Savannah River Remediation

We do the right thing.

Savannah River Site Tanks: Structures and Materials

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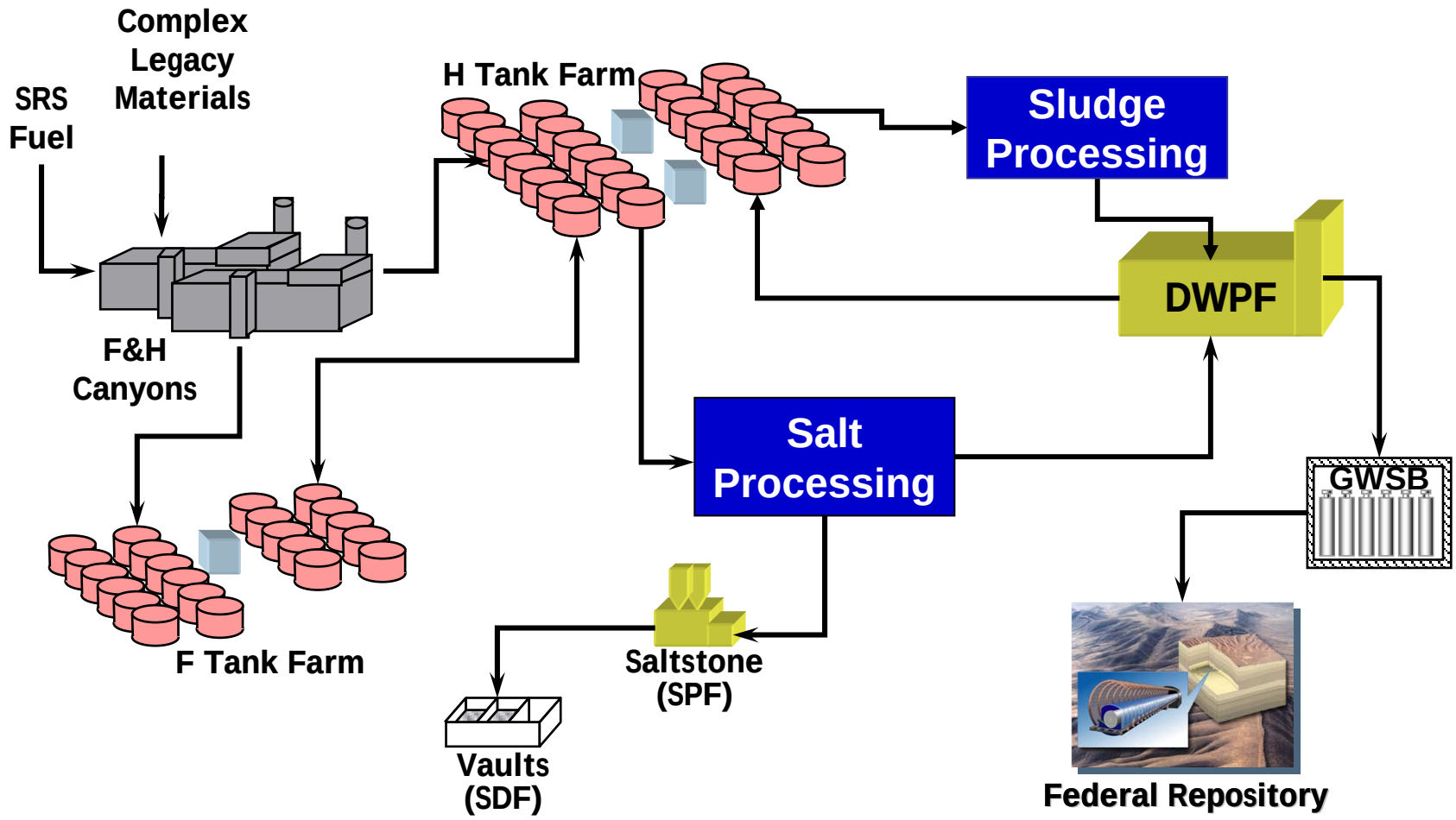
Savannah River Remediation

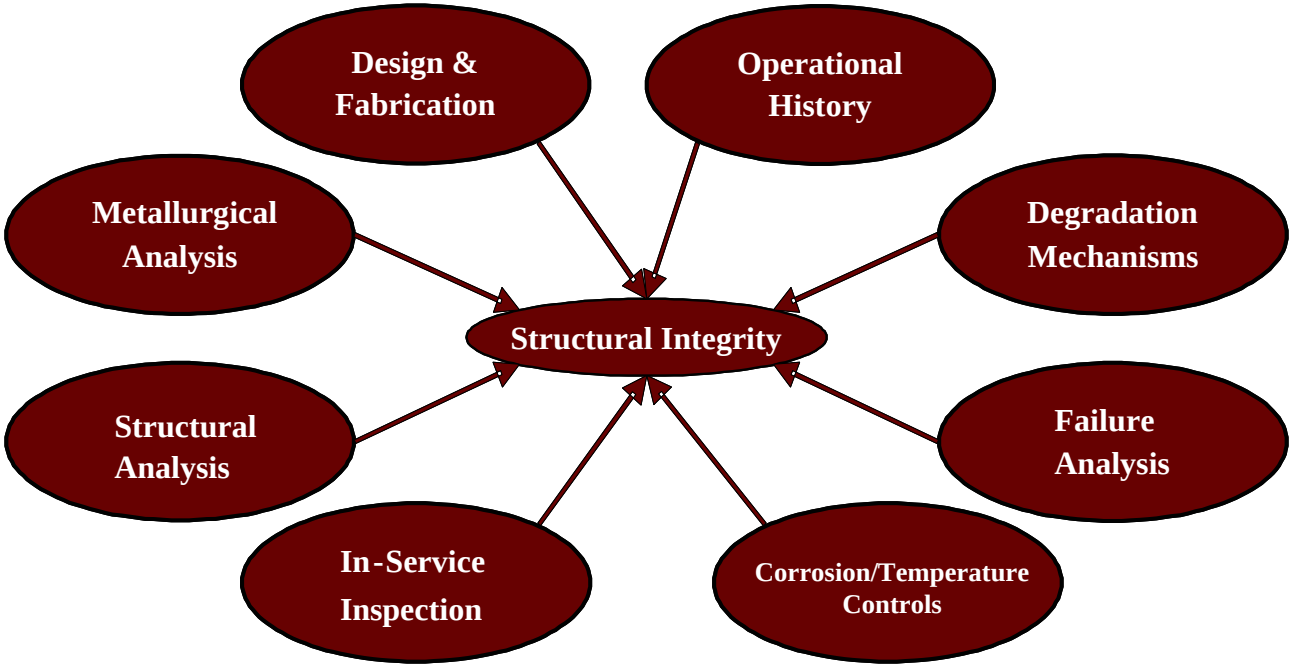
Non-Destructive Examination Independent Review

SRS Liquid Waste Operations

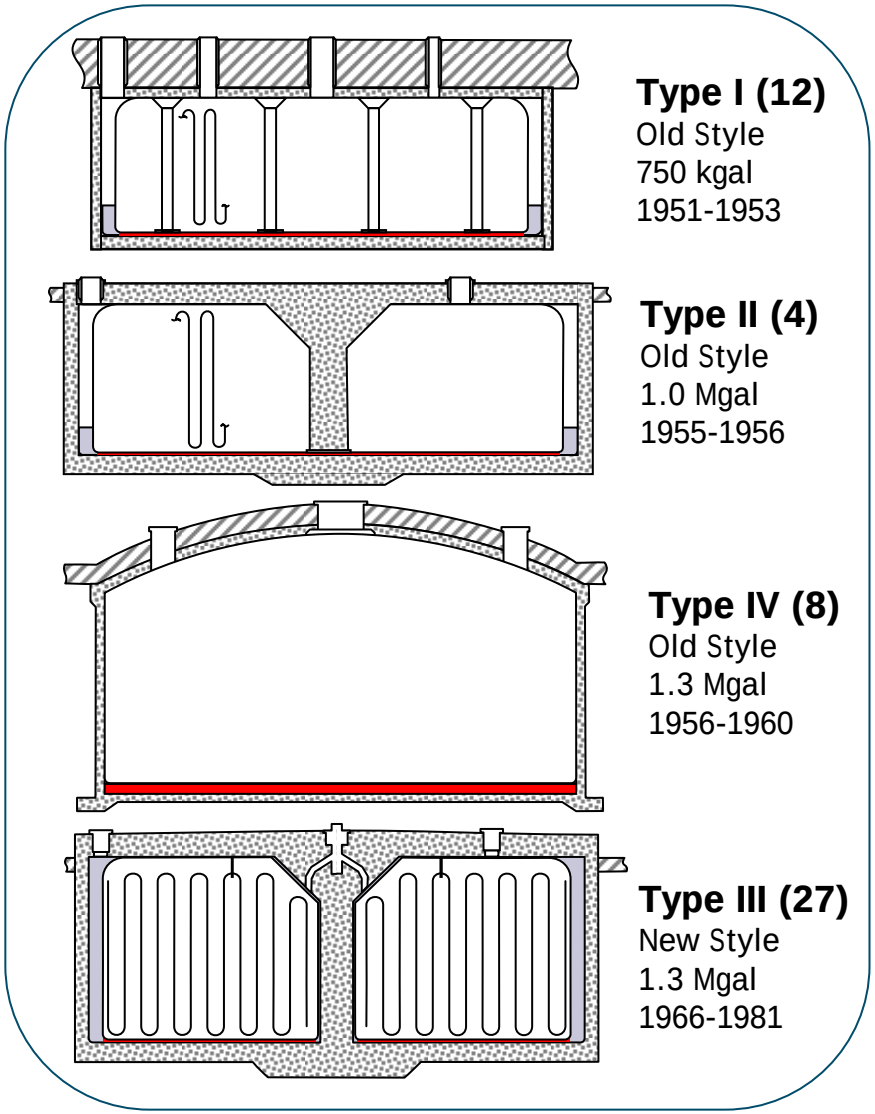


Structural Integrity Program

- Waste tanks provide critical interim containment for waste prior to processing and permanent disposal
- Comprehensive integrated approach to maintaining structural integrity of tanks, a critical component of operations
- Evolving program to successfully address emerging issues and preclude consequential degradation



Waste Tanks

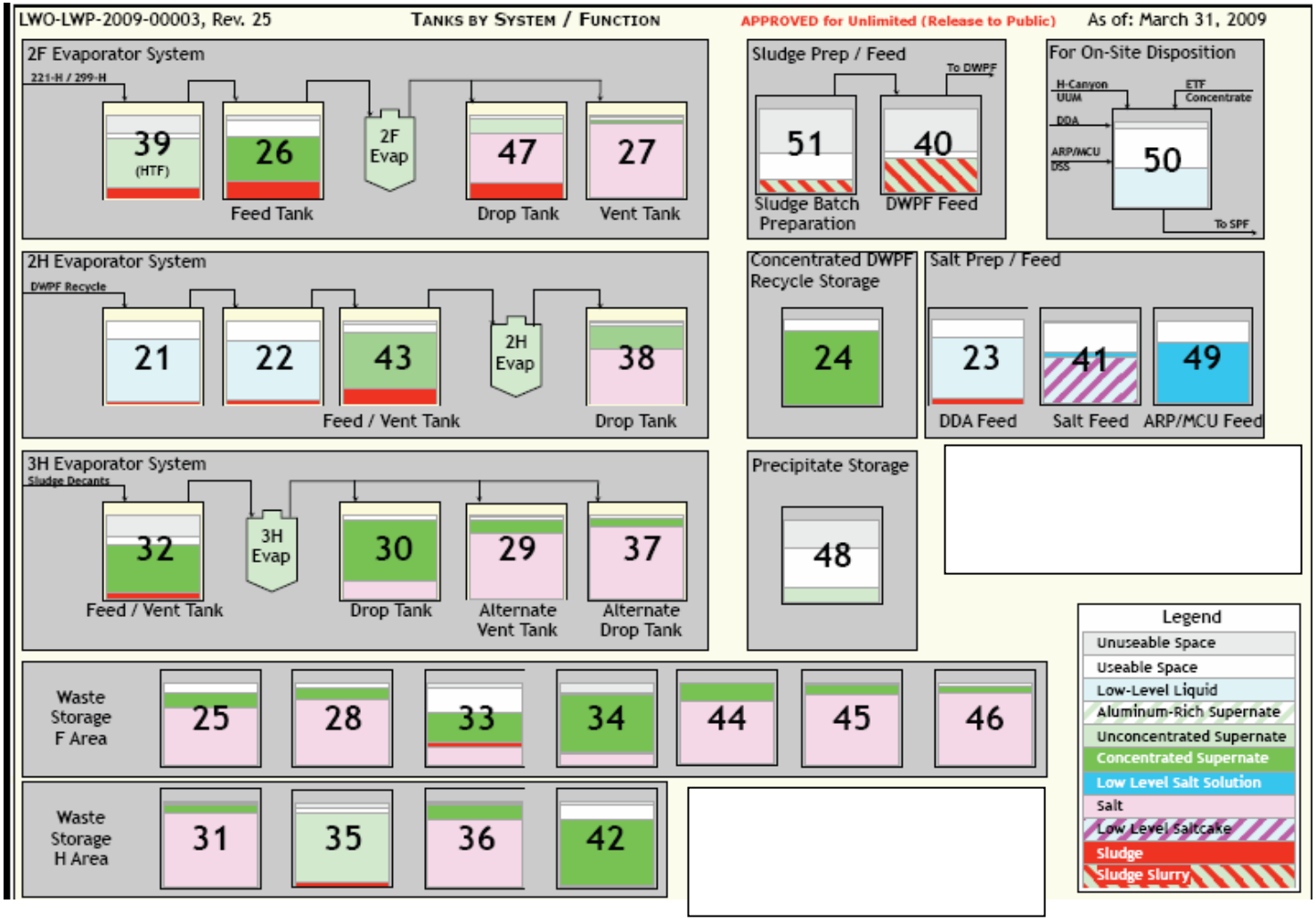


- (24) Old Style Tanks
  - Type I/II: partial secondary containment
  - Type IV: single shell tanks (SST)
  - Up to 50 years old
  - Do not have full secondary containment
  - (2) have been closed
  - No active leaksites today
- (27) New-Style Tanks
  - Full secondary containment
  - No leakage history
  - Receive all new waste
  - Used for all processing activities

Operational History

- Supernate - liquid waste from the fuel processing facility
- Sludge – solid metal oxides that settle to the bottom of the tank (iron, manganese, etc.)
- Saltcake – Solid crystallized waste that has returned from the evaporator.

Current Tank Function



Design and Fabrication

TANK MATERIALS OF CONSTRUCTION EVOLVED BASED ON DEGRADATION CONCERNS

ASTM A285-B Carbon Steel (Type I and II, and IV)

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ASTM A212-B Carbon Steel (Type IV)

ASTM A516-70 Carbon Steel (Type III)

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ASTM A516-70 Carbon Steel (Type III)

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ASTM A537 Class I Carbon Steel (Type IIIA)

- Improved resistance to SCC and brittle fracture
- Stress-relief of Type III/IIIA primary

Historical Environment

- Concentration Range of Major Anion Constituents in Supernate

Waste	Nitrate (M)	Hydroxide (M)	Nitrite (M)	Form
Fresh	1-5	0.6-1.5	0.5 -1	Sup/Sl
Salt Receiver	1-3	3-13	0.5 -1.5	Sup/Sa
Dilute Low-Level	0.01-0.5	0.01-0.6	0.01 -.5	Sup

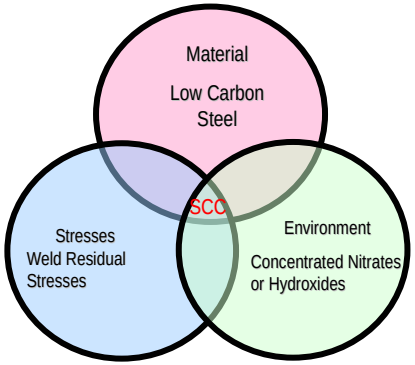
- Temperatures during storage and operation

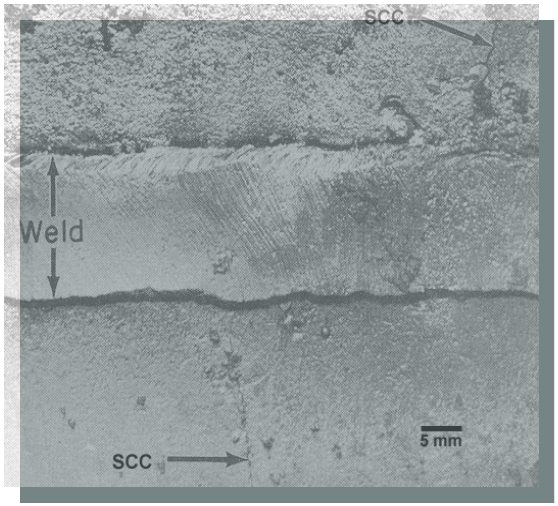
Waste	Supernate (C)	Salt (C)	Sludge (C)
Fresh	50-70	-	120-140
Salt Receiver*	30-50	50-80	-
Dilute Low-Level	20-35	-	-

*May be higher if part of an active evaporator system

Degradation Mechanisms

- Primary mode of degradation is nitrate-induced stress corrosion (SCC) cracking near fabrication welds or repair welds
- Occurred early in service in non-stress relieved Type I/II Tanks
- Type III Tanks have no known leaksites
  - Better materials of construction
  - Post-weld heat treatment to relieve weld residual stresses
- Corrosion control program to preclude further degradation





In-Service Inspection

- Routine Visual Imagery Techniques (1971- present)
  - Wide-angle Photography (field of view ~100°)
  - Direct Photography by Shielded Camera
  - Closed Circuit Television
  - Percentage of tank viewed from the annulus:
    - Type I: 13-75%
    - Type II: 73-96%
    - Type III/IIIA: 100%
  - Interior of Type IV tank walls and concrete dome inspected
- Summary of visual observations
  - Direct visual detection of leaksites (Type I and II)
  - Visual of liquid/salt in secondary tank pan (Type I and II)
  - Rainwater intrusion through liner of Type IV
  - Minor Surface Corrosion on Outer Walls (Type I, II, III)

In-Service Inspection

- Wall Thickness Measurements 1971-1985 (Type I, II, III, IV)
  - > 24,000 point measurements
  - No reportable wall thinning
- P-scan 1994 (selected Type IIIA: Tanks 40, 42 & 48-51)
  - No reportable wall thinning or pitting observed
- P-scan 2002-2007 (All Type III/IIIA tanks and 1 Type II Tank)
  - No reportable wall thinning or pitting observed (2002-2007)
  - No cracks observed on Type III/IIIA tanks (2002-2007)
  - Stress Corrosion Cracks on Type II tank were characterized in 2002 and 2007.

Stress Analyses

- Primary tank, secondary liner and concrete vault for all waste tank types were evaluated for the demands resulting from operating and natural phenomena hazard (NPH) loads.
- Primary tank
  - Type I and II: ASME Section VIII, Div. 2
  - Type III/IIIA: ASME Section III, Div. 1, Subsection NC-3200

Stress Analyses

- Seismic structural analysis was based on site-specific geotechnical information per DOE order 6430.1.
  - 1995 areas of concern were slope stability, shallow liquefaction, and subsidence of “soft zones”.
- All tanks have been analyzed for tank top equipment loads.

Fracture Analyses

- Fracture Analysis (FAD)
  - Utilized API 579 Fitness-for-Service Approach
  - Site specific material properties
  - Fill limit calculations for Type I and II tanks with cracks
- Fracture Analysis J-integral
  - Utilized J-T approach
  - Evaluated specific cracks in Type I and II tanks
- Comparison of two methodologies demonstrated no difference for this application.

Looking Ahead

- Maintaining the structural integrity of the waste tanks is a critical component of operations
- The design, fabrication, and operational controls of the tanks have consistently evolved as part of the SI program
- The SI program now evolving to meet the aggressive closure goals