1. NAME OF PROPERTY

Historic Name: USS Nautilus (SSN-571)

Other Name/Site Number:

2. LOCATION

Street & Number: Not for publication:__

City/Town: Groton Vicinity:__

State: Connecticut County: New London County Code: Zip Code:

3. CLASSIFICATION

Ownership of Property		Category of Property	
Private:	___	Building(s):	___
Public-Local:	___	District:	___
Public-State:	___	Site:	___
Public-Federal:	X	Structure:	___
		Object:	X

Number of Resources within Property

Contributing	Noncontributing	
___	___	buildings
___	___	sites
___	___	structures
___	___	objects
___	___	Total

Number of Contributing Resources Previously Listed in the National Register:__

Name of Related Multiple Property Listing:

4. STATE/FEDERAL AGENCY CERTIFICATION

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this ____ nomination ____ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property ____ meets ____ does not meet the National Register Criteria.

Signature of Certifying Official Date

State or Federal Agency and Bureau

In my opinion, the property ____ meets ____ does not meet the National Register criteria.

Signature of Commenting or Other Official Date

State or Federal Agency and Bureau

5. NATIONAL PARK SERVICE CERTIFICATION

I hereby certify that this property is:

___ Entered in the National Register
___ Determined eligible for the National Register
___ Determined not eligible for the National Register
___ Removed from the National Register
___ Other (explain): ______________________

Signature of Keeper Date of Action

6. FUNCTION OR USE

Historic: Government (Naval) Sub:

Current: Museum Sub:

7. DESCRIPTION

Architectural Classification: N/A

Materials:

Foundation: N/A
Walls: N/A
Roof: N/A
Other: N/A

Describe Present and Historic Physical Appearance.

The following description of USS Nautilus is taken from Norman Pollmar and Thomas B. A11an, Rickover, (New York, 1982), pp. 161-64.

Like other postwar U.S. submarines, Nautilus incorporated several design features of the German Type 21 U-boat, including a rounded bow, straight deck lines, and streamlined "sail" structure to house the periscopes and retractable masts. There were no deck guns, a feature that further enhanced her underwater speed.

The foremost compartment of Nautilus was the torpedo room, with the inner doors of the submarine's six torpedo tubes. The tubes fired torpedoes almost twenty-one feet long, weighing some two thousand pounds.

The next compartments on the uppermost level were the crew's quarters and "officers' country." One Nautilus skipper would write that "two things impressed me almost as much as the [nuclear] plant. One was the crew, the other the comfort of habitability..." In the crew's quarters each sailor had an individual bunk with foam rubber mattress, and adjacent storage for personal items. The officers had small, shared staterooms (except for the captain, who had a private room), and a large wardroom, where the ship's dozen officers could eat, do paper work and relax.

Below these rooms were the submarine's galley, where all food was prepared, and the large crew's mess, which doubled as a classroom and movie theater. Thirty-six men could sit at one time for meals, or fifty could be accommodated for lectures or movies. This was the first submarine to have an ice-cream machine, Coke dispenser, and a nickel-a-play juke box connected to a built-in hi-fi system, which, coupled with bright interior colors, made Nautilus seem unreal to veteran submariners. At the lowermost level Nautilus had storerooms and a large electric storage battery for emergency power.

Amidships, below the sail structure, were the attack center and control room. Nearby were the small radio and sonar rooms. The sail structure was too narrow for the traditional conning-tower compartment from which submarine commanders directed underwater attacks. Other than shafts for the periscopes and masts, the sail, as in later submarines, had only a ladder in a pressure tube opening to a small exposed bridge atop the sail.

Most of the after portion of Nautilus was devoted to the propulsion plant. Behind heavy shielding was the reactor, more than two stories, high, with a narrow deck running atop the reactor to the engine and machinery rooms. Twin geared steam turbines, fed with steam from the reactor's secondary coolant system, turned the submarine's two propeller shafts. Nautilus' reactor plant, originally designated Submarine Thermal Reactor TSTR) Mark II, was identical with the Mark I plant operating in the Idaho desert. At one point, according to Rickover, a twin reactor plant had been considered, to reduce the possibility that the submarine would be disabled or lost at sea because of a reactor failure. But size was a constraint, and Nautilus was built with only one reactor. An auxiliary diesel generator, complete with snorkel installation for submerged operation, was also installed. It could bring Nautilus home in an emergency at a few knots' speed.

The aftermost compartment of Nautilus was the after crew's quarters, where the remainder of the submarine's ninety-odd crewmen were berthed. There were no stern torpedo tubes as in earlier submarines; there was just not enough space. Stuffed into corners were an automatic clothes washer and dryer, a small machine shop, a photographic darkroom, a library with several hundred volumes, and a small laboratory.

Nautilus was fully air-conditioned with a carbon-monoxide "scrubber" to remove harmful gases from the submarine's atmosphere. With fresh oxygen periodically bled into the craft from storage tanks, Nautilus could remain submerged with a completely closed atmosphere. But the crewmen could smoke as much as they liked. The air-conditioning kept the temperature between sixty-eight and seventy-two degrees and the relative humidity at about fifty percent regardless of what area of the world the submarine happened to be operating in. These features of Nautilus made ancient history of the comment of German U-boat historian Harald Busch, who, in his classic U-boats at War, wrote: "To those who have never been to sea in a submarine, it is hard indeed to convey an adequate idea of what is means to live, sometimes for months on end, in a narrow tubular space amid foul air and universal damp."

8. STATEMENT OF SIGNIFICANCE

Certifying official has considered the significance of this property in relation to other properties:
Nationally:_ Statewide:_ Locally:_

Applicable National
Register Criteria: A_ B_ C_ D_

Criteria Considerations
(Exceptions): A_ B_ C_ D_ E_ F_ G_

NHL Criteria: 1, 4

NHL Theme(s): IV. Shaping the Political Landscape
3. Military institutions and activities

VI. Expanding Science and Technology
2. Technological applications

Areas of Significance: Engineering, Military

Period(s) of Significance: 1900's

Significant Dates: 1955-80

Significant Person(s):

Cultural Affiliation:

Architect/Builder: N/A

Historic Contexts:

State Significance of Property, and Justify Criteria, Criteria Considerations, and Areas and Periods of Significance Noted Above.

“USS Nautilus"--From Idea to Reality

On January 17, 1955, a cold and windy day at the New London submarine base on the Thames River in Connecticut, a veteran submariner named Comdr. Eugene P. Wilkinson ordered the lines cast off from a submarine with the number 571 on its sail.

In outward appearance there was little to indicate that Commander Wilkinson's new command was a revolutionary ship. Three hundred and twenty feet long, 271/2 feet at the beam, and displacing 3,350 tons on the surface, the vessel was similar in hull design and configuration to other submarines based at New London. The resemblance ended in the form. Inside 571’s double hull, pressurized water circulated around the rods of a fissioning uranium pile. The water absorbed heat created by the fission process. Called the primary coolant, this highly radioactive water and the heat it contained was then carried to a steam generator where the heat was transferred to a secondary non-radioactive, water system that generated steam. The steam in turn drove turbines that powered two shafts. At the end of these shafts were the propellers that drove the ship through the water. A short time after casting off, Commander Wilkinson signaled to helicopters flying overhead and to thousands of sightseers on shore, "Underway on Nuclear Power." The message signaled a revolution in ship propulsion. For the first time the power of the atom provided a source of energy to move a ship.

The Idea

The idea to build USS Nautilus, or more closely defined, the idea to apply nuclear power to propel a submarine, originated in 1939. In January of that year, Dr. Ross Gunn, a physicist employed at the Naval Research Laboratory in Washington, D.C., together with colleagues from academia, attended a session of the Fifth Washington Conference on Theoretical Physics. Also present were Nils Bohr, the distinguished Danish physicist, and Enrico Fermi, a young Italian Nobel Prize winner in physics. Bohr and Fermi had exciting news. Through Lise Meitner, a German-born Jewish physicist who had worked at the Kaiser Wilhelm Institute in Berlin, before Nazi racial policies forced her to emigrate to Denmark, Bohr had learned that the great German physicist Otto Hahn and his colleague Fritz Strassman had succeeded in splitting the uranium atom and creating a fission process that released energy. Bohr and Fermi's announcement immediately set off a flurry of activity throughout the United States as physicists hurried to confirm the German experiment. What Fermi did not tell his audience in Washington was that he and others suspected that the fission process released high energy neutrons that might be used to start additional fissions. The result would be a chain reaction that released vast amounts of energy.

Dr. Gunn was also excited by the news. On March 17, 1939, at a meeting at the Naval Research Laboratory attended by Dr. George Peagram of Columbia University, Dr. Ross Gunn, Capt. Hollis Cooley, R. Adm. Harold Bowen, Fermi revealed his assumptions.

If certain technical problems could be solved, he reported, it should be possible to initiate a chain reaction that could be used in an explosive or that could be controlled. In either case energy would be released. Three days after this meeting, Captain Cooley and Dr. Gunn outlined a plan to Admiral Bowen to build a "fission chamber" that would generate steam to drive turbines to power a submarine. The idea that would eventually lead to USS Nautilus had been conceived.

An Idea Deferred

The construction of a nuclear powered submarine was one of the first possibilities envisioned for applying the new knowledge of fission. There was, however, little follow-up on the idea. Dr. Gunn did continue to study the problems involved in developing a fission chamber, but the absence of government support for research, the Navy's lack of interest in such a novel project, and government regulations governing outside contracting limited the Naval Research Laboratory's efforts. Above all, beginning in 1939, when Albert Einstein wrote his famous letter to President Franklin D.

Roosevelt, the attention of the Nation's physicists was directed to the possibility of building the bomb. In 1942, the Manhattan Project began. The Navy, the first of the services, with the exception of a few ordnance people, to show interest in nuclear power, was excluded from the project that was placed under the direction of the United States Army.

Although the Navy was excluded from the Manhattan Project, Dr. Gunn was not idle. He hired a promising young physicist named Philip H. Abelson to work in the Naval Research Laboratory on the problem of separating uranium 235 from uranium 238 by means of a thermal diffusion process. Abelson's work made a contribution to the Manhattan Project. In 1944, a thermal diffusion plant based on his design was constructed at Oak Ridge. The success of the plant advanced by a week the delivery of fissionable material to the Trinity test site in New Mexico. In general, however, during World War II, the Navy was isolated from the main stream of nuclear power development with the result that the idea to build a nuclear propelled submarine was deferred.

An Idea Continued

During the war no attempts were made to initiate a nuclear reactor project that could lead to the development of a propulsion plant for use in ships. In August 1944, however, Brig. Gen. Leslie Groves, the officer commanding the Manhattan Project, appointed a committee under Dr. Richard C. Tolman of the California Institute of Technology to look into the peaceful or non-destructive uses of nuclear power. Two Naval Officers, R. Adm. Earle W. Mills and Capt. Thorwald A. Solberg, served on the committee. In its December 1944 report, the Tolman Committee proposed that, "The government should initiate and push, as an urgent project, research and development studies to provide power from nuclear sources for propulsion of naval vessels."[1] A year later, when the war was over and the public was beginning to learn about nuclear reactors and their potential, Dr. Gunn appeared before a Special Committee on Atomic Energy of the United States Congress. In his testimony, Dr. Gunn stated that a future function of atomic energy would be "turning the world's wheels and driving its ships."[2]

To demonstrate that nuclear power could drive ships, Philip Abelson prepared a report on the feasibility of building a nuclear powered submarine. Completed in March 1946, the report outlined how a nuclear pile could be fitted to a German type-26 U-Boat design, the most advanced submarine of the period. The submarine could be built in two years, Abelson contended, could operate at 25 to 30 knots submerged, and could, in theory, be used as a missile platform. Although Abelson's report proved to be technically inaccurate and vague, partly because it contained no information on the reactor itself, the report was read by many within the Navy and it served the function of educating naval personnel to the possibility of a nuclear powered submarine. Vice Adm. Charles Lockwood, who commanded submarines during the war, remembered Abelson and Gunn's briefing on the report:

> If I live to be a hundred, I shall never forget that meeting on March 28, 1946, in a large Bureau of Ships conference room, its walls lined with blackboards which, in turn, were covered by diagrams, blueprints, figures, and equations which Phil (Abelson) used to illustrate various points as he read from his document, the first ever submitted anywhere on nuclear powered subs. It sounded like something out of Jules Verne's Twenty Thousand Leagues Under the Sea.[3]

By the middle of 1946, thanks to officers like Mills, Cooley, and Bowen and scientist such as Gunn and Abelson, the idea to build a nuclear propelled submarine had been revived. As Richard Hewlett and Francis Duncan point out in their history of the nuclear propulsion project, Nuclear Navy, the challenge was gaining the necessary knowledge and authorization to realize the idea.

In 1946, the Navy set out to cultivate the necessary technical knowledge to build nuclear reactors. In June, the Bureau of Ships, the Navy organization responsible for ship construction, organized two groups of naval personnel, both officers and civilians, one to study nuclear reactor technology at Oak Ridge, Tennessee, and the other assigned to the Knolls Atomic Power Laboratory in Schenectady, New York. The former team was to work on the so-called Daniel's nuclear reactor project, while the later was to study General Electric's effort to build a nuclear reactor to power a destroyer. The senior officer assigned to Oak Ridge was one Capt. Hyman G. Rickover, a 46-year-old Engineering Duty Officer (EDO) who had spent the war in the Electric Division of the Bureau of Ships and whose most recent duty had been mothballing ships on the Pacific coast. Throughout 1946 and 1947, these men, who would for the core of the nuclear propulsion project, enthusiastically mastered the literature of the then primitive "state of the art" in nuclear reactor technology. They met with distinguished physicists, and visited various Manhattan Project laboratories around the country. When the time came to begin the project, they would be ready.

Also during 1946 and 1947, and into 1948 the Navy sought authorization to proceed with a nuclear propulsion program. Authorization for the program came from two sources, the Department of Defense and Atomic Energy Commission (AEC), the civilian successor to the Manhattan Project.

Within the Department of Defense it was necessary to convince the Navy's high command, the Secretary of the Navy, and the Secretary of Defense that the project was necessary and feasible. The highest ranking Navy officer, the Chief of Naval Operations (CNO), was at the time fleet Adm. Chester Nimitz, the hero the Campaigns in the Pacific. Stimulated by memoranda and by officers in the Office of the Chief of Naval Operations, Nimitz, in the fall of 1946, had asked the Submarine Officers' Conference, a group of experienced submariners who advised the CNO on matters pertaining to submarines. In January 1947, the submarine officers reported:

> Present anti-submarine techniques and new developments in submarine design have rendered our present fleet submarines obsolete; offensively and defensively, to a greater degree than any other type (of warship). The development of a true submarine capable of operating submerged for unlimited periods, appears to be probable within the next ten years, provided nuclear power is made available for submarine propulsion.[4]

Although Nimitz endorsed this report, it was not until the following December that he sent a memorandum to the Secretary of the Navy for transmittal to the Secretary of Defense. According to Nimitz's biographer, the memorandum was almost the final act of his watch as Chief of Naval Operations.[5] The second paragraph of the secret memorandum stated:

> The most secure means of carrying out an offensive submarine mission against an enemy is by the use of a true submarine, that is one that can operate submerged for very long-periods of time and is able to make high submerged speeds... it is important that the Navy initiate action with view to prompt development, design, and construction of a nuclear powered submarine.[6]

In their biography of Adm. Hyman G. Rickover, naval historians Norman Polmar and Thomas B. Allan call this memorandum the genesis of the nuclear submarine program. Secretary of the Navy, John L. Sullivan, immediately endorsed Nimitz's memorandum and forwarded it to Secretary of Defense James V. Forrestal. Forrestal also endorsed the proposal, which constituted Department of Defense authorization to seek funds to build the submarine.

At the beginning of 1948, the proposal that the Navy initiate the construction of a nuclear propelled submarine enjoyed the support of the Nation's military. It was still, however, necessary to gain authorization for the project from the Atomic Energy Commission. In the Atomic Energy Act of 1946, Congress granted to the AEC, jurisdiction over all matters pertaining to nuclear development. This meant that the Commission was responsible for nuclear reactor development. The Navy's Bureau of Ships could build all the submarines it wanted, but without the AEC it would have no reactors to put in them.

To the frustration of Admiral Mills and Captain Rickover, the AEC procrastinated in authorizing a naval reactor program. During 1947, the first year of its existence, the AEC experienced difficulties in organizing itself and in selecting and setting priorities for the projects it would support. Nuclear weapons production enjoyed the Commission's highest priority, but after that many commissioners desired to move slowly and develop a balanced nuclear research program divided between pure science research and applied technology. Further complicating the Navy's desire to begin a ship reactor immediately was a proposal to develop a nuclear-powered airplane. The Navy's primary interest rested not in unraveling the secrets of the atom, but rather in applying the existing physical knowledge of the fission process in creating the "hard" technology of nuclear propulsion. In short, the Navy wanted nuclear engineering, not theoretical nuclear physics. The Navy had little or no interest in a nuclear powered airplane.

In January 1948, the Bureau of Ships attempted to work out an agreement with the AEC. Under the agreement the AEC would establish a formal nuclear propulsion project. The Commission's Argonne Laboratory near Chicago would work on reactor design, while the Navy's Bureau of Ships would take the lead in the design, engineering, and construction of the submarine. Throughout much of 1948 the Navy and AEC went back and forth working out the details of this agreement. In April, Admiral Mills delivered a hard-hitting speech at a meeting of the Undersea Warfare Symposium. With several hundred officers and civilians, including members of the AEC, listening, Mills complained publicly about the Commission's foot dragging on nuclear propulsion. In June, Mills arranged a formal meeting with the Commission. Citing the advances the Soviet Union was making in submarine development, and emphasizing the threat a large Soviet submarine force could pose to America's command of the sea, Mills all but demanded that the AEC establish the necessary organizational framework for developing nuclear propulsion. Impressed, the Commission committed itself to the project. To assure that the AEC followed up on its commitment, Mills made a decision in July that would have effects far beyond the actual construction of Nautilus. He appointed Captain Rickover to be the Bureau of Ships liaison with the AEC. The assignment effectively placed Rickover in charge of nuclear propulsion in the Navy, a position he would hold for the next 31 years. In assessing Mills' reasons for making the assignment, AEC historians Hewlett and Duncan observed:

> The decision was not an easy one for Mills. Some of the qualities which Rickover would bring to the job troubled Mills and many of his fellow officers in the Bureau. Rickover flouted Navy tradition and ridiculed a system that seemed to him to give more weight to an officer's social accomplishments and willing- ness to conform than to his practical ability and industry. Mills could guess that once he gave Rickover a free hand, he would outwork, outmaneuver and outfight the Commission, its laboratories and the Navy. He would threaten, cajole, and even insult those who stood in his way. In the process he would no doubt embarrass Mills and the Navy, but Mills was ready to do what the situation demanded.[7]

What the situation demanded in July 1948 was for someone to take charge and accept responsibility for organizing and directing nothing less than a technological revolution in ship propulsion. In August, Mills established a Nuclear Power Branch (Code 390) within the Bureau of Ships with Rickover in command. Finally possessing an organizational identity and a delegation of authority that gave him a great deal of freedom, Rickover quickly reassembled his colleagues from the Oak Ridge group to staff the branch. Coincidentally, Rickover initiated contacts with Westinghouse and General Electric to discuss the participation of the two companies in the project. In January 1949, the AEC gave organizational reality to the Navy project by establishing a Division of Reactor Development and within that division a Naval Reactors Branch (NRB).

Instead of attempting to organize and staff the branch from scratch, which would have caused further delay, the AEC accepted Rickover's Bureau of Ships Nuclear Power Branch as its own NRB. By this action the AEC formally recognized that the initiative for the direction of the nuclear propulsion project had passed to the Navy. Indeed, some within the Commission, who wanted the AEC to pursue pure research in nuclear physics, were probably relieved. On organizational charts, Rickover, now headed a branch in two organizations, the AEC and the Navy. He had become effectively "two-hatted" and in a position to exploit the authorities, procedures, and resources of both the AEC and the Navy to accomplish his objective,--the design, engineering, and construction of Nautilus.

Building the Ship

When Admiral Mills retired in March 1949, Rickover became the single most important actor in the naval propulsion project. According to his biographers, “His efforts, his control, and his single-mindedness of purpose overshadowed those of all other individuals, regardless of their contributions or advocacy.”[8] To manage the project, Rickover devised management techniques and procedures that Hewlett and Duncan call "the Rickover approach." The approach was not a formal management system. It was not contained in a text book nor taught at the Harvard Business School. It is difficult to describe or define. If the approach can be said to have had a unifying concept, that concept was NRB's centralized, "customer", responsibility both for the definition of the desired product, the traditional Navy practice, and responsibility for the project's actual execution. NRB controlled not only what work would be carried out, but also how and when it was to be accomplished and what would be delivered. To implement this concept, Rickover established NRB control over all the principal actors involved in the design, engineering, and construction of the nuclear propulsion system and of those portions of the ship related to the system. The control was carried out by NRB personnel both military and civilian. The NRB cadre, who were carefully selected and trained in the relevant engineering and scientific disciplines, were stationed in Washington and at all the laboratories, factories, field offices, test stations, and shipyards involved in the project.

The NRB physicists, engineers, and technicians had two major functions. The first was to monitor and report to Washington on the technical and administrative problems of the project. The second was to participate actively in the work itself. At the center, reading the reports, monitoring the replies, and issuing directives sat the tireless Rickover.

The construction of Nautilus took place between 1949 and 1955. On the government side were the AEC with its field offices and laboratories and the Navy through the Bureau of Ships. Industry was represented by the Westinghouse Corporation as general contractor and by Electric Boat and a host of other companies as sub-contractors to Westinghouse.*

In theory the division of labor called for the AEC's Argonne laboratory to be responsible for fundamental design, certain design criteria, and for approval of certain significant steps in the detailed reactor design. Westinghouse, which viewed the Navy project as its introduction to a potential growth industry centered on nuclear energy, would be responsible for the design and engineering of the rest of the system and for the construction of the reactor. To support Westinghouse's efforts, the AEC built the Bettis laboratory near Pittsburgh. In practice, engineers and scientists at both Argonne and Bettis often found themselves working on both research and engineering questions. Electric Boat, eager to gain contracts for its yard that was caught up in the post-World War II shipbuilding depression, would construct the submarine. Rickover selected both Westinghouse and Electric Boat primarily because both companies had a corporate stake in the project's success and thus would be more amenable, if not actually subservient, to his directions.

In August 1949, the Navy finally got around to catching up with it owns procedures. On August 19, Chief of Naval Operations, Adm. Louis E. Denfield endorsed a memorandum establishing a Navy requirement to build a nuclear powered submarine. Hewlett and Duncan wrote that the memorandum, “did little more than give formal status to the development of a nuclear propulsion plant.”[9] The requirement set 1955 as the target date for the completion of an operational propulsion system and its installation in a submarine. It is vague how the Navy arrived at this date, but it is certain that Rickover viewed it as if it were a self-imposed deadline.

In the amazingly short period of four years, between 1949 and 1953, Rickover and the thousands of people who worked to his beat, designed, manufactured, and tested not just one, but two prototypes of the nuclear propulsion system that would power Nautilus. In building Nautilus, Rickover took many original steps that broke with traditional design and development projects.

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*At the same time, the AEC contracted with the General Electric Company to build a sodium cooled intermediate reactor for use in a submarine. This action followed the Manhattan Project's practice of taking more than one approach to a problem. Rickover was also responsible for the GE reactor. The reactor was built, but it was plagued by corrosion problems. It was installed in USS Seawolf, but it was shut down shortly after the ship finished its sea trials and replaced by a pressurized water reactor.

Normally, engineers would build a prototype to test the system without regard for the system's final size or configuration. The prototype, for example, could be spread out across a laboratory to give the technicians better access to observe, test, and replace components. Rickover's innovation to this so-called "breadboard" system was his decision that the prototype would be from the very beginning designed and engineered in such a fashion that it would fit the hull of an operational submarine. "He insisted," Polmar and Allan reported, "that the Mark I reactor be both an engineering prototype and a shipboard prototype, completely sized to fit a submarine's hull. This approach would cost engineering flexibility, but with it Rickover could speed up the development schedule."[10] The plan called for two hull-ready prototypes that were designated Mark I and Mark 2. Problems encountered in Mark I would be corrected in Mark 2. In Rickover's words, "Mark I equals Mark 2." The culmination of the extraordinary effort came on June 25, 1953, at the AEC's testing facility in the desert near Arco, Idaho. On that day, Mark 1, which was situated in a mock-up submarine hull built by Electric Boat, achieved full power (the reactor had first gone critical on March 30). Not only did the test prove the system a success, it also spawned a Rickover story. The engineers had called for a 48-hour full power test. After 24 hours, they thought they had obtained all the data they required and prepared to shut down the reactor. Rickover intervened. Eager to silence all critics and doubters, he ordered that the test be extended to simulate the run of a submerged submarine across the Atlantic. While anxious engineers fixed minor problems in the system, and while coyotes howled nearby, Mark I steamed 2,500 miles to Iceland. The prototype worked and Mark 2 went into Nautilus.

The construction of the ship at Electric Boat followed the pattern Rickover established in building Mark 1 and Mark 2. Normally, the ship would not be started until the propulsion system had proven itself. Changes in the design of the propulsion system could force design changes in the hull. At the outside, the propulsion system might not work at all and the ship construction would be superfluous. Rickover decided to run the risk. Just as he had decided to build the ship-ready prototypes at the same time, so he also forged ahead to build the hull concurrent with power plant development. As Rickover told the Joint Committee on Atomic Energy in February 1950, what sense did it make to build a propulsion plant and not have a hull to put it in, especially in light of the Soviet Union's rapid advances in atomic energy. The Soviets had shortly before tested their first A-bomb.[11]

The construction of the ship followed the same relentless and disciplined methods that Rickover imposed on all phases of the Nautilus program. Unlike the building of the propulsion system, Rickover did not have complete control over, nor interest in, all aspects of hull construction.

Overall construction and supervision were vested in various branches of the Bureau of Ships. Nevertheless, because Rickover determined crew selection and training and had control over the propulsion system, he became involved in the construction process for virtually the entire ship.

On June 12, 1952, President Harry S. Truman officiated at the keel laying. A year and a half later on January 21, 1954, Mrs. Dwight D. Eisenhower sponsored the ship when she swung the traditional champagne bottle launching USS Nautilus. After further outfitting and testing at dockside, the vessel was commissioned on September 30, 1954. More testing and crew training followed until on January 17, 1955, USS Nautilus put to sea. The date was a mere two weeks behind the schedule set in 1949. This is especially remarkable in these times of routine failure to meet construction schedules.

Driven by the world's first nuclear propulsion system, Nautilus was preordained to set records and accomplish "firsts." On her maiden voyage to Puerto Rico in May 1955, Nautilus remained submerged for 1,381 miles and 89.9 hours, the longest submerged cruise to that date, by a submarine and at the highest sustained submerged speed heretofore recorded for a period of more than one hour's duration.[12] In 1957, Nautilus became the first submarine to travel under the polar ice pack. On August 3, 1958, to much acclaim and world-wide publicity, she became the first ship to reach the geographic north pole. For most of her 25 years in the depths, Nautilus served in the fleet as a good will ship and, in her military role, as a target submarine in anti-submarine warfare exercises and as an attack submarine.

Nautilus cruised 62,562 miles on her reactor's first core, 91,324 miles on the second, and 150,000 miles on the third. Decommissioned in 1980 Nautilus is presently at Mare Island Naval Shipyard being prepared for display as a public monument near the place of her construction at Groton, Connecticut.

Significance

In one of his many appearances before the Joint Committee on Atomic Energy, Admiral Rickover in the late 1950s looked back on the development of Nautilus and told his admiring audience:

> There is hardly a single idea that is new. What really counts is to take an idea, fight for the authority to do it, establish the organization, find and train the necessary scientists and engineers, justify to Congress large sums of money involved, worry and solve the thousands of technical difficulties. Well, about two hundred million dollars and eight years after the 1946 'idea,' and with devoted efforts of many, many hundreds of companies, we finally had the Nautilus.[13]

Rickover's statement was an articulate summary of how Nautilus came to be. What she was, as he and his listeners knew, was the world's first true submarine.

For centuries the men who built the ships of the world's navies had dreamed of being able to attack an enemy's ships from underwater. In the seventeenth and eighteenth centuries enthusiastic ship designers concocted numerous exotic submersibles. For example, one eighteenth century craft was a rowboat covered with skin that when submerged was powered by oars. During the American Revolution, David Bushnell built a walnut shaped submersible. When submerged, a one man crew powered the craft by means of a hand cranked propeller. The daring submariner would sink an enemy ship by drilling a hole in her bottom and attaching an explosive. Such was actually attempted in New York Harbor, but the brave venture failed when the master of Turtle could not drill the necessary holes in the hull of an unsuspecting British ship-of-the-line.

In 1801, Robert Fulton of Claremont fame built a submersible that incorporated ballast tanks, but he could not interest the American Navy. And so it went throughout the nineteenth century as new boats were invented that incorporated the lessons of their predecessors. It was not until the end of the nineteenth century that the submarine as we know it today was invented. In 1897, John P. Holland, an American, launched Holland. This 57-foot boat incorporated water ballast tanks, an electric motor for propulsion when submerged, a gas engine for surface propulsion, and she was armed with torpedoes. War is the handmaiden of military technology. At the beginning of World War I, the submarine was a minor warship confined to coastal waters. The submarine was not to be compared with the mighty dreadnoughts. By the end of the war the vessel had become a major commerce destroyer. The major submarine innovation during World War I was the adoption of the fuel efficient diesel engine. During Wold War II the submarine came into its own as a major instrument of destruction. German U-Boats sank millions of tons of commercial shipping in the Atlantic and Mediterranean and also sent many of the British Empire's finest warships to the bottom. In the Pacific, American submarines sank one-third of the Emperor's navy and literally drove Japanese commerce from the ocean. Important technological innovations during World War II included the snorkel, an air-intake and exhaust system that allowed submarines to cruise and recharge their batteries at periscope depth; larger and stronger batteries; and improved hull design in relation to both strength and streamlining. The German type 21 U-Boat, the most advanced submarine produced in quantity, could attain 17 knots for one hour while submerged or could travel submerged for two days at 6 knots. In addition, one version of the boat could dive to the then unheard of depth of 850 feet. German experimental submarines, such as the Walter boat that could convert hydrogen peroxide to oxygen, demonstrated even greater advances. "It was clear," British expert Vice Adm. Sir Arthur R. Hezlet wrote, "that the submarine had now become a potentially decisive weapon against warships as well as against commerce."[14]

After the war the United States Navy quickly incorporated the German advances in a new Tang class diesel-electric submarine. The Navy also converted existing World War II submarines to reflect the German technology and give them greater underwater propulsion, an achievement of the "Guppy" program.

By 1946, the capability of the modern submarine was indeed impressive, but the boat remained what it had always been, namely, a naval vessel that could operate underwater for limited periods of time. The submarine, at the time, still remained dependent on the surface with its oxygen for survival. During the war, the inventors of anti-submarine warfare techniques and technology had not been idle. Both radar and sonar had become progressively more sensitive. A submarine that could attain a relatively high speed for more than twenty knots for only a short period of time, or that eventually had to expose its snorkel to recharge her batteries, could find herself in serious trouble when detected by the sonar and radar of fast destroyers, hovering blimps, or low flying aircraft.

Nautilus was a turning point. Her nuclear propulsion system made her independent of the surface. She needed oxygen only for her crew, and she could manufacture that by herself or carry on board. For the first time a submarine could take advantage of the ocean's thermal layers, that scatter sonar waves, by diving deep and, most important, staying there. Nautilus' nuclear propulsion system gave her unlimited range. She could operate on all the world's oceans free from bases not of her choosing and independent of refueling tankers. Perhaps the most significant of all, Nautilus could steam submerged at full speed for as long as her captain desired, barring, of course, mechanical failure. In short, unlike any submarine before her, Nautilus could travel rapidly to an operational area, seek and destroy her quarry, and then avoid detection by diving deep and quickly clearing the area. Because the entire operation could be performed submerged, Nautilus became the first true submarine.

Assessing the historical significance of the nuclear propelled submarine in general, and Nautilus in particular, Sir Arthur Hezlet observed:

> The historical study of turning-points of naval warfare and the reasons why the galley was replaced by the galleon, the ship of the line by the steam ironclad, and the battleship by carrier- borne aircraft is very relevant. It is difficult to escape the conclusion that another turning point has been reached.[15]

Another student of submarine warfare has written:

> "The application of nuclear power to the submarine made of it a weapons system with only the name in common with its World War I and World War II counterparts."[16]

And some of Nautilus' more enthralled admirers make the claim that her existence made a surface navy all but obsolete. For Admiral Rickover, Nautilus' historical significance was clear. Remembering an historic day in 1903 near a small village on the outer banks of North Carolina, the admiral said, "Nautilus did not mark the end of a technological road. It marked the beginning. It should be compared with the first airplane that flew at Kitty Hawk. It marks the beginning of technological revolution at sea."[17]

When in 1980, the world's first nuclear propelled submarine retired from the depths, she left a formidable legacy to the world's major navies. Nautilus had been joined by 115 American nuclear submariners, 170 bearing the hammer and sickle 14 steaming under the Union Jack, and 5 flying the French tricolor.[18] American nuclear propelled submarines are divided into two major types, the attack or hunter-killer submarine (SSN) and the strategic ballistic missile submarine (SSBN). The primary function of the SSN, is to seek out and destroy enemy submarines. In addition the SSN that is armed with missiles (SUBROC) and acoustic and heat seeking torpedoes, can destroy surface ships.

As early as 1946, Philip Abelson noted in his March report that a nuclear propelled submarine would make an ideal platform from which to launch a guided missile. With the success of Nautilus, the Navy, anxious to have a strategic role, moved quickly to enter the guided missile era. USS Halibut, commissioned in 1960, was designed and built to carry the Regulus cruise missile. The principal American effort to unite the deep diving and endurance capabilities of the nuclear powered submarine with the ballistic missile came in the Polaris submarine program. USS George Washington, the first of 41 Polaris firing submarines, was launched in 1959. Together with the Minuteman and the B-52, the SSBN, armed with Polaris, Poseidon, and Trident missiles forms a leg on the triad of the American strategic deterrent: some claim that the SSBN is the most important leg, given the vulnerability of the B-52 and the increasing vulnerability of the Minuteman.

In 1981, USS Ohio, a 560' long giant that displaces 18,600 tons submerged, became the newest SSBN class to join the fleet. The SSBN is a weapons system in and for itself. She incorporates most of the scientific developments that have revolutionized naval warfare, such as the nuclear warhead ballistic missile, nuclear propulsion, and inertial guidance for navigation. Innovations in hull design incorporate new metals that give greater strength thus extending the collapse depth. The "tear drop" form brought dramatic increase in speed. There have also been dramatic advances in anti-submarine warfare technology, such as super-sensitive passive sonar, and heat, acoustic, and wake detection of submarine "signatures".

Nautilus demonstrated that not only submarines, but also naval vessels in general, could be powered by the atom. Nuclear propulsion, however, can not bring about as dramatic an increase in the capability of surface ships as was the case with the submarine. The dynamics of running submerged are different than the dynamics of surface steaming through water and waves. The "tear drop" hull form of a USS Los Angeles class attack submarine, combined with a powerful reactor (S6G), allows a submerged speed of at least 35 knots. This is a dramatic increase over the 23-knot submerged speed of the best World War II U-Boat or the 20+ knots of Nautilus. (The Alfa class Soviet submarine is said to have a speed of 43 knots submerged!)

The advantage of nuclear propulsion in surface ships does not rest in dramatically increased speed. Rather, the superiority of the nuclear propelled surface ship over the fossil fuel powered vessel rests in the ability of the former to travel at high speed for unlimited distances. The nuclear ship is independent of tankers and friendly ports. She can steam at full power and not rapidly burn up her fuel. The fossil fuel burning ship requires a friendly port and can travel at full speed for only a short time before requiring refueling. A nuclear propelled aircraft carrier with high performance aircraft on board escorted by nuclear propelled missile cruisers and also screened by nuclear propelled submarines is a powerful task force that can operate freely and quickly on all the world's oceans. As of 1980, the United States had constructed three nuclear propelled aircraft carriers and nine nuclear propelled cruisers four of which were originally designated frigates. These ships are also apart of Nautilus' legacy.

Another aspect of Nautilus' historical significance is relatively little known, but it was of great importance to the industrialization of nuclear power. Between 1953 and 1957, nearly concurrent with the development of the reactors for Nautilus and Seawolf, Admiral Rickover's Nuclear Reactors Branch designed, engineered, and constructed the Nation's first nuclear power plant at Shippingport, Pennsylvania. "Shippingport demonstrated in away a thousand paper studies never could have," AEC historians Hewlett and Duncan contend, "that nuclear power was an engineering reality rather than a scientific dream. The performance of Shippingport launched the development of civilian nuclear power in the United States and ultimately throughout the world."[19] The energy source for the Shippingport power plant was a pressurized water reactor similar in design to that which powered Nautilus.

The nuclear propulsion project that built Nautilus brought significant additional benefits to what President Dwight D. Eisenhower called "atoms for peace." First, the project helped create a nuclear equipment industry. The fuel elements, pressure vessels, pumps, tubing, and the like could also be built for nuclear power plants. Second, new standards of precision in manufacture and products were established in the naval nuclear propulsion project. They, too, carried over to the peaceful use of the atom. Third, the naval propulsion program provided a personnel base for the nuclear industry in the United States. Just as the United States Air Force and the Navy have long supplied American airlines with a steady stream of trained pilots and maintenance personnel, so too Admiral Rickover's nuclear training program has funneled thousands of engineers and technicians into the American electric power industry. (In both cases private industry was saved literally millions of dollars in education and training costs.)

Nautilus is also historically significant in the history of engineering in general and naval engineering in particular. This report makes no effort to assess the engineering significance, in a technical sense, of the world's first nuclear propulsion system. Literature on the subject is limited and such an assessment requires knowledge of nuclear technology. There is, however, little doubt that Mark 1 and Mark 2 were landmarks in the history of engineering. Mark 2 harnessed and put to work the energy of the atom to move a ship and thus applied for the first time the knowledge of nuclear physics that began with Einstein and that reached a milestone when Hahn "split the atom" and uncovered the fission process. If engineering is the practical application of pure science knowledge, then "underway on nuclear power" was a statement of and tribute to the art.

The final two areas of Nautilus' historical significance are difficult to assess and can only be suggested. They are of recent origin and have not been adequately studied. The first is the impact of Nautilus on the composition of the United States Navy. The second is the ship's association with Admiral Hyman G. Rickover.

Nautilus revolutionized ship propulsion and in so doing transformed the military capability of warships. Nautilus made clear that the ideal naval vessel, and not only the submarine, should be atomic powered. Sustained high speed and almost unlimited range and endurance were attributes that naval designers and engineers had previously only dreamed of and that no fossil fuel burning surface ship could hope to equal. It was understandable that members of Congress, defense experts, and many officers in the Navy desired to build, if not an all nuclear Navy, than at least as many nuclear propelled aircraft carriers and their escorts as possible. But there was a major problem. Nuclear propelled ships became progressively more expensive to build.

In time of "reduced defense budgets", such as in the post-Vietnam war years, the Navy was unable to obtain sufficient appropriations to both build ever more sophisticated nuclear vessels with their attendant weapons systems, i.e. the nuclear propelled aircraft carrier with its 90 high performance aircraft, and coincidentally have available in the fleet sufficient modern ships to meet the basic requirement of controlling the seas in the various scenarios and contingencies envisioned by naval strategists. Oversimplified, the issue became, what should be the "mix" of ships that constitute the United States Navy. There is every indication that the issue divided politicians, defense experts, and the Navy itself.

Within the Navy, the issue became personalized. In his On Watch, A Memoir, Adm. Elmo R. Zumwalt, Jr., Chief of Naval Operations from 1970 to 1974, discusses his fight for more conventionally propelled ships, including smaller fossil fuel burning carriers. Calling his proposal for a balanced fossil fuel--nuclear fleet a "high-low" mix, Zumwalt contends that he was defeated by Admiral Rickover, Rickover's supporters in Congress, and Rickover's so-called "nucs" within the Navy and defense establishment. "A final malady that afflicted--and continues to afflict--the whole Navy," Zumwalt wrote, "though the surface Navy was and is the greatest sufferer, can be described in one word, a word I have already used: Rickover." [20] In her very success, Nautilus presented the country with a dilemma. Had the best become simply too expensive?

The final area of Nautilus' historical significance is the ship's association with Admiral Rickover. In their biography of the man Polmar and Allan state that few naval officers have had a lasting impact on their countries. One of the officers that they place in this class is Admiral Rickover. "Admiral Rickover has affected his navy and the nation," they write:

> He pushed the United States Navy into nuclear propulsion--a "revolution" in naval matters--and virtually took it upon himself to thrust the nation into nuclear civilian power. ...It is difficult to find another twentieth-century American who has striven so hard in so many areas of military and civil endeavor.[21]

Nautilus brought Rickover the title "father of the nuclear Navy. Although conjectural, it is here suggested that just as Nautilus marked the beginning of the nuclear era in the United States Navy, she also represented the beginning of Admiral Rickover's extraordinary career. When Nautilus got underway on nuclear power in January, 1955, the political, organizational, and prestige ingredients that contribute to the Rickover saga were, either by accident or design, in place.

As of 1955 Rickover had secured a powerful political base in the United States congress for himself and for the nuclear propulsion program. The Joint Committee on Atomic Energy, which included among its members some of Capitol Hill's most powerful politicians, supported Rickover from the beginning. Rickover's political influence in the Congress throughout his career was such that neither the Chief of Naval Operations, nor the Secretary of the Navy, nor the Secretary of Defense, his nominal superiors, were able to remove him from his position as head of the nuclear propulsion project or to amend his influence on naval personnel training and ship construction. Nautilus made Rickover not only a "father," she made him one of Congress' favorite public servants.

Also by 1955, Rickover had put on his famous "two-hats". One hat carried the braid of rear admiral in the United States Navy. In 1951, and again in 1952, the Navy hierarchy wanted to pass over Rickover for promotion and retire him. Both times his supporters in Congress, in the Navy, and in the public at large came to his defense and forced through his promotion. Although he rarely if ever put on a uniform, Rickover retained his Navy hat until he retired. The other hat was that of a Washington official in charge of the Nuclear Reactors Branch in the AEC. "This was a masterpiece of cutting administrative red-tape." Polmar and Allan contend, “it let Rickover cite Navy rules that were not being followed when he ran into trouble with the AEC and to cite AEC rules when he ran into trouble with the Navy.”[22] As Eli Roth, who worked with Rickover, said, "It [the "two-hats"] worked both ways--like the old shell and pea game--even when an action was proper by both rules."[23] For Admiral Zumwalt the "two-hat" organizational structure that supported, Rickover made him "an independent baron within the Navy."[24] Rickover acquired his unique organizational position to build Nautilus; he retained it throughout his career.

Nautilus brought Rickover immense personal prestige for his contributions to the ship's construction. His picture appeared on the cover of Time. At a time when the naval heroes of World War II like Ernest J. King, Chester W. Nimitz, and William F. Halsey, awaited biographers, Rickover already had a book written about him. An image arose of an unconventional and progressive officer who fought a tradition-bound Navy to build Nautilus. Thousands of Americans, who had never heard of Dr. Ross Gunn, Dr. Phillip Abelson, R. Adm. Earle W. Mills, or submariners' report championing nuclear propulsion, were convinced that Rickover alone was responsible for the revolutionary vessel. Admiral Rickover became not just an expert, but rather the expert on nuclear power in general and the nuclear Navy in particular. Thanks to this public recognition, Rickover acquired a personal prestige that transcended the organizations of which he was a part. He became a public figure in his own right. From 1955 to the day of his official retirement in January 1982, Rickover skillfully employed this prestige to retain his position and to pursue and accomplish his goals.

Rickover built Nautilus. There is general agreement that he was the single most important individual and that without him Nautilus would not have been constructed for at least another five years. But Nautilus also made a man who, for the next 26 years, influenced the United States Navy like few before him. The nature and extent of Rickover’s impact, where it was negative and where it was positive, already divides students of naval history and will probably continue to do so. It is certain that Nautilus' association with Adm. Hyman G. Rickover is an important element in the ship's historical significance. The world's first true submarine is, in a sense, Rickover's monument.

FOOTNOTES

1. Norman Polmar and Thomas B. Allan, Rickover (New York, 1982) p. 121.

2. Richard C. Hewlett and Francis Duncan, Nuclear Navy (Chicago, 1974), p. 23.

3. As quoted in Polmar and Allan, Rickover, p. 122.

4. Ibid., p. 136.

5. E.P. Porter, Nimitz (Annapolis, 1976).

6. Polmar and Allan, p. 139.

7. Hewlett and Duncan, Nuclear Navy, p. 76.

8. Polmar and Allan, p. 178.

9. Hewlett and Duncan, p. 155.

10. Polmar and Allan, p. 149.

11. Hewlett and Duncan, p. 163.

12. Dictionary of American Naval Fighting Ships (Washington, 1970), p. 28.

13. As quoted in Herbert J. Gimpel, The United States Nuclear Navy (New York, 1965), p. 53.

14. Vice Admiral Sir Arthur R. Hezlet, The Submarine and Sea Power (London, 1967), p. 209.

15. Ibid., p. 262.

16. Robert F. Keunne, The Attack Submarine, A Study in Strategy (New Haven, 1963), p. 191.

17. As quoted in Joseph M. Dukert, Nuclear Ships of the World (New York, 1973), p. 13.

18. Polmar and Allan, P. 680.

19. Hewlett and Duncan, p. 382.

20. Elmo R. Zumwalt, Jr. On Watch, A Memoir (New York, 1976), p. 64

21. Polmar and Allan, pp. 10-11.

22. Ibid., p. 660.

23. Ibid.

24. Zumwalt, On Watch, p. 108.

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Previous documentation on file (NPS):

__ Preliminary Determination of Individual Listing (36 CFR 67) has been requested.
_X_ Previously Listed in the National Register.
__ Previously Determined Eligible by the National Register.
__ Designated a National Historic Landmark.
__ Recorded by Historic American Buildings Survey: #
__ Recorded by Historic American Engineering Record: #

Primary Location of Additional Data:

__ State Historic Preservation Office
__ Other State Agency
__ Federal Agency
__ Local Government
__ University
__ Other (Specify Repository): U.S. Government, Department of the Navy
Connecticut Historical Commission

10. GEOGRAPHICAL DATA

Acreage of Property:

UTM References: **Zone Easting Northing**

Verbal Boundary Description:

Boundary:

Boundary Justification:

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NATIONAL HISTORIC LANDMARKS SURVEY
Designated May 20, 1982

The format of this nomination has been updated to reflect the current standard for National Historic Landmark nominations. Within Section 8, NHL criteria and theme(s) have been applied. For some nominations (prior to the adoption of a separate NHL form), information on function or use – Section 6 – was added. Otherwise no information in the nomination was altered, added or deleted.