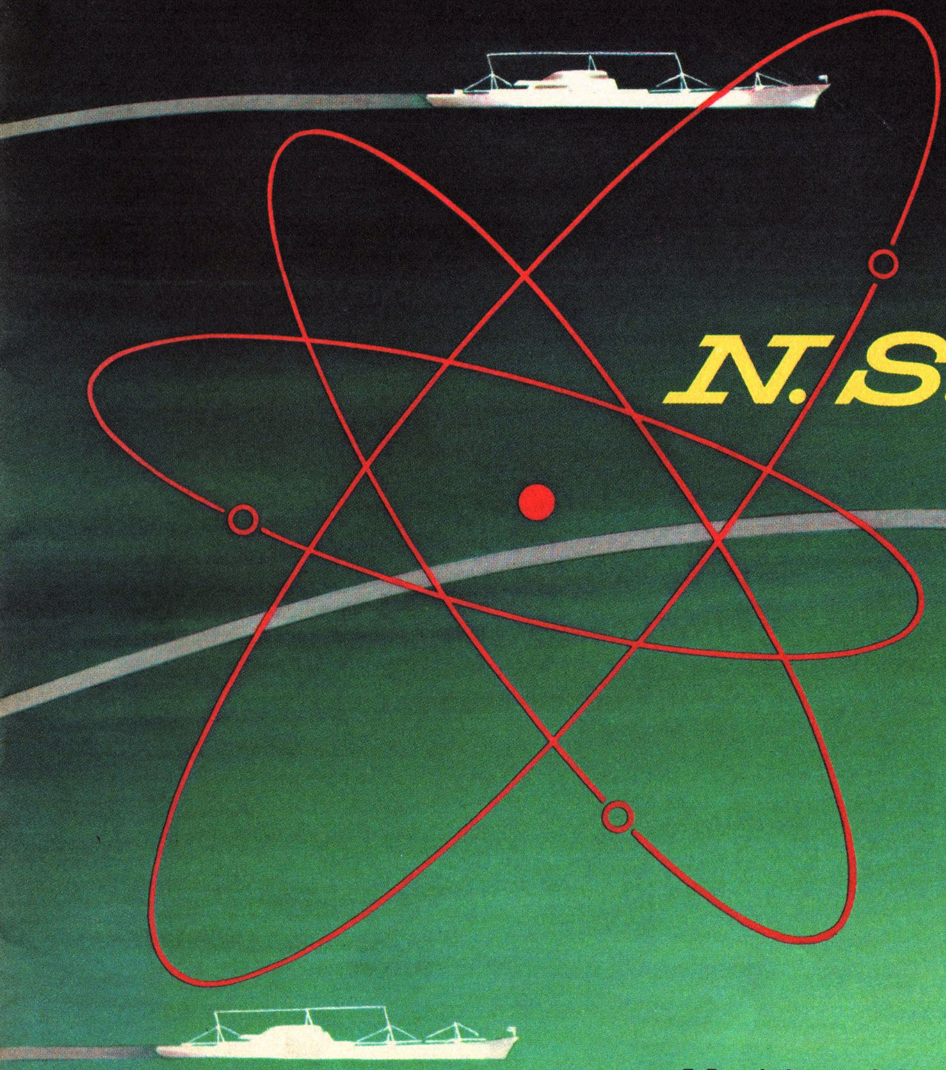
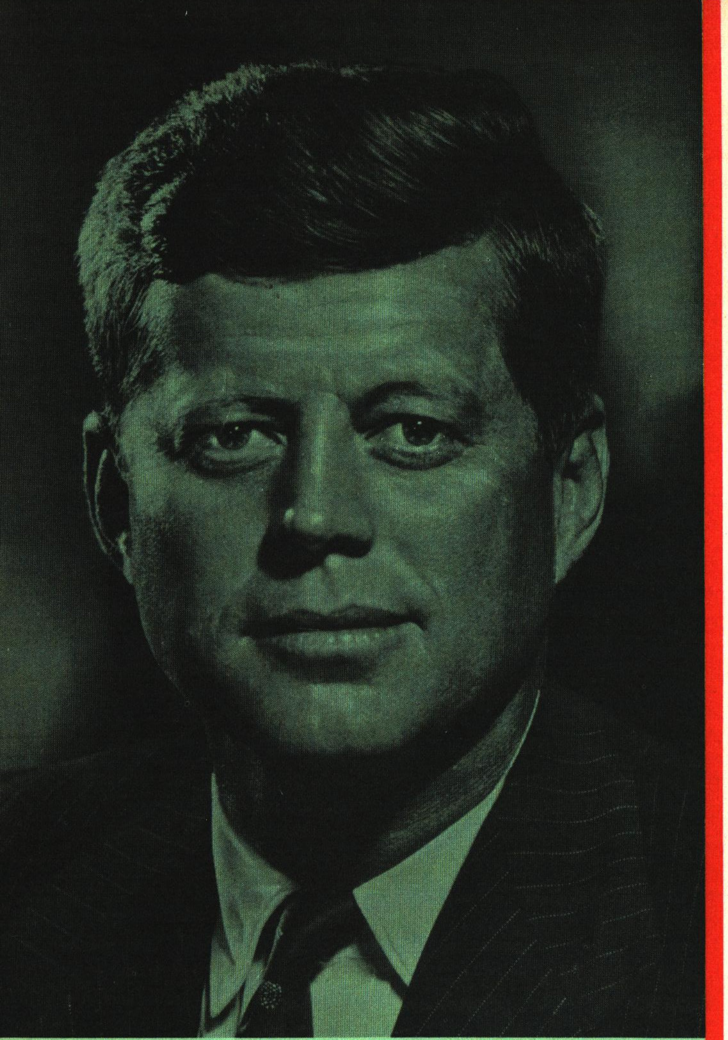
The World's First Nuclear Powered Merchant Ship . . .



N.S. SAVANNAH

A Joint Project of the
United States Atomic Energy Commission
and the
Maritime Administration of the United States Department of Commerce

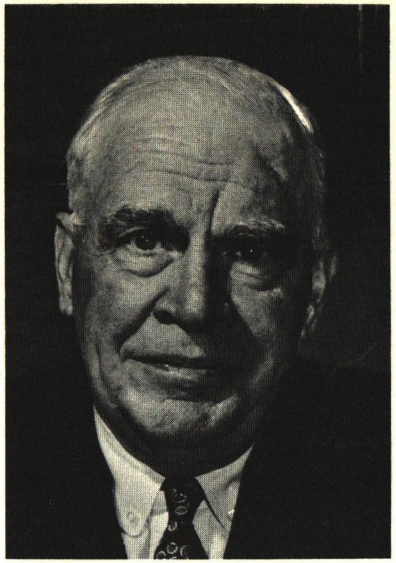


". . . 1962 is the year in which the world's first nuclear-powered merchant ship, the N.S. Savannah, first went to sea . . . In the years to come, this nuclear-powered merchant ship will demonstrate to the peoples of the world the intent of the United States of America to use the atom for peaceful purposes . . . The citizens of this Nation may take justifiable pride in the building of this ship and in its future dedication to our peaceful trade and world commerce."

—President John F. Kennedy

From his National Maritime Day Proclamation, 1962

DEPARTMENT OF COMMERCE



The Hon. Luther H. Hodges
Secretary of Commerce

Clarence D. Martin, Jr.
Undersecretary of Commerce for Transportation

Donald W. Alexander
Maritime Administrator

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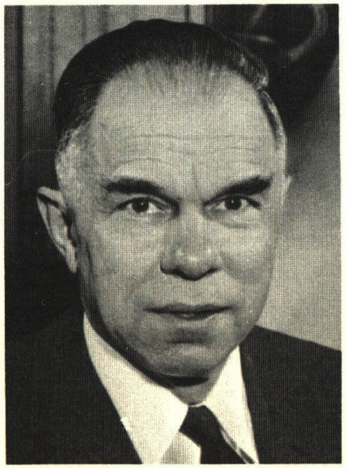
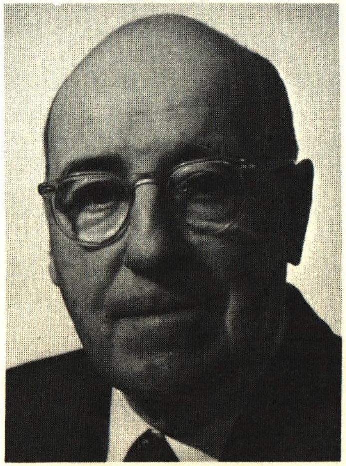
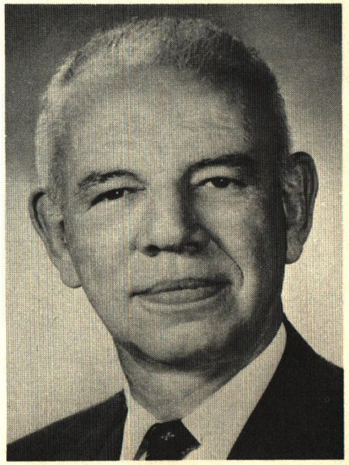
UNITED STATES ATOMIC ENERGY COMMISSION



Dr. Glenn T. Seaborg
Chairman

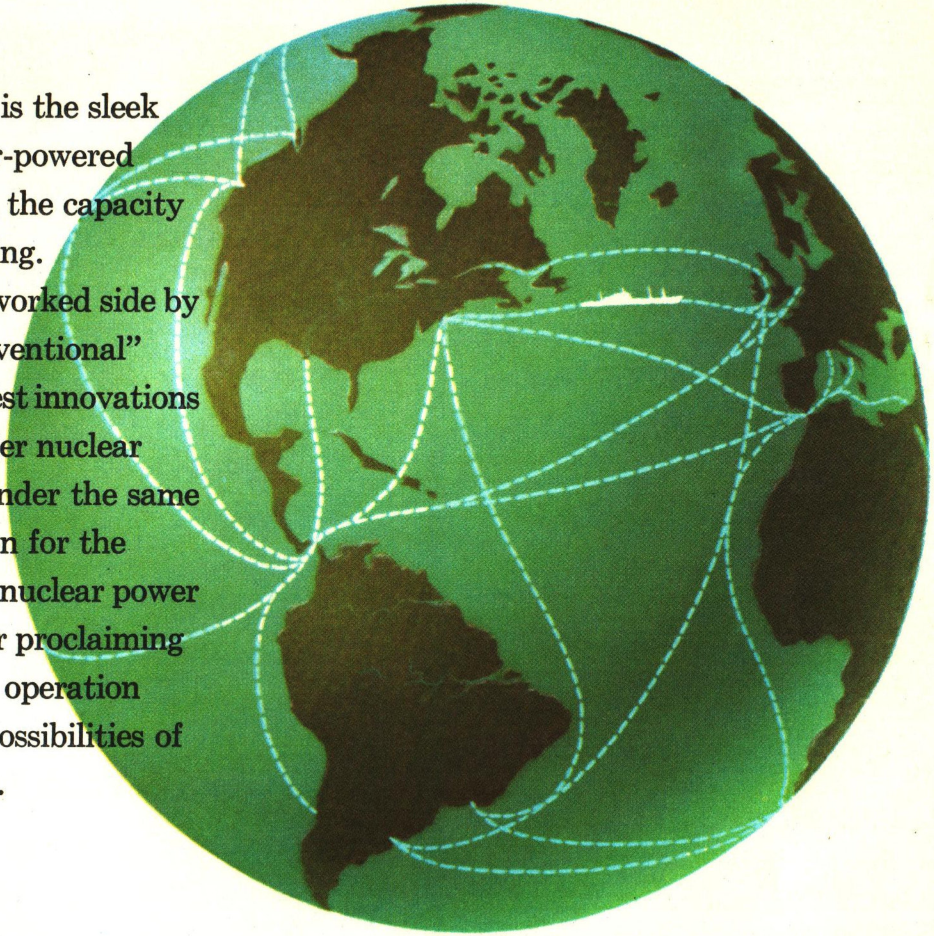


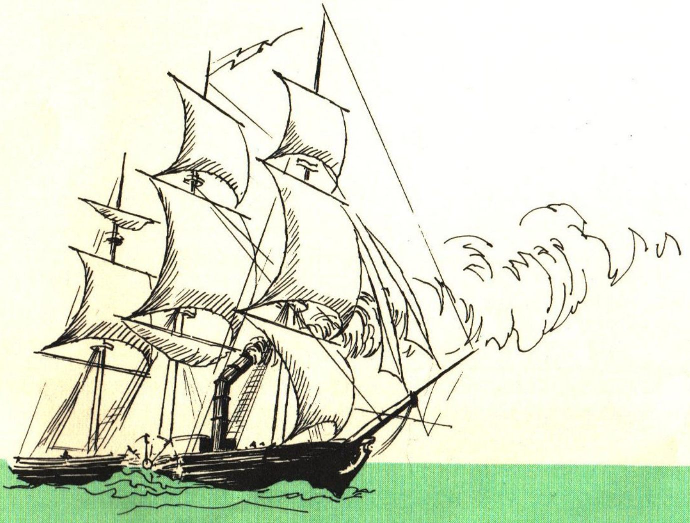
Dr. Robert E. Wilson



Dr. Leland J. Haworth

Steaming into the harbors of America and the world is the sleek Nuclear Ship SAVANNAH, the world's first nuclear-powered merchant ship. At her heart is a nuclear reactor with the capacity to take her 14 times around the world without refueling. Naval architects, shipbuilders and nuclear engineers worked side by side to design and build the SAVANNAH. Her "conventional" features boast a stylish, streamlined design and the latest innovations for accommodating passengers and handling cargo. Her nuclear plant was designed and installed—and is operated—under the same rigid controls used by the Atomic Energy Commission for the construction and operation of reactors in shore-based nuclear power plants. The N.S. SAVANNAH is a floating messenger proclaiming the peaceful uses of atomic energy to the world. Her operation affords every nation an opportunity to observe the possibilities of nuclear propulsion for all types of commercial ships.





Namesake of the *Nuclear Ship* SAVANNAH is the *Steamship* SAVANNAH —which pioneered another revolutionary method of ship propulsion in 1819 by being the first vessel to use steam in an ocean voyage. The tiny American vessel crossed the Atlantic from Savannah, Georgia, to Liverpool, England, carrying enough fuel for about 89 hours of steaming. For most of the 29 days and 11 hours of her journey she was under sail.

A THREE AND ONE-HALF YEAR FUEL SUPPLY

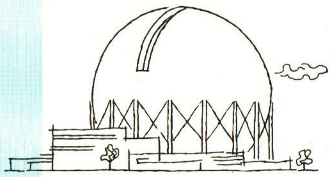
In a conventional steamship, an oil-fired boiler heats water, converting it into steam which drives a turbine. The turbine turns the propeller shaft.

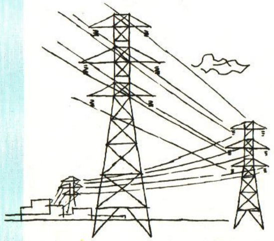
In the SAVANNAH the heat source is a nuclear reactor which takes the place of the boiler. The reactor's fuel is enriched uranium oxide formed into 682,200 pellets, each the size of a half inch stack of dimes. A controlled nuclear reaction takes place within the reactor and creates the needed heat. Water is circulated in the reactor around the hot fuel and carries this heat to a "heat exchanger" where water in a secondary system is converted into steam. This steam drives the SAVANNAH's turbine which, in turn, drives the ship's propeller shaft.

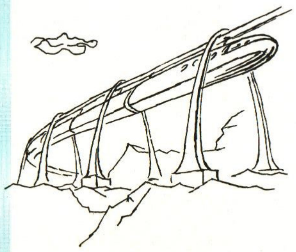
If we were to split all the atoms in a pound of this amazing nuclear fuel, the heat energy released would be two and a half million times that given off by burning a similar amount of oil.

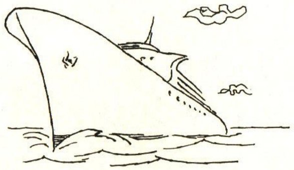
One loading of the SAVANNAH's fuel supply is designed to last for 3½ years of operation.

WHY NUCLEAR









The world's fossil fuels—coal, oil and gas—are ample for years to come, but not inexhaustible. So we look to the atom for a new kind of fuel—to help meet future needs for power.

Development of the atom as a source of energy has become one of the major technological challenges of our generation. In addition to the SAVANNAH, a joint project of the U.S. Atomic Energy Commission and the Maritime Administration of the U.S. Department of Commerce, the Commission and private industry are working together in research and development programs aimed toward making nuclear power an economical source of heat and energy for a wide variety of peaceful uses.

In merchant shipping, the prospect of nuclear propulsion is attractive for a number of reasons.

Nuclear ships, for example, will be able to operate on longer runs at higher sustained speeds than conventional ships. They also will be able to carry larger cargoes than conventional ships because reactors will require less space than conventional equipment and the storage space needed for large supplies of fuel.

Some dozen nations now are actively engaged in studies of non-military nuclear powered ships. As such studies and developmental programs progress, more atomic vessels can be expected to dot the sea lanes of the world.

WHAT IS NUCLEAR POWER?

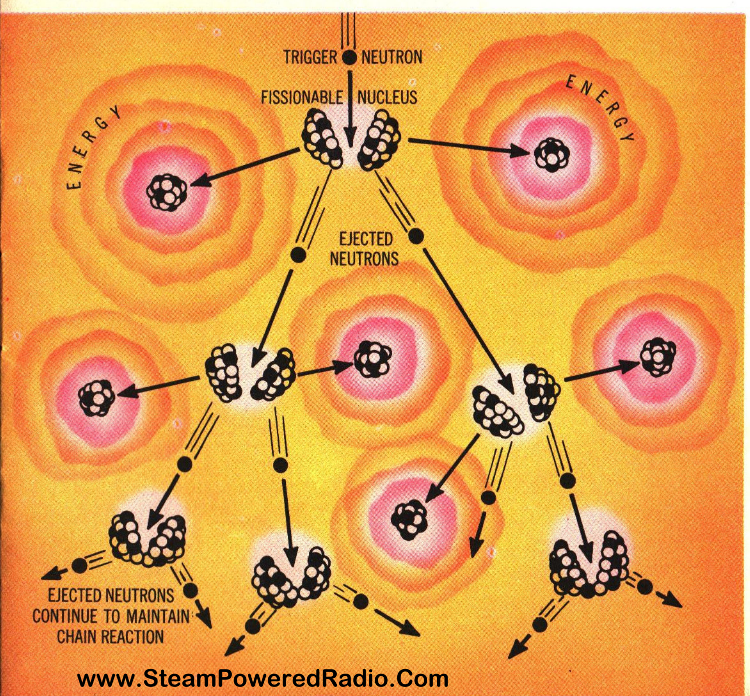
Nuclear energy originates in the nucleus or heart of an atom. Atoms are the smallest possible units of the chemical elements that

POWER?

are the "building blocks" of our universe. Oxygen, hydrogen, carbon and uranium are some of these chemical building blocks.

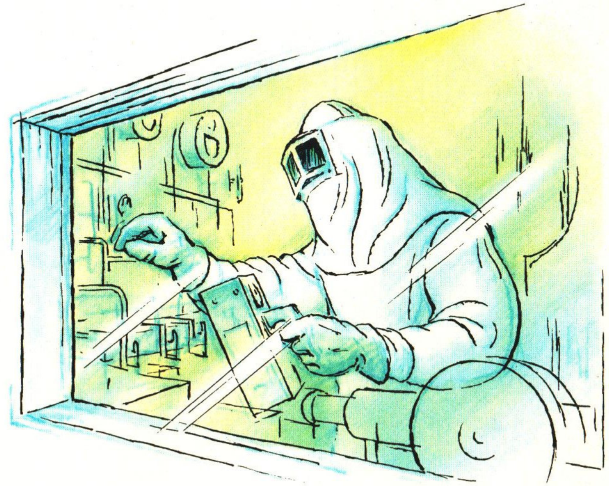
Small as the atom is (no one has ever seen an individual atom) it is made up of various parts: the *nucleus* that contains minute particles called *protons* and *neutrons* and an outer shell made up of other particles called *electrons*. A force binds the nucleus and electrons together.

In similar manner, the particles within the *nucleus*—the *protons* and *neutrons*—are bound to each other by a force. It is the nucleus which is "split", or fissioned, in a nuclear reactor. When this happens, part of the force holding the protons and neutrons together is changed into energy in the form of heat. Also, as fission occurs, the nucleus ejects additional neutrons which are available to split other atoms, thus sustaining a "chain reaction".



When a neutron splits the nucleus of a fissionable atom of uranium 235, tremendous energy—most of it in the form of heat—is released. As fission occurs, the nucleus ejects two to three additional neutrons which are available to split other uranium 235 atoms, thus sustaining the chain reaction.

A BRIEF HISTORY OF NUCLEAR POWER



The first self-sustaining nuclear chain reaction in history was accomplished by scientists working at the University of Chicago on December 2, 1942.

The Atomic Energy Act of 1946 assigned the responsibility for atomic development in the United States to a newly formed government agency, the Atomic Energy Commission.

In the early 1950's the Commission undertook a comprehensive program of basic research and development in atomic propulsion of ships, atomic electric power production and the peaceful use of atomic energy in many other fields. This work has continued with increasing emphasis on finding and developing more and more uses of the atom for the betterment of mankind.

STEP ABOARD THE SAVANNAH

. . . watch the operation of her reactor controls from a special glassed-in observation area . . . inspect her cargo holds and handling equipment, her well-appointed passenger staterooms and public rooms . . . visit the bridge with its array of meteorological and navigation equipment.

Visitors are welcome, because the SAVANNAH belongs to the people!

(1) *Navigating bridge deck.* Pilot house, chart room, radio room, instruments.

(2) *Boat deck.* Officer accommodations.

(3) *Promenade deck.* Public lounge, veranda and cocktail bar. "Walk around" terrace has colorful ceramic tile floor, gives unobstructed view of the sea through windows 30 inches high. Veranda opens through sliding glass doors onto a swimming pool. Dance floor surrounded by tables with illuminated tops.

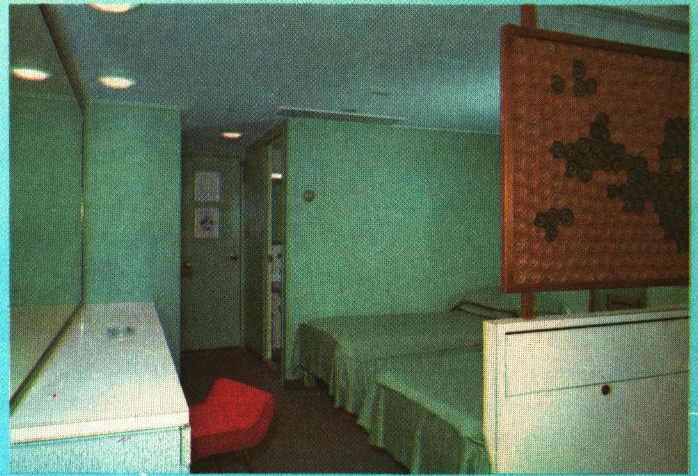
(4) *"A" deck.* Main lobby. Offices for purser, steward, doctor and nurse. Dispensary. Air-conditioned staterooms and suites to accommodate 60 persons.

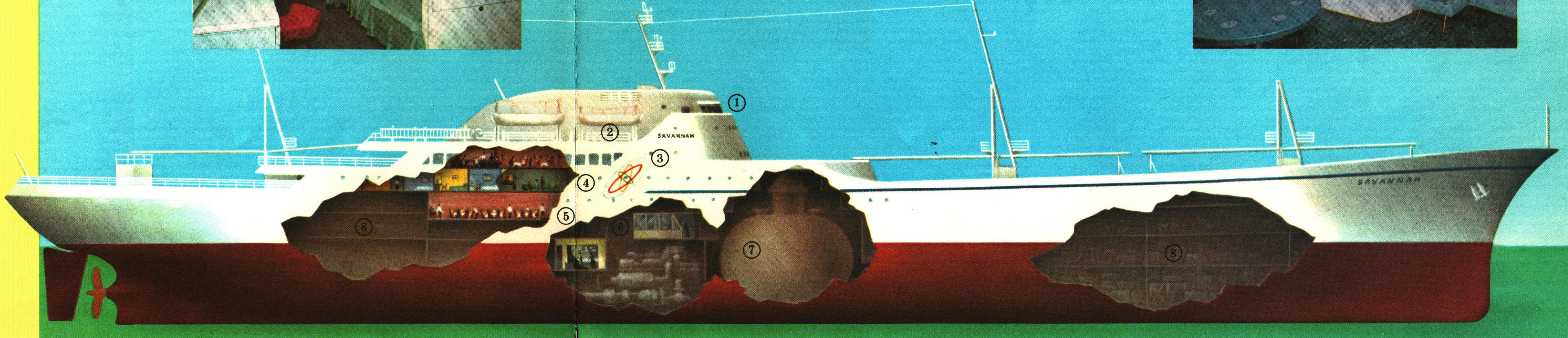
(5) *"B" deck.* Dining room seating 75 people. Sculptured mural provides dramatic background at one end; opposite is a golden model of the original SAVANNAH suspended in a glass panel.

(6) *"C" deck.* Reactor control room viewing gallery. Service and storage areas.

(7) *Reactor area* (see next page).

(8) *Holds.* The SAVANNAH's seven cargo holds accommodate 9400 tons of freight in approximately 746,200 cubic feet of cargo space.





Design. By George G. Sharp, Inc. The N.S. SAVANNAH is a single screw passenger cargo vessel of advanced design with modern sweeping lines from raked bow to modified cruiser stern.

Interiors carry out this advanced design, utilizing a wide variety of materials and products, some in unusual ways. In staterooms, lounges, dining rooms and stairways there are examples of American art—paintings, woodcuts, etchings, sculpture, murals, abstract color photography and ceramics.

Specifications. Length 545 feet between perpendiculars, 595.5 feet overall; 78 foot molded beam; 29.5 feet draft (maximum); displacement 22,000 tons (full load); cargo deadweight 9400 tons; horsepower 20,000 shp (normal); speed 20 knots.

Other features. Hydraulic stabilizers, located amidships, are installed to reduce "roll". These fins are operated from a console in the wheel house and controlled by a gyro system capable of sensing sea motion.

The vessel is equipped also with diesel generators and an emergency motor with sufficient power to propel the ship at a speed of six knots.

Servicing. Handled by Todd Shipyards Corporation under a contract with the Maritime Administration. Todd operates eight yards and has a nuclear division which directs drydocking, repair, maintenance and refueling of the vessel.

Above left. Thirty staterooms adjacent to the lobby are arranged for single, double or three-passenger accommodations. Some convert into suites. Decor is muted, relaxing, but not lacking in interesting detail.

Above right. Public rooms are scaled to the grander job of receiving large groups which will visit the SAVANNAH. The veranda is carefree, open and light in feeling to suit daytime gatherings as well as evening festivity.

The Savannah's Nuclear Power Plant

The diagrams on this page give a more detailed picture of what the SAVANNAH's power plant looks like.

Fuel elements (Figure 1) are assemblies containing pellets of enriched uranium oxide fuel encased in stainless steel tubes. When all 32 fuel elements are in place, within the reactor, the reactor looks as it does in Figures 2 and 3.

Boron stainless steel control rods (heavy black lines in Figure 2) are used to regulate the reaction that takes place. On "shut down" all the 21 control rods are fully in place, and the neutrons released by the enriched uranium oxide are absorbed by the rods so that a chain reaction cannot take place. When the plant is "started up," these control rods are withdrawn to allow the neutrons to split the atoms in the uranium and to begin a controlled chain reaction.

Surrounding the reactor vessel and associated systems is a containment vessel (Figure 4) which is 50.5 feet long and 35 feet in diameter. Weighing 275 tons and occupying 41,300 cubic feet, the containment vessel is immediately forward of the bridge and extends downward to just above the level of the ballast tanks. The containment vessel, in turn, is shielded by 2000 tons of lead, polyethylene and concrete.

The SAVANNAH's advanced pressurized water reactor was designed and manufactured by the Babcock & Wilcox Company.

One of the 32 fuel element assemblies in the SAVANNAH reactor. Each element contains four bundles of 41 fuel rods. Active fuel is contained in the central 60 inches of the 72-inch bundle length.

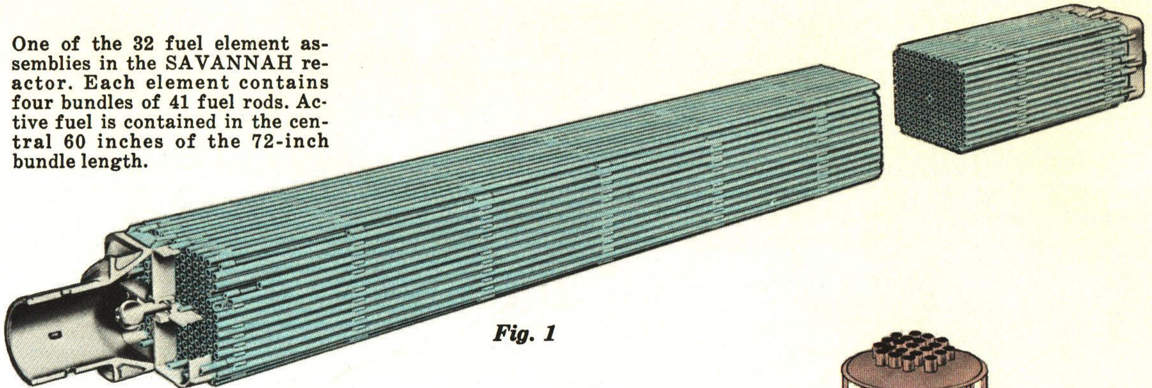


Fig. 1

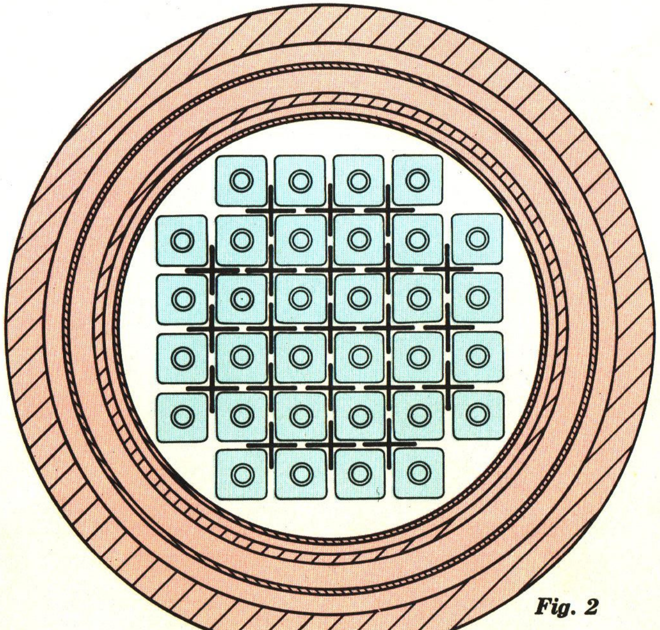


Fig. 2

Top view of reactor core showing the arrangement of fuel elements and control rods. Rods are in heavy black.

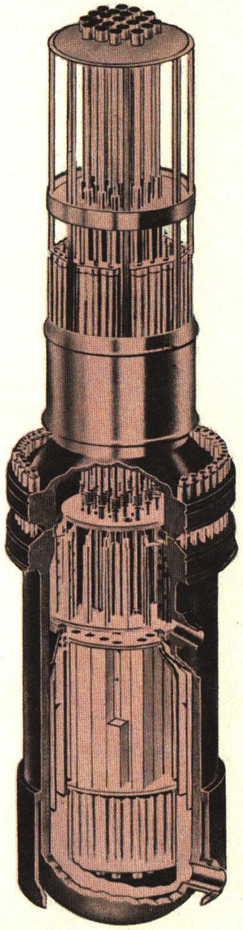


Fig. 3

Interior view of reactor with fuel housed in square-shaped fuel elements at center. Rods extending up through the vessel head control the fission process and chain reaction.

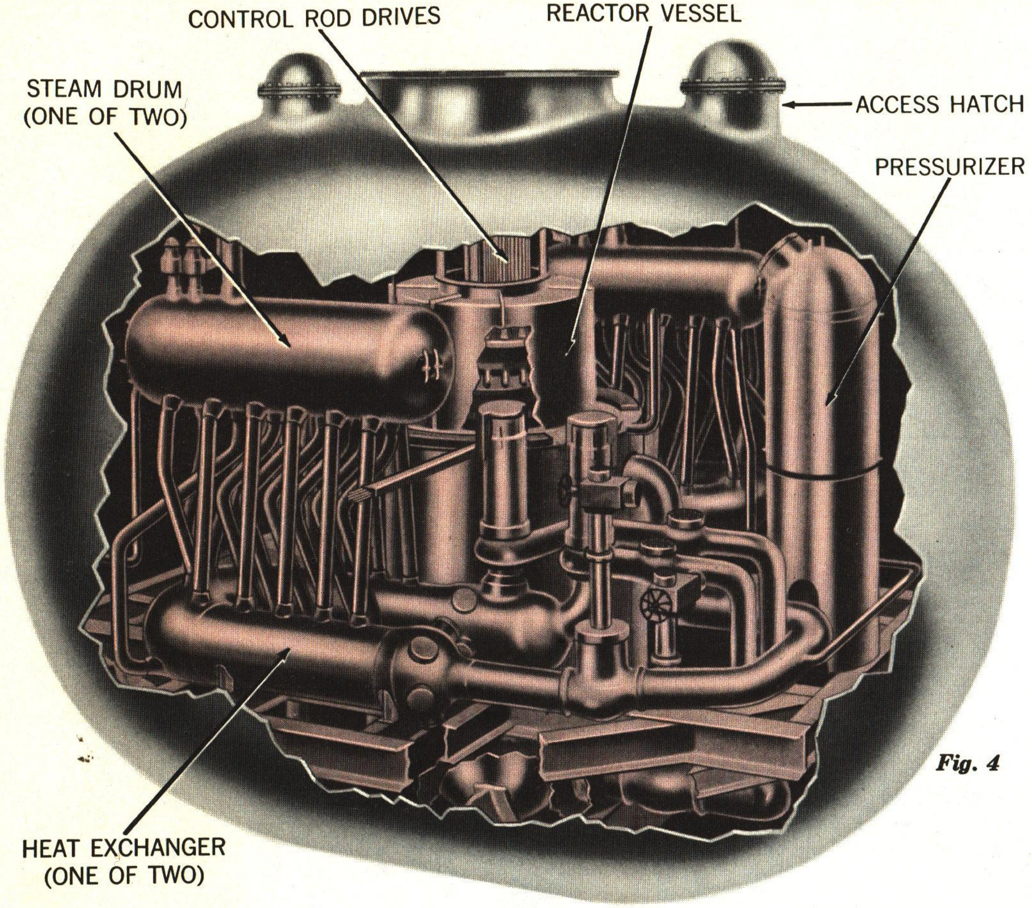
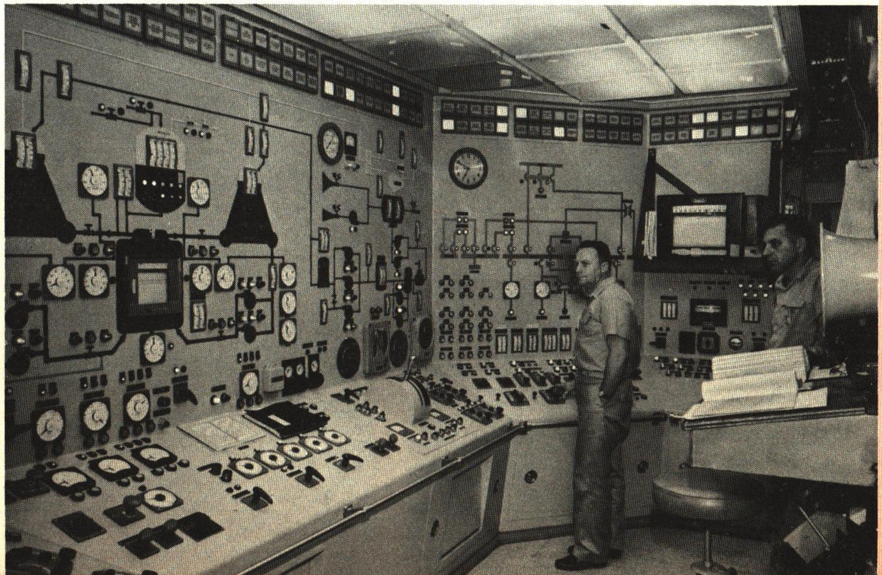


Fig. 4

Cutaway drawing of containment vessel with components of nuclear power plant shown. Vessel is sealed at all times during plant operation and is well protected on all sides.



Master control panel can be seen by visitors from the viewing gallery on "C" deck. Flow diagram on wall is color-coded for more accurate identification of various sections of the SAVANNAH'S complex propulsion system.

IS THE SAVANNAH POWER PLANT SAFE?

There is no chance that an atomic reactor can explode as does an atomic bomb. The chain reaction by which a reactor works is a controlled reaction—not the instantaneous fissioning of a large amount of nuclear materials involved in a bomb explosion. Should a power reactor go out of control, the principal nuclear damage would be a melting of its core.

Design, construction and operation of all types of reactors – whether for power, research or other purposes – are controlled in the U.S. by strict Atomic Energy Commission regulations with public safety uppermost in mind. As the world's first commercial, nonstationary type of nuclear power plant, the SAVANNAH's design and construction have resulted in a vessel with a high degree of safety. Basically, the safety considerations concern two separate but closely interrelated factors:

(1) The hull and interior structure. These surpass the highest standards of safety, both in the conventional marine sense and in the light of the additional factors created by the installation of a nuclear propulsion plant; and

(2) The nuclear propulsion system. The basic difference in safety between a nuclear powered ship and a conventionally powered ship involves radioactivity which results from the fission process. Provision has been made to control this radioactivity on the SAVANNAH under all forseeable conditions.

IMPORTANT MILESTONES in the SAVANNAH PROGRAM

Construction of the N.S. SAVANNAH was proposed on April 25, 1955, in a New York speech by former President Dwight D. Eisenhower. Construction was authorized by Congress on July 20, 1956, as a joint project of the United States Atomic Energy Commission and the Maritime Administration of the United States Department of Commerce. The keel was laid on May 22, 1958 and the ship was launched on July 21, 1959.

The following general plan was established by the Government and has been followed in the development and operation of the SAVANNAH:

(1) Construction of vessel, nuclear reactor and other equipment.

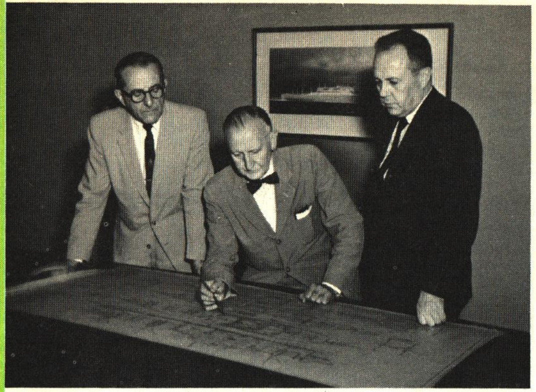
(2) Component and systems testing at dockside.

(3) Loading of nuclear fuel.

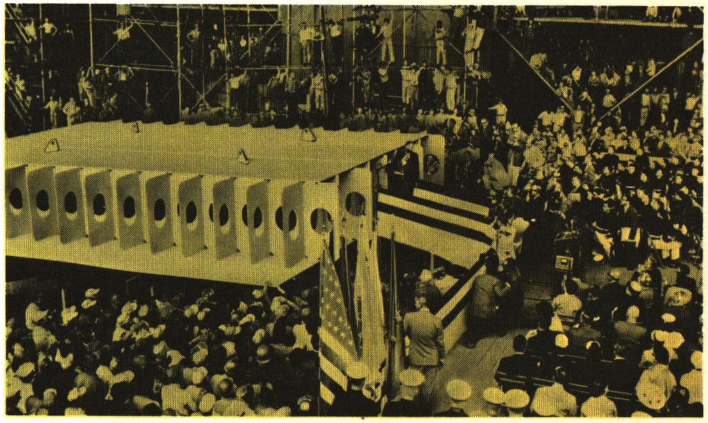
(4) Dock power trials.

(5) Sea trials.

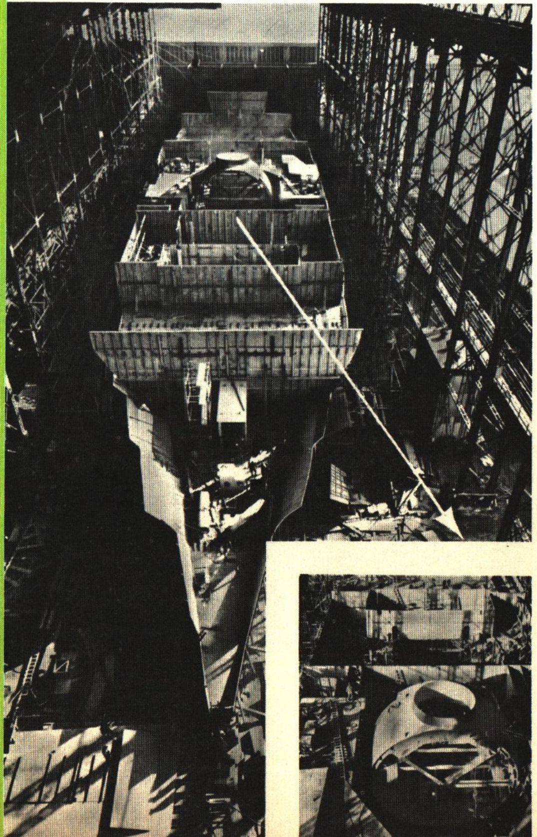
(6) Voyages initially to United States ports of call and then to major ports of the world in modified commercial service—that is, carrying passengers and cargo at prevailing rates but on schedules designed to demonstrate the ship as appropriate in each port. Full commercial operation on regular trade routes will come later.



The first nuclear merchant ship takes form on designing boards at George G. Sharp, Inc.

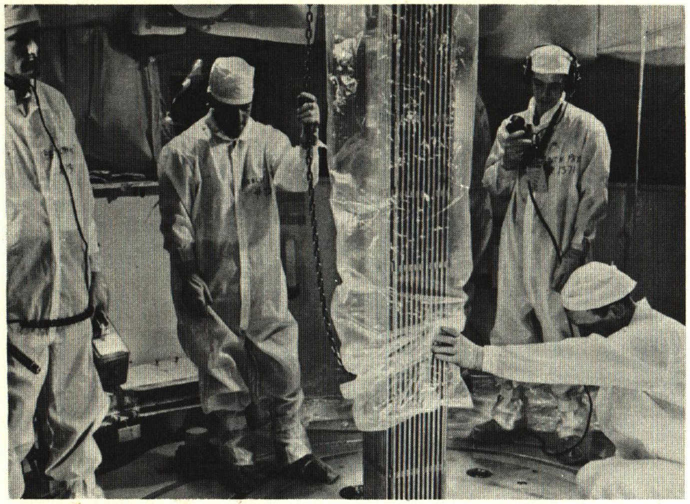


The SAVANNAH'S keel was laid on National Maritime Day.



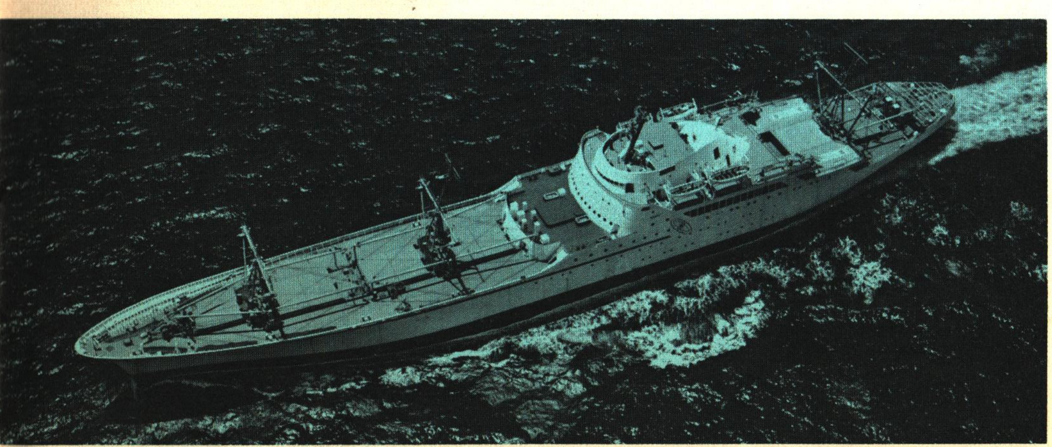
At New York Shipbuilding Corporation, Camden, New Jersey, a section of the reactor containment vessel is now in place.

Deck officers and engineers from States Marine Lines received intensive training in nuclear subjects including classes at Lynchburg College (Va.) under supervision of the Babcock & Wilcox Company.



Fuel element is loaded into the reactor core under maximum "clean" conditions.

The Nuclear Ship SAVANNAH slides down the ways after her launching at Camden.



Off for her sea trials from a base near Yorktown, Va.

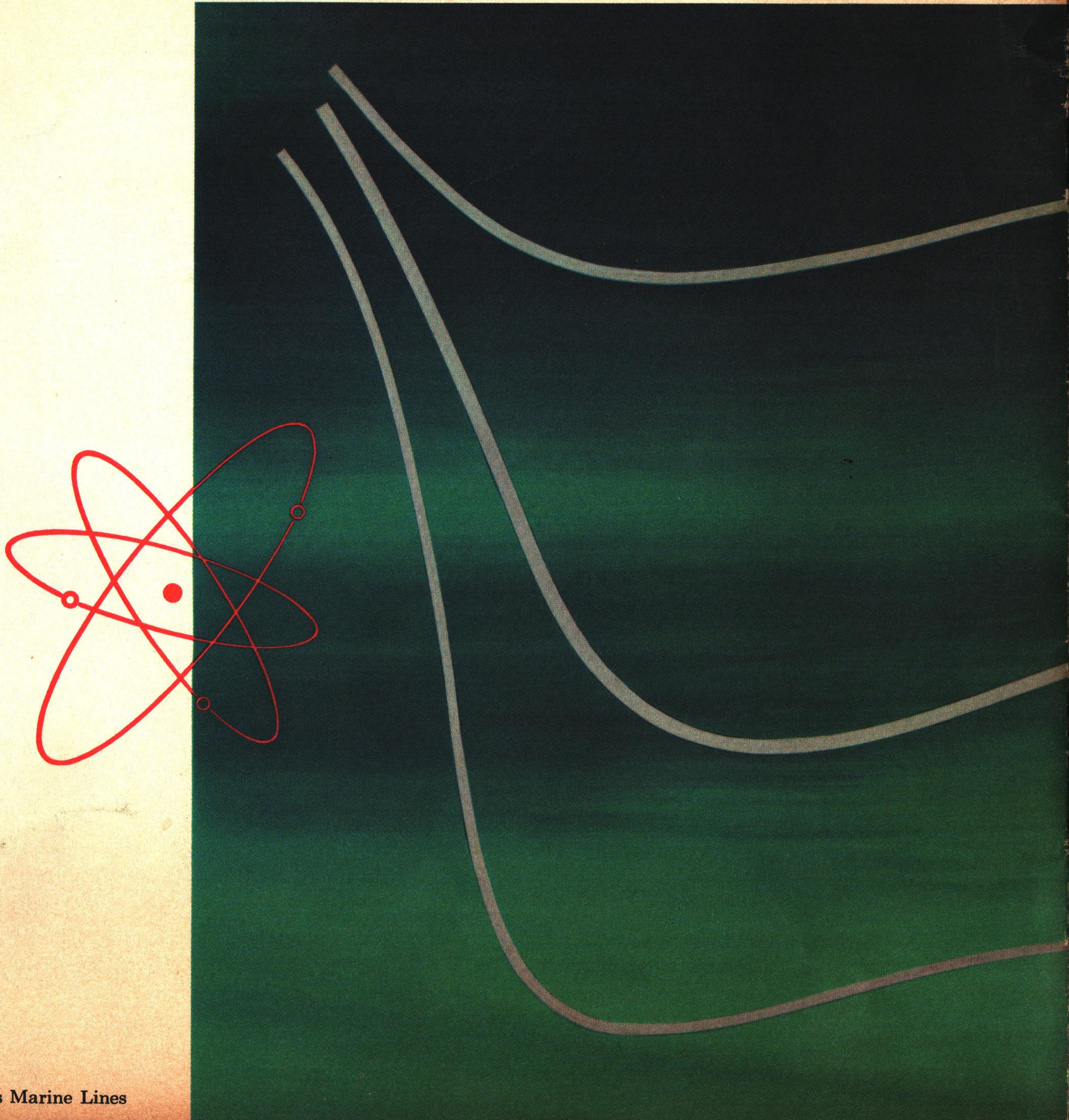
NEW YORK SHIPBUILDING CORPORATION
Camden, New Jersey
—Ship Construction

The BABCOCK & WILCOX COMPANY
161 East 42nd Street
New York 17, New York
—Nuclear Plant

GEORGE G. SHARP, INC.
30 Church Street
New York, New York
—Naval Architects

STATES MARINE LINES, INC.
90 Broad Street
New York 4, New York
—General Operating Agent

TODD SHIPYARDS CORPORATION
1 Broadway
New York 4, New York
—Maintenance & Repair



Booklet prepared by States Marine Lines