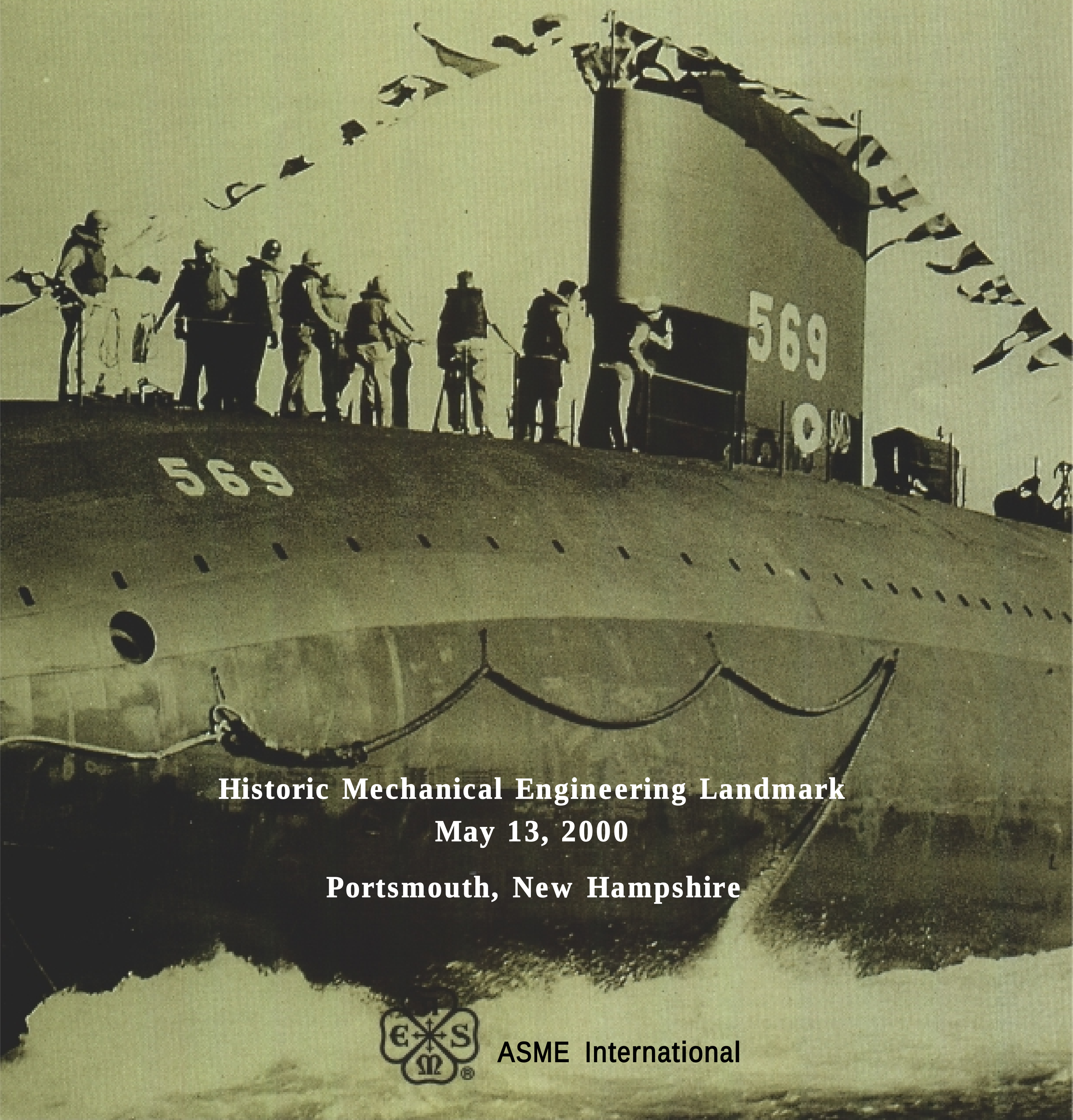
USS ALBACORE (AGSS-569)



Historic Mechanical Engineering Landmark

May 13, 2000

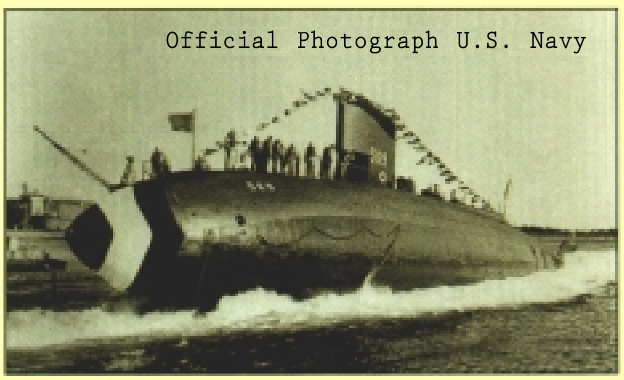
Portsmouth, New Hampshire

ASME International

Praenuntius Futuri
(Forerunner of the Future)

Albacore's motto, Praenuntius Futuri (Forerunner of the Future) describes her purpose well. She was intended as the test vessel for a generation of submarine design innovations that would point the way for submarines of the future.

Albacore's mission was experimental. She was meant to be modified, modified again and then again in a series of configurations designed to test submarine hydrodynamics. The *Albacore* is an example of the value of testing and experimentation to the engineering profession and the design process. Also, the pioneering engineers and technicians who worked on her were unknowingly developing the roots of a new technical discipline, Ocean Engineering.



The uss *Albacore* served as the floating submarine design laboratory for 19 years. During this time period she underwent five re-fits or phase conversions to test and evaluate new concepts. Much of the equipment developed and tested on the *Albacore* was fitted onto other submarines in the United States Navy. The marriage of the hull form pioneered on the *Albacore* with nuclear power technology pioneered in the USS *Nautilus* resulted in the first submarines capable of sustained underwater performance.

Introduction

Submarine operations during World War II demonstrated to the United States Navy the importance of underwater speed, maneuverability and endurance. Following the war, the Undersea Warfare Committee of the National Science Foundation issued a set of design recommendations to meet these needs. They called for a submarine with a streamlined hull constructed of new high strength steel. After many debates, the decision was made to build an experimental submarine incorporating the recommendations of the committee before proceeding with the design of a military version. Where subs had always been surface vessels that could avoid detection, for the first time, a submarine was to be designed as a vessel meant to operate under the sea instead of on the surface. This meant a complete change in design philosophy.

Like everything that involves radical change, the design issues were a subject of hot debate in the submarine community. The *Albacore* was going to test the new designs and settle the arguments once and for all.

In order to determine the optimum shape for the outer hull, the designers made extensive tests using the towing tank at the David Taylor Model Basin and at the Langley full scale tunnel. [The David Taylor Model Basin is also an ASME Landmark.] The original shape selected for study was based upon the form of the R101, a World War I dirigible. Eventually, the data from these tests was published in a document called Series 58. In order to obtain data at high Reynolds numbers, large-scale models of the *Albacore* were tested in a wind tunnel. As a result of all these tests, the optimum shape and dimensions were determined.

Design and Construction

As first proposed by Rear Admiral Charles Momsen, Assistant Chief of Naval Operations for Undersea Warfare and inventor of the Momsen Lung, *Albacore* was to be a "target" used for anti-submarine warfare practice. This ruse was necessary in order to get the approval to build her At the time, aircraft carriers had replaced the battleship as the navy's premier vessel. Since submarines were aircraft carriers' most feared adversary, approval to build her as a training tool came quickly. As a "target," *Albacore* would also be unarmed, which meant her designers would not be restricted by the requirements of numerous naval design bureaus responsible for different aspects of naval combat ships. The designers were free to follow Momsen's orders, "When in doubt, think speed."

Her keel was laid on March 15, 1952. The hull was made from a new type of steel, HY-80. HY-80 had yield strengths of 80,000 PSI, greater than any other steel available. This was the first application of that steel for a submarine pressure hull. But even with high strength steel, the dimensional restrictions required by the hull shape posed design difficulties. The hull was shorter and wider than that of WWII submarines. In order to maintain the minimum number of watertight compartments, the internal bulkheads had to be placed close together; a fact that made internal arrangements more difficult.

As originally built, her control planes and rudders were positioned aft of the propeller in a cruciform, or "+" configuration. She also had a small dorsal rudder fitted on the rear portion of the sail. The placement of control planes and rudders with respect to the propellers was a topic of many debates in the submarine community. Another topic of debate was the single propeller placed on the centerline of the hull. While this provided an increase in propulsive efficiency, it was not an accepted practice at the time. *Albacore* would be used to test various control designs and to correlate actual sea trial performance with that predicted in tow-tank tests.

Service History and Testing Operations

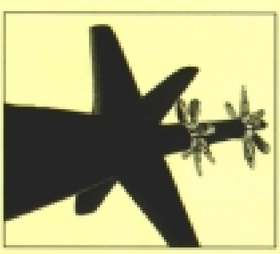
Albacore was launched on August 1,1953 and commissioned on December 5,1953.

After her initial Phase I testing was completed, *Albacore* returned to Portsmouth Naval Shipyard in December of 1955, for her Phase II conversion. The dorsal rudder mounted behind the sail was removed. It had also been found that mounting the rudders aft of the screw caused high stresses in the structural support members. Therefore, the rudders and diving planes were moved forward of the screw. Later, her screw was replaced with one larger in diameter Because of the effectiveness of the stern diving planes, the bow diving planes were also removed.

By this time, the basic teardrop hull form pioneered by *Albacore* had become standard for U.S. nuclear submarines, and other nations had begun to adopt similar shapes for their hulls.

She entered the shipyard again in November 1960 to begin her Phase III conversion. She emerged in August 1961 with a radical "X" configuration of stern planes. This configuration became popular with foreign submarine designers but has never reappeared on U.S. submarines. Other changes included adding a larger rudder behind the sail, dive brakes around her middle, and new sonar During this time, she also tested a new towed sonar array Towed sonar arrays, towed behind the submarine, are now standard on modern submarines.

One interesting side note during this phase was the installation of a parachute on *Albacore*. A B-47 bomber drag chute was borrowed from nearby Pease Air Force Base and deployed underwater in a series emergency stopping tests. While the concept did not make it past the testing phase, it does demonstrate creativity at work and the value of the *Albacore* as a test vehicle.



Her Phase IV conversion took from December 1962 to March 1965. The single screw was replaced with two concentric counter-rotating propellers. These were installed to test the capability to harness the power of nuclear steam-turbine power plants without noisy reduction gears and to attempt a further increase in propulsive efficiency. The distance between these two screws was varied throughout the testing period. A photographic system was installed for direct observation of the cavitation characteristics of the propellers. It was at this time that high capacity silver-zinc batteries replaced the usual lead-acid type. These new batteries provided the submarine with three times the power of the old lead-acid type and effectively doubled the available shaft horsepower for short duration. Also, an emergency main ballast tank blow system, part of the "Subsafe" program, was added in response to the Thresher disaster Another innovation was the testing of the "fly-around-body", a remote controlled underwater kite used to deploy antenna systems.

The fifth, and final, phase conversion was for a series of tests to increase speed. That system, and the results of the test are still classified.

Albacore twice set world submerged speed records. She was also awarded the Navy's Battle Efficiency Pennant and was granted permission to display the White "E" for overall readiness to perform her assigned mission.

Albacore Today

Albacore was decommissioned on December 1, 1972 and placed in the reserve fleet in Philadelphia. In 1982, a citizens group began the process of bringing the *Albacore* back to Portsmouth, NH, as a tangible monument to the area's naval heritage. On May 3, 1985, the Navy transferred responsibility for the submarine to the Portsmouth Submarine Memorial Association. She was towed back to Portsmouth in 1984. A permanent display site was selected that was one-quarter mile inland and 27 feet higher than the Piscataqua River. Moving the *Albacore* required dismantling 30 feet of railway trestle, crossing a four-lane highway and finally lifting it above the level of the river. This was done by enclosing the submarine in a series of earthen "locks" and literally floating her into position. She was set on her cradle on October 3, 1985 and opened to the public on August 30, 1986.

ASME History and Heritage Program

The ASME History and Heritage Recognition Program began in September 1971. To implement and achieve its goals, ASME formed a History and Heritage Committee, composed of mechanical engineers, historians of technology, and the Curator Emeritus of Mechanical and Civil Engineering at the Smithsonian Institution. The committee provides a public service by examining, noting, recording, and acknowledging mechanical engineering achievements of particular significance. The History and Heritage Committee is part of the ASME Council on Public Affairs and Board on Public Information. For further information, please contact Public Information, ASME, Three Park Avenue, New York, NY 10016-5990, 212-591-7740; fax 212-591-8676.

An ASME landmark represents a progressive step in the evolution of mechanical engineering. Site designations note an event or development of clear historical importance to mechanical engineers. Collections mark the contributions of several objects with special significance to the historical development of mechanical engineering.

The ASME Historic Mechanical Engineering Recognition Program illustrates our technological heritage and serves to encourage the preservation of the physical remains of historically important works. It provides an annotated roster for engineers, students, educators, historians, and travelers, and helps establish persistent reminders of where we have been and where we are going along the divergent paths of discovery. The USS *Albacore* is the 209th Historic Mechanical Engineering Landmark designated by ASME.

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Albacore Park
AGSS-5699

A National Historic Landmark

First Hydrodynamic Submarine

Authorized November 24,195O

Keel Laid March 15,1952

Launched August 1,1953

Commissioned December 5,1953

World's Fastest Submarine 1966

Decommissioned
December 1, 1972

Arrived at *Albacore* Park
May 4,1985

Joseph Sawtelle, President
Board of Directors

ASME Ceremony
Committee Members

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Our Thanks To:
Portsmouth Naval Shipyard
for their assistance

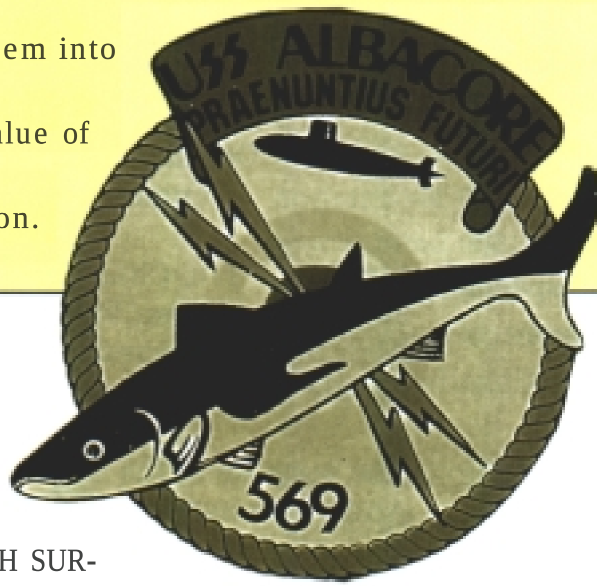
The Portsmouth Sheraton
for their support

The Officers and Crew of
USS *Albcore*

You can visit the *Albacore* at the
Port of Portsmouth Maritime
Museum & *Albacore* Park
600 Market Street, Portsmouth,
NH 03801 (603)436-3680

USS ALBACORE (AGSS-569)
Statement of Significance

The submarine USS *Albacore,* AGSS-569 (Auxiliary General Submarine) inaugurated a radical change in submarine design. Experience in World War II had shown that speed, endurance and maneuverability were key requirements for submarines. As a result of this experience, *Albacore's* hull was designed with underwater speed as the prime requirement. She was also built with a newly developed high-strength steel. Along with these two innovations, *Albacore* was to serve as a test vessel for the newest designs in submarine technology. Throughout her career she tested many innovative concepts. As a result, the United States Navy was able to refine these designs before incorporating them into the fleet. The USS *Albacore* is tangible evidence of the value of testing and experimentation to the engineering profession.



HISTORIC MECHANICAL ENGINEERING LANDMARK

U.S.S. ALBACORE

DECEMBER 1953

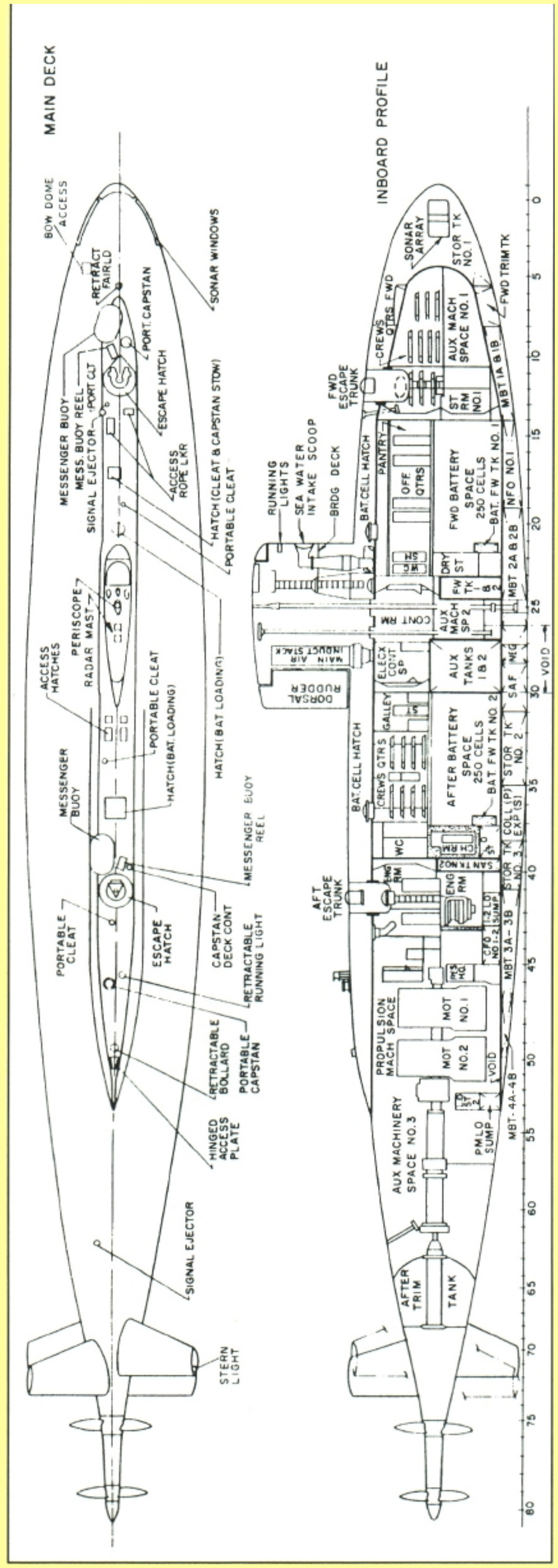
THE USS ALBACORE WAS THE FIRST NAVY-DESIGNED VESSEL WITH A TRUE SUBMARINE HULL FORM, IN WHICH SURFACE CHARACTERISTICS WERE SUBORDINATED TO REQUIREMENTS OF UNDERWATER PERFORMANCE. THE ALBACORE'S UNIQUE TEARDROP-SHAPED HULL DESIGN, THE RESULT OF YEARS OF EXTENSIVE MODEL TESTING, ENABLED HER TO SET TWO NEW UNDERWATER SPEED RECORDS WITH IMPROVED CONTROL. DURING HER NINETEEN YEARS OF SERVICE, THE ALBACORE CARRIED OUT TESTS OF SPEED, DEPTH CHANGES, AND UNDERWATER MANEUVERING. PROVING ITS SUCCESS, THE ALBACORE'S HULL DESIGN BECAME THE MODEL FOR ALL FUTURE U.S. NAVY SUBMARINES THAT FOLLOWED.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

2000

A Partial Listing of Concepts Tested on *Albacore:*

- Body of Revolution Hull with Propeller Mounted on Axis
- Low L/D Ratio of 7.5:1
- HY-80 Steel
- Stern Plane Placement Forward of Propeller
- Counter-Rotating Propellers
- Underwater Dive Brakes
- Towed Sonar Arrays
- Silver-Zinc Batteries
- Sound Dampening Technology
- High Pressure Hydraulic System
- Fly-Around-Body Antenna Deployment System
- Light Wright Radial Diesel Engines
- "X" Shaped Stern
- Dorsal Rudder
- Single Stick "Aircraft" Type Controls



Principle Ship Characteristics

Length: 205.3 feet (62.6 m)

Beam: 27.3 feet (8.3 m)

Draft: 18.6 feet (5.7 m)

Surface Displacement: 1692 tons

Submerged Displacement: 1908 tons

Test Depth: 600 feet (182.9 m)

Collapse Depth: 1170 feet (356.6 m)

Power Plant:
Two(2) General Motors 16-cylinder, two cycle radial diesel engines, 1000 BHP each

Generators:
Two(2) Elliot 710 volt, 1150 amp single armature, 817 KW each

Propulsion Motors:
Two(2) General Electric double armature, 730/925 VDC, 8000 amp per armature, 50-250 rpm,7500 HP each

Propulsion Surfaced:
(Diesel-Electric Drive), Speed: 12 Knots

Propulsion Submerged:
7500 SHP (Lead-Acid Batteries), Speed: 25 Knots

Propulsion Submerged:
15,000 SHP (Silver-Zinc Batteries), Speed: over 25 Knots

Crew: 5 officers, 50 enlisted