



THE HANFORD SITE

Hanford Tank Integrity Program Overview and Recent Work

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Hanford Advisory Board

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- Watch weather reports to know what hazards you may encounter
- Slow down and drive for the conditions; just because part of your commute is dry doesn't mean all of it will be
- Check your tires for proper inflation and winterize your vehicle
- Keep the gas tank at least half full to avoid gas line freeze-up
- Do not use cruise control on any slippery surfaces
- Use your seat belt every time you get into your vehicle
- If you become snowbound, stay with your vehicle; it provides temporary shelter. Tie a brightly colored cloth to the antenna or place a cloth at the top of a rolled-up window to signal distress.



- The purpose of the briefing is to inform the Hanford Advisory Board of the evolution of the tank integrity programs, including recent progress and future work
 - Tank integrity is recognized as a key component to the Hanford tank waste mission
 - The Tank Integrity program is a dynamic program addressing new information and implementing new technologies
 - The program continues to be guided by the Tank Integrity Expert Panel, which provides independent expert guidance and specific recommendations for preventive and recovery actions
- Outline
 - Double-shell tanks (DST) and single-shell tanks (SST)
 - Double-shell Tank Integrity Program evolution and key elements
 - Single-shell Tank Integrity Program evolution and key elements
 - Current focus areas

177 Tanks Total - Many Shapes and Sizes

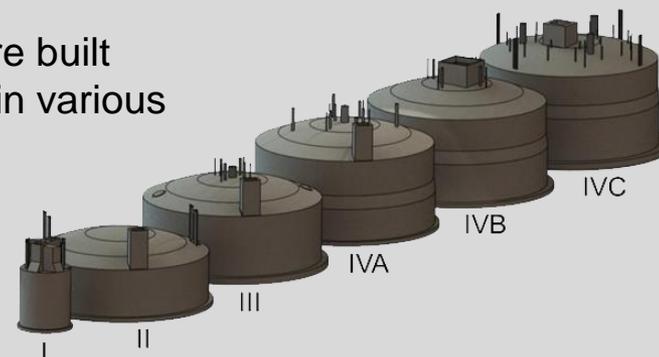
28 double-shell tanks were built between 1968 and 1986. The design of each is largely the same, with only minor variations.

Tank Farm	Total Tanks	Capacity
241-AY	2	1,018 Kgal
241-AZ	2	1,018 Kgal
241-SY	3	1,160 Kgal
241-AW	6	1,160 Kgal
241-AN	7	1,160 Kgal
241-AP	8	1 at 1,160 Kgal 7 at 1,257 Kgal

(kgal = 1,000 gallons)

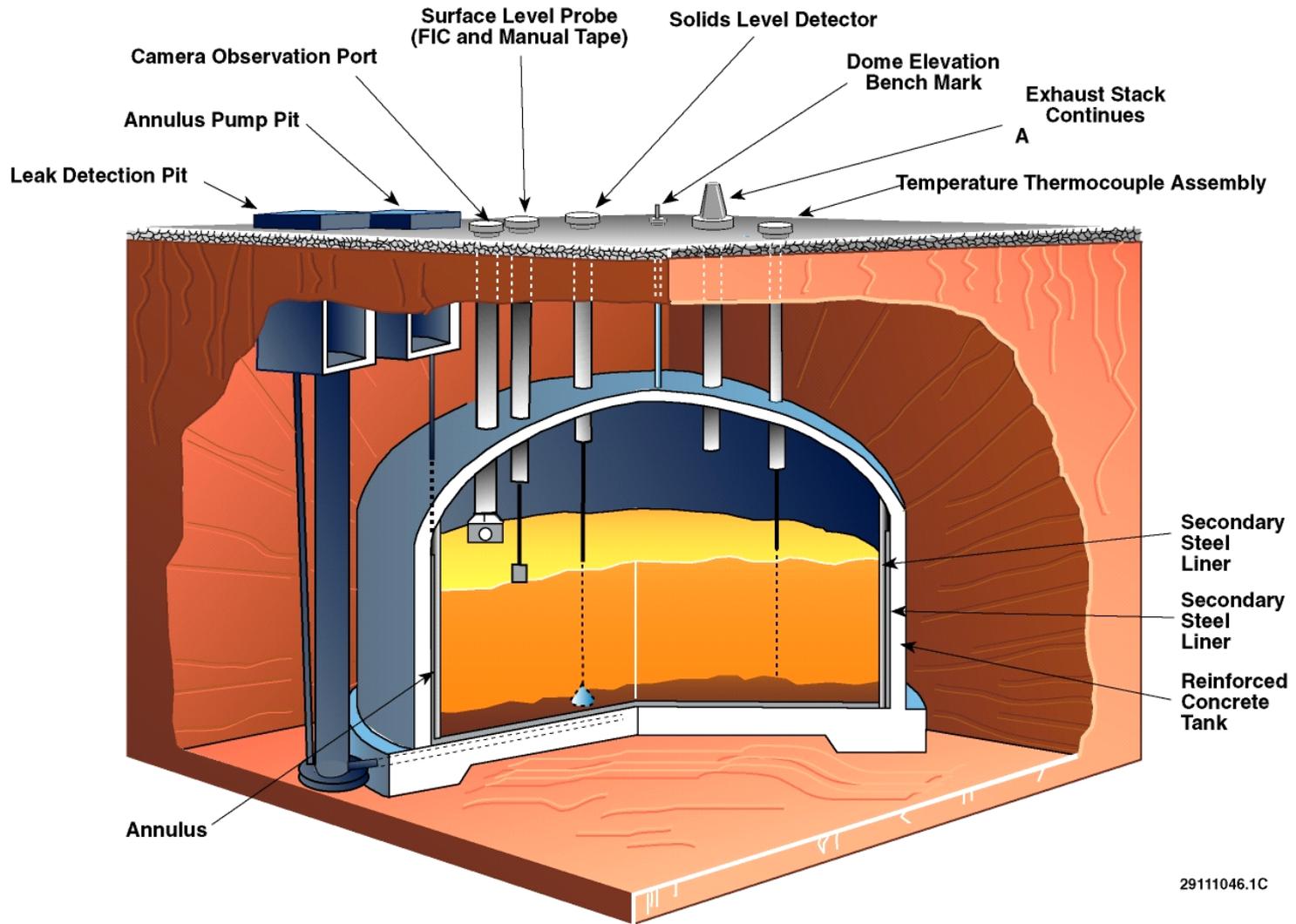
149 single-shell tanks were built between 1944 and 1965, in various designs and capacities:

- Type I: 55 kgal
- Type II: 530 kgal
- Type III: 760 kgal
- Type IV: 1 million gal



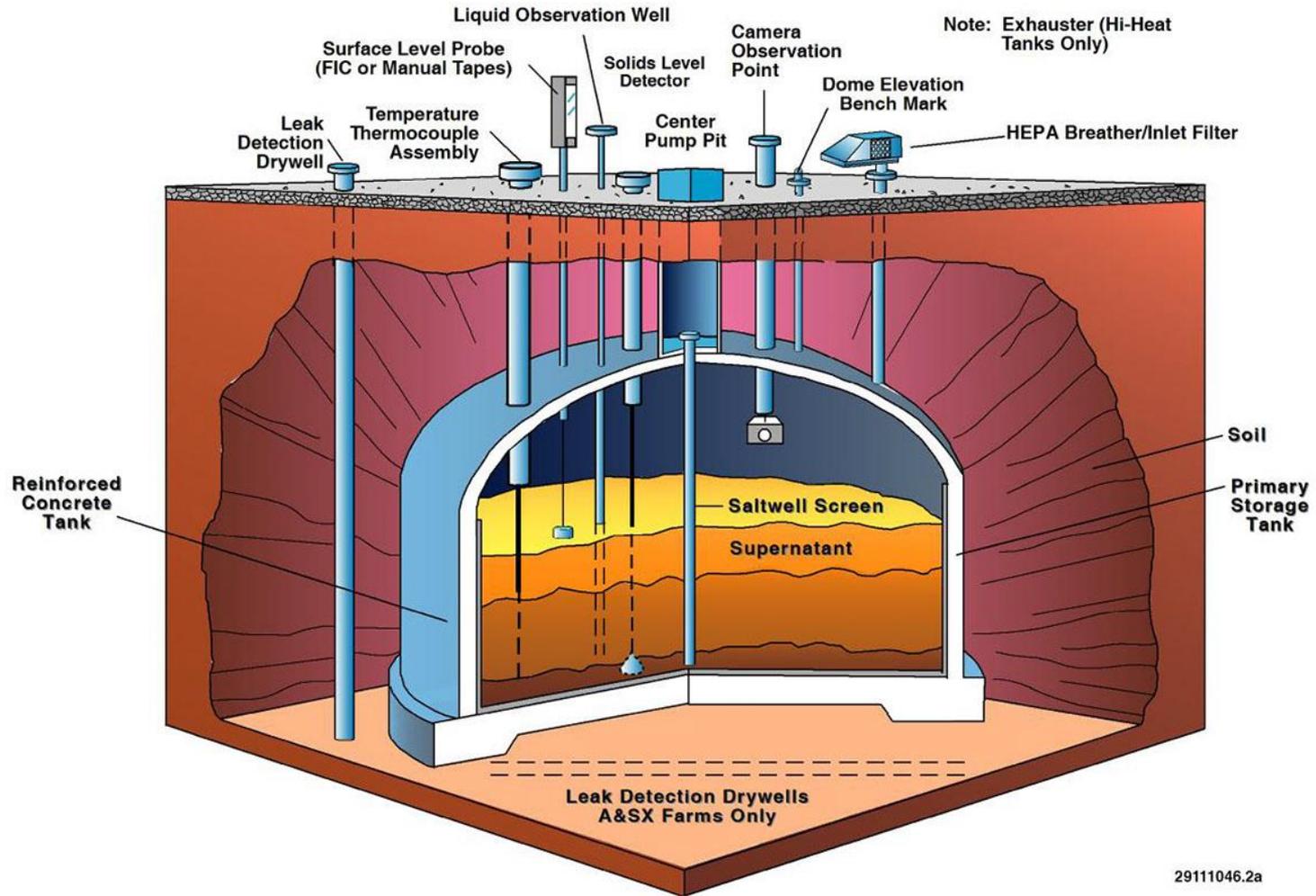
Tank Series	I	II	III	IVA	IVB	IVC
Farms	241-B 241-C 241-T 241-U	241-B 241-BX 241-C 241-T 241-U	241-BY 241-S 241-TX 241-TY	241-SX	241-A	241-AX
Total Tanks	16 Tanks	60 Tanks	48 Tanks	15 Tanks	6 Tanks	4 Tanks

Typical Double Shell Tank (DST)



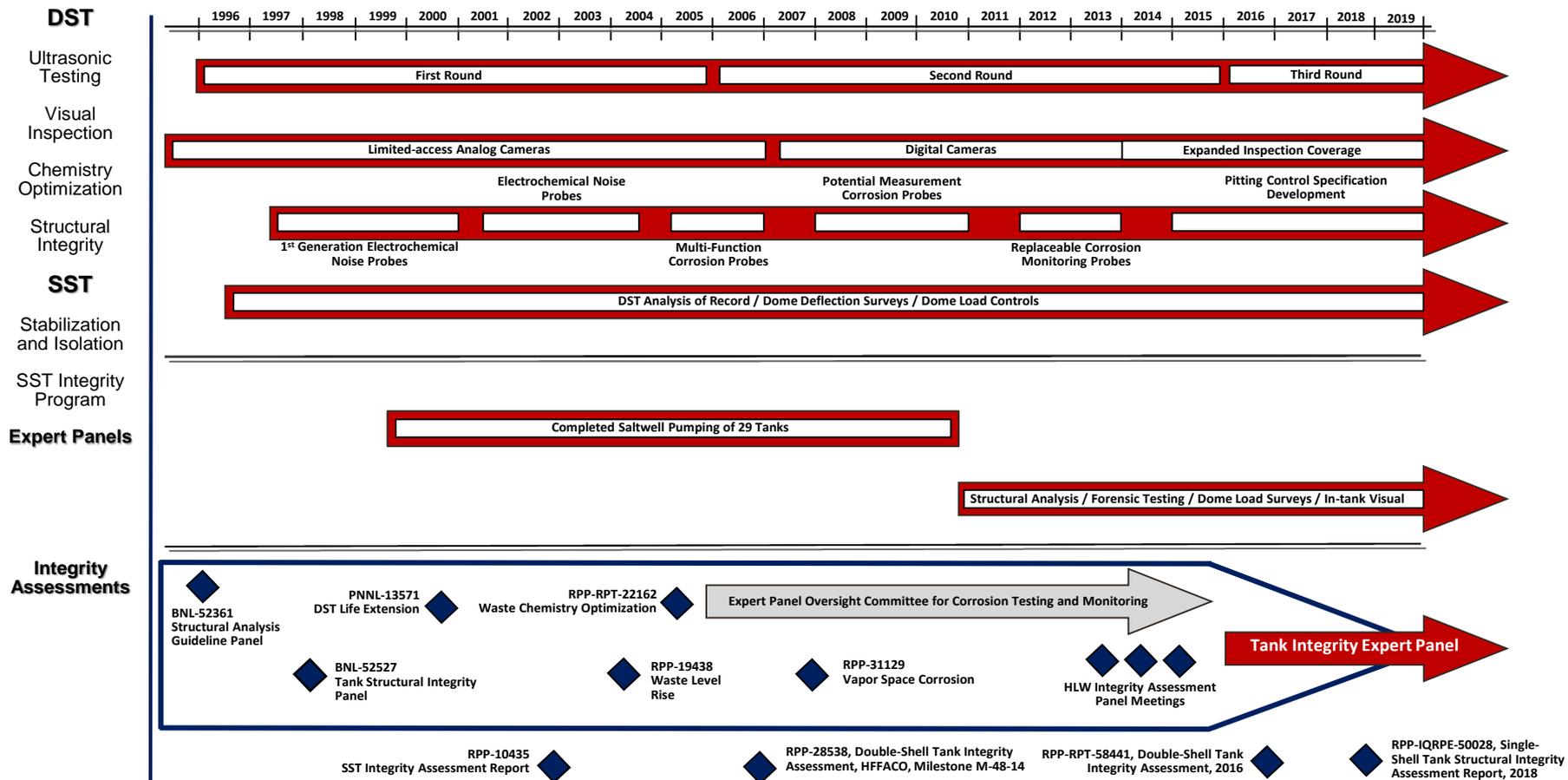
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Typical Single Shell Tank (SST)



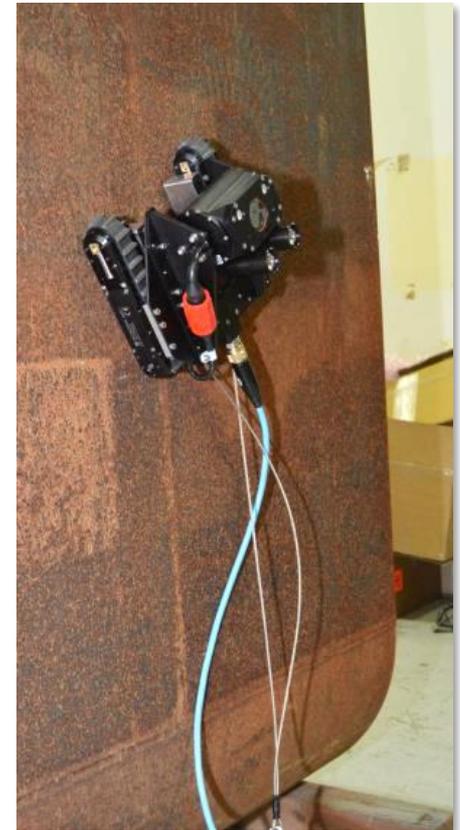
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Integrity Program History



Double-shell Tank Integrity Program

- Maintain DST structural integrity to support waste-processing operations while maintaining safe storage
- Meet regulatory requirements
- Program elements
 - Corrosion Control
 - Waste chemistry envelope
 - Waste chemistry sampling and adjustment
 - Inspections
 - Visual and volumetric
 - Primary tank wall
 - Secondary tank
 - Under-tank Inspection
 - Structural analyses and studies
 - Repair technology development



Visual-inspection crawler

DST Chemistry Control to Limit Corrosion

- Maintain chemistry concentrations to limit pitting corrosion and prevent cracking corrosion
- Periodically sample and model the chemistry of our waste tanks
- Refine ranges using a corrosion testing program with guidance from laboratories and experts
- Measure electrochemical potential of a sample set of tanks with corrosion probes to verify laboratory work
- New DST limits have recently been developed to include a pitting factor as a function of halides

Species	Minimum	Maximum
Nitrate (M)	-	5.5
Nitrite (M)	0.2	-
Nitrite/Nitrate	0.15	-
Temperature (°C)	-	75
Hydroxide (M)	0.01 (pH 12)	6
Pitting Factor*	1.2	-

$$*Pitting\ Factor = \frac{8.06*[Hydroxide]+1.55*[Nitrite]}{[Nitrate]+16.7*[Chloride]+5.7*[Fluoride]}$$

Current Chemistry Control Specification

Waste Chemistry Limits for All DST Waste Except the Interstitial Liquid in Tanks
241-AN-102, AN-106, AN-107, AY-101, and AY-102

FOR [NO ₂ ⁻] RANGE	VARIABLE	FOR WASTE TEMPERATURE (T) RANGE		
		T < 167 °F	167 °F ≤ T ≤ 212 °F	T > 212 °F
[NO ₂ ⁻] ≤ 1.0M	[OH ⁻]	0.010M ≤ [OH ⁻] ≤ 6.0M	0.010M ≤ [OH ⁻] ≤ 5.0M	0.010M ≤ [OH ⁻] < 4.0M
	[NO ₂ ⁻]	0.011M < [NO ₂ ⁻] < 5.5M	0.011M < [NO ₂ ⁻] < 5.5M	0.011M < [NO ₂ ⁻] < 5.5M
	[NO ₂ ⁻] / ([OH ⁻] + [NO ₂ ⁻])	< 2.5	< 2.5	< 2.5
1.0M < [NO ₂ ⁻] ≤ 3.0M	[OH ⁻]	0.1 ([NO ₂ ⁻]) ≤ [OH ⁻] < 10M	0.1 ([NO ₂ ⁻]) ≤ [OH ⁻] < 10M	0.1 ([NO ₂ ⁻]) ≤ [OH ⁻] < 4.0M
	[OH ⁻] + [NO ₂ ⁻]	≥ 0.4 ([NO ₂ ⁻])	≥ 0.4 ([NO ₂ ⁻])	≥ 0.4 ([NO ₂ ⁻])
[NO ₂ ⁻] > 3.0M	[OH ⁻]	0.3M ≤ [OH ⁻] < 10M	0.3M ≤ [OH ⁻] < 10M	0.3M ≤ [OH ⁻] < 4.0M
	[OH ⁻] + [NO ₂ ⁻]	> 1.2M	> 1.2M	> 1.2M
	[NO ₂ ⁻]	≤ 5.5M	≤ 5.5M	≤ 5.5M

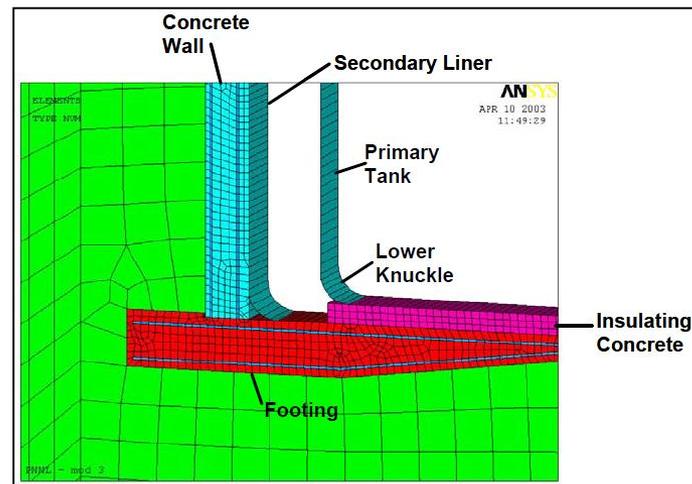
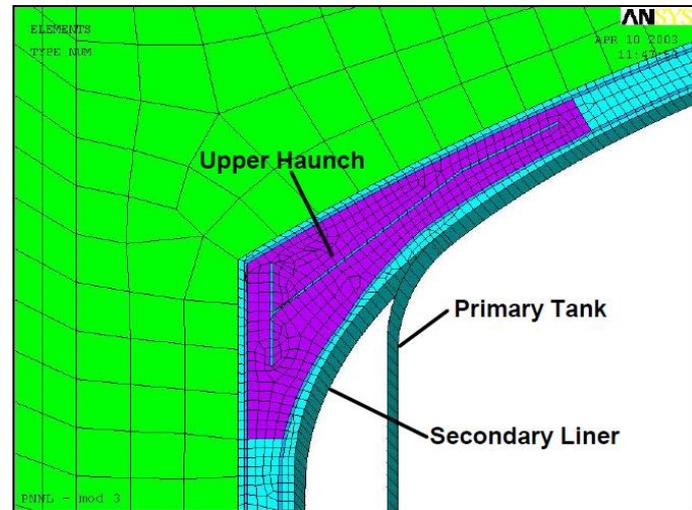
Table 1.5.1-2 Waste Chemistry Limits for the Interstitial Liquid of Tanks
241-AN-102, AN-106, AN-107, AY-101, and AY-102

TEMPERATURE	VARIABLE	LIMIT
≤ 122 °F	[NO ₂ ⁻]/[NO ₃ ⁻]	≥ 0.32 ¹
	pH	≥ 10
> 122 °F	Limits in Table 1.5.1-1 above apply ²	

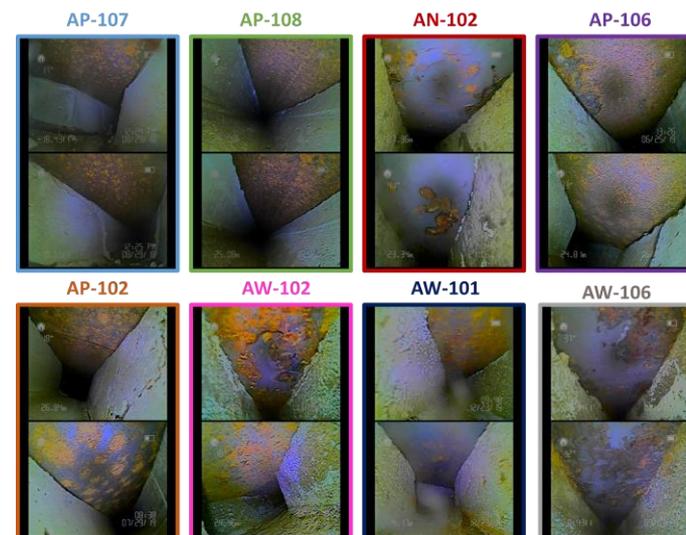
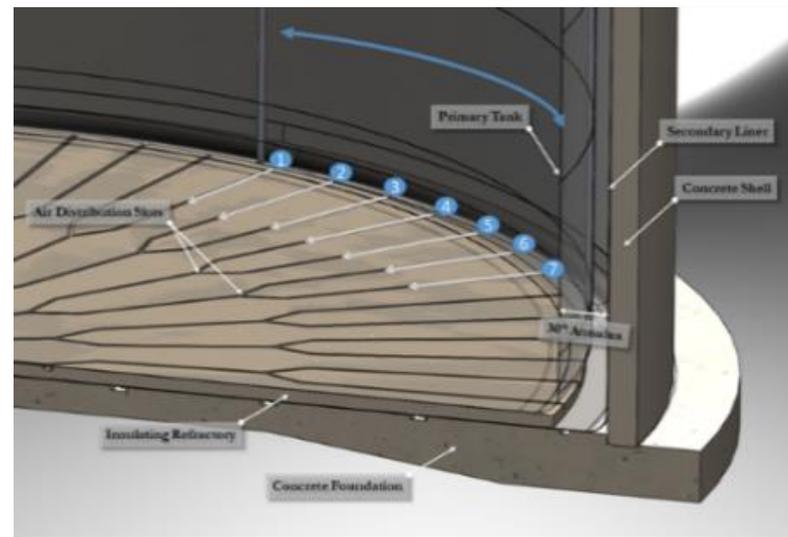
Notes:

1. The [NO₂⁻]/[NO₃⁻] limit ≥ 0.32 does not apply to 241-AY-102
2. 241-AY-102 chemistry limits apply for temperatures not in excess of 170°F

- Analyzed in the Analysis of Record
 - Finite Element Analysis using engineering simulation software
 - Considers operating history
 - Reflects current operating conditions
 - Thermal and Operating Loads Analysis
 - Seismic analysis
- Provides technical basis for operating parameters
 - Dome load limits
 - Maximum waste height
 - Allowable specific gravity
 - Maximum temperature



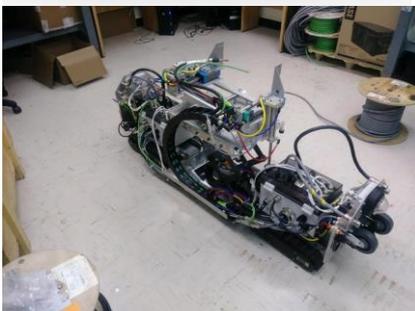
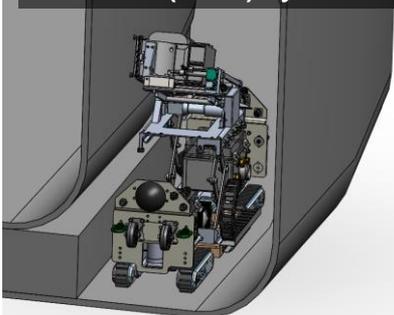
- Tank annulus visual inspection
 - Prior to 2014, inspected every 5-7 years through four risers
 - Since 2014, enhanced inspection every three years with >95% coverage of annulus floor
 - Document any visual anomalies between inspections
- Primary tank wall volumetric inspection
 - 8-10 year frequency
 - Inspect portions of the primary tank wall and secondary liner
- Current development
 - Deployed first-time under-tank visual inspections
 - Under-tank volumetric inspections



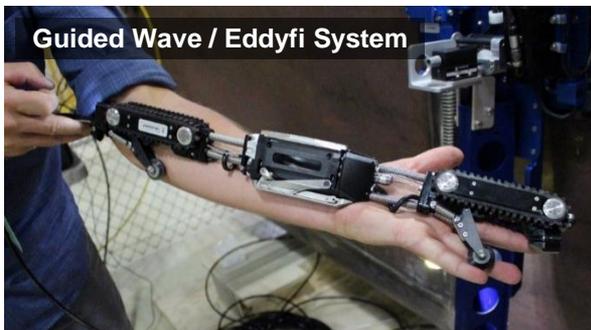
DST Current Focus Area: Tank Bottom Volumetric Inspection Systems

- Once these systems are fully evaluated and tested in a laboratory setting, they will be advanced to performance demonstration testing and operator training for field use
- Successful incorporation and periodic deployment within the DST integrity program is the end-state goal for these tools

Southwest Research
Institute (SWRI) System



Guided Wave / Eddyfi System



ITIVS System

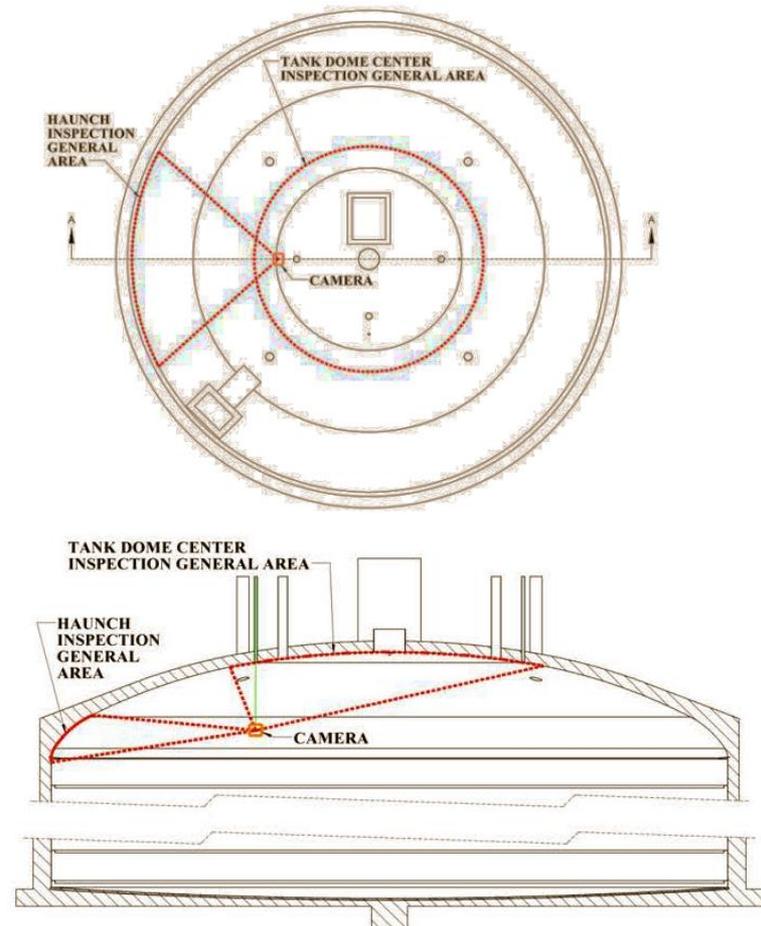


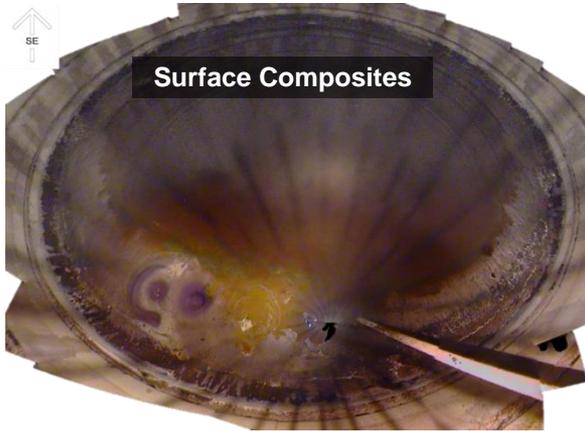
- New waste additions stopped in 1980 by Congress
- Interim stabilized (i.e., last pumpable) liquid removed in 2004
- SSTs still contain approximately 28 million gallons of waste (sludge, saltcake, supernatant)
- Waste retrieval and transfer from the SSTs to DSTs is underway
 - Sixteen of the SSTs have been retrieved
 - Preparing for 241-A/AX farm SST retrieval as part of consent decree

SST Integrity Program Plan Elements

- Structural Analyses: Analysis of Record completed with modern structural analyses to show tanks are sound
- Execution of program
 - Dome loading program to protect structural analyses
 - Periodic dome deflection surveys
 - Waste liquid level evaluations
 - Visual inspections
 - Intrusion mitigation
- Leak assessment process

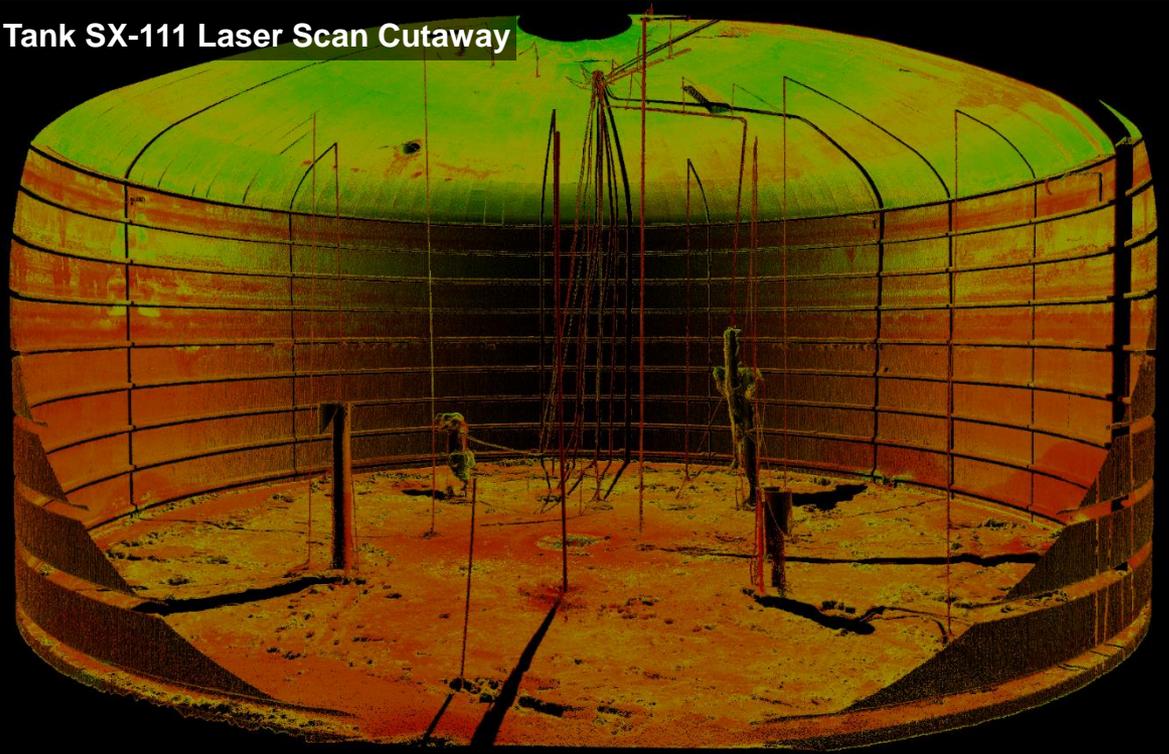
- Observing waste surface conditions in relation to level-monitoring devices, signs of intrusion or leakage, and structural condition (of steel and concrete)
- Ramping up pace to complete 15 tanks per year to support a 10-year frequency
- Similar camera hardware is used as in DST annulus visual inspections, but supplementary lighting is often needed
- Reports are completed annually to document observations and compare findings to historical photos and information





SX Farm Laser Scan Examples

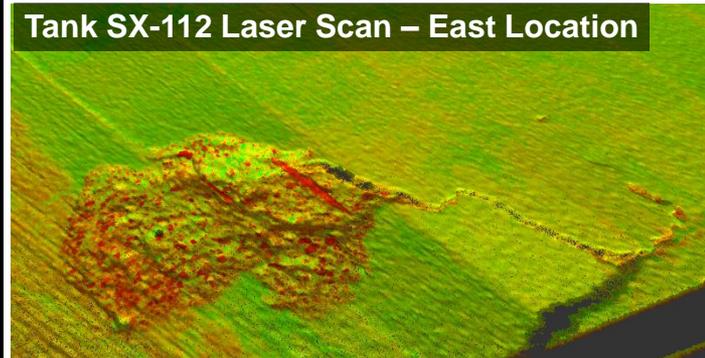
Tank SX-111 Laser Scan Cutaway



Tank SX-112 laser scan showing 3 spalled locations



Tank SX-112 Laser Scan – East Location



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Questions?