



N.S. SAVANNAH License Termination Plan (LTP) Post-Acceptance Public Meeting

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Erhard W. Koehler
Senior Technical Advisor, NS SAVANNAH
Maritime Administration

MMARAD

U.S. MARITIME ADMINISTRATION



Previous Docketed Decommissioning Presentations

- **03/11/2009:** PSDAR Public Meeting
- **07/12/2017:** Pre-Submittal Meeting, Dismantlement and Disposal License Amendment Request
- **10/24/2019:** LTP Pre-Submittal Meeting No.1, Kickoff
- **06/30/2021:** LTP Pre-Submittal Meeting No. 2, End-State Overview
- **11/17/2021:** LTP Pre-Submittal Meeting No. 3, Dose Modeling Workshop

Follow-Up Presentations

- **01/19/2022** NSS 2019 Exterior Hull Survey v FSS and NSS NUREG 1640 Clarification

Presentation Outline

- **Introduction / Facility History & Milestones**
- **Decommissioning Overview and Progress**
- **Historic Preservation and End State Considerations**
- **Demonstrating Compliance with the License Termination Radiological Criteria**

A copy of this presentation will be posted on MARAD's website at:

<https://www.maritime.dot.gov/outreach/history/ns-savannah-decommissioning-and-disposition>

Nuclear Ship *SAVANNAH* is:

- ❖ **The World's First Nuclear-Powered Merchant Ship**
- ❖ **A National Historic Landmark of the United States**

(National Park Service, 1991)

- ❖ **An International Historic Mechanical Engineering Landmark**

(American Society of Mechanical Engineers, 1983)

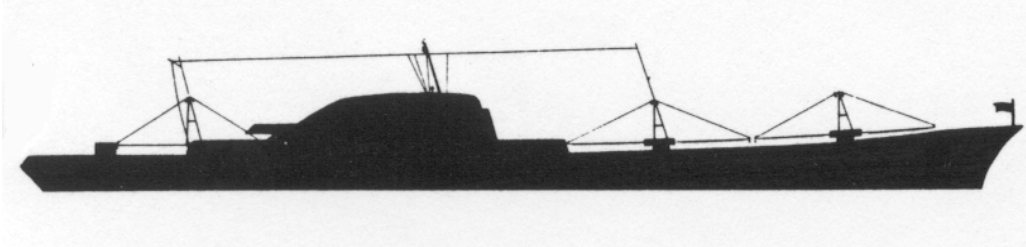
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- ❖ **A Nuclear Engineering Landmark**

(American Nuclear Society, 1991)

- ❖ **Ship of the Year**

(Steamship Historical Society, 2012)

The **SAVANNAH** Project was proposed by President Eisenhower in 1955 as a joint program of the Atomic Energy Commission and the Maritime Administration.



It was authorized by an Act of Congress on July 30, 1956.

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

***SAVANNAH* in Nuclear Context**

Proposed and Authorized 1955 - 1956

Constructed 1958-1962

Operated 1962-1970

Defueled and Mothballed 1971 - 1976

- **DOE Manhattan Project Sites at Hanford, Oak Ridge, 1943/44-1970**
- **First nuclear-powered ship: *USS Nautilus*, 1955-1980**
- **First full-scale nuclear generating station: Shippingport, 1957-1982**
- **First nuclear-powered surface ship: Soviet Icebreaker *Lenin*, 1959-1989**
- **First nuclear-powered aircraft carrier: *USS Enterprise*, 1962-2012**
- **Piqua nuclear generating station (AEC Demo), 1963-66**

The core objectives and accomplishments of the *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 international maritime industry to support operations by nuclear powered merchant ships**

Key Milestones in the Reactor Operating History

- **First Criticality:** December 21, 1961
- **Operations under AEC Auth:** 1962 - 1965
- **NS-1 License Issued:** August 1965
- **Final Shutdown:** November 9, 1970
- **Power History:** 2.423 EFPY
- **Fuel Removed:** September 29, 1971
- **Defueling Completion:** December 3, 1971⁻¹
- **Mothballing Preps:** 1975-1976
- **Possession-Only License:** 1976

(1) This date later accepted as the Permanent Cessation of Operations

***SAVANNAH's* Post-Operations History**

- **After defueling, the ship was moved to Savannah, GA to establish the Eisenhower Peace Memorial. This effort was not successful, and *SAVANNAH* was moved to Charleston, SC in 1975 for possession-only / mothballing work.**
- **Legislation authorized *SAVANNAH's* operation as a museum at the Patriots Point Naval and Maritime Museum near Charleston. The ship opened to visitation on Christmas Day, 1981. The museum period ended in Spring 1994.**
- ***SAVANNAH* was drydocked in Baltimore, MD, then moved into retention at MARAD's James River Reserve Fleet near Newport News, VA; anticipated storage until 2025.**
- **Plans changed after 9-11. Decommissioning of the ship's nuclear power plant was authorized, and the ship moved to Baltimore in 2008. Funding was finally provided in 2017.**

MARAD's Decommissioning Objective

Terminate the NS-1 License Without Restrictions to Permit Disposition of the Ship Afterwards

There are three disposition pathways available to MARAD:

1. Preservation
2. Destruction via Shipbreaking (recycling / scrapping)
3. Sinking as an Artificial Reef

Decommissioning planning considered each pathway; however, preference was given to the preservation outcome, as described in the PSDAR.

National Historic Landmark Considerations for NSS Decommissioning Planning

- **Section 110(f) of the NHPA applies, and states in part:**
 - *... before approval of any Federal undertaking which may directly and adversely affect any NHL, the head of the responsible Federal agency shall ... undertake such planning and actions as may be necessary to minimize harm to such landmark, and shall afford the ACHP a reasonable opportunity to comment ...*
 - *... the agency should consider all prudent and reasonable alternatives to avoid an adverse effect on the NHL.*
- **MARAD had to find a middle ground between decommissioning and minimizing harm. To do so, we adopted preservation-conscious guiding principles.**

MARAD's Decommissioning Principles

(established 2005)

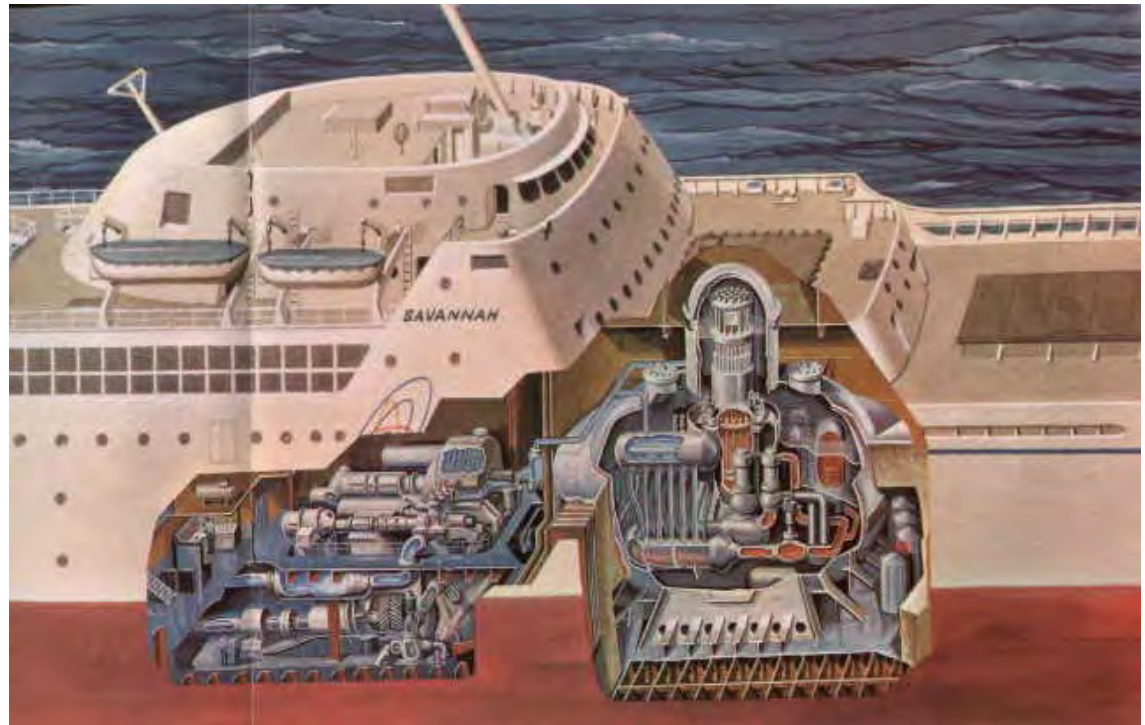
Our preferred outcome after decommissioning and license termination is preservation of the ship; consequently:

- **Wherever possible, decommissioning activities are undertaken in a manner that fosters future preservation;**
- **All dismantlement activities will use existing ship accesses to minimize impacts to adjacent structure;**
- **Whenever an option is presented or evaluated, the path that promotes preservation is given preferential consideration; and,**
- **Opportunities to improve the ship concurrent with decommissioning are exercised.**

Scope of *SAVANNAH* Decommissioning

Remove and dispose systems, structures and components as needed to meet license termination criteria:

- Control Rod Drive System
- Pressurizer
- Reactor Pressure Vessel
- Neutron Shield Tank
- Steam Generators
- Primary System piping
- Outlying equipment



Project Summary 1

- **Appropriations in FY 2017 and 2018**
- **Project Phase I started October 1, 2017**
 - Engineering and Planning
 - Developed Supplemental Environmental Assessment
 - License Amendments to authorize and execute Dismantlement
 - Ship Infrastructure Modifications to support DECON
 - Minor systems and components removal, including Charge Pumps while on Drydock.
 - COVID Pandemic Emergency Suspension, March – July 2020.
 - Acquisition of DECON-LT services; contract award March 2021.
 - Phase I completed March 31, 2021.

Major Ship Improvements

- Climate controls
- Sanitary spaces
- Shore power
- Mechanical systems
- Mooring and Access/Egress equipment
- Alarm and monitoring systems (fire/smoke, intrusion, flooding, security cameras)
- Restored public spaces, office and admin infrastructure











Project Summary 2

- **Project Phase II started April 1, 2021**
 - Detailed Engineering and Planning
 - Developed Waste Management Plans
 - Minor components and interference removals began September 2021
 - Major Component Removal Change in Approach approved February 2022.
 - Extract RPV from inside the NST; retain NST outer annular wall
 - Remove PZR Internals and retain Shell
 - CRDM Tower, RPV Head, RPV Internals and RPV Removed, July – November 2022.
 - Major Dismantlement Completed Spring 2023.
 - Phase II wrap-up in progress.

Small Bore Piping Removal, Sept – Dec 2021



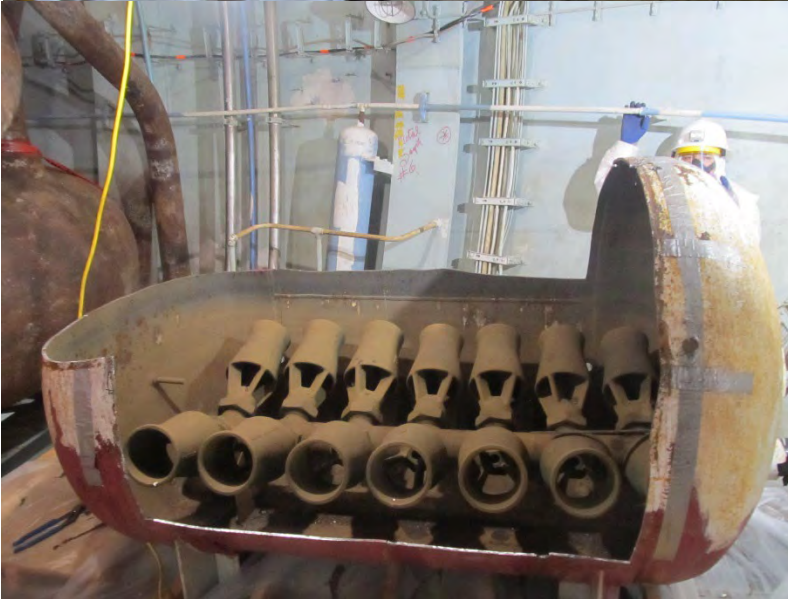
Waste Material Handling via CV Portal



Waste Packaging in CH 4 – (4) 20' Intermodals



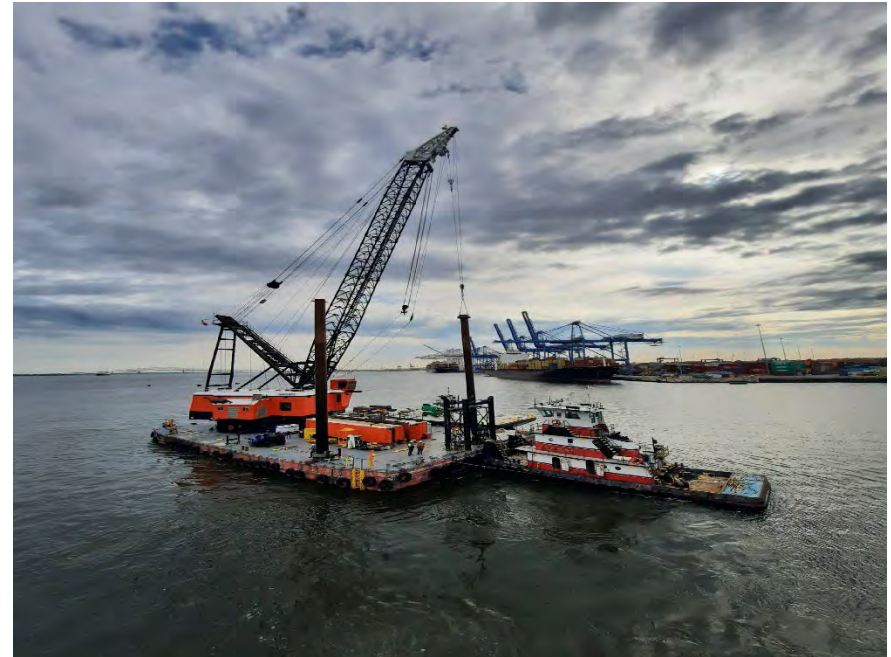






Intermodal Handling and Waste Transportation







N.S. SAVANNAH Reactor Vessel removal, November 8, 2022

Project Update

- **Project Phase III (LT) In Progress**
 - Formally started with submittal of the LTP on 10/23/2023
 - Preparations in progress since Spring 2021
- **Final Dismantlement in-Progress inside CV**
 - Removal of existing grating material (to be replaced with new grating)
- **Final Status Surveys Commenced week of April 21, 2024**
- **Working towards Confirmatory Surveys, Summer 2024**
- **Monthly Status Meetings with NRC Ongoing**

Historic Preservation Considerations for the End-State Condition - 1

■ Consultation under the NHPA

- Initiated in 2018 (informal discussions back to 2013)
- Executed a Programmatic Agreement in March 2023, covering both decommissioning and disposition as a combined Undertaking
- NRC is a signatory

■ Meeting the “Minimize Harm” Standard

- Using characterization data, Identify Components and Structures likely to meet the radiological release criteria. Plan for their retention.
- After DCGLs were finalized, and revised RPV removal approach adopted, expand the component retention list.

Historic Preservation Considerations for the End-State Condition - 2

- **Retention of Components and Structures Must Allow Any Disposition Alternative**
 - All Disposition Alternatives involve EPA oversight.
 - MARAD adopted the EPA 15 mrem/year standard to prevent regulatory complication after LT.

NSS Exposure v Background Radiation

- The average American receives a dose of about 620 mrem per year from all potential sources. About half of this is from background sources.
- Background sources are both naturally-occurring, and the result of human actions (*weapons testing fallout, accident contamination, etc.*).
- Numerous factors affect individual dose.
- The current background exposure on NSS is estimated at about 26 mrem per year for employees. Annual occupational dose (*i.e., dose received from radiation work*) was Zero (0) before DECON started.
 - Public exposure on NSS is less than 1 mrem per visit.
 - Source – NSS DECON Radiation Fact Sheet

NSS Release Considerations

- Outside of the Reactor Compartment and outlying Radiologically Controlled Areas (RCA), NSS already meets the unrestricted release criteria.
- Implicit in the release criteria is the possibility that some material containing residual radioactivity may remain after the license is terminated.
- The NSS challenge is to demonstrate that the dose to workers (and public) from residual radioactivity in the post-license end-state scenarios meets the release criteria.

Expected End-State of the Nuclear Power Plant

- Equipment and systems in spaces surrounding the Reactor Compartment have been removed.
- Inside the Containment Vessel, a surgical approach was taken to extract the Reactor Vessel from its surrounding structure. The exterior annulus of the Neutron Shield Tank remains in place.
- Small bore piping, valves, minor equipment was removed. Contaminated interiors of the Pressurizer and Steam Generator heat exchangers were removed.
- This approach **results in substantial preservation of the viewshed from the CV Portal**. The CV has been opened up for access, and future interpretation.

NSS Disposition Alternatives and their License Termination Considerations

■ Preservation

- Any prospective use of the ship that involves unrestricted public access (museum, conference center, entertainment venue or educational facility)
- Preservation scenarios are not indefinite and will at some future date result in shipbreaking. The LTP demonstrates that this exposure scenario is well below the release criteria for preservation workers. For visitors, exposure is essentially zero.

■ Shipbreaking

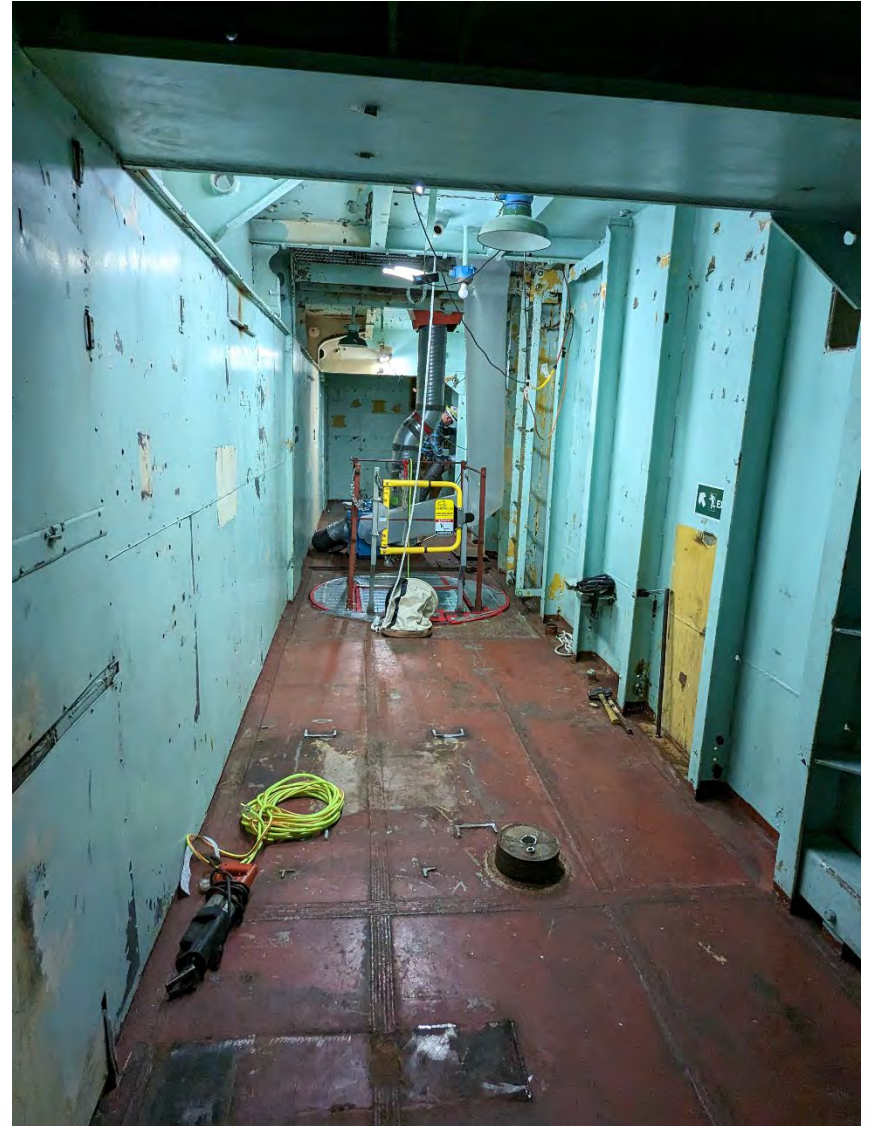
- At the end of the life of the ship, the process by which the steel structure is broken down and recycled. Results in the destruction of the ship.
- Shipbreaking will be performed by MARAD through its Ship Disposal Program.
- The LTP demonstrates that immediate shipbreaking is the “worst case” exposure scenario, but again well within permissible exposure limits.

■ Reefing

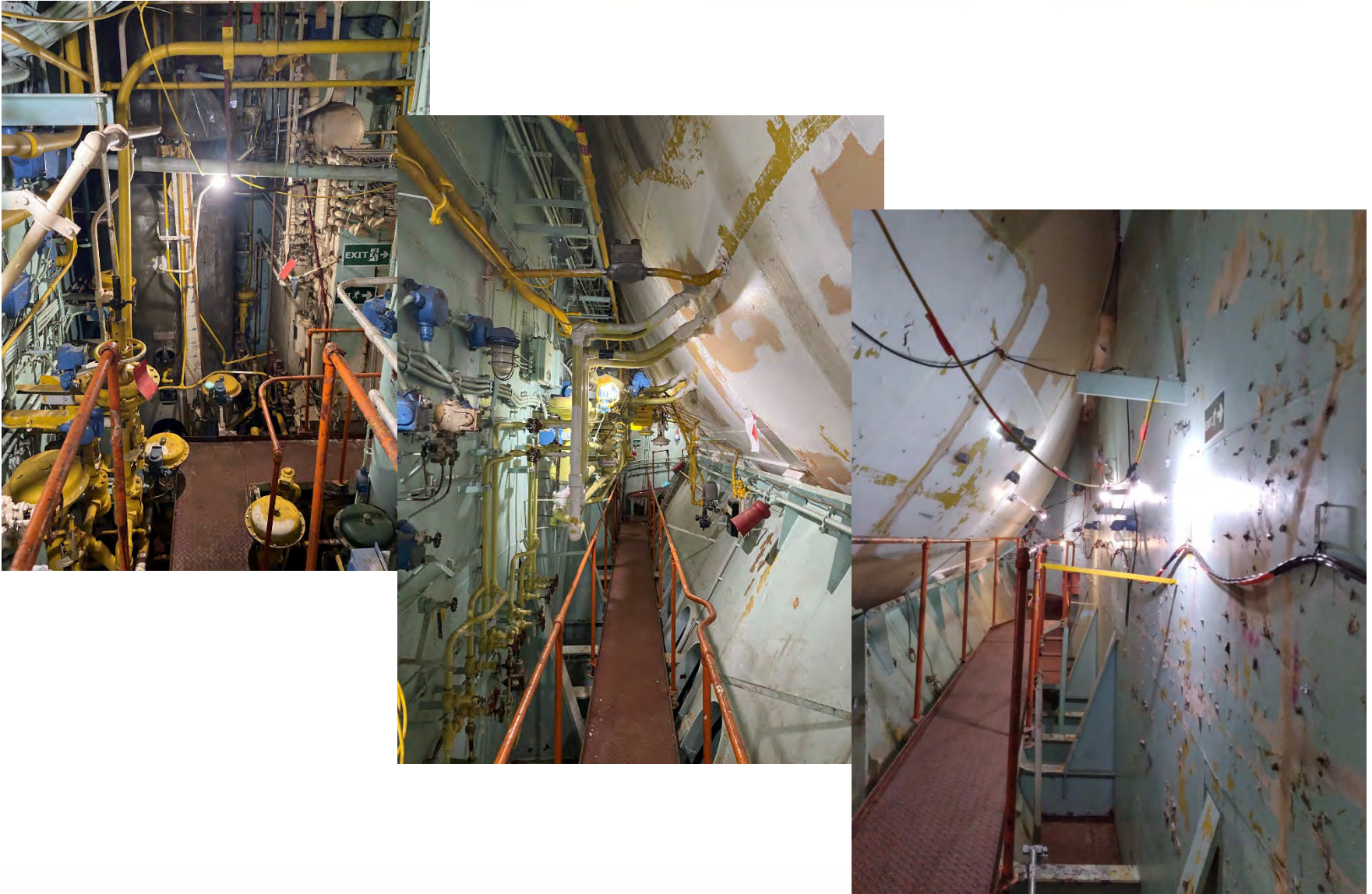
- Considered as Less Likely But Plausible (LLBP)
- The LTP explains the EPA restrictions likely to be imposed (i.e., removal of remaining structures containing residual radioactivity). Includes analysis of possible exposure pathways to residential fishermen, or sport divers if those structures remain in place.



Charge Pump Rooms – Before and After



Forward Control – Before and After



Reactor Compartment Lower Level – Before and After



Containment Vessel – Before



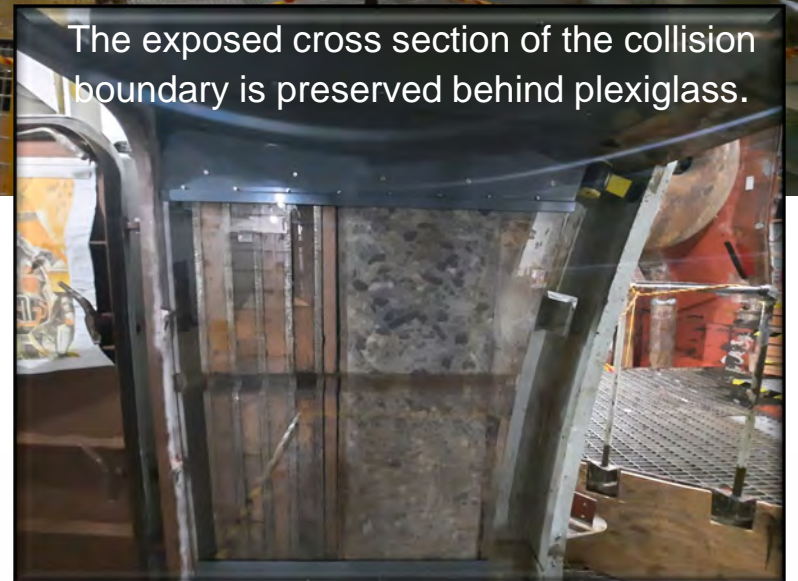
Containment Vessel – After

One-of-a-kind Preserved Former Nuclear Power Plant



The preserved viewshed inside the Containment Vessel (above), as viewed from the entrance portal. At left is the starboard Steam Generator; in the center is the Neutron Shield Tank outer annulus (reactor was in the center); at right is the Pressurizer shell.

There is no other pressurized water reactor in the world today that can offer this sort of experience.



The exposed cross section of the collision boundary is preserved behind plexiglass.

