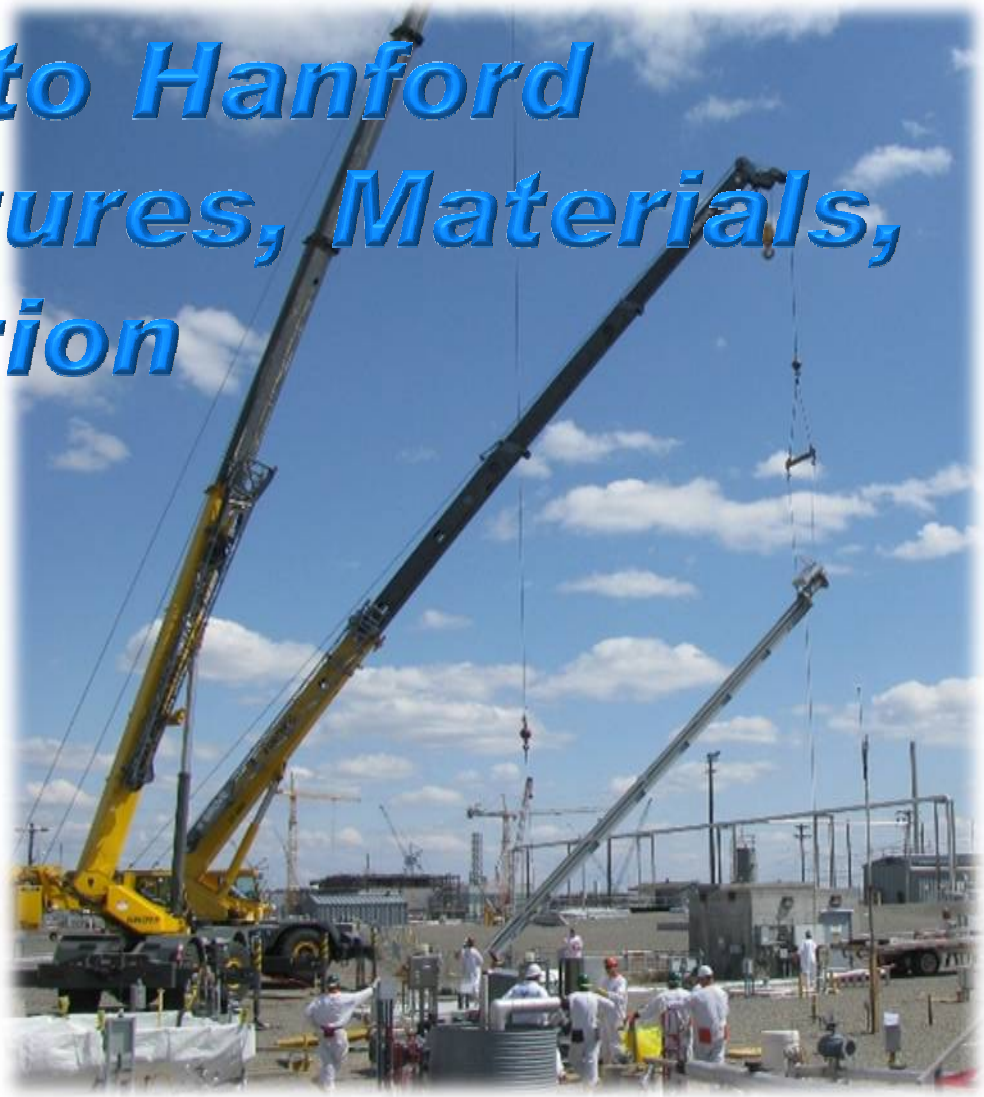
Introduction to Hanford Tanks: Structures, Materials, and Degradation Mechanisms



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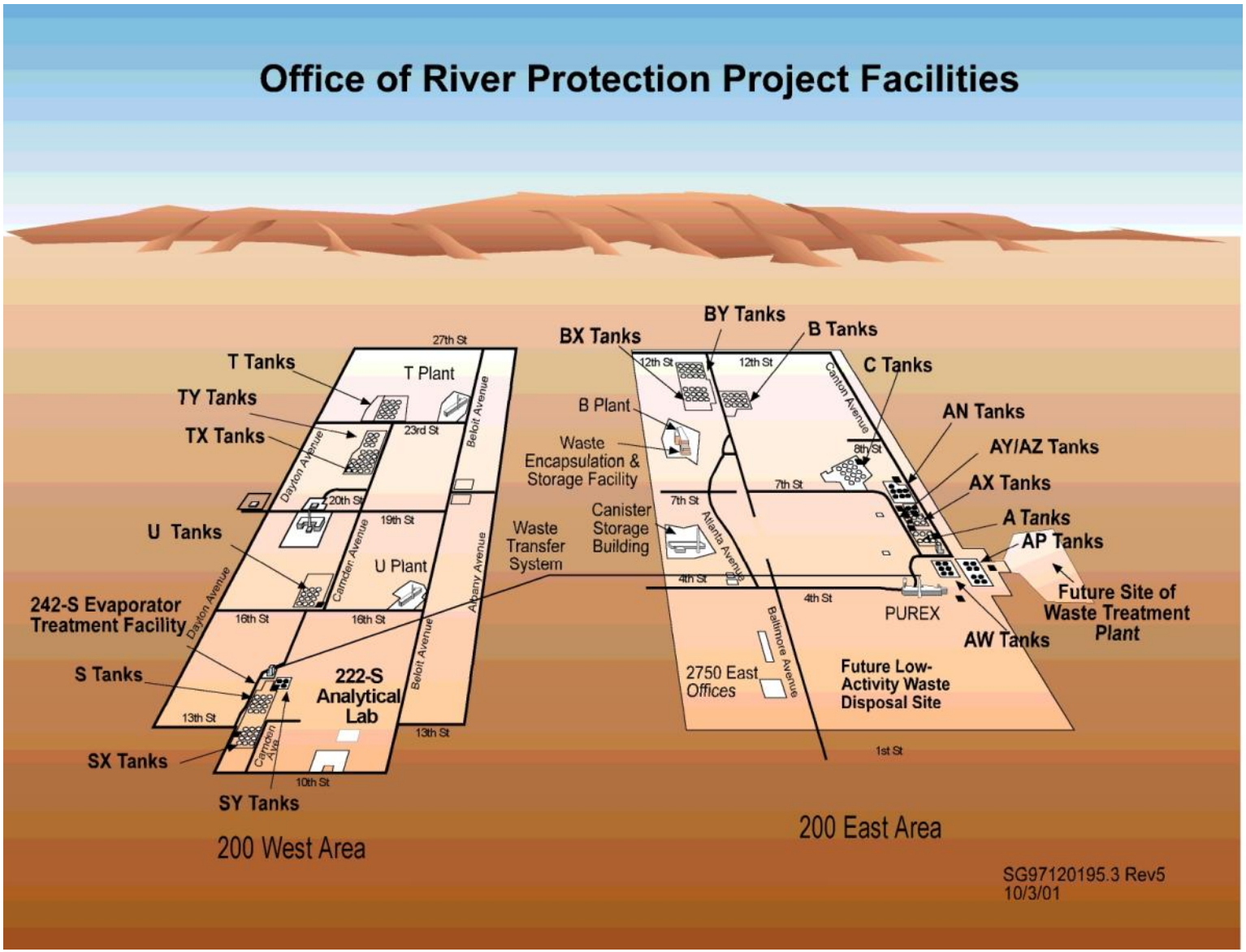
Introduction

- The Hanford site's principle historic mission was plutonium production for the manufacture of nuclear weapons.
- Between 1944 and 1988, the site operated nine graphite-moderated, light-water, reactors to irradiate fuel and produce plutonium. The N Reactor also generated electricity.
- Four large chemical separations plants were run to extract plutonium from the fuel.
- The site included by a variety of laboratories, auxiliary facilities, and related infrastructure to support production.
- The Hanford Site processed approximately 100,000 metric tons of uranium and generated several hundred thousand metric tons of waste.

Introduction

- Hanford production activities at the site between 1943 and 1991 resulted in a broad range of contaminated materials and facilities that are now being managed and remediated.
- The major waste to be dealt with is the approximately 53 million gallons of high-level waste, stored underground in the 149 Single-Shell Tanks (SSTs) and the 28 Double-Shell Tanks (DSTs).
- WRPS must maintain and monitor the DSTs and SSTs to support the River Protection Project mission, which requires use of the tanks through 2040 or later.

200 Areas Plateau for Chemical Processing



Single-Shell Tanks

- SSTs were built between 1944 and 1964 in twelve tank farms.
- DOE stopped discharges to the SSTs in 1980 to comply with the Congressional mandate that prohibited waste additions to the SST after 1/1/1981.
- Hanford completed interim stabilization of the SSTs in 2004 by removing the SST supernate to less than 5,000 gallons and drainable interstitial liquid less than 50,000 gallons from the SSTs.
- Following stabilization Hanford interim isolated the SSTs by blanking off and sealing access points to the tanks.

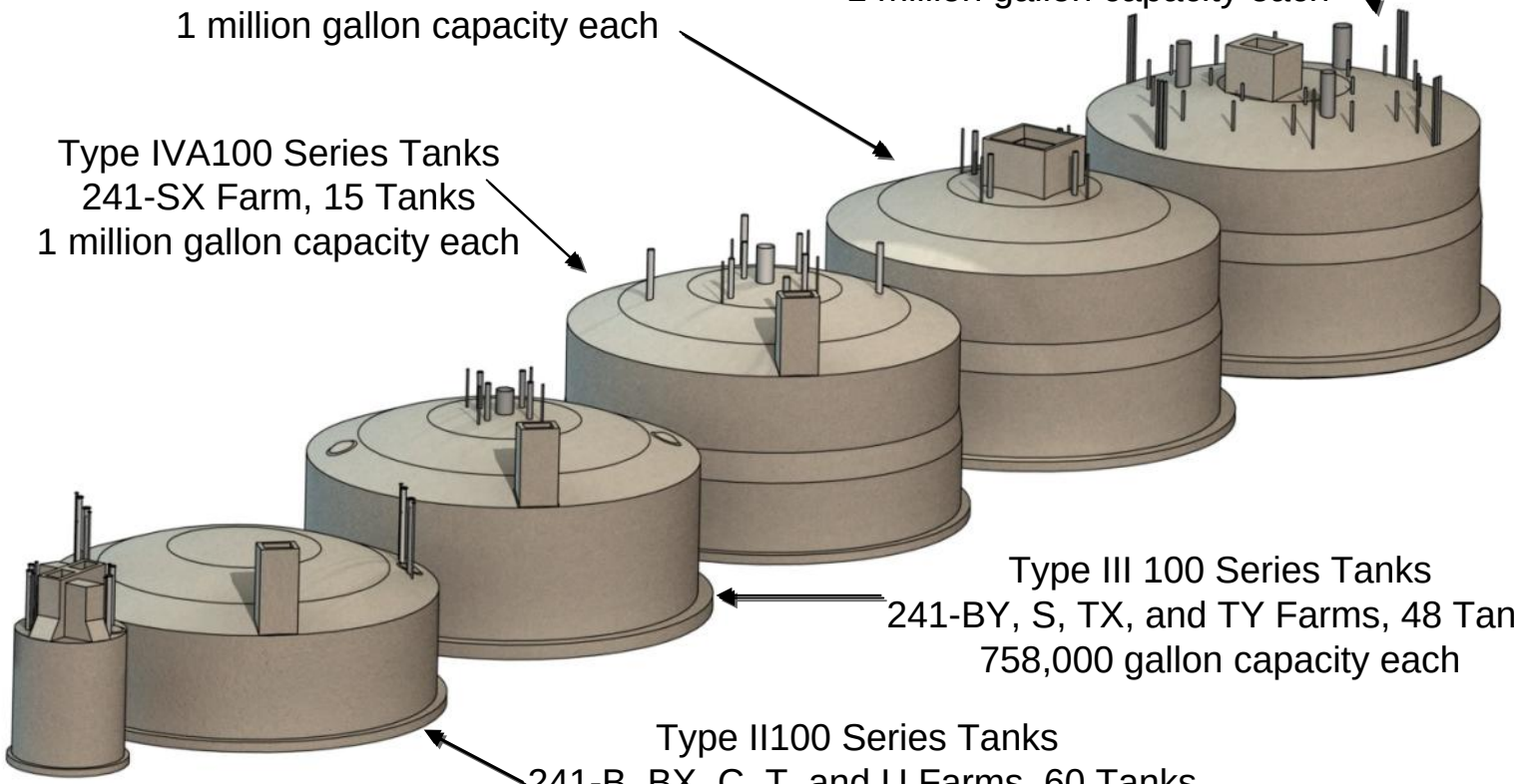
Single-Shell Tank Construction

Tank Farm	Initial Operation	Design Criteria	Design Specification	Estimated Service Life (Years)	Current Age (2009)
241-A	1956-1957	None Listed	HWS-5814 HWS-4799-S	Not Cited	53
241-AX	1965-1966	HW-70529 HW-72780	HWS-8237 HWS-4799-S	25	44
241-B	1945-1947	HW-1946	HW-1946	Not Cited	64
241-BX	1948-1950	Construction Drawings	HW-7-5264	Not Cited	61
241-BY	1950-1951	None Listed	HW-3783	Not Cited	59
241-C	1946-1947	HW-1946	HW-1946	Not Cited	63
241-S	1952-1953	None Listed	HW-3937, HW-4038	Not Cited	57
241-SX	1954-1959	None Listed	HW-4957	Not Cited	55
241-T	1944-1947	HW-1946	HW-1946	Not Cited	65
241-TX	1949-1952	None Listed	HW-3061	Not Cited	60
241-TY	1953	None Listed	HW-4696	Not Cited	56
241-U	1946-1949	HW-1946	HW-1946	Not Cited	63

Materials of Construction and Finishes

Tank Element	Material	Comment
Tank Liner	Carbon steel	A10, A283, A201
Liner Water Proof	3-ply water proofing membrane, asphalt, and bitumen paint	Covered with gunite
Liner Interior Coating	Painted	De Lux Seachrome, oil based, red primer, red lead primer
Concrete	3,000 psi reinforced	15 inches to two feet inches
Concrete Coating	Lapidolith	Zinc magnesium fluorosilicate

Single Shell Tank Size Comparison



Type IVB100 Series
Tanks 241-A Farm, Six Tanks
1 million gallon capacity each

Type IVC100 Series
Tanks 241-AX Farm, Four Tanks
1 million gallon capacity each

Type IVA100 Series Tanks
241-SX Farm, 15 Tanks
1 million gallon capacity each

Type III 100 Series Tanks
241-BY, S, TX, and TY Farms, 48 Tanks
758,000 gallon capacity each

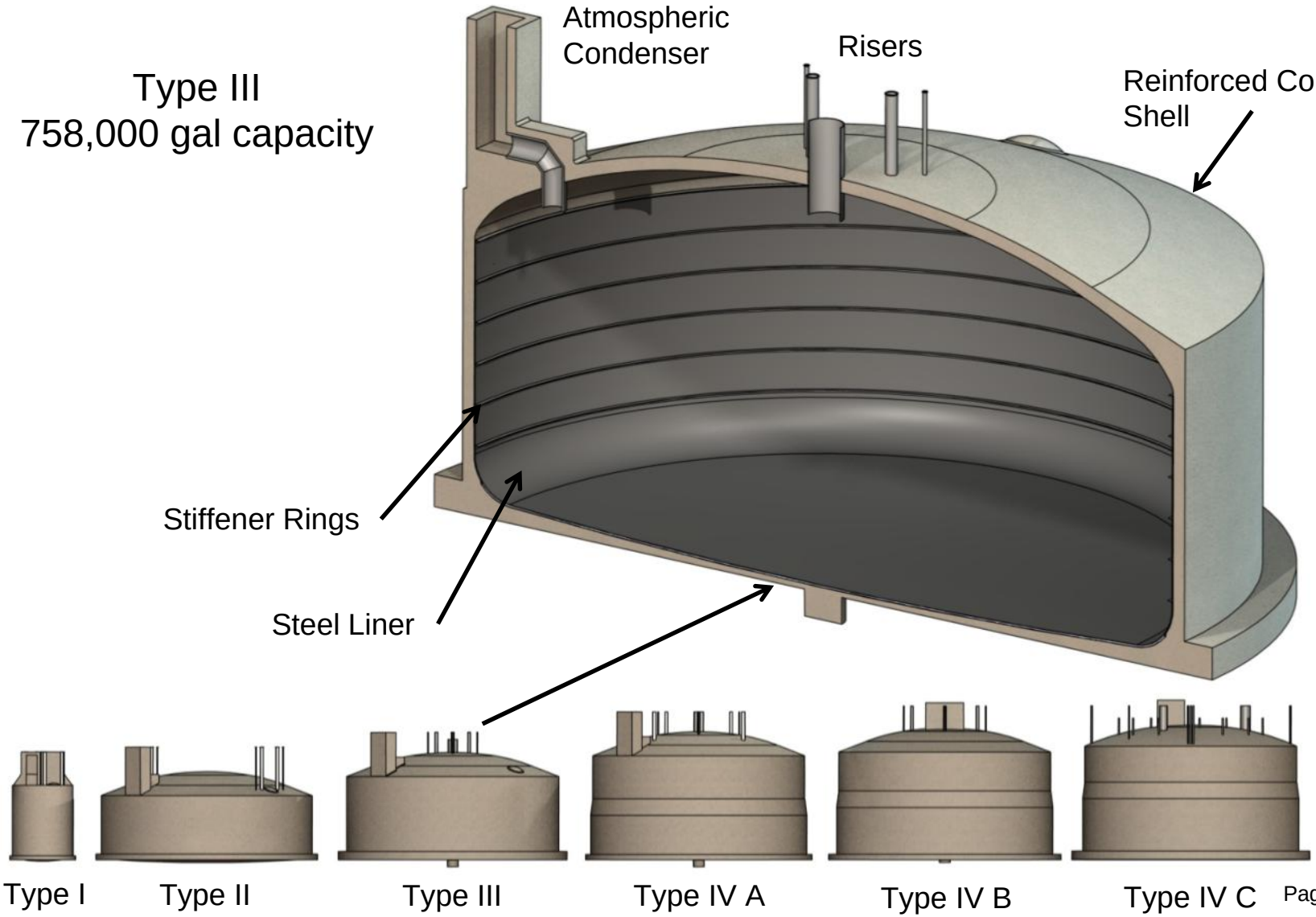
Type II100 Series Tanks
241-B, BX, C, T, and U Farms, 60 Tanks
530,000 gallon capacity each

Type I 200 Series Tanks
241-B, C, T, and U Farms, 16 Tanks
55,000 gallon capacity each

12 Single Shell Tank Farms with 149 SSTs were Constructed between 1943 and 1964

Single-Shell Tank Description

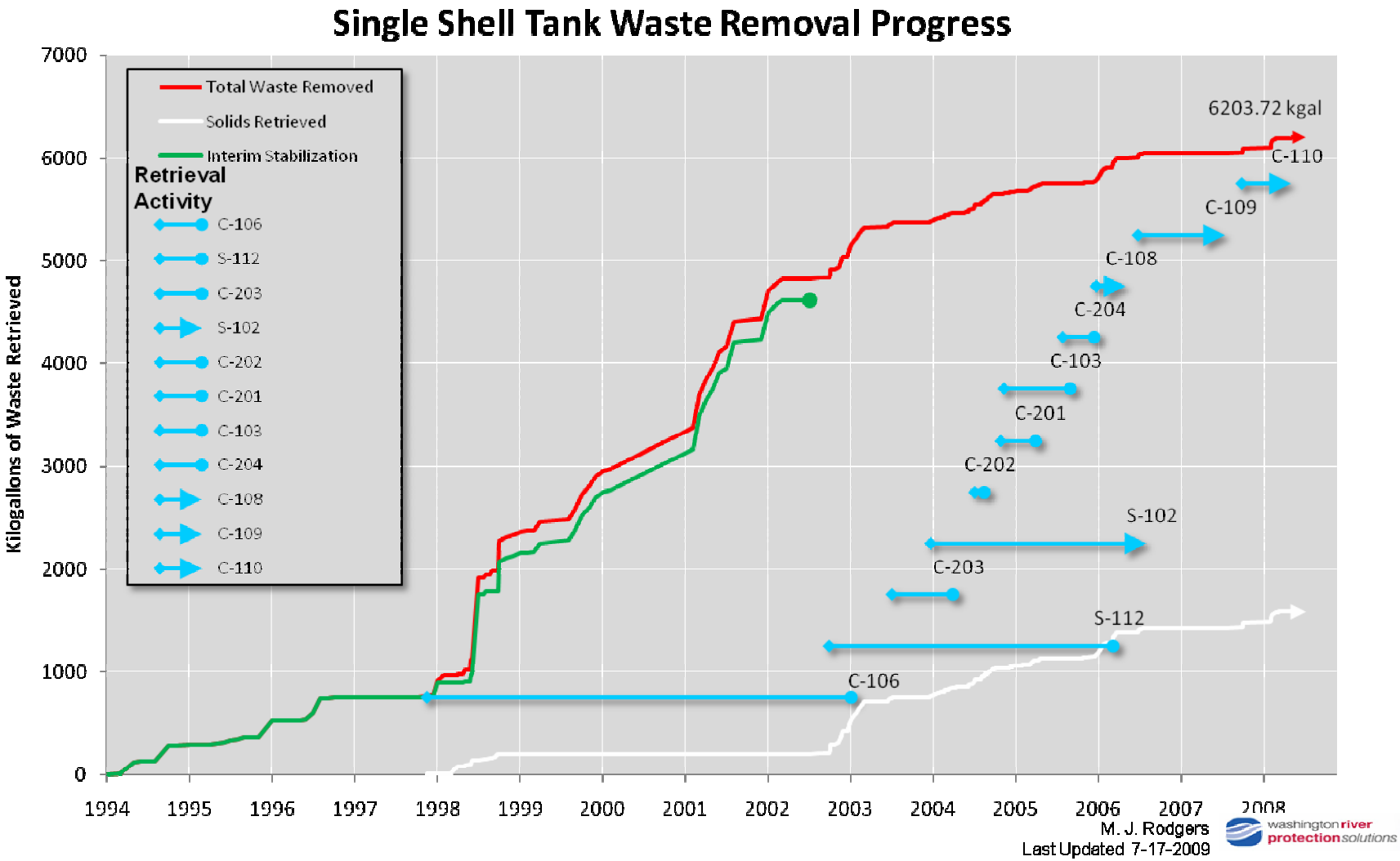
Type III
758,000 gal capacity



241-BX Tank Preparation August 1947

Single-Shell Tank

SST Retrieval History



Single-Shell Tank Integrity Panel Members

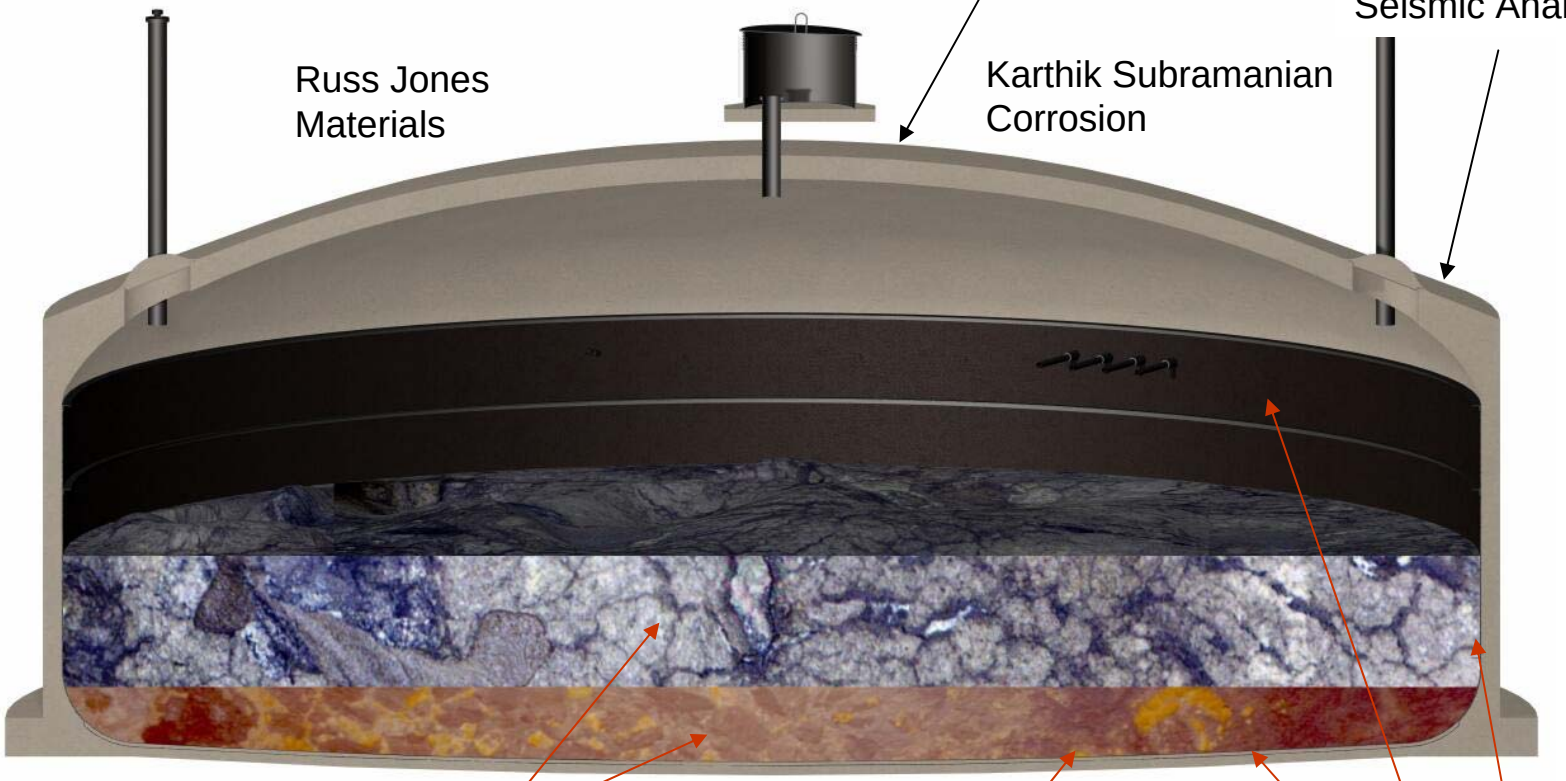
Mike Terry Chair
Todd Martin Co-Chair
Mike Rinker Analysis Lead

Bruce Thompson
Non-Destructive Evaluation

Bob Kennedy
Structural and
Seismic Analysis

Russ Jones
Materials

Karthik Subramanian
Corrosion



Steve Cullen
Soil and Vadose
Zone Analysis

Leon Stock
Waste Chemistry

John Beavers
Stress Corrosion Cracking

Jerry Frankel and
Bruce Wiersma
Electrochemistry

Double-Shell Tanks for Active Operations

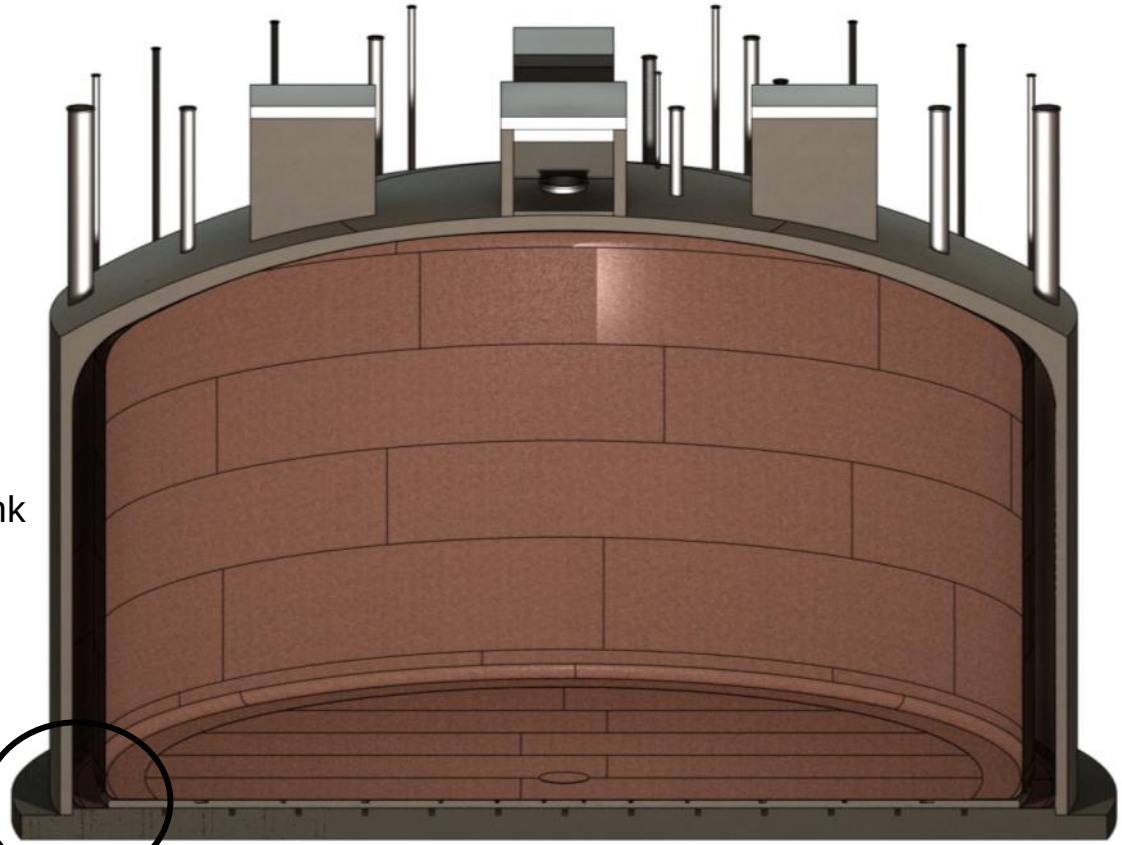
- Waste removed from SSTs has been pumped to DSTs, using temporary Hose-In-Hose transfer lines to the direct buried DST lines.
- The 28 DSTs were built between 1968 and 1986.
- Until recently the primary focus of Hanford integrity activities has been on the development of a robust program for the DSTs, that included:
  - In service inspection
    - Visual of the primary and annulus space of the DSTs
    - Ultrasonic testing of the primary tank and secondary liner by access through annulus risers.
  - Chemistry control for:
    - The prevention of general uniform corrosion, localized corrosion and stress corrosion cracking
    - Optimization of the controls to reduce chemical additions.

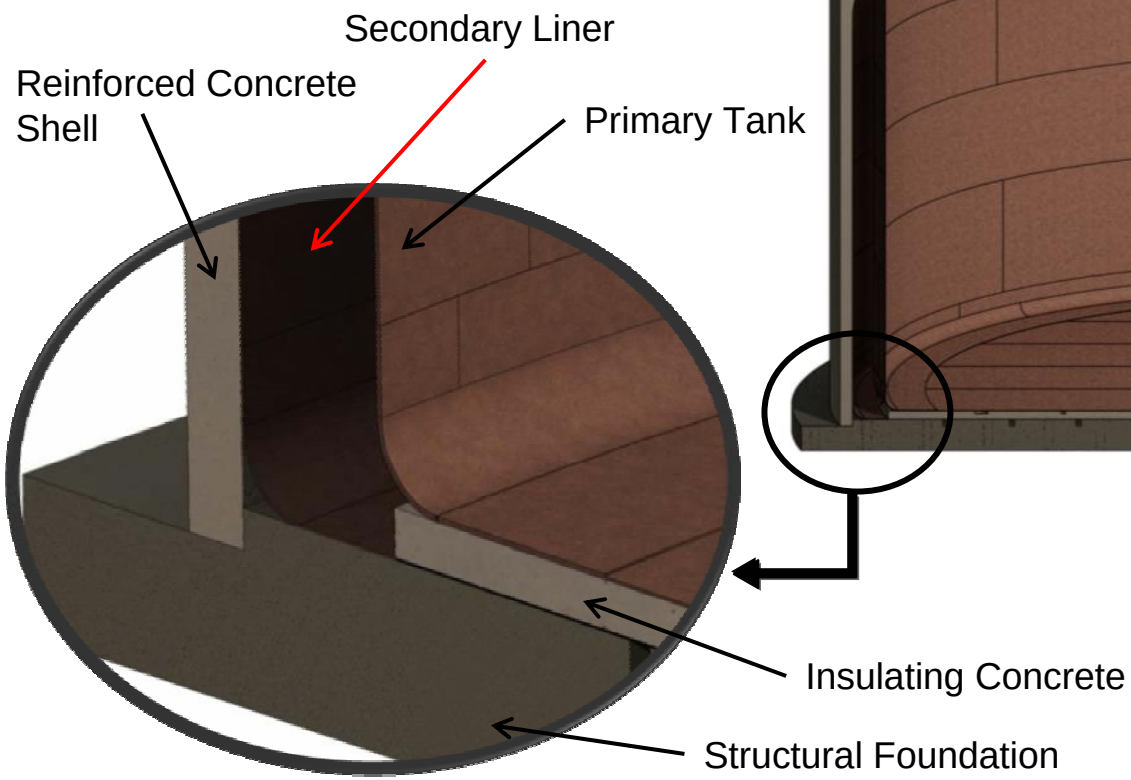
Double-Shell Tank Farms

Tank Farm	241-AY	241-AZ	241-SY	241-AW	241-AN	241-AP
Constructed	1968-70	1971-76	1974-76	1977-80	1978-81	1983-86
Number of Tanks	2	2	3	6	7	8
Design Life (yrs.)	25	20	50	50	50	50
Initial Service	mid-1971	late-1976	1977	mid-1980	1981	1986
Years in Service as of 2008	38	33	32	29	28	23
Type of Steel	A515	A515	A516	A537	A537	A537
Capacity (Mgal.)	1	1	1.16	1.16	1.16	1.25
Maximum Waste Depth – feet	30.3	30.3	35.2	35.2	35.2	38.3

Double-Shell Tank Description

- Six DST Farms
- 28 DSTs
- 1,000,000 gal capacity per tank





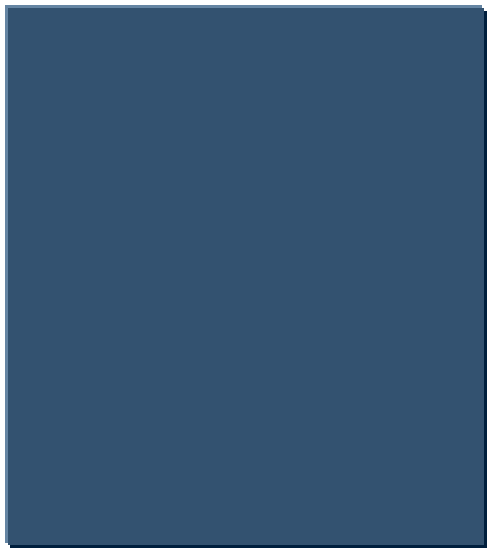
Double-Shell Tank 241-AP Construction

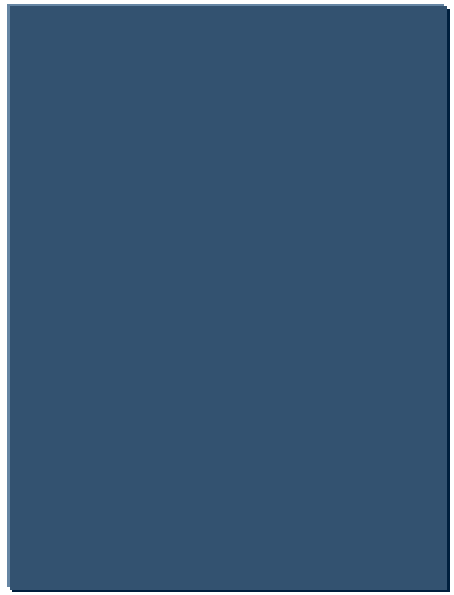
241-AP Tank Farm after Construction

Double-Shell Tank Integrity

- Assure continued tank integrity
  - Maintain 28 Double-Shell Tanks to safely store and transfer 53 Million gallons of highly radioactive chemical waste for treatment
  - Extend DSTs lives from 20 to 50 years to 100 years
  - Provide sufficient assurance of tank integrity to allow for repair and replacement
  - Prevent the need for additional tanks (up to $100 M per tank).
- Status tank corrosion
  - Monitor with ultrasonic testing, visual inspections, and corrosion monitoring to project tank corrosion to facilitate corrosion minimization and safe operations
  - Provide advanced notice of repair or replacement requirements
- Meet RCRA monitoring legal requirements as a result of proactive project activities
- DST System Infrastructure
  - Piping and pits to support transfer system
  - Piping cathodic protection system
  - 242-A Evaporator, AZ-301, and 204 AR

Hose-In-Hose Transfer System





Mechanism of Degradation

- Steel
  - Review types of corrosion by life extension panel
  - Identified general corrosion, pit corrosion, and stress corrosion cracking a the mechanism of concern
  - Examining in the solution liquid-air interface, and vapor space
- Concrete
  - High temperature levels have been experienced in the tanks
  - Fill-drain cycles have been experienced in tanks