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PREPARATION, LIFTING & LOADING OF THE SHIPPINGPORT REACTOR PRESSURE VESSEL/ NEUTRON SHIELD TANK PACKAGE

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INTRODUCTION

The Shippingport Atomic Power Station (SAPS) has provided many "firsts" for the nuclear industry:

- In 1957, Shippingport demonstrated the safe peace-time use of nuclear energy as the first nuclear power plant to produce electricity for a public utility.

- In 1976, following reactor conversion to a Light Water Breeder Reactor (LWBR), Shippingport demonstrated that the breeder principle can be safely applied in a light water reactor.

- In 1985, following end-of-life testing and defueling, the Shippingport Station Decommissioning Project (SSDP) commenced physical decommissioning to demonstrate that the final stage of a nuclear plant lifecycle, decommissioning, can be performed both safety and cost effectively. The shipment of the shielded irradiated Reactor Pressure Vessel/ Neutron Shield Tank (RPV/NST) Package from Shippingport, PA to Richland, WA by barge as a single package was the largest non-military radioactive shipment ever made.

This paper discusses the basis for the one-piece removal option, describes how the RPV/NST was prepared to comply with government regulations for shipping radioactive material, and the methods utilized to lift the RPV/NST and load it onto a barge for its subsequent shipment to Richland, WA.

DISCLAIMER

DISPOSAL OPTIONS

The first consideration regarding the disposition of the RPV was the disposal location and the second was the method of removal and transport.

- Location

  The nuclear portion of the SAPS, which includes the RPV, was the property of the Department of Energy (DOE). The land upon which the plant was built was leased from the utility, Duquesne Light Company, in 1954 with the condition that it be returned by 1994 in a radiologically safe condition. Since DOE owns and operates the Hanford facility in the sparsely populated desert area of eastern Washington, DOE concluded during initial planning that all radioactive waste from SSDP should be transported to and buried at, Hanford, WA.

- Method of Removal and Transport

  The two major alternatives considered for the removal and transport of the RPV were:

  1. Segmentation and packaging for several truck or rail shipments, and

  2. Whole-piece removal with barge or rail shipment.

  Since the technology exists for either option, the decision was based on radiation exposure and economic considerations. An engineering study performed by Nuclear Energy Services, Inc.([1]) concluded that one-piece removal, when compared to segmentation, would reduce radiation exposure by 150 man-Rem, would reduce cost by $4M and reduce the duration of the project by 1 year. The one-piece option was therefore adopted as the safest, most cost effective approach.

REGULATIONS

Although it could be argued that that RPV/NST and its non fuel bearing internals would satisfy the Department of Transportation (DOT) requirements for Low Specific Activity (LSA) Material, the DOE chose to impose the more stringent Type B Packaging requirements due to its unprecedented size and to better satisfy the "demonstration" objectives of the project, since other RPV's may not qualify as LSA material.

DOE issued a Certificate of Compliance (COC) for the RPV Package based on the Safety Analysis Report for Packaging (SARP) which demonstrated compliance with both DOE and NRC requirements for a Type B Package. Reference (2) provides additional information on the certification of the Package.

PREPARATION OF RPV/NST PACKAGE

The lower two-thirds of the RPV, which is approximately 10 feet in diameter and 31 feet high, was surrounded by the 18 foot diameter Neutron Shield Tank (NST) which supported the RPV and provided approximately 3 feet of water for neutron attenuation during reactor operation. The RPV/NST Package was prepared by extending the NST cylinder to provide a complete envelope around the RPV and by filling all void spaces within and around the RPV with a light-weight concrete grout. A lifting beam was installed at the top which was bolted to the RPV head flange and welded to the skirt extension to provide redundant load paths during subsequent lifting and down-ending operations. Reference(3) provides a more detailed discussion of the RPV/NST Package preparations. Figure 1 provides a cutaway section of the completed package.

LIFT AND LOADING OF THE RPV/NST PACKAGE

In order to load the RPV/NST onto a barge on the Ohio River, the 900 Ton package had to be lifted from the below grade reactor enclosure, down-ended to a horizontal position on a land transport vehicle, and transported over land to the barge.

A specially designed lifting tower was constructed above the Reactor Enclosure. The lifting mechanism consisted of a trolley upon which four (4) 600 Ton, hydraulically operated center hole jacks were positioned. The tower and lifting device were designed and load tested in accordance with DOE's nuclear lifting standard([4]).

In December, 1988 the Package was lifted approximately 77 feet vertically, moved horizontally approximately 43 feet using the tower trolley to a position over the land transport vehicle, lowered and attached to a down-ending device on the land transport vehicle, and rotated to its horizontal position into a support cradle. Figure 2 shows the RPV Package being removed from the reactor enclosure.

The land transport vehicle consisted of a modular trailer with 320 rubber tires, each set of 4 being independently suspended through a common hydraulic system to assure equal load sharing with elevation differences up to approximately two feet.

After removal of the package extremities (the NST support cone and the lifting lugs) the RPV Package was secured to the land transport vehicle and was hauled over a specially prepared road and barge facility on the south bank of the Ohio River onto the barge. Reference([5]) discusses the barge transportation to Richland, Washington, overland transportation to the DOE Hanford Reservation Burial Facility and final off-loading of the Package.

SIGNIFICANCE

The Shippingport Project has demonstrated that whole-piece removal of large radioactive components, such as steam generators and reactor pressure vessels, is practical and can be done safely and cost effectively. Since it has been estimated that an 1100 MWt PWR vessel could be prepared for shipment in a package of commensurate size and weighing approximately 1200 Tons([6]), this removal method should be seriouly considered for future decommissioning projects.

REFERENCES

1. SSDP Decommissioning Plan, Engineering Study 3.2.

2. Licensing and Regulatory Process for the Shipment of the Shippingport Reactor Pressure Vessel Package, G. E. VanSickle, 1988, ANS Annual Meeting Transactions.

3. Preparation of the Shippingport Reactor Pressure Vessel Shipping Package, D. M. Yannitell, 1988, ANS Annual Meeting Transaction.

4. NE-F-8-6T: Nuclear Standard - Hoisting and Rigging of Critical Components and Related Equipment, dated November 1985.

5. Marine Transportation and Burial of the Shippingport Reactor Pressure Vessel/Neutron Shield Tank (RPV/NST) Package, P. J. Coughlin, 1989, ANS Annual Meeting Transaction.

6. Shippingport: A Relevant Decommissioning Project, F. P. Crimi, 1988, ANS Annual Meeting.

SHIPPINGPORT STATION
DECOMMISSIONING PROJECT

Shippingport RPV/NST Transportation Package

Diameter	18 ft.
Height	41 ft.
Weight	900 tons
Activity	16,000 Ci
~ 50% Co^{60}	
~ 50% Fe^{55}	

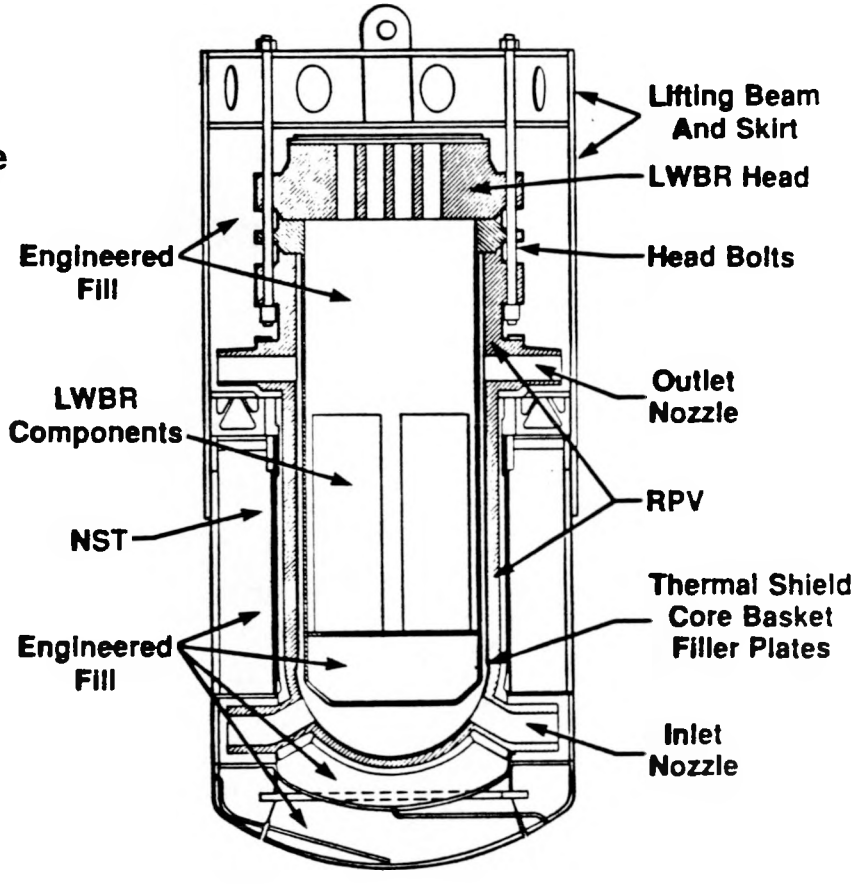

FIGURE 1

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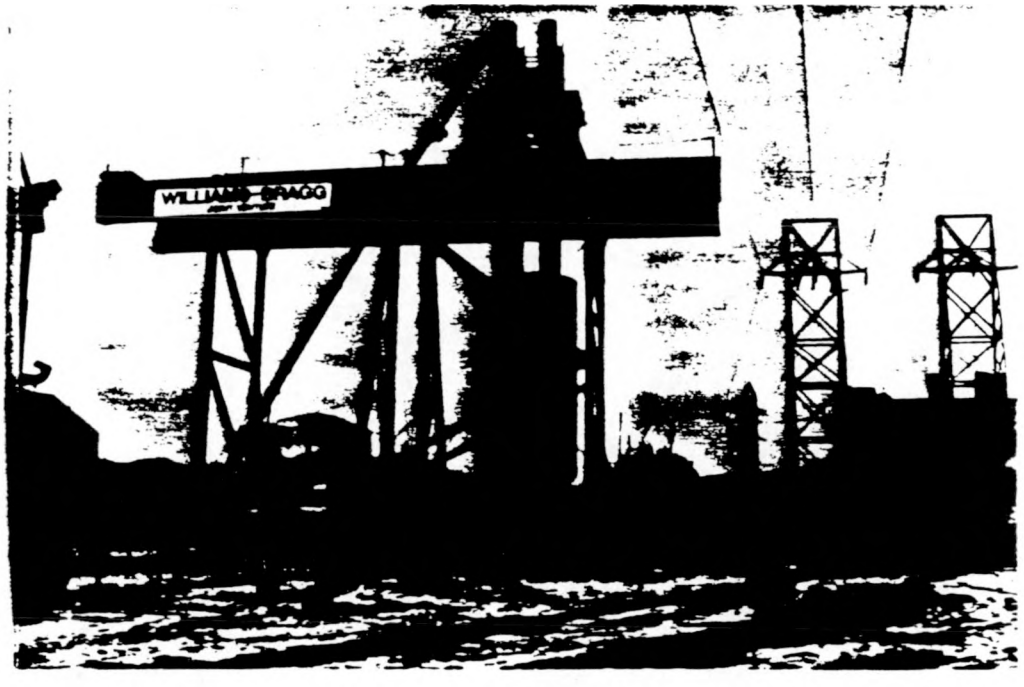

FIGURE 2

ANS Annual Meeting
Atlanta, Georgia
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PREPARATION, LIFTING & LOADING OF THE SHIPPINGPORT REACTOR PRESSURE VESSEL / NEUTRON SHIELD TANK PACKAGE

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SHIPPINGPORT STATION DECOMMISSIONING PROJECT

SHIPPINGPORT "FIRSTS"

1957: 1ST Utility Nuclear Power Plant

1976: 1ST Light Water Breeder Reactor

1985-1989: 1ST Physical Decommissioning of a Full-Scale Nuclear Power Plant

1989: 1ST Non-Military Shipment of an Irradiated Reactor Pressure Vessel

SHIPPINGPORT STATION DECOMMISSIONING PROJECT

RPV DISPOSAL OPTIONS

Location

- Hanford, WA
- Savannah River, GA

Method of Removal & Transport

- Segmentation
  - Truck or Rail
- Whole Piece
  - Barge
  - Rail

SHIPPINGPORT STATION DECOMMISSIONING PROJECT

RPV REMOVAL OPTIONS*

	Segmentation	Whole Piece
Schedule (Weeks)	54	7
Exposure (Man-Rem)	330	172
Cost ($ x 10^6) 1981	$ 8.0	$ 4.0

* Decomissioning Plan; Engineering Study 3.2

SHIPPINGPORT STATION DECOMMISSIONING PROJECT

DESIGN SAFETY FACTORS AND LOAD TEST REQUIREMENTS FOR RPV LIFT & DOWNENDING EQUIPMENT

	Safety Factor	Load Test (% of Design)
Lifting Beam & Skirt	7.50	125%
Lift Rigging	7.50	150%
Lift Tower & Trolley		110%
- Primary Load-Bearing Parts	6.25	
- Structural Members	3.75	
- Foundations	3.03	
Downending Device	7.50	150%

SHIPPINGPORT STATION DECOMMISSIONING PROJECT

TRANSPORTER SPECIFICATIONS

Size	105' x 25' (8 Modules)	
Tires	320; 18 Ply; 175 psi	
Suspension	Hydraulic w/ 2' Lift	
Steering	All-Wheel Hydromechanical	
Weights	Tare	211 Tons
	RPV & Skid	965 Tons
	Total	1176 Tons

Weight/Tire = 7,350 lb. = 103 psi

SHIPPINGPORT STATION DECOMMISSIONING PROJECT

SIGNIFICANCE

Whole-Piece Removal of Large Radioactive Components Such as Steam Generators and Reactor Pressure Vessels Has Been Demonstrated to Be:

- **Practical**
- **Safe**
- **Cost Effective**

Should Be Considered for Future Decommissioning Projects

SHIPPINGPORT STATION DECOMMISSIONING PROJECT

TYPICAL RELEASE CERTIFICATION PACKAGE

I. Statement of Review and Approval

II. Release Plan

A. Scope

B. History

C. Release Requirements

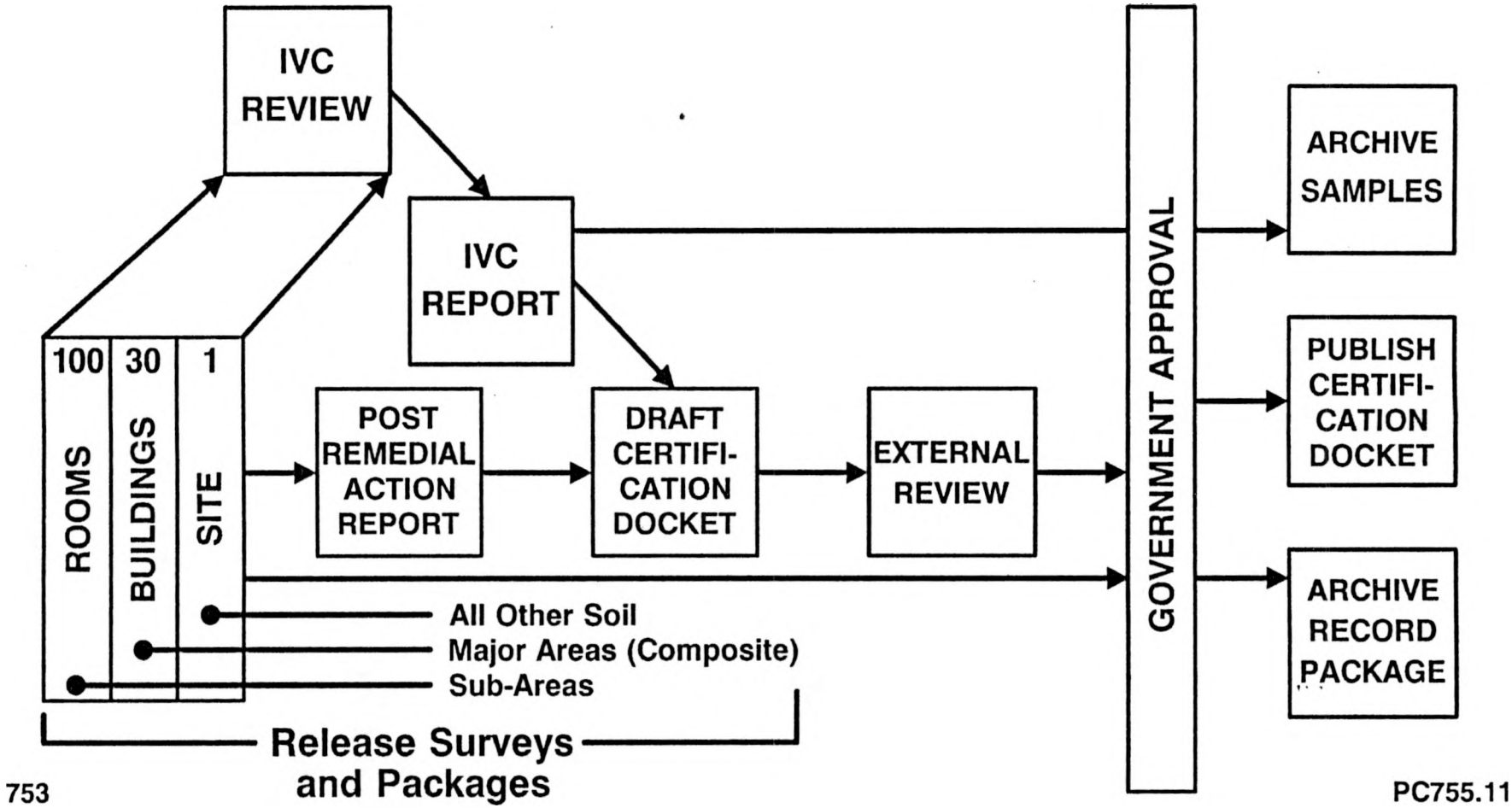
D. Survey Plan

E. Action to Prevent Recontamination

III. Release Survey Results

SHIPPINGPORT STATION DECOMMISSIONING PROJECT

FINAL DOCUMENTATION METHODOLOGY



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