


Nuclear Ship *Savannah*

Virginia Section, American Nuclear Society
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Erhard W. Koehler

Manager, NS *Savannah* Programs

Office of Ship Operations

400 7th Street, SW | Washington | DC 20590

www.dot.gov

MARAD

U.S. MARITIME ADMINISTRATION

N.S. *Savannah*

MARAD

Presentation Outline

MARAD

- Introduction
- Origins of the *Savannah* Program
- Ship's Characteristics and Features
- History and Operations
- The *Savannah* Today
- Decommissioning
- Future Plans
- Conclusion
- Questions

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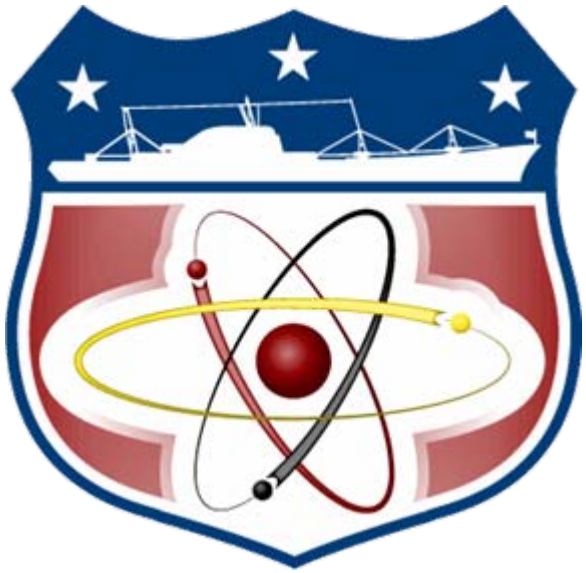
Today's tour and tonight's meeting are intended to begin the reintroduction of the N.S. *Savannah* to industry and the public,

to describe the Maritime Administration's plans for decommissioning the *Savannah's* nuclear facilities,

and to describe our goals for future preservation of this National Historic Landmark.



Savannah Technical Staff

"The McCready Shield"

By John Spears, 2005

From an original sketch by RADM Lauren S. McCready, USMS, 1965

About MARAD

- An agency of the U.S. Department of Transportation, MARAD promotes the development and maintenance of an adequate, well-balanced United States merchant marine, sufficient to carry the Nation's domestic waterborne commerce and a substantial portion of its waterborne foreign commerce, and capable of serving as a naval and military auxiliary in time of war or national emergency.
- MARAD traces its ancestry to the United States Shipping Board, created in 1916 under the auspices of the Shipping Act.
- MARAD has constructed, owned, operated and maintained merchant ships since its inception. The Office of Ship Operations (under various names) dates to the earliest days of the agency.

About MARAD

- As the United States Maritime Commission, our agency managed the greatest ship construction program ever undertaken. Over 5,000 ships were constructed and operated by the USMC between 1941 and 1945.

- The present-day Maritime Administration resulted from a reorganization of the USMC in 1950; originally part of the Department of Commerce, MARAD was transferred to the Department of Transportation (DOT) in 1981.

Savannah Technical Staff

- The STS is the organizational unit in the Office of Ship Operations that manages the N.S. *Savannah*, and serves as the licensee organization. It was re-established in 2005.
- Present-day STS is based on historical models from the 1956 – 1976 timeframe.
- From 1976 – 2005, the license was managed on a collateral basis, using the Review and Audit Committee as the umbrella responsible organization.
- STS draws on in-house expertise, contractor staff, and partnerships with external organizations including DOE (Argonne Nat'l Lab and Jefferson Lab) and DOT's Volpe Center.

Origins of the *Savannah* Program

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Origins of the *Savannah* Program

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A nuclear-powered merchant ship was first proposed by President Dwight Eisenhower in a speech to the United Nations in April 1955.

N.S. *Savannah* was the centerpiece of the program that grew from that speech and became known as …

"Atoms for Peace."

Origins of the *Savannah* Program

"America will demonstrate to people everywhere the peacetime use of atomic energy, harnessed for the improvement of human living."

The N.S. *Savannah* Program

was a joint project of the

United States Maritime Administration and

the Atomic Energy Commission.

It was authorized by an act of Congress, PL 848,

on July 30, 1956.

Origins of the *Savannah* Program

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MARAD contracted for construction of the ship and directed ship operations.

Savannah was constructed by the New York Shipbuilding Corp., in Camden, New Jersey

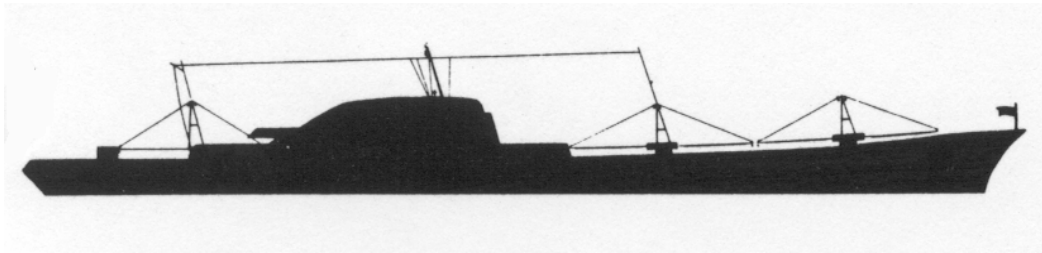
AEC contracted for the nuclear power plant and provided initial crew and reactor operator training.

Savannah's nuclear reactor was supplied by the Babcock & Wilcox Co., of Lynchburg, Virginia

The core objectives of the N.S. *Savannah* program were:

- **to demonstrate to the world the peaceful use of atomic power**
- **to demonstrate the feasibility of nuclear-powered merchant ships**
- **to establish international recognition and acceptance of peaceful nuclear power**
- **to establish an infrastructure in the marine industry to support operations by nuclear powered merchant ships**

Ship's Characteristics



The *Savannah* is "a practical merchant vessel of combined passenger and cargo design." *PL 848 legislative history.*

Length Overall	**595 ft**
Beam	**78 ft**
Draft	**29 ft**
Reactor Power	**80 MWth**
Propulsion Power	**22,000 SHP**
Speed	**21 kts**
Passengers	**60**
Total displacement	**22,000 tons**
Total deadweight	**9,570 tons**

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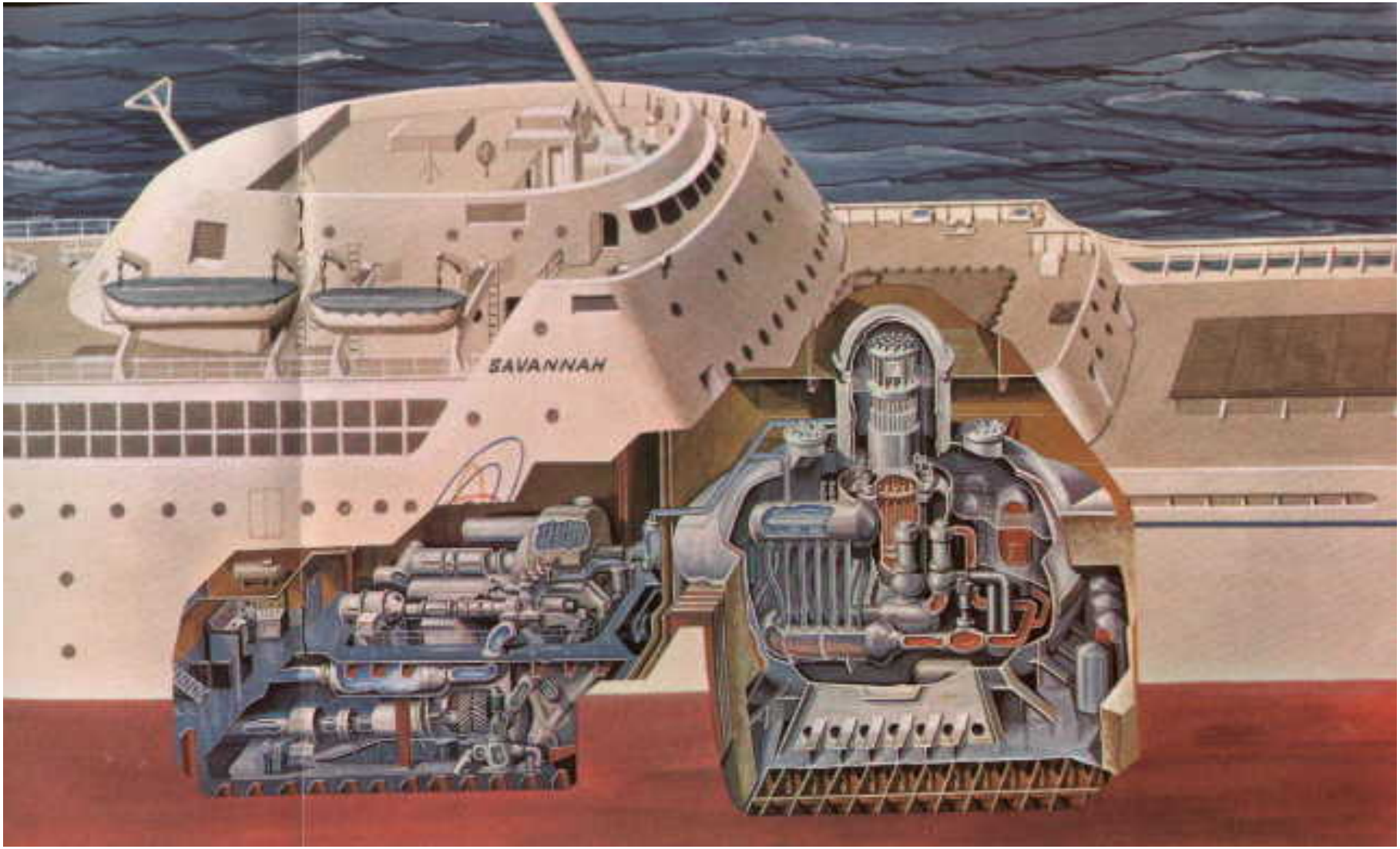
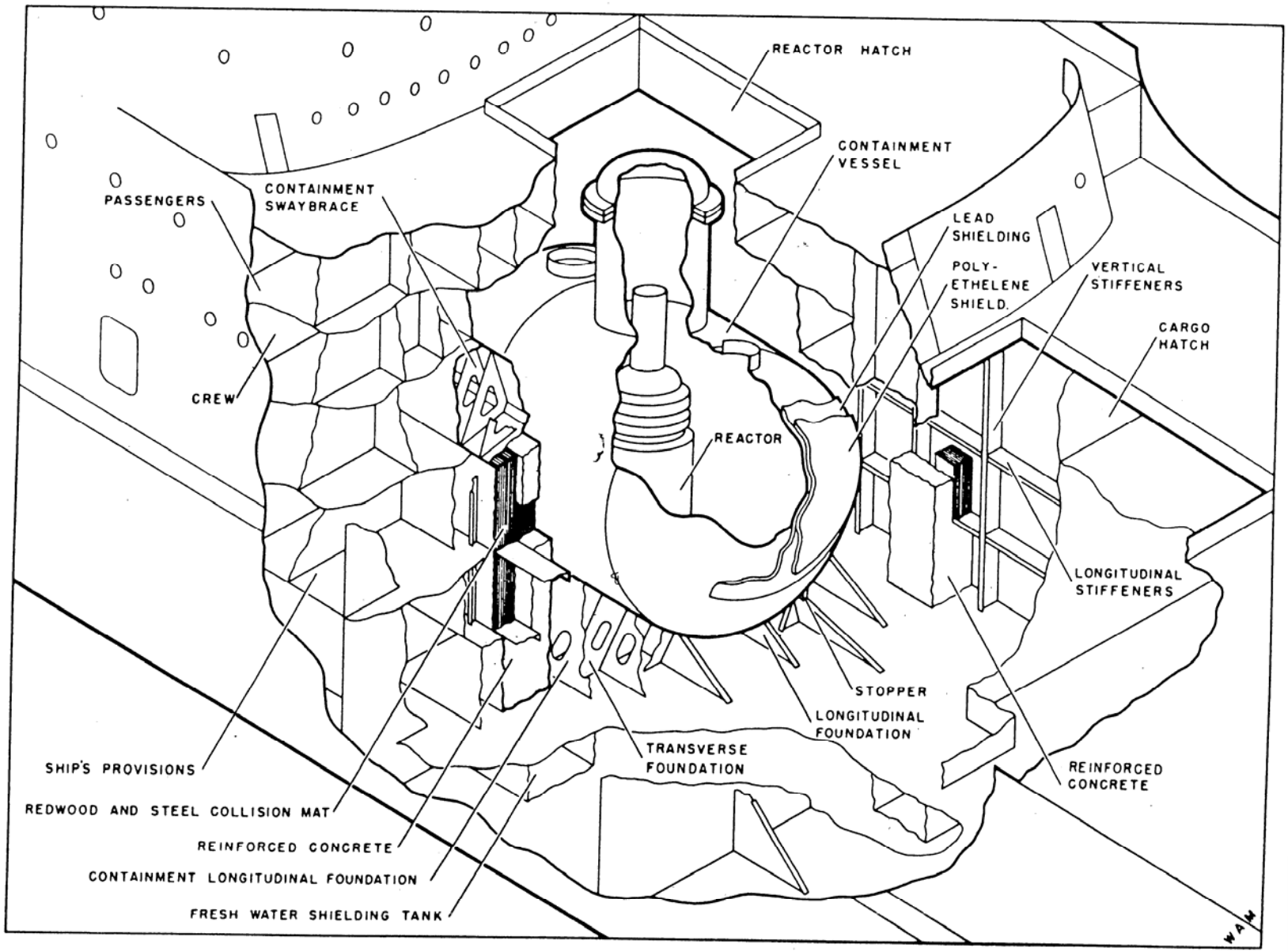
Savannah was designed to be among the safest ships afloat. Protection of the public and the environment were key design objectives.

- **Reactor space is surrounded on all sides by a collision protection system and shielding**
  - **Laminated steel, concrete and redwood impact matting**
  - **Steel welded inner sheath in secondary spaces**
  - **Space between containment vessel and inner steel sheath**
  - **Personnel quarters outboard of collision protection barriers**
  - **Inner bottom tanks between the lower secondary and the sea**

Construction Features



Reactor Compartment Cut-Away



Savannah Arrangements

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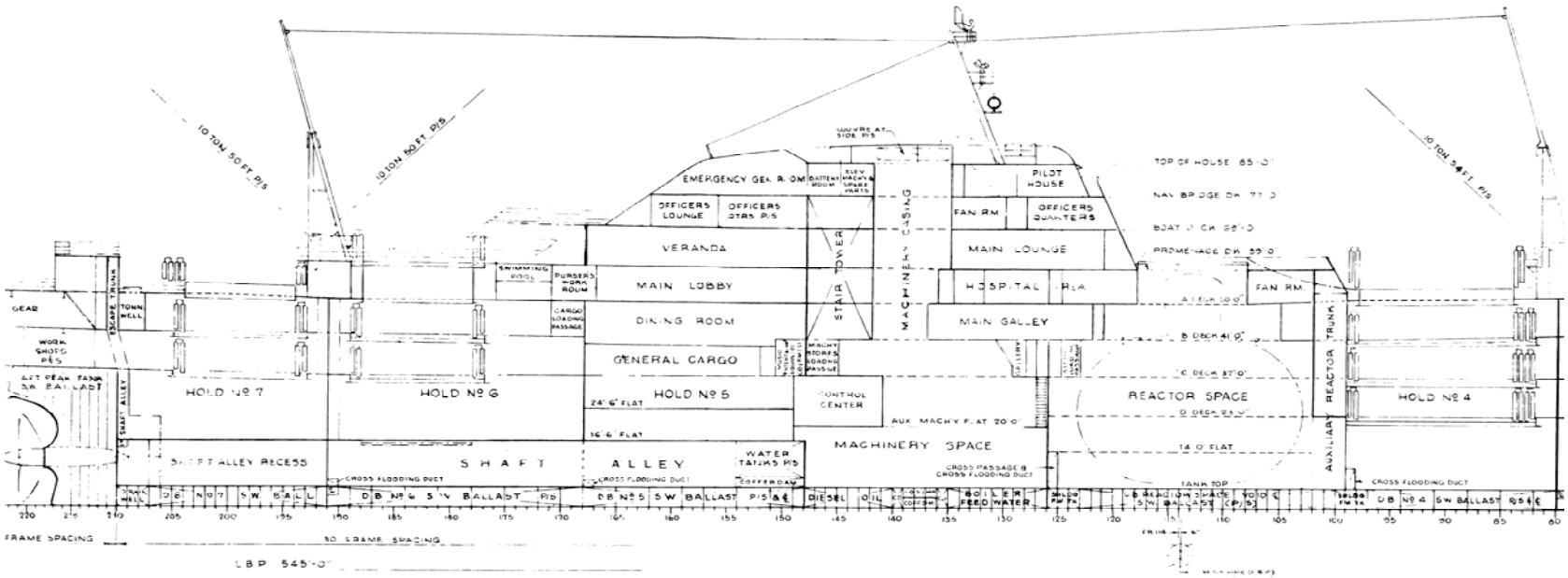
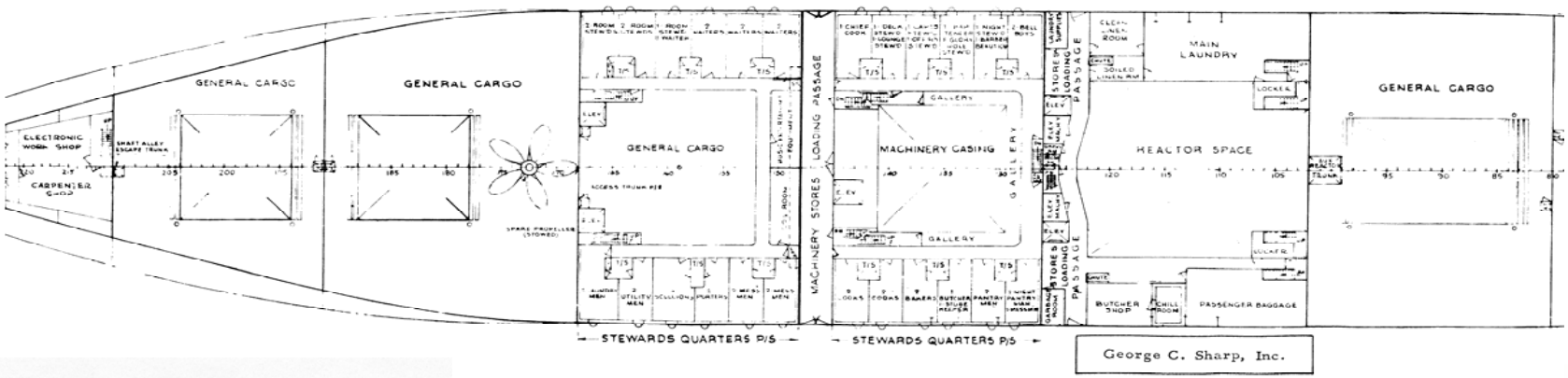
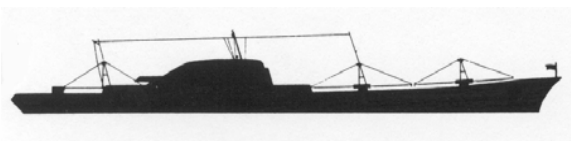
Inboard Profile (partial)







"C" Deck (partial)

Location of Radiological Spaces

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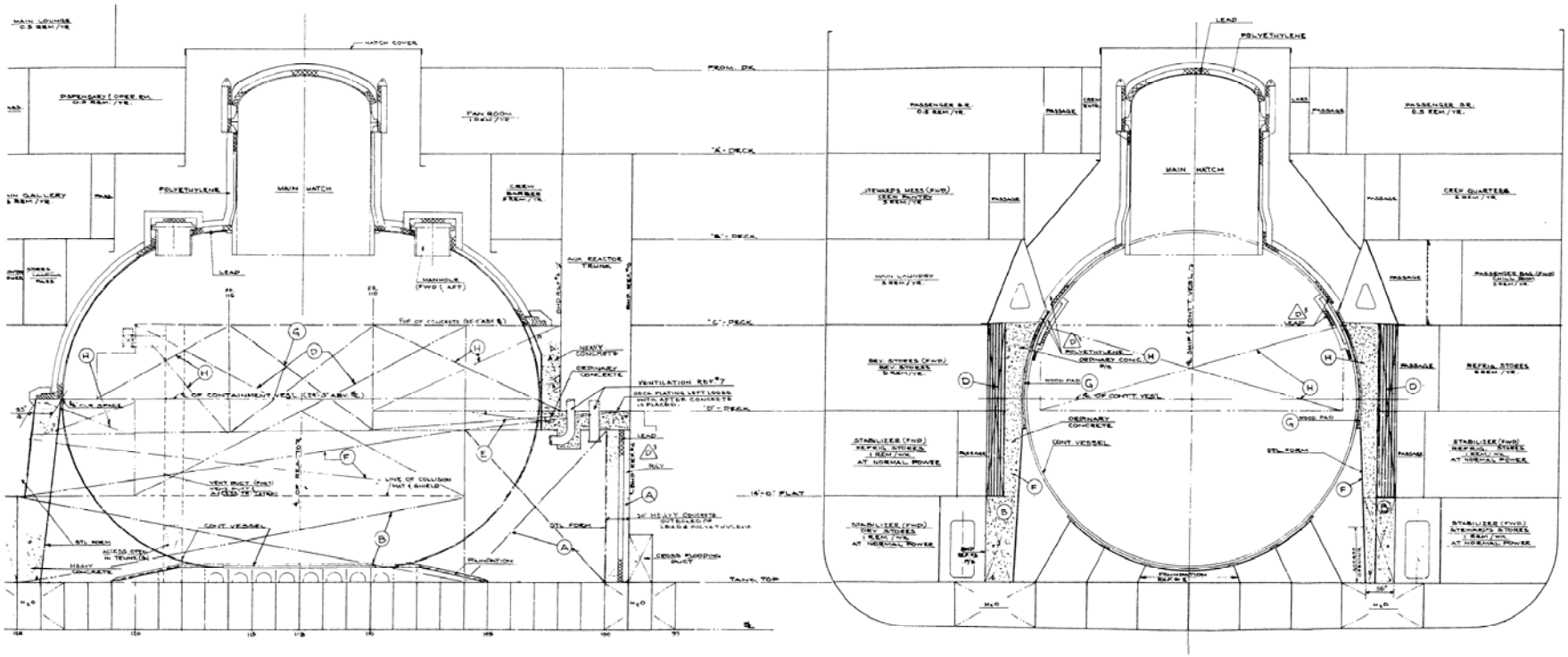
Space	Location
▪Reactor Containment	Midships, Frame 103 to 123
▪Lower Secondary	Midships, B Deck, Frame 99 to 126
▪Upper Secondary	Midships, Promenade Deck, Frame 99 to 126
▪Forward Control Area (Auxiliary Reactor Trunk)	Midships, Frame 99 to 102
▪Hold 5 Hot Chem Lab	Hold 5, Flat 16’6” Portside
▪Port/Starboard Stabilizer Spaces	Midships, Frame 103 to 123
▪Port/Starboard Charge Pump Rooms	Midships, B Deck, Frame 99 to 126

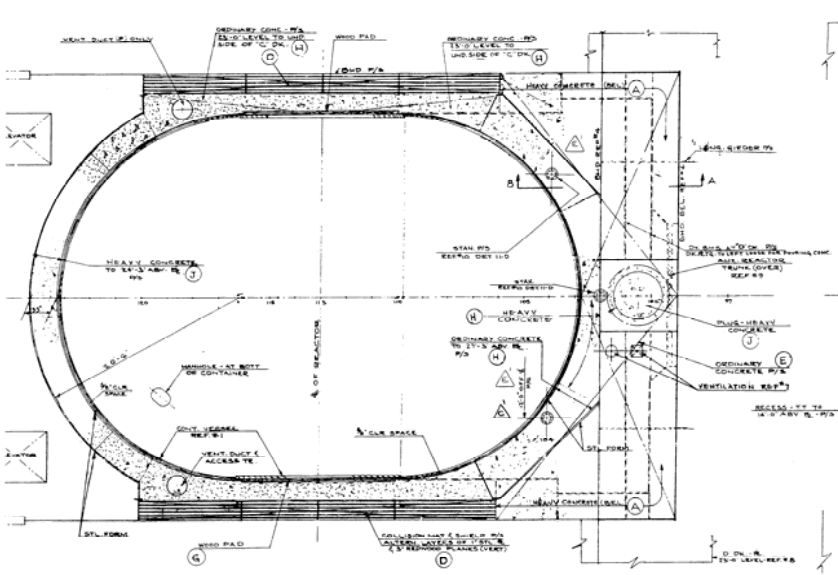
Reactor Compartment Sections



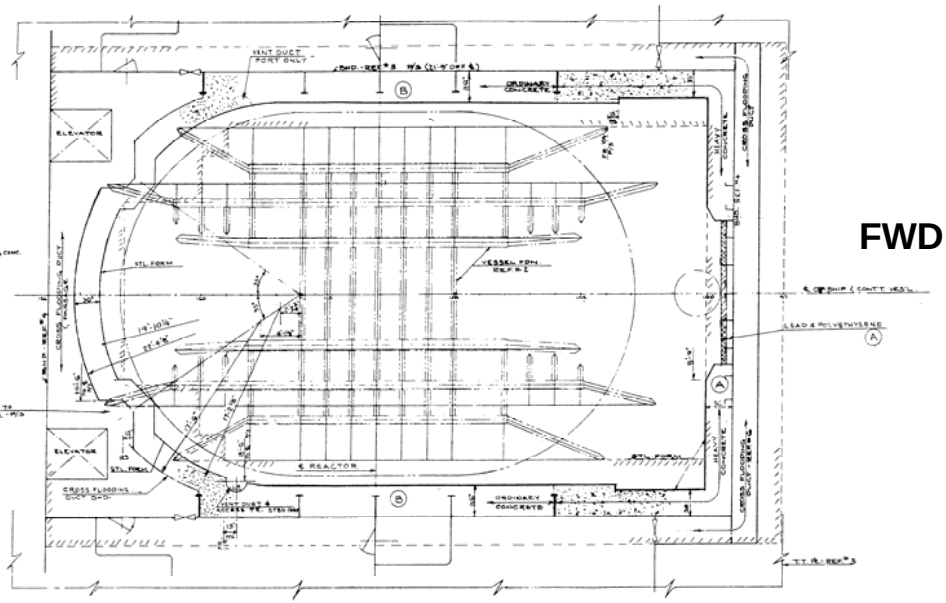
Longitudinal Section

Transverse Section

Reactor Compartment Sections

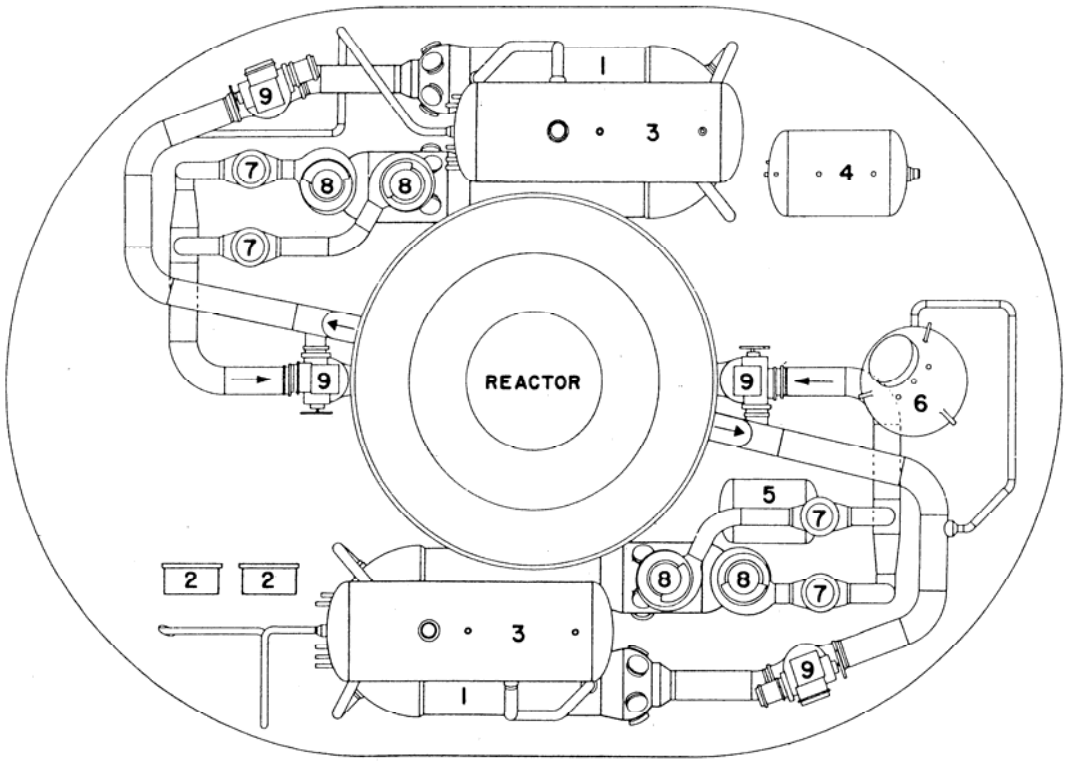


Shielding Arrangement, D Deck



Shielding Arrangement, Tank Top

Equipment Arrangement inside Containment



① HEAT EXCHANGER ② LET DOWN COOLERS
③ STEAM DRUM ④ CONDENSING TANK
⑤ CONT. DRAIN TANK ⑥ PRESSURIZER
⑦ CHECK VALVE ⑧ PUMP ⑨ GATE VALVE

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Key Dates in *Savannah's* Construction
Keel Laying, National Maritime Day, May 22, 1958
Launching, July 21, 1959 (sponsored by Mamie Eisenhower)
Initial Reactor Criticality, December 21, 1961
Builders Tests and Sea Trials, Yorktown, VA May 1962

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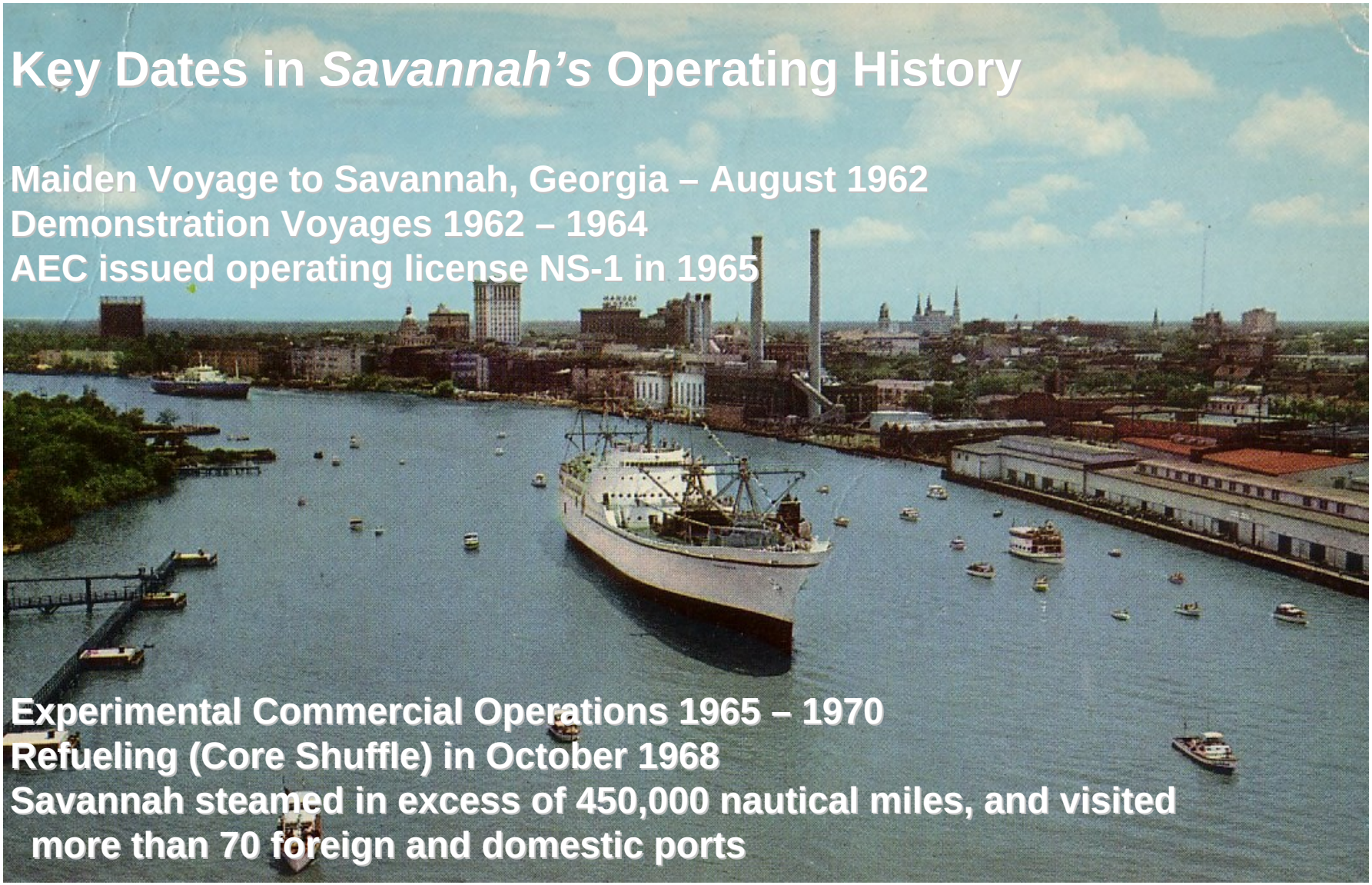

Key Dates in *Savannah's* Operating History

Maiden Voyage to Savannah, Georgia – August 1962
Demonstration Voyages 1962 – 1964
AEC issued operating license NS-1 in 1965

Experimental Commercial Operations 1965 – 1970
Refueling (Core Shuffle) in October 1968
Savannah steamed in excess of 450,000 nautical miles, and visited more than 70 foreign and domestic ports

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The *Savannah* was NOT intended to be economical in service!

- ***Savannah* was not intended to be a prototype ship.**
- ***Savannah* was NOT removed from service because it did not make money – although that factor contributed to the decision.**
- ***Savannah* accomplished all of its original program objectives.**
- **Many misnomers and "old wives tales" exist about *Savannah*, and cloud the fact that she was a very successful ship and project. Among them …**
  - She was not "too small to be an efficient cargo ship or passenger ship."
  - Her cargo gear was not WW2 surplus.

Savannah **Successfully Completed all of its program objectives, and was removed from service in 1970.**

Savannah **was defueled in 1971, and all fuel was returned to the AEC for reprocessing.**

Savannah **was made permanently inoperable in 1973-76.**

Savannah's **license was amended to "possession-only" in 1976 by the Nuclear Regulatory Commission.**

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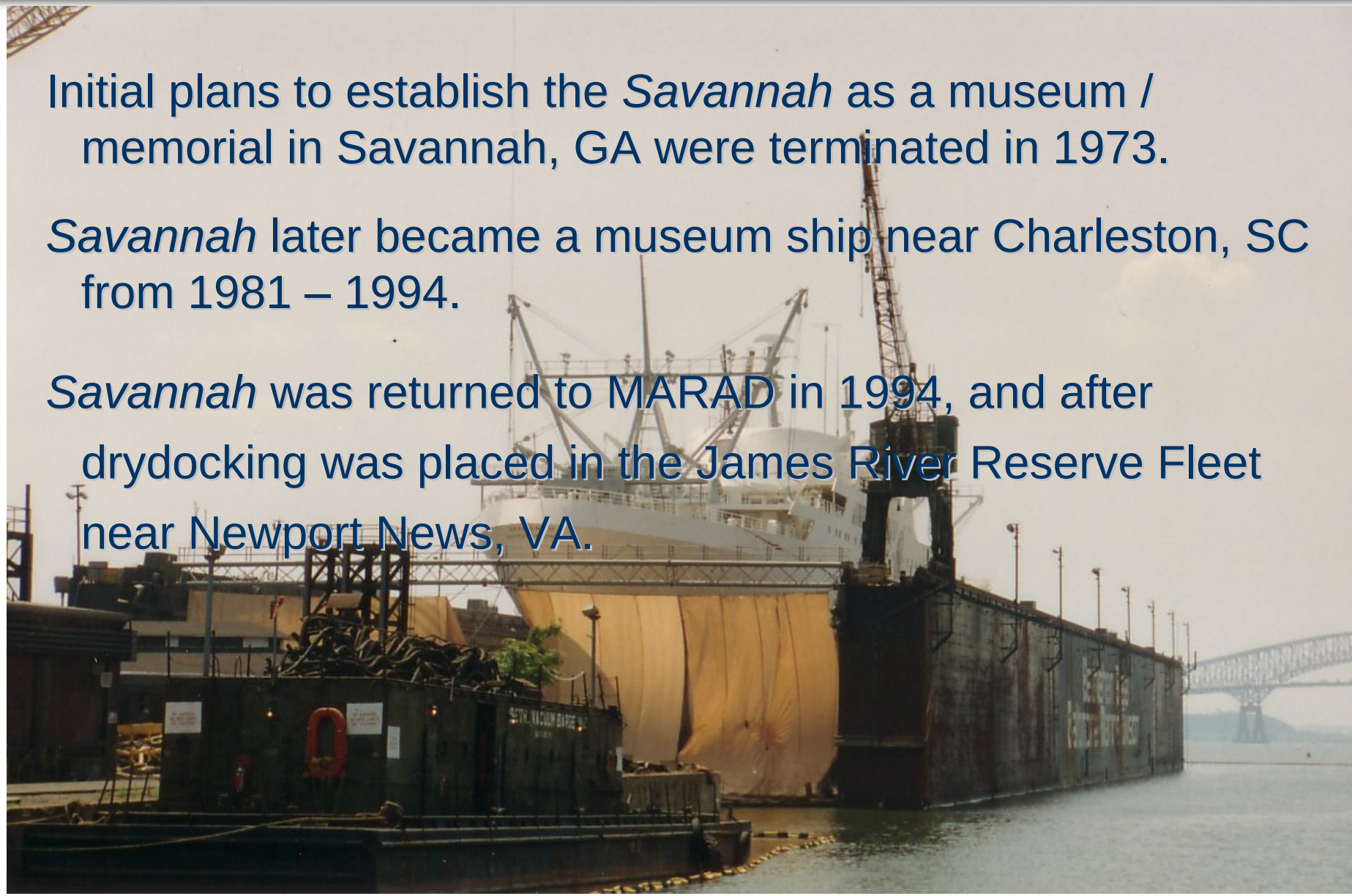

Initial plans to establish the *Savannah* as a museum / memorial in Savannah, GA were terminated in 1973.

Savannah later became a museum ship near Charleston, SC from 1981 – 1994.

Savannah was returned to MARAD in 1994, and after drydocking was placed in the James River Reserve Fleet near Newport News, VA.

History – Initial Decommissioning & SAFSTOR

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- NS SAVANNAH operated in experimental and demonstration service from 1962 to 1970.
- Ship was laid-up in 1970, pending studies for alternative uses - reactor was placed in wet lay-up for potential reactivation.
- Reactor was defueled in 1971, but remained in wet lay-up. The NRC license was not modified. Defueling was completed and all fuel was returned to AEC; shipped to SRS
- Decision to permanently retire the ship was made in 1973. NRC license was amended. Initial decommissioning completed in 1976 in Charleston, SC.

History – Initial Decommissioning & SAFSTOR

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- The reactor was rated for 80 MW_{th}
- Initial criticality occurred on December 21, 1961.
- Defueling was completed on October 14, 1971.
- The reactor operated 2.423 EFPY over approximately 8 calendar years of operations (1962-1970).
- The plant had excellent steam generator and fuel performance. No detectable failed fuel contamination or steam generator leakage.
- Cruciform control rods left in core positions.
- One extra control rod (damaged) is in a fuel location in the reactor vessel
- 1,100 gallons of water in the bottom head of the reactor vessel (will be removed prior to packaging).

History – Initial Decommissioning & SAFSTOR

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- **Fission chambers shipped to Barnwell, SC for disposal on June 28, 1973.**
- **Subsequent decommissioning accomplished in Charleston, SC in March 1976.**
  - Removed/disposed of reactor coolant
  - Removed/disposed of all liquid radioactive waste
  - Disposed of demineralizers and resins
- **NS SAVANNAH later chartered to State of South Carolina, Patriots Point Development Authority (PPDA), for use as museum.**
- **PPDA added to NRC license as co-licensee on August 14, 1981.**
- **Ship removed from Patriots Point for drydocking, May 1994. PPDA terminated bareboat charter; removed from NRC License.**

NS *Savannah* Today

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NS *Savannah* Today

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- **The *Savannah* is owned and maintained by the Maritime Administration.**
- **The *Savannah* nuclear facility is licensed and regulated by the Nuclear Regulatory Commission.**
- **License NS-1 was last amended in 1994, and the terms of that amendment are in effect.**
- **MARAD submitted a pre-decommissioning license amendment to the NRC in August 2006.**

- **Savannah's nuclear facility is substantially intact, but is defueled and modified to make it inoperable.**
- **All structural safety features remain intact and functional.**
- **Certain components and highly-irradiated materials were removed 30+ years ago.**
- **The remaining components, equipment and systems are maintained in a state of preservation to ensure they do not deteriorate or pose a threat to the public or environment (sim to NRC SAFSTOR).**

NS *Savannah* Today

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From 1994 to 2006 the *Savannah* was laid-up in a "retention" status at the James River Reserve Fleet.

To support future decommissioning activities, MARAD awarded a contract to Colonna's Shipyard, Norfolk, VA for topside repairs and interior cleaning.

Savannah was towed from the JRRF to Colonna's on August 15, 2006.

Savannah will be drydocked for exterior hull repairs and painting in 2007.

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What is Decommissioning?

- Decommissioning of nuclear facilities is defined and regulated by the Nuclear Regulatory Commission.
- It involves safely removing a facility from service, reducing residual radioactivity, dismantling and disposing of plant components and equipment, and protecting the public and the environment.
- The end result (for *Savannah*) is termination of the facility license.

Why Decommission *Savannah* Now?

- MARAD first considered decommissioning about 1996, in response to Navy's decommissioning of nuclear combatants.
- Active consideration resumed post-9/11.
- NRC Regulations require decommissioning within 60 years of cessation of operation.
- Mature commercial decommissioning experience exists.
- 1st generation of experienced reactor designers and operators have retired; potential loss of corporate knowledge and experience that MARAD requires for *Savannah.*

The time is right!

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What needs to be done?

- **Removal of all remaining systems, structures and components associated with the nuclear power plant, including:**
  - Reactor Pressure Vessel
  - Control Rod Drive System
  - Steam Generators and Pressurizer
  - Neutron Shield tank
  - Primary System piping, valves, etc.
- **Disposal of these items in licensed low-level radioactive waste disposal sites.**

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Where will it be done?

- Decommissioning could not be accomplished at the reserve fleet.
- Decommissioning requires an adequate marine industrial facility that can host experienced nuclear decommissioning firms and equipment.
- It does NOT need to be done in a nuclear shipyard.
- MARAD is evaluating U.S. East Coast ports for potential host sites for this work.

Timeline for Site Selection

- **Site selection anticipated in late November 2006.**
  - MARAD must complete its NEPA Environmental Assessment prior to selecting a port complex.
  - The Draft EA was posted to the DOT Public Docket the week of August 14; and noticed to the Federal Register in early September.
  - Completion of public comment period and consultation is approximately 45-60 days – or mid October 2006.
  - MARAD conducted initial public outreach presentations in the candidate port cities of Norfolk, VA; Wilmington, NC; and North Charleston, SC in late August.
  - MARAD submitted a License Amendment Request to NRC in August 2006; proposed modifications to the Technical Specifications to allow the ship to be located at a port.

Factors Affecting Decommissioning

- **The reactor was conservatively designed, constructed and operated.**
  - The reactor operated about 2.5 Effective Full Power Years over approximately 8 calendar years in service.
  - The plant had excellent steam generator and fuel performance. No detectable failed fuel contamination or steam generator leakage.
  - No known secondary system contamination
  - Very compact “radiological site” – effectively a space of 56’ by 60’ by 38’ in the ship
- **The plant was laid-up and prepared for storage very well.**
- **All fuel and highly radioactive materials (start-up sources, primary system purification resins) were removed between 1971 – 75.**

Challenges To Decommissioning

- The NS-1 license was effectively dormant after 1976; the *Savannah* existed in a "time warp" from that date onwards.
- MARAD's licensing competency gradually diminished from 1976 – 2003.
- Contemporary Environmental, ODCM, Nuclear Facility QA, and other activities that are precursors of current or traditional power reactor decommissioning models were not current.
- MARAD needed to re-establish its licensing competency in order to effectively undertake decommissioning.
- MARAD began that process in 2003 with pre-decommissioning planning contracts, and continued with rigorous self-assessment activities and "dragging the license into the present-day"

Challenges To Decommissioning

- **The New *Savannah* Technical Staff provides a competent licensee organization sufficient to manage contractor activities associated with pre-decommissioning and decommissioning activities.**
  - Competencies include conventional ship husbandry, industrial safety & health, nuclear quality assurance and licensing compliance
- **MARAD's contemporary licensing framework is being developed and implemented.**
  - QA Plan, PSDAR, Updated Final Safety Analysis Report are among contemporary documents prepared and to be submitted to NRC.

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Contemporary Surveys and Information

- MARAD completed radiological and environmental characterization surveys (sampling & analysis) of the nuclear and non-nuclear sections of the ship in April 2005
- Additional sampling and analysis of the Reactor Pressure Vessel was completed in November 2005.
- RPV was found to be Class A (low level) radioactive waste.
- The plant is radiologically stable, with lower levels of residual contamination and radioactivity than predicted when initial project planning began in 2003.

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Conclusions

- Decommissioning needs to be done.
- MARAD and the Department of Transportation have committed to the process.
- Resources are available to perform the work.
- The Time is Right.

N.S. *Savannah* Future

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"Savannah" i Helsingborg i september 1964. © Jan Lindahl.

The Nuclear Ship *Savannah* is:

- **A National Historic Landmark of the United States**

  (National Park Service, 1991)

- **An International Historic Mechanical Engineering Landmark**

  (American Society of Mechanical Engineers)

- **A Nuclear Engineering Landmark**

  (American Nuclear Society)

Future Preservation of the *Savannah* is the stated goal of the Department of Transportation and the Maritime Administration.

- Preservation of the *Savannah* is consistent with the President's "Preserve America" Initiative.
- Preserve America (E.O. 13287, March 3, 2003) calls for Federal Agencies to take a leadership role in preserving America's heritage.
- Goal Number 1 of the initiative is
  - ***To Preserve America's heritage by actively advancing the protection, enhancement, and contemporary use of the historic properties and resources owned by the Federal Government.***

Decommissioning *Savannah* is an important step towards future preservation.

- **Following decommissioning and license termination, UNRESTRICTED use of the ship will be possible, with public access to all previously radiological controlled areas.**

- ***Savannah* is important to both the maritime and nuclear industries; both of whom are hoped to support future preservation activities.**

***Savannah* is unique.**

Savannah is arguably among the most significant ships ever built.

Savannah is arguably among the most beautiful ships ever built.

Savannah had an inherently public purpose, and can still perform her mission to educate the world about maritime and nuclear issues.

Preserving Savannah is the right thing to do.

Conclusion

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For More Information …

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- Email us at Savannah@dot.gov

- The *Savannah* Decommissioning Project website can be accessed from www.marad.dot.gov

- Procurement information related to the *Savannah* Decommissioning can be found on MARAD's Virtual Office of Acquisition website at:

  https://voa.marad.dot.gov

  Click on "Programs" and then "NS Savannah"

- The Nuclear Regulatory Commission website is www.nrc.gov and contains information and points of contact for decommissioning questions, and public record documents pertaining to the *Savannah* license

  (License NS-1, Docket No. 50-238)

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MARAD may establish a

Citizens Advisory Board

in the decommissioning port. If you are interested in serving on the board, please email us at Savannah@dot.gov and put "CAB" in the subject line.

MARAD may also establish a

Historic Preservation Committee

If you are interested in serving on the committee, please email us at Savannah@dot.gov and put "HIST" in the subject line.

Thank You for participating tonight!

Questions …

MARAD