NUCLEAR SHIP *SAVANNAH*

HAS BEEN DESIGNATED A

NATIONAL HISTORIC LANDMARK

THIS VESSEL POSSESSES NATIONAL SIGNIFICANCE IN COMMEMORATING THE HISTORY OF THE UNITED STATES OF AMERICA.

CONCEIVED AS A PEACE SHIP BY PRESIDENT DWIGHT EISENHOWER, THE N.S. *SAVANNAH* IS THE WORLD'S FIRST NUCLEAR-POWERED MERCHANT SHIP. IT SUCCESSFULLY PROVED THE FEASIBILITY OF COMMERCIAL NUCLEAR SHIPS AND SAFELY BROUGHT EISENHOWER'S VISION OF "*ATOMS FOR PEACE*" TO THE NATIONS OF THE WORLD.

1991
NATIONAL PARK SERVICE
DEPARTMENT OF THE INTERIOR

1. NAME OF PROPERTY

Historic Name: N.S. Savannah

Other Name/Site Number: Savannah

2. LOCATION

Street & Number: Not for publication:__

City/Town: Newport News (City) Vicinity:__

State: VA County: Newport News Code: 700 Zip Code:

3. CLASSIFICATION

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

Number of Resources within Property

Contributing	Noncontributing	
__	__	buildings
__	__	sites
1	0	structures
__	__	objects
1	0	Total

Number of Contributing Resources Previously Listed in the National Register: 1

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:	Transportation Government Commerce/Trade	Sub:	water-related public works
Current:	Recreation and Culture	Sub:	museum

7. DESCRIPTION

Architectural Classification: N/A

Materials: steel

Foundation: (hull) steel
Walls: (decks) steel
Roof:
Other:

Describe Present and Historic Physical Appearance.

The Nuclear Ship Savannah is a boldly-styled passenger/cargo vessel powered by a nuclear reactor. Despite the deteriorated condition of the ship's passenger areas, her general appearance and cargo-handling features continue to evoke the dashing ship design seen by millions while she visited international ports. The necessary removal of the nuclear reactor's fuel, and certain other highly radioactive components, does not significantly denude Savannah's integrity.

Type	Single Screw
Length (Overall)	595'-6"
Beam (Molded)	78'
Draft (Loaded)	29.5'
Displacement (Loaded)	21,800 tons (24,416 short tons)
Cargo Capacity	10,000 tons (11,200 short tons)
Passengers	60
Operating personnel (approx.)	
Officers	25
Crew	85
Reactor type	Pressurized water
Reactor fuel	Uranium oxide (4% enriched U-235)
Reactor rating	74 MW (million watts)
Speed	21 knots (25 mph)

Savannah has nine water-tight subdivisions consisting of seven cargo holds, a reactor compartment, and a machinery compartment.[1] The vessel is fitted with three complete decks. Ten main transverse, watertight bulkheads divide the ship into eleven compartments. The hull is built on a transverse framing system except the inner-bottom, which is a combination of transverse and longitudinal framing stiffened in the reactor area to provide protection to the nuclear steam plant in case of ship collision.

In traditional passenger-cargo ships, the superstructure and passenger accommodations are located directly over the machinery spaces so the cargo spaces may be easily serviced by overhead cargo gear. In Savannah's case, however, the weight and extra space taken up by the nuclear reactor's containment vessel, as well as access and refueling requirements of this specialized equipment, required the superstructure to be placed aft of the reactor hatch.[2] Savannah's teardrop-shaped superstructure is set sufficiently aft to enhance the vessel's foresection which tapers to its well-raked bow. This expanse of deck accommodates hatch openings for Nos. 1, 2, 3 and 4 cargo holds which are served by specially designed cargo gear: two sets of cargo gear support trusses and their eight attendant ten-ton booms and cargo handling gear. Immediately aft of No. 4 cargo hold and forward of the wheelhouse another hatch is located to provide access to the reactor space. The regular cargo handling rig of king posts and masts, found on standard cargo ships, was replaced on Savannah by a modified burtoning rig. This system comprised lighter tubular cargo handling gear developed for the modified Ebel rig and fitted for rapid handling of cargo. According to the ship's builders, this rig made it possible for one or two deck hands to unstow and position all booms on the ship for cargo operations in less than an hour. Furthermore, the shifting of booms from inshore to offshore operation during loading could be accomplished in one or two minutes without the winch operator having to move from his station. An inherent safety condition in this system made the rig refuse to lift a load if tension in the falls exceeded a safe limit. In practice, however, this safety feature worked too well. During the ship's cargo demonstration phase, the modified cargo handling equipment was too often found inadequate to lift heavy cargo.

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[1] Portions of the description come from: "Technical Press Information, N.S. Savannah," compiled for the U.S. Atomic Energy Commission, and U.S. Department of Commerce, Maritime Administration. Part II-A. This extensive document was distributed shortly before the 1959 launching of the ship.

[2] "Pioneer in Commercial Nuclear Propulsion," Marine Engineering Log 67 (August, 1962): p. 57.

Aft, the superstructure steps down to a generous expanse of deck at the promenade and "A" deck levels. One set of support trusses equipped with four ten-ton booms serves No. 6 and No. 7 cargo holds. Cargo hatch covers are set in coamings on "A" deck and are of the flush-closing type on "B" and "C" decks. All hatch covers except two non-tight, lift-off pontoon covers on the cargo deep tanks in No. 6 hold, are hydraulically operated from local stations at each hatch. The vessel has one additional cargo hold, No. 5, which is served by side ports exclusively. Later modifications to allow containerized cargo included the installation of container box tie-downs on "A" deck.

The forwardmost end of the uppermost deck, the navigating bridge deck, contains the pilothouse. The radio room is on the starboard side and the chartroom on the port side, outboard of the gyrocompass compartment. The remainder of this deck included quarters for three radio operators and two cadets, as well as space for the fan rooms, a battery room, and the emergency generating room.

The pilothouse was outfitted with the latest navigation and communication equipment, such as a reflecting-type magnetic compass, the first to be manufactured in this country. On either side of the steering stand were the "true motion" navigation radars. Another important unit in the wheelhouse was the control console for the anti-roll stabilizers manufactured by the Sperry Gyroscope Company, which are located on the port and starboard sides amidship. These fins automatically adjusted their angle to counteract the roll of the ship, and when not in use, folded back into the ship. In addition to providing a more comfortable ride for passengers, these fins enhanced the ship's stability, and thus the safety of the nuclear reactor. Savannah was the sixth vessel to feature this system.[3]

Comprehensive meteorological instruments for recording sea water temperature, atmospheric pressure, humidity, air temperature, and wind direction and velocity were incorporated into the vessel making her a veritable floating weather station. Additional safety was afforded by including a special radio facsimile receiver which received world-wide weather map transmissions at sea from the U.S. Weather Bureau in Washington, D.C.

The next uppermost deck, the boat deck, was devoted entirely to officers' accommodations. A spacious officers' lounge located in the tapered after-end afforded observation on either side of the ship as well as aft overlooking the passenger recreation area.

The promenade deck was devoted exclusively to public rooms and spaces. The enclosed promenade was treated as a terrace and the deck was covered in ceramic tile of various tones of blue and green. The interior and exterior styling were executed by the marine specialist, Jack Heaney and Associates, of Wilton, Connecticut. In keeping with the modernity of its nuclear propulsion system, a modern decor was carried out in the staterooms and public areas. All of the ship's public areas were air conditioned. While the ship was in operation, provisions were made for paintings and sculptures by American artists to be exhibited to passengers and visitors. A "walk around," the full width of the deck, featured a series of 30" polarized windows permitting an unobstructed, yet sheltered forward view of the sea. The main lounge, located at the forward end of the promenade deck, is elliptical in shape. It could be closed off from the adjacent cardroom by folding screens. The lounge was equipped with motion picture projection equipment as well as a closed-circuit television for viewing the reactor spaces. The lounge furniture included one 8' oval table of Vermont white statuary marble, and two 30"-diameter coffee tables of petrified wood.[4]

On the aft end of the promenade deck, the Veranda Bar looked out on the swimming pool area through a deck-to-deck glass bulkhead. The dance floor, centered in the room, was bordered by tables with illuminated tops. Nearby, the illuminated dials of six clocks, showed the time in various cities around the world. The remaining deck space on this level was utilized as a shipboard game area.

Within the hull structure, "A" deck level was assigned to the main lobby, passenger staterooms and accommodations for the purser, steward, doctor, nurse, and beauty and barber shops. Thirty staterooms, each with private bath, accommodated

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[3] R.L. Moxey, "Savannah," Compressed Air Magazine (reprint), 1962.
[4] "Interior Decor Epitomizes Advanced Design," Marine Engineering/Log 67 (August, 1962): p. 74.

one, two, or three passengers. Adjoining rooms opened up to form suites. The ship's hospital and dispensary were also located on this level, as was the health-physics laboratory. On this deck exhibits were provided by American industries to demonstrate various scientific developments. Furthermore, the Eastman Kodak Company provided a series of color transparencies presenting images of American life.[5]

The dining room on "B" deck seated approximately 75 people. A large, white parabolic mural entitled "Fission," sculptured by Pierre Bourdelle, provides a dramatic background for the captain's table at the aft end of the room. The overhead lights in the dining room feature the ship's trademark--a decorative grillwork representing the swirling atom. While the ship was in operation, a small golden model of the original Savannah was suspended in a glass panel at the entrance foyer. "B" deck also included crew quarters, lounges, and messing facilities. The main galley on this level features stainless steel kitchen appliances, as well as an early "Radarange" oven. Built by the Raytheon Company, the microwave oven was used in the "preparation of special gourmet dishes for first-class passengers to shorten cooking time6 and for emergency thawing of food that has been frozen solid."[6]

In addition to crew quarters, the main laundry and a butcher shop, "C" deck included a viewing gallery which allowed visitors to observe the engineroom and the reactor control room. The rest of "C" deck and all of "D" deck contained cargo, machinery, storage spaces, and the reactor.

Containment Vessel

A large containment vessel housed the majority of the equipment associated with the nuclear reactor. This vessel was designed to contain all the water and steam released in the event of a failure of the pressurized water loops. The vessel is made up of a 35' diameter cylindrical section, with hemispherical ends. It has an overall length of 50'. The wall thickness, varying from about 2.5" to almost 4" of carbon steel, was designed to withstand a pressure of 186 psig. The 186 psig. is the pressure that would result from the rupture of a primary coolant pipe and the instantaneous release and expansion of the contents of the primary system.

A total of 82 penetrations for piping, electrical cables, pneumatic lines, and access, are provided in the containment shell. The largest penetration is the 14'-diameter "cupola" at the top. This opening was used for initial installation of equipment within the containment vessel, as well as for refueling the reactor core. Two 24" x 18" manholes in the lower portion of the vessel and two 42"-diameter manholes in the upper portion provide access to the containment vessel. If the ship sank, the two lower manholes were designed to open inwardly under an external head pressure of 100' of water. This allowed flooding and prevented the collapse of the containment vessel. Except when entry was necessary, the containment vessel remained sealed. If entry was required, it could be done thirty minutes after the reactor was shut down, once the radiation level within the vessel was below 200 millirem per hour. Entry into the containment vessel was minimized since the internal equipment requiring normal maintenance was installed in duplicate. In addition, certain segments of the reactor system could be isolated and bypassed without affecting plant operation.

The bottom half of the containment vessel rests in a cradle of steel surrounded by a wall of reinforced concrete 4' thick. The top half of the containment vessel is encased in a 6" layer of lead, plus a 6" layer of polyethylene. In addition, both sides of the containment vessel are protected by a 24" thick collision mat constructed of alternate layers of 1" steel and 3" redwood lumber.

According to design estimates, in the event of a broadside collision opposite the reactor space, the ramming ship would have to penetrate 17' of stiffened ship structure, the heavy collision bulkhead, 2' of collision mat, 1.5' of reinforced concrete shielding, and the reactor containment vessel, before the reactor plant could be damaged. The high strength of

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[5] Ibid., p. 72.

[6] "Microwave Range Speeds Cooking on Savannah," Marine Engineering/Log 67 (August, 1962): p. 110; Thomas V. DiBacco, "Microwave's Generation, America Begins Cooking to a Different Beep," Washington Post, 31 May 1990, Home Section, p. 31.

the inner-bottom, plus the very strong supports for the containment vessel, also offered strong resistance to reactor plant damage due to grounding.

Propulsion Plant

In simplified terms, the difference between a nuclear-powered ship and a conventional ship is that the nuclear reactor, rather than an oil-fired boiler, produces the steam to drive the turbines. In addition to different methods of boiling water, these two propulsion systems required different designs for the storage and delivery of fuel. A conventional steamship requires the storage of vast and fluctuating quantities of fuel, as well as complex pumping and piping systems. A nuclear-powered ship substituted a central, internally constrained storage, delivery, and consumption system.

Savannah featured the same general type of atomic power plant as USS Nautilus (1955) and the Shippingport Atomic Power station (1957), a Pressurized Water Reactor (PWR). A PWR reactor operates on the principle that water under great pressure (1,750 psi) can be heated to a high temperature without boiling. In the reactor's primary system, a separate and contained loop of pressurized water is heated to a temperature of more than 500 degrees. It then comes into contact with a heat exchanger, which transfers this heat to water of a secondary system. Under much lower pressure, the enclosed secondary water boils rapidly, producing steam. This steam passes through and powers reduction turbines, turning the shaft of the ship's propeller. The enclosed pipes of the secondary system then pass through cold seawater, condensing the steam back to water. The cycle continues as this water is then pumped back to the heat exchanger, where the primary system heats it back to steam. The major features of the reactor were installed in duplication so either could be operated independently of the other. Therefore, in case of a leak or failure in one of the secondary loops, the other could continue to generate steam.

Within the larger containment vessel, the reactor itself was housed within a "primary shield." This shield was a water-filled, 17' high, 2" to 4" thick lead tank. The reactor's active core was a circular right cylinder 62" in diameter and 66" high. The core was made up of 32 fuel elements. Each fuel element comprised 164 stainless steel fuel rods, .5" in diameter. The rods contained uranium oxide pellets, enriched to an average of 4.4 percent of U-235. The fuel rods in the centermost 16 fuel elements contained uranium oxide at an enrichment of 4.2 percent U-235, and in the outer 16 fuel elements the enrichment was 4.6 percent U-235. This compares to the longer lasting, 90 percent enriched uranium used in Navy reactors.[7] Savannah's uranium oxide pellets, were .4255" in diameter, and the space between the pellets and the inner tube wall contained helium gas under pressure to assure good heat transfer across the fuel rod.

Reactivity control was provided by 21 cruciform control rods. Each control rod was a composite of boron-stainless steel jacketed with stainless steel plate. They measured 8" across, tip to tip, and were .375" thick. Each rod had an effective length of 66". The amount of heat generated by atomic fission in the reactor depended upon how far the control rods were raised. When the rods were in the full down position, they absorbed the neutrons emitted by the nuclear fuel. Raising the rods permitted the neutrons to bombard the surrounding fissionable uranium atoms and sustain the chain reaction necessary to produce heat continuously. The higher the rods were raised, the greater the heat that was generated. Inversely, lowering the rods restricted the fissioning action and reduced the heat. In the full down position, the chain reaction was cut off entirely. Dropping all rods quickly and simultaneously to the full down position is called "scramming." An emergency "scram" insertion would lower the control rods in 1.6 seconds. The control rods were originally driven by hydraulic pistons, which were later replaced with more reliable electric motors.[8]

A radiation monitoring system determined the amount of radiation at selected points throughout the ship and gave an alarm if the level became dangerous. There were 32 monitoring points; 12 were constantly monitored, the remaining 20 were scanned automatically or manually as conditions dictate.

[7] Joseph M. Dukert, Nuclear Ships of the World (New York: Coward, McCann & Geoghegan, Inc., 1973), p. 30.
[8] Rowland F. Pocock, MSE, Nuclear Ship Propulsion (London: Ian Allen Ltt., 1970), p. 78.

The steam propulsion machinery area is located aft of the nuclear space. This space is 55' long and 78' wide. It extends from the tank top to "C" deck, a distance of 32'. This space contained all the major machinery required to propel and service the ship.

The main control room is located in the upper level of the machinery compartment just aft of the propulsion units. From here the reactor engineers monitored the reactor and controlled the speed of the ship. The bulkhead common with the engineroom was fitted with large, double-thickness glass windows to permit observation of the main control console from the visitors gallery and the machinery space. Likewise, the console operators could visually monitor the engineroom situation at all times. The main control console was a nerve center whose primary function was to monitor, display and control all the essential functions pertaining to the ship's nuclear reactor, propulsion system, and electrical power plant.

For emergency take-home power, a 750 hp electric motor could be coupled to the main turbine through the main gearing. This was originally a non-reversible, low-starting torque motor, designed to take the ship back to port if a loss of nuclear power occurred. It was later upgraded to a reversible, high-starting torque motor affording greater maneuverability, capable of moving the ship clear of its pier in the event of a nuclear hazard while in port.[9] Two supplemental 750 kw diesel generators were designed to start automatically upon failure of either turbine generator. This ensured reliable power for reactor heat removal after shutdown, and also provided sufficient power for the take-home motor and other essential electrical demands.

While the non-reactor machinery components were typical of those found in conventional steam turbine plants, numerous departures from conventional arrangements were necessary. As reported in a maritime journal of the day:

> ...the saturated steam conditions produced by the reactor required special precautions by the turbine manufacturer to prevent blade erosion. Consequently, the last three stages of the 9-stage impulse-type, high pressure turbine incorporated moisture-collecting provisions in the diaphragm design. Similar provisions were provided in 6 of the 7 stages of the L-P turbine. In addition, the exhaust from the H-P entered a two-stage moisture separator, which by baffles and centrifugal force, dried the steam before it entered the L-P. Another departure from conventional practice was the 750-hp take-home motor, which required a special coupling to be designed by the gear manufacturer to engage the high-pressure, high-speed pinion.[10]

Radioactive Wastes

The ship was designed to contain more than 10,000 gallons of liquid radioactive waste (at least 100 days accumulation). However, actual waste output initially exceeded storage capacity. During her first year in operation, Savannah released more than 115,000 gallons of radioactive waste at sea.[11] Later, modifications were made to bring the amount of waste resulting from valve leaks in line with the ship's onboard storage capacity.

When operating properly, radioactive wastes were stored in the ship until disposal could be arranged at a licensed facility, or it could be discharged to its special servicing barge. N.S.V. (Nuclear Servicing Vessel) Atomic Servant was designed by the Electric Boat Division of General Dynamics Corporation for the Atomic Energy Commission.[12] The 129' long, 36' wide barge was built in 1960 at Houston, Texas, by the Todd Shipyard Corporation. She included no propulsion power of her own. Atomic Servant displaced 650 tons, and included a 50' crane and a specially designed fuel storage pit. Lined by approximately 12" of lead on all sides, this pit contained a replacement set of Savannah's fuel elements and control rods. Atomic Servant was to be on call for servicing Savannah anywhere in the world. Furthermore, the Todd Shipyard

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9 U.S. Congress, Senate, Committee on Commerce, United States Nuclear Merchant Fleet, 90th Cong., 1st sess., November 1967, p. 64.
10 "N.S. Savannah--Nuclear Forerunner," Marine Engineering/Log (August 1959): p. 83.
11 J.H. MacMillan, D.C. MacMillan, J.E. Robb, H.I. Lill, Jr., R.O. Mehann, "NS Savannah Operating Experience," Society of Naval Architects and Marine Engineers 11 (1963): p. 14.
12 "'NSV Atomic Servant'-Unique Barge will Service Savannah," Marine Engineering/Log 67 (August 1962): p. 79.

Corporation was selected to establish a special nuclear ship servicing facility at Galveston.[13] It was reported that the Galveston yard could "serve 20 or more nuclear ships per year as well as handle most licensing, training, inspection, refueling, start-up, maintenance, and repair functions associated with nuclear ships."[14]

Present Appearance and Integrity

Despite a modest amount of decay common among deactivated ships, Savannah maintains her historic external appearance. Her sleek white hull, with red and blue detailing, continues to strike an impressive appearance. Internally, however, the ship's integrity has suffered much more. When Savannah discontinued her passenger service in 1965, and operated solely as a cargo ship for another half decade, the passenger spaces were closed. Some of the decorative furnishings and all of the exhibitions were removed at that time. This period of disuse, followed by the deactivation of the entire ship in the early 1970s, cast a pallor of decay on these once attractive public spaces. Much of the specially-designed furnishings remain, yet the ship's staterooms, lounges, crew quarters, and facilities have a ransacked and derelict appearance. Nevertheless, these spaces could be restored to their historic appearance.

Savannah's cargo features maintain a higher level of integrity. Even though containerized cargo tie-downs were mounted on the ship's deck during her final years of operation, the storage and cargo handling elements maintain their original appearance and configuration. The Patriots Point Maritime Museum has begun to convert cargo holds into museum display spaces, but this modification could be easily reversed.

Although removal of the reactor was considered, no action was taken because it would require the costly removal of large sections of the ship's structure.[15] The reactor's uranium oxide fuel has been removed, and returned to the Atomic Energy Commission. The radioactive water from the reactor's primary system has been removed, as have certain of the more heavily radioactive elements of the reactor system (such as the ion exchanger) .The secondary system's water was also removed. In a 1976 Congressional hearing, it was reported that the total amount of residual radioactivity in the reactor vessel was approximately 60,000 curies, primarily in the form of iron 55 (2.4 year half life) and cobalt 60 (5.2 year half life). These conditions, however, were deemed safe because the reactor remains shielded by concrete and steel, and access to the containment and reactor vessels has been made secure.[16] While the reactor could technically be restored to use if these components were replaced, current nuclear operating standards and licensing requirements would make the resurrection of the outdated reactor virtually impossible.[17]

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[13] J.H. MacMillan, et. al., Society of Naval Architects and Marine Engineers, p. 5.
[14] Ibid., p. 32.
[15] U.S. Congress, Senate, Committee on Commerce, Subcommittee on Merchant Marine, Nuclear Ship Savannah, 94th Cong., 2nd sess., S. 2142, 20 February 1976, p. 77.
[16] Ibid. , p. 29.
[17] Telephone interviews with Lloyd Fink, Maritime Administration, May 1990.

8. STATEMENT OF SIGNIFICANCE

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

Applicable National Register Criteria:	A X B_ C X D_
Criteria Considerations (Exceptions):	A_ B_ C_ D_ E_ F_ G X
NHL Criteria:	1, 4
NHL Theme(s):	IV. Shaping the Political Landscape 4. Political ideas, cultures and theories V. Developing the American Economy 3. Transportation and communication 4. Workers and work culture VI. Expanding Science and Technology 2. Technological applications VIII. Changing role of the United States in the World Economy 1. International relations 2. Commerce
Areas of Significance:	Maritime History Transportation Engineering Politics/Government Commerce
Period(s) of Significance:	1958-1971
Significant Dates:	1958, 1962, 1965
Significant Person(s):	
Cultural Affiliation:	
Architect/Builder:	Babcock & Wilcox Company (Nuclear Reactor); George G. Sharpe, Inc./New York Shipbuilding Corp. (Ship)
Historic Contexts:	IX Political and Military Affairs After 1945 XII: H, 3 Business: Power and Lighting, Nuclear XII: L Business: Shipping and Transportation

XIII: A, 2 Science: Physical Sciences, Physics
XIV: B Transportation: Ships, Boats, Lighthouses, and Other Structures
XVIII: B Technology: Transportation
XVIII: C Technology: Energy Conversion, Utilization and Distribution

Maritime Heritage of the United States NHL Theme Study -- Large Vessels

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

SUMMARY STATEMENT OF SIGNIFICANCE

Although less than fifty years old, N.S. Savannah possesses exceptional national significance as the first application of nuclear power to a commercial ship; and as the structure most associated with President Eisenhower's Atoms for Peace initiative. The combination passenger/cargo ship demonstrated to the world the safe and reliable operation of this new technology, resulted in the establishing of a nuclear ship training program for civilian crew members, established procedures for commercial nuclear ships to enter domestic and foreign ports, and identified a series of issues which would require resolution in a second generation of commercial nuclear ships (disputes over crew pay scales, liability, and commercial viability). In addition to her important role in maritime history, Savannah served a unique public relations role as a floating exhibit on the peaceful use of nuclear energy. In this context, she traveled more than 450,000 miles to 32 domestic ports and 45 foreign ports, and was visited by more than 1.4 million people. This level of public exposure was unprecedented for a nuclear facility. A concurrent benefit of this favorable exposure was the acceptance of naval nuclear ships in foreign ports. N.S. Savannah became a symbol of Eisenhower's Atoms for Peace initiative.

HISTORIC CONTEXT

Atoms For Peace

President Eisenhower's December 8, 1953, "Atoms for Peace" speech at the United Nations was received throughout the world with hope and anticipation. Even before ascending to the presidency, America's only General/President of the twentieth century understood the risks inherent in the escalation of nuclear arsenals. These concerns were magnified after he become President-elect, and was secretly briefed on the destructive capabilities of anew class of thermonuclear weapons. However, the full magnitude of these new weapons was not appreciated until classified data was received on the dangers of radioactive fallout. While no doubt prepared to use these weapons if necessary, Eisenhower supported several policy initiatives designed to keep the "atomic genie" under control.[18]

In the first year of his Presidency, Eisenhower introduced "Operation Candor." He believed that a more open presentation of the increasingly catastrophic implications of nuclear conflict would yield a more sober attitude toward the importance of improved global relations. Progressing further along this path, Eisenhower advanced the cause of those who proposed the broadening of atomic development when he introduced his Atoms for Peace initiative before the United Nations and the world. Subsequent initiatives for nuclear disarmament and test bans, although unsuccessful, suggest Eisenhower's acceptance of a "moral imperative" to offset the terrible implications of this military technology with beneficial, peaceful applications.[19]

Nevertheless, the complexity and inconsistency of U.S. foreign policy during the Cold War prohibits a portrayal of the Eisenhower administration's policies as entirely conciliatory. At the same time the administration was proposing Operation Candor, Atoms for Peace, and nuclear test bans, Secretary of State John Foster Dulles espoused the government's hard line anti-communism rhetoric, and the defensive policy of "massive retaliation.”

Despite such incongruities, Eisenhower's commitment to Atoms for Peace was more than mere Cold War public relations. The specific goals outlined in his U.N. address included various forms of international cooperation. Most prominent among them was a call for the donation of "fissile" material from nuclear nations. This pool of material was to be administered by an international atomic energy agency under the auspices of the United Nations. They would make it available to non-nuclear nations for research, power generation, and medical purposes. As originally presented, the

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[18] Richard G. Hewlett and Jack M. Holl, Atoms for Peace and War, 1953-1961, Eisenhower and the Atomic Energy Commission (Berkeley, CA: University of California Press, 1989).
[19] Ibid., p. 307.

program could conceivably result in nuclear disarmament, whereby the world's nuclear capabilities would ultimately be diverted from national military stockpiles to an international energy pool. Former Atomic Energy Commission Chairman and Energy Department Secretary James R. Schlessinger described this program as “a Marshall Plan for atomic energy.”[20]

On the domestic side, the first Republican administration in twenty years sought to reduce the monopoly of government-sponsored development and ownership of this new technology. The demonstrated adaptation of nuclear power for commercial purposes, it was believed, would convince private industry to commit its own resources to further development. In addition to demonstration land-based nuclear power generating plants, the Eisenhower Administration approved the development of an experimental nuclear merchant ship.

Initial Planning

Decades before scientists learned how to harness nuclear power, a popular notion foresaw that a small amount of radioactive material could propel a ship for months.[21] After the power of the atom was unleashed many believed that the best test of commercial nuclear propulsion viability would be in the form of a single-function trade ship, such as an oil tanker. President Eisenhower, however, had other ideas. He wanted to build a nuclear-powered "peace ship," or roving goodwill ship, to build world-wide support for the non-military benefits of nuclear power.[22] According to a top administration official: "The President seeks no return on this vessel except the goodwill of men everywhere… Neither will the vessel be burdened by proving itself commercially feasible by carrying goods exclusively."[23] This proposal, however, did not get underway until two elements of Eisenhower's plan were modified. First, the "peace ship" was recast as a combination passenger/cargo merchant vessel to serve as a roving goodwill ship as well as to demonstrate the application of nuclear propulsion to commercial shipping. Second, the proposal to copy the Navy's Nautilus reactor was replaced by a plan to develop anew reactor design, untainted by any direct association with military technology and designed to meet commercial requirements.[24]

Although these modifications increased the demonstration value of the ship, they also contributed to one of her shortfalls. The combination of the public relations mission with that of cargo vessel resulted in unfortunate design compromises. During the ship's passenger/cargo vessel demonstration phase, these compromises posed few problems. However, once she began her cargo demonstration phase, it became clear that the wasteful inclusion of luxurious passenger facilities, inefficient cargo hatch locations, and inadequate cargo cranes hampered her commercial competitiveness.

On April 25, 1955, (less than seven months after launching the first nuclear vessel, the submarine USS Nautilus,) President Eisenhower announced his plans to build a nuclear-powered merchant ship. The development of Nuclear Ship Savannah was authorized by Congress in July of 1956, and put under the joint direction of the Maritime Administration and the Atomic Energy Commission.

N.S. Savannah was named after S.S. Savannah, the first steamship to make a transatlantic voyage in 1819. This 110'-long paddle steamer contained a one-cylinder, 90 hp steam engine as well as three full-rigged masts of sail. Burdened with as much fuel as she could stow (75 tons of coal, and 25 cords of wood), she carried virtually no cargo. Yet, during much of her four-week voyage from New York to Liverpool, she was under sail to conserve fuel. Despite S.S. Savannah's accomplishment, she was not soon followed by other ocean going steamships. In fact, her own steam engine was later removed and she was operated as a sailing vessel for her remaining years. Those who meant to honor the name of this

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[20] Joseph F. Pilat, Robert E. Pendley, and Charles K. Ebinger, eds., Atoms for Peace, An Analysis After Thirty Years (Boulder, CO: Westover Press, 1985), p. 5.
[21] Spencer R. Weart, Nuclear Fear (Cambridge, MA: Harvard University Press, 1988), p. 10.
[22] Hewlett and Holl, p. 506.
[23] U.S. Congress, Senate, Authorizing the Construction of a Nuclear Powered Prototype Merchant Ship, Report #1269, 84th Cong., 1st sess., July 30, 1955.
[24] Ibid.

ship hoped the new vessel, with another revolutionary propulsion system, would be more appreciated than its namesake had been. Unfortunately, in this regard, N.S. Savannah would have much in common with her predecessor.

It was noted from the outset that the design for the ship's nuclear plant placed safety and reliability above efficiency and economics.[25] A primary goal was to design and operate a nuclear maritime vessel which was safe to the crew, the passengers, and the public. Duplication of components and backup systems were utilized to enhance the ship's safety. Savannah's design and construction resulted in a vessel with an unprecedented concern over safety. She was built to the requirements of the applicable codes of the U.S. Coast Guard, the American Bureau of Shipping, the Maritime Administration, the U.S. Public Health Service, the AIEE Marine Code, and the U.S. Atomic Energy Commission.[26]

In a 1955 Maritime Administration study, it was noted that the reactors developed by the Navy were designed to withstand greater shocks, perform with greater control, and meet stricter size and weight requirements than necessary in merchant ships. The report concluded that rather than following unnecessarily expensive military precedents, the Maritime Administration's project should produce a reactor specifically designed for merchant ship propulsion.[27] The decision to depart from previous practice and utilize the less costly low-enriched uranium reactor, however, introduced other design challenges. Nevertheless, the Maritime Administration did not plan to develop a fully-competitive commercial vessel. Instead, they proposed a "floating laboratory to study design, operation and manning of nuclear ships, not a vessel to 'prove or disprove the economics' of nuclear propulsion."[28]

Construction, Training, and Testing

Savannah was designed by George G. Sharp, Inc., of New York. She was constructed by the New York Shipbuilding Corporation in Camden, New Jersey, opposite Philadelphia. The primary contractor for the design and construction of the nuclear power plant was the Babcock & Wilcox Company. The De Laval Steam Turbine Company was the subcontractor for the engineroom turbines and gears. The original operating agent for the ship was States Marine Lines, Inc., one of America's largest steamship companies.

With the wave of an "atomic wand" the keel was laid by Patricia Nixon, wife of the vice President, on Maritime Day, May 22, 1958. When the wand, with its small amount of radioactive material, activated the clicking noise of a Geiger counter, a crane operator was cued to swing the first keel section into place.[29] This unusual "atomic wand" illusion had previously been used at the ground breaking ceremony of an earlier Atoms for Peace site, the Shippingport nuclear power plant. Throughout the next year 1,000 men continued assembly work under a giant covered shipway at the 273-acre "New York Ship" facility.[30]

The hull was constructed utilizing conventional methods. The reactor and the containment vessel, however, required special procedures. A full-scale mock-up of the reactor plant, surrounded by an outlined skeleton representing the containment vessel, was constructed at the Camden yard while the ship was under construction. This not only minimized unforeseen problems during installation and hookup of the reactor system components, but served to train the crew in reactor maintenance. A control panel identical to the one on Savannah, was also provided.

While the ship was under construction, civilian deck and engineering personnel underwent special training for their new duties on the first commercial nuclear vessel. Engineers from other countries were included in the early training classes to promote the international advantages of the peaceful atom.[31]

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[25] "N.S. Savannah--Nuclear Forerunner," Marine Engineering/Log (August 1959): p. 76.
[26] "Technical Press Information, N.S. Savannah," Part III, p. 25.
[27] Rowland F. Pocock, Nuclear Ship Propulsion (London: Allan Ltt, 1970), pp. 74-75.
[28] Ibid.
[29] Dukert, p. 94.
[30] "Atom Merchant Ship Taking Shape," New York Times, 17 May 1959.
[31] "The Nuclear Ship Savannah," Motion Pictures Branch, National Archives, Washington, D.C. (Produced by Orleans Film Productions for the U.S. Maritime Administration, 28.5 minutes).

In September of 1958, the first group of students (13 licensed marine engineers) began 31 weeks of lecture-room instruction at Lynchburg College, Virginia. This instruction included review courses in mathematics, physics and chemistry, and the fundamentals of nuclear technology. The second group (ten engineers) started their training seven months later. Since the latter trainees were college graduates, their classroom phase was shortened to 24 weeks. For both groups, the theory phase of their training was followed by 30 weeks of field training under the Atomic Energy Commission at various nuclear facilities, including the Large Ship Prototype AIW reactor at the National Reactor Testing Station in Idaho, the Vallecitos Boiling Water Reactor, and the SM-l Argonne low-power reactor. Each engineer also underwent training on a simulator of Savannah's control panel, which was constructed by the Westinghouse Corporation. They were required to perform at least four start-ups and shut-downs before reporting to one of the Navy's nuclear submarines to gain watchkeeping experience at sea. Each engineer was later sent to Camden for training in Savannah herself.[32] After the summer of 1962, engineer-trainees received their instruction at the U.S. Merchant Marine Academy at Kings Point, NY.[33]

The first class of deck officers (six licensed masters) began their special training in May 1959. They received 13 weeks of academic lectures followed by field training under the Atomic Energy Commission at land-based reactors and in nuclear submarines. Their training included less emphasis on technical subjects and more on reactor management, emergency procedures, personnel control, health physics, and damage control.[34]

On July 21, 1959, fourteen months after the keel laying ceremony, Mrs. Dwight D. Eisenhower christened the world's first nuclear merchant ship. During the next two and a half years the ship underwent final construction, installation of the reactor, systems testing, nuclear fuel insertion, power tests, and sea trials before delivery of the vessel was made to the operating company.[35] On January 31, 1962, Capt. Gaston DeGroote assumed command of the ship and, under temporary oil-fired auxiliary steam power, sailed Savannah to Yorktown, Virginia, for additional testing and modifications during sea trials. The reactor was tested at quayside and at sea at less than full power, until the first week of April, when it was brought to full power. She was then run at speeds in excess of 22 knots. On May 1, 1962, Savannah was accepted by the Maritime Administration and delivered by them to the operator, States Marine Lines, Inc.

The ship's demonstration phase began three months later, on August 20, when she set sail to her home port of Savannah, Georgia.[36] Initially overmanned for safety reasons, the ship's crew was soon cut to 124--27 in the Deck Department, 35 in the Engine Department, 49 Stewards, and 13 in various support functions (including one senior nuclear advisor and three health physics monitors).[37]

Operation

By the time Savannah completed her trials, the United States had added more than a dozen nuclear submarines to join USS Nautilus, as well as the guided missile cruiser Long Beach (the Navy's first nuclear surface ship), and the first nuclear aircraft carrier, Enterprise.[38] The Soviet Union also had nuclear submarines, as well a nuclear icebreaker.[39]

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[32] Pocock, p. 82.
[33] "The Nuclear Ship Savannah" (film).
[34] Pocock, p. 82.
[35] MacMillan et al., Society of Naval Architects and Marine Engineers, pp. 8-14.
[36] Pocock, p. 82.
[37] MacMillan et al., p. 3.
[38] Clark G. Reynolds, "The Ships of Patriots Point," (Charleston, SC: Patriots Point Naval and Maritime Museum, 1983), p. 13.
[39] Alan Villiers, "World's First Nuclear Merchant Ship: Aboard the N.S. Savannah," National Geographic 122 (August 1962): p. 281.

On the first leg of her voyage, the proud ship and crew suffered embarrassment after a faulty pressure indicator initiated a reactor "scam." Unfortunately, this caused the media to mistakenly report that she had suffered a major nuclear failure.[40]

Based on performance, Savannah's operators were pleased that the power plant exceeded the projected 20,000 shaft horsepower by more than ten percent; and, instead of a speed of 20 knots, she cruised steadily at 24 knots.[41] The ship's operators boasted:

> The response of the power plant in meeting changes in steam demand has been excellent. While it is difficult to compare performance qualitatively with that of a conventional ship, it can be said that the Savannah reactor can meet large changes in load demand in roughly one half to one quarter of the time required for a conventional power plant.[42]

As the first of her kind, Savannah broke new ground in establishing various types of operating procedures. New rules governing the operation and docking of commercial nuclear vessels at domestic and foreign ports emphasized safety from potential nuclear hazards. In each port she visited, arrangements were made to have stand-by tug services to move the ship out to sea in the event of a nuclear accident.[43] Of concern to foreign authorities was the potential liability associated with nuclear-ship operation. While no private insurance was provided for Savannah, the U.S. Government bolstered the ship's acceptability to foreign authorities by extending the provisions of the Price- Anderson Act.[44] This Act provided a $500,000,000 indemnification to cover claims filed against AEC-licensed facilities by victims of nuclear accidents.

Savannah's accomplishments in securing permission to enter foreign ports had implications beyond future prospects for a nuclear maritime fleet. Breaking ground with a ship of such benign intentions, which was engineered under rigorous safety guidelines, undoubtedly facilitated the world-wide acceptance of America's growing nuclear Navy fleet as well.

After cruising through the Panama Canal, and port visits along the West Coast and Hawaii, Savannah became a popular exhibit at the 1962 Seattle World's Fair during a three week visit. In early 1963 she returned to her special facilities at Galveston for a 30,000-mile check-up, which included general system upgrading and miscellaneous repair work. In addition, she underwent her annual U.S. Coast Guard and American Bureau of Shipping certifications.

While this work was underway a labor dispute erupted. Savannah's engineering officers had been allotted extra pay in compensation for their additional nuclear training. The deck officers, however, cited the tradition that they receive higher pay than engineering officers. After a labor arbitrator ruled in favor of the traditional pay scale, the engineers shut the reactor down in protest in May of 1963. When the engineers refused to go back to work, the Maritime Administration canceled its contract with States Marine Lines and selected American Export Isbrandtsen Lines as the new ship operator. The resulting need to train a new crew interrupted Savannah's demonstration schedule for nearly a year.

Although the change in operators alleviated the immediate labor problem, the failure to resolve this dispute would forever cloud the feasibility of nuclear merchant ships. Many feared that abandoning the Masters, Mates, and pilots (M.M.& P.) and the Marine Engineers Beneficial Association (MEBA) trade unions merely deferred the necessary resolution of this conflict. After all, these two unions represented deck and engineering officers on a majority of all other U.S.-flag operated ships.[45]

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[40] Pocock, p. 82.
[41] Dukert, p. 95.
[42] MacMillan, et al., p. 32.
[43] Ibid., p. 4; Pocock, p. 83.
[44] U.S. Congress, Senate, Committee on Commerce, United States Nuclear Merchant Fleet. 90th Cong., lst sess., November 1967, pp. 66-67.
[45] Ibid. , p. 56.

In the spring of 1964 Savannah was again underway with a tour of Gulf Coast and East Coast ports. She began her maiden transatlantic voyage later that summer (New York to Bremerhaven in ten days). At her first four European port visits (Bremerhaven, Hamburg, Dublin, Southampton), 150,000 people toured the ship.[46]

Before these foreign port visits, representatives from the U.S. Department of Commerce and the ship's operating company traveled to meet with officials at each port. Permission to dock was not authorized until all three parties were satisfied with the ship's projected operations while in port.[47]

After travelling a total of 90,000 miles, and hosting 1.4 million visitors, Savannah's passenger/cargo demonstration phase was completed in 1965. She had visited 28 domestic and 18 foreign ports in 13 countries. She had carried 848 passengers, and 4,800 tons of cargo.[48] In preparation for Savannah's commercial demonstration phase, her passenger spaces were sealed and 1,800 tons of solid ballast were removed. First Atomic Ship Transport, Inc. (FAST), a subsidiary of American Export-Isbrandtsen Lines, was licensed to operate the ship for three years as a cargo vessel. To compensate for the expense of operating a demonstration vessel, FAST was given a one dollar per year lease on the ship, with no charge for the fuel.[49] Despite delays caused by the replacement of the main coolant pumps, on August 5, 1965, the Atomic Energy Authority issued to the operator nuclear reactor operator's license, serial number NS-1.[50]

In September, 1965 Savannah departed New York for her first commercial voyage with a capacity load of 10,000 tons of general cargo. During 1967 her cargo activity generated $2,600,000 in revenue.[51] Furthermore, while performing as a cargo vessel, Savannah continued to fulfill her responsibilities as goodwill ambassador in visits to ports in Europe, Africa, and the Far East.

After travelling 350,000 miles (or the equivalent of nearly 14 times around the world), Savannah returned to Galveston in late 1968 for maintenance and her first refueling.[52] Although a complete reactor core was ready for installation, it was not needed. Only four of the original 32 fuel bundles required replacement. The remaining bundles were rearranged to compensate for variations in fissioning activity depending on their original proximity to the core's center.[53]

Just when the momentum for an enlarged U.S. nuclear merchant fleet should have been greatest, the single largest client for such a fleet decided to use traditionally powered vessels exclusively. The Defense Department, a major customer of U.S. shipping, concluded that oil-fired freighters were more cost- effective than nuclear ships. Furthermore, with budgetary priorities of the mid 1960s shaped by the Vietnam Conflict, funding for the nuclear merchant program was at risk. Later, the Maritime Administration and the Atomic Energy Commission initiated significant cutbacks in funding for the merchant ship reactor program.[54] Even though the ship's operators described her as "the most reliable ship we have operating," the Maritime Administration decided that little more could be gained by adding to the $90,000,000 thus far invested in the Savannah project. A last-minute suggestion for the Army to use the nuclear ship as a floating emergency power plant was not acted upon.[55]

By late 1970, Savannah had traveled more than 450,000 miles to 32 domestic ports, and 45 foreign ports in 26 countries. The 163 pounds of uranium she consumed was estimated to have provided the equivalent power of nearly 29,000,000

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[46] Dukert , p. 97.
[47] Pocock, p. 84.
[48] U.S. Congress, Senate, Committee on Commerce, United States Nuclear Merchant Fleet, pp. 52-54.
[49] Dukert, p. 98; Pocock, p. 84.
[50] Pocock, p. 85.
[51] Frank Kesterman, "Lessons from the Savannah," Ocean Industry (December 1968): p. 35.
[52] Ibid.
[53] Dukert, p. 99.
[54] Pocock, p. 152.
[55] Dukert, p. 99.

gallons of fuel oil. Included among Savannah's accomplishments, was the production of nearly $12,000,000 in revenue during her first five years of cargo operation (1965 to 1970).[56]

Savannah was deactivated in late 1971, and presented to Savannah, Georgia, in early 1972 as part of a proposed Eisenhower Peace Memorial. Adequate support for the peace memorial never materialized. Several years later, Congress passed public law 96-331, which authorized the Secretary of Commerce to transfer the ship (under a bare boat charter) to the Patriots Point Naval and Maritime Museum in South Carolina. Since late 1981, she has served as a floating exhibit in Charleston Harbor. N.S. Savannah was listed on the National Register of Historic Places on November 14, 1982. In 1983 Savannah was dedicated as an International Historic Mechanical Engineering Landmark by the American Society of Mechanical Engineers.

The Absence of Additional U.S. Nuclear Merchant Ships

Several nations considered developing their own nuclear merchant ships. Yet, despite expectations for a second generation of smaller, lighter, more powerful and less expensive reactors, very few nuclear merchant ships were produced. The Soviet's quasi-military nuclear icebreaker Lenin, was in operation at least a year before Savannah. Three other Soviet nuclear ice breakers were in operation during the 1980s (Arktika, Sibiri, and Russia). In 1968, West Germany produced the nuclear-propelled ore carrier Otto Hahn. Although less glamorous than Savannah, she proved to be far more cost effective. The only other commercial nuclear vessel was Japan's small, "special cargo" Mutsu, built in 1971.[57]

The failure of the u.s. nuclear merchant ship program is important to the history of nuclear energy, but does not nullify the significance of N.S. Savannah. The absence of subsequent nuclear ships may be attributed to several contributing factors, but not to a failure of Savannah to carry out her defined objectives. The development and operation of its low-enriched uranium reactor was a technological success. Following modifications made during her first year in operation, the reactor proved safe, reliable, and more powerful and responsive than expected. Nevertheless, toward the latter part of her operation, many viewed Savannah as a failure.[58] Such appraisals, however, were usually based upon factors beyond the scope of the ship's design and operation.

Supporters of the program correctly refer to preconstruct ion statements that the goals of Savannah were limited to a few specific areas:

> 1) To demonstrate to the world the employment of nuclear power in an instrument of peace for the benefit of mankind, 2) To bring the power of the atom into the market places of the world in peaceful trade and commerce, 3) To enlighten the public to the fact that nuclear-powered ships are entirely dependable and safe, 4) To stimulate early solutions to such problems as international liability and indemnification, and, win for nuclear ships, acceptance in the world's ports, 5) To give the Maritime Administration and the Atomic Energy Commission the opportunity for prudently assessing the possible contributions of atomic power to the progress of the American Merchant Marine in providing shipping services on routes essential for maintaining the flow of the foreign commerce of the United States.[59]

The preceding study demonstrates that these goals were met.

Among the more frequent criticisms of the Savannah are those which refer to her inability to sustain commercial competitiveness with traditional merchant vessels. Such comparison is unfair, and ignores the history of the ship's early

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[56] "NS Savannah, Program Status," U.S. Department of Commerce, Maritime Administration, 1970. (Mimeographed.)
[57] Dukert, p. 102.
[58] "Supporting Case Studies," Analysis of Federally-Funded Demonstration Projects (Santa Monica, CA: Rand Corporation, 1976), pp. A-1 to A-50.
[59] "Technical Press Information, N.S. Savannah," Part I, pp. 3-5.

design phase. Once the Eisenhower administration decided to add the public relations component by combining a passenger and cargo ship, Savannah was removed from commercial viability. Concern over appearance and passenger comfort was not without expense, and resulted in design compromises. For example, the passengers' swimming pool was located over one of the cargo holds, prohibiting the most efficient access to that hold.[60] Other compromises included: the tilt-back design of the ship's masts (adopted to improve her appearance) which impeded operation of the forward end of the hatches; the shorter than normal length of Savannah's booms, coupled with her broad beam (necessary to accommodate the reactor and its shielding), made the maximum onshore reach four to six feet less than desirable; the less-than-standard lift capacity of booms and cargo gear required doubling and tripling of cranes when handling heavyweight cargoes; and, the lightly constructed hydraulic hatch covers leaked and were easily damaged.[61]

In addition to specific design elements which contributed to Savannah's lack of commercial viability, several external factors contributed to the absence of additional U.S. nuclear merchant ships. Some of these factors are also linked to the general decline in the development of land-based nuclear energy projects.

Despite warnings that the aging U.S. Merchant Marine fleet was in danger of being eclipsed by competing nations, the federal subsidies required by the maritime industry for development of nuclear merchant vessels were not appropriated. While the industry had expected to benefit from the nation's pride in Savannah, the nuclear merchant program proved to be a dead end. Rather than emphasizing this new propulsion technology to keep up with foreign competition, the U.S. maritime industry responded by overcoming the burden of costly loading and unloading expenses (three to ten times that of foreign costs) by building larger and faster containerized cargo ships.[62] On this point, the timing of the Savannah program was unfortunate. Although she was designed as a bulk-type cargo ship prior to the industry's conversion to more efficient containerized ships, Savannah's designers have been unfairly criticized for the ship's conventional cargo storage and handling features.

The merchant marine industry's reluctance to develop a fleet of truly commercial nuclear ships no doubt rests heavily with the lack of sufficient federal subsidy. Even with the ground broken by Savannah, private industry was not willing to absorb the costs and risks inherent in this type of research and development. Furthermore, as concern over the safety of nuclear reactors increased, the time and money expended on securing and maintaining operating licensing became even more burdensome. Finally, operating expenses remained high. In addition to the larger and more highly trained on-board crew, nuclear ship operation required the staffing of specially trained shore staff to service nuclear reactor repair, maintenance, and storage of radioactive materials. Even with soaring fuel costs during the 1970s the presumed economy of nuclear-powered ships failed to fulfill expectations. The once-popular notion of an inexpensive, "thimble-size" amount of nuclear material to power a ship proved overly optimistic.

While the success or failure of the Atoms for Peace initiative may be debated endlessly, its historical significance is firmly grounded in its representation as an unprecedentedly bold foreign policy venture. The initiative served as recognition of the solemn responsibilities of nuclear-nation status during the Cold War. Even if one accepts the critical appraisal that this policy produced few tangible results, the Atoms for Peace initiative had a broad psychological impact. It was perceived by most during the mid-1950s as a call for caution and reason during tense and anxious days.

At least for the present, the shifting attitudes about nuclear safety and the uncertain economics of nuclear energy have tabled the dreams of those who believed Savannah would lead to a fleet of nuclear merchant ships. While, this anticipated outgrowth of the nuclear merchant ship program has not been realized, the larger demonstration to the world of the peaceful potential of atomic energy was accomplished.

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[60] "Supporting Case Studies," p. A-15.
[61] Ibid., pp. A-33 & 34.
[62] U.S. Congress, Senate, United States Nuclear Merchant Fleet, p. 4.

Comparative sites

The most obvious sites associated with the pursuit of the peaceful atom are civilian nuclear reactors. While comparison of America's early reactors is difficult because of numerous design variations (fuel type, moderating mediums, etc.), they may be grouped into two broad categories: experimental and prototype reactors.[63]

Before President Eisenhower initiated the Atoms for Peace program, the Atomic Energy Commission had begun to develop experimental reactors, such as Experimental Breeder Reactor No. 1 (a National Historic Landmark), which produced the world's first useable electricity from atomic energy in 1951. In several instances, these experimental reactors were modified or dismantled after they had performed their objectives. The most promising of the experimental reactors served as models for prototype power reactor. Unlike the purely technical studies of the experimental reactors, the full-sized prototype reactors were designed to produce marketable quantities of power and to test the economic prospects for the commercial development of nuclear energy.

The earliest such prototype reactor was the Shippingport Atomic Power station in Pennsylvania, which began operation at the end of 1957. The Shippingport and Savannah reactors had some similarities; both were pressurized-water reactors, and both were joint government/private industry projects. Shippingport, however, had been an outgrowth of Admiral Rickover's pressurized water reactor research, and was more closely linked to the Navy's USS Nautilus submarine (a National Historic Landmark) than Babcock and Wilcock's design for Savannah's reactor. If not for the recent decommissioning and dismantling of the Shippingport reactor, containment vessel and reactor building, it could be argued that this earlier land-based prototype reactor possessed superior technological significance.[64]

Other early civilian prototype reactors, such as the Dresden Nuclear Power station at Morris, Illinois and the Yankee Atomic Electric Company's reactor at Rowe, Massachusetts, invite comparison to the Savannah. Unlike Shippingport and Savannah, these two reactors were strictly commercial design, construction and operation projects. The Dresden reactor, which began operation in 1959, was the world's first large-scale boiling water-type reactor. It has subsequently been decommissioned. The Yankee reactor, placed in operation in 1960, is an off-shoot of the Nautilus and Shippingport pressurized water reactors. Its most unique achievement may be that it continues to generate electricity for New England consumers thirty years later.

The last group of sites associated with the peaceful use of the atom are those created under Operation Plowshare.[65] The Atomic Energy Commission's program investigated the feasibility of utilizing nuclear detonations to excavate canals and harbors. Forty-one test detonations were conducted, beginning with Project Sedan in July of 1962. This 100-kiloton explosion at the Atomic Energy Commission's Nevada Test site created a crater 320' deep and 1,280' in diameter. Shortly thereafter, however, at the risk of committing technical violations of the 1963 Limited Test Ban Treaty, presidential support for the program waned. Another element of Operation Plowshare tested the feasibility of freeing trapped natural gas from geological formations. This too proved a dead end for the peaceful use of the atom. The first of these tests, Operation Gasbuggy, was conducted in December of 1962 and was typical of subsequent detonations. Even though Operation Gasbuggy's 29-kiloton explosion increased yield, the natural gas was radioactive and could not be sold commercially. While the Operation Plowshare sites relate to the efforts to harness the atom for peaceful purposes, they do not match the initiatives main thrust of developing commercial power reactors.

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[63] Atomic Energy Commission, 1960 Annual Report, pp. 433-463.
[64] Telephone interview with Michael L. McKernan, Senior Project Engineer, Roy F. Weston, Inc., Germantown, Maryland, 2 August 1990. Mr. McKernan served as the technical support contractor overseeing the dismantling and removal of the Shippingport reactor. Although the reactor and its surrounding structure were dismantled and removed, and the immediate site cleared to three feet below grade, several related structures remain. The administration building formerly adjacent to the reactor building, which contains the main control room, remains largely intact. The visitor's center (which includes a full-scale, cut-away model of the reactor) and the turbine building (with the slow speed, saturated steam turbines intact) remain on the Duquesne Light Company site.
[65] Atomic Energy Commission, 1962 Annual Report, pp. 241- 263; Glenn T. Seaborg and Benjamin S. Loeb, "The Perils of Plowshare," Stemming the Tide (Lexington, MA: Lexington Books, 1987) pp. 309-352.

Several of the experimental and prototype civilian reactors which preceded Savannah possess national technological significance. The most technologically significant of these reactors are Experimental Breeder Reactor No.1 in Idaho, (designated a NHL in 1965), and the Shippingport plant, which unfortunately lost much of its integrity following decommissioning and dismantling. From a strict technological perspective, other early prototype civilian reactors may possess a degree of national significance comparable to that of Savannah. Looking beyond technological significance, however, the highly visible nuclear merchant ship was designed not only to demonstrate the technological and commercial feasibility of safe and reliable nuclear energy, but to carry this nuclear exhibit to the citizens of the world. By travelling to dozens of ports around the world, where she was visited by more than 1.4 million people, N.S. Savannah has achieved exceptional significance and represents the Atoms for Peace initiative better than any other extant site.

9. MAJOR BIBLIOGRAPHICAL REFERENCES

Braynard, Frank O. S.S. Savannah: The Elegant Ship. New York: Dover Publications, 1988.

David, Heather M. Admiral Rickover and the Nuclear Navy. New York: Putnam Press, 1970.

DiBacco, Thomas V. "Microwave's Generation: America Begins Cooking to a Different Beep." Washington Post 31 May 1990, Home section, 28.

Dukert, Joseph M. Nuclear Ships of the World. New York: Coward, McCann & Geoghegan, Inc., 1973.

Fifty Years, New York Shipbuilding Corporation. Camden, NJ: New York Shipbuilding Corporation, 1949.

Hewlett, Richard G. and Holl, Jack M. Atoms for Peace and War, 1953-1961: Eisenhower and the Atomic Energy Commission. Berkeley, CA: University of California Press, 1989.

Horne, George. "Atom Merchant Ship Taking Shape." New York Times. 17 May 1959.

Kesterman, Frank. "Lessons From the Savannah." Ocean Industry (December 1968) : 35-38.

MacMillan, J.H., MacMillan, D.C., Robb, J.E., Lill, H.I. Jr., and Mehann, R.O. "NS Savannah Operating Experience." The Society of Naval Architects and Marine Engineers 11 (1963).

McDaniels, J.D. Jr. "Savannah: Refuelling." Nuclear Engineering (October 1960) : 455-459.

Moxey, R.L. "Savannah." Compressed Air Magazine (1962).

"The Nuclear Ship *Savannah*." [produced by Orleans Film Productions for the U.S. Maritime Administration and the Atomic Energy Commission, 1964] Motion Pictures Branch, National Archives. Washington, D.C.

New York Shipbuilding Corporation: A History and Record. Camden, NJ: New York Shipbuilding Corporation, 1931.

"N.S. Savannah." The Generator. (June-July 1959) : 1-18.

N.S. Savannah, Illustrated with Deck Plans. New York: American Export Isbrandtsen Lines, 1964.

"N.S. Savannah--Nuclear Forerunner." Marine Engineering/Log (August 1959) : 75-84.

"N.S. Savannah Special Issue." Marine Engineering/Log 67 (August 1962) : 57-81.

Pilat, Joseph F., Pendley, Robert E., and Ebinger, Charles, eds. Atoms for Peace, An Analysis After Thirty Years. London: Westover Press, 1985.

Pocock, Row1and. Nuclear Ship Propulsion. London: Ian Allan Ltt., 1970

Reynolds, Clark G. The Ships of Patriots Point. Mt. Pleasant, SC: Patriots Point Naval and Maritime Museum, 1983.

Seaborg, Glenn T. and Loeb, Benjamin S. Stemming the Tide: Arms Control in the Johnson Years. Lexington, MA: Lexington Books, 1987.

"Supporting Case Studies." Analysis of Federally-funded Demonstration Projects. Vol. 3. Santa Monica, CA: Rand Corporation, April 1976.

Technical Press Information, N.S. Savannah. Camden, NJ: New York Shipbuilding Corporation, 1959.

U.S. Atomic Energy Commission. Annual Reports to Congress, 1952-1965.

U.S. Congress. Senate. Committee on Commerce. United States Nuclear Merchant Fleet. 90th Cong., 1st sess., November 1967.

U.S. Congress. Senate. Committee on Commerce. Nuclear Ship Savannah, Hearings before the subcommittee on Merchant Marine on S. 2142. 94th Cong., 2nd sess., February 1976.

U.S. Department of Commerce. Maritime Administration. N.S. Savannah: Program Status, 1970.

Villiers, Alan. "World's First Nuclear Merchantman: Aboard the N.S. Savannah." National Geographic 122 (August 1962) : 280- 298.

Weart, Spencer R. Nuclear Fear. Cambridge, MA: Harvard University Press, 1988.

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
_X_ Other (Specify Repository): Philadelphia Maritime Museum
Patriots Point Maritime Museum

10. GEOGRAPHICAL DATA

Acreage of Property: Approximately 2.5 acres

UTM References:	**Zone**	**Easting**	**Northing**
	17	602200	3628160

Verbal Boundary Description:

All that area encompassed within the extreme beam and length of the vessel as she stands at her berth.

Boundary Justification:

The boundary incorporates the entire area of the vessel.

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NATIONAL HISTORIC LANDMARKS SURVEY
Designated July 17, 1991

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.

N.S. *Savannah*, Newport News, Virginia. Deck view of cranes, facing the bow, at Patriots Point, Mount Pleasant, South Carolina. Photo by James P. Delgado, 1988

N.S. *Savannah*, Newport News, Virginia. As a museum vessel at Patriots Point, Mount Pleasant, South Carolina. Photo by James P. Delgado, 1990. Courtesy of the NPS National Maritime Initiative.

INVENTORY FORM OF HISTORIC PLACES

Agency: Maritime Administration   Date: December 15, 1971

1. Name of property: Nuclear Ship Savannah

2. Location of property:
   A. State and County: Georgia, Chatham

   B. Latitude and Longitude:

   C. Township, Range & Section: City of Savannah

   D. Other legal description:

   E. Map Reference:

3. Nature of Property:
   A. District ( )   Site ( )   Building ( )   Object (x)

   B. Description, present condition and use:

10,000 ton combination passenger-cargo vessel, 596 feet long, with nuclear reactor steam generator system energizing 22,000 SHP turbine propulsion plant. Presently in a deactivated condition, nuclear core removed, and lying (after January 15, 1972) in Savannah, Georgia, at dock.

4. Importance of Property:

The N. S. Savannah was conceived as a part of President Eisenhower's "Atoms for Peace" program. She was the first nuclear powered merchant ship, and sailed about 450,000 miles, 90,000 in demonstration trips, and 360,000 in trade route liner cargo service. She demonstrated convincingly the technical feasibility of nuclear power for merchant ships by making port calls in 32 domestic and 45 foreign seaports.

5. Names and addresses of persons preparing this inventory:

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