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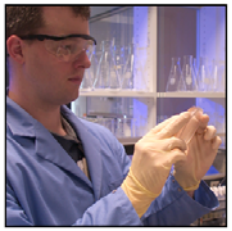
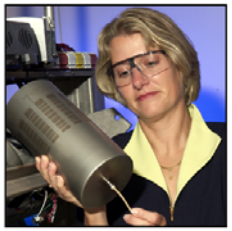
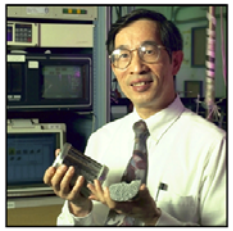
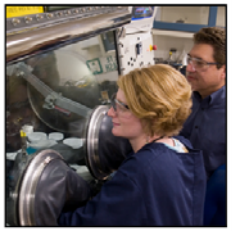
We Put Science To Work

High-Level Liquid Waste Tank Integrity Workshop – 2008

Karthik Subramanian

Bruce Wiersma

November 2008

High Level Waste Corporate Board Meeting

karthik.subramanian@srnl.doe.gov
bruce.wiersma@srnl.doe.gov

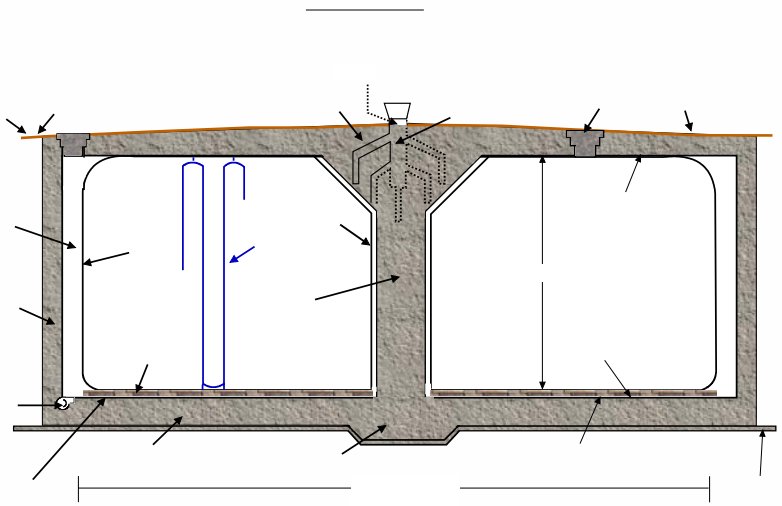
EM Office of Environmental Management

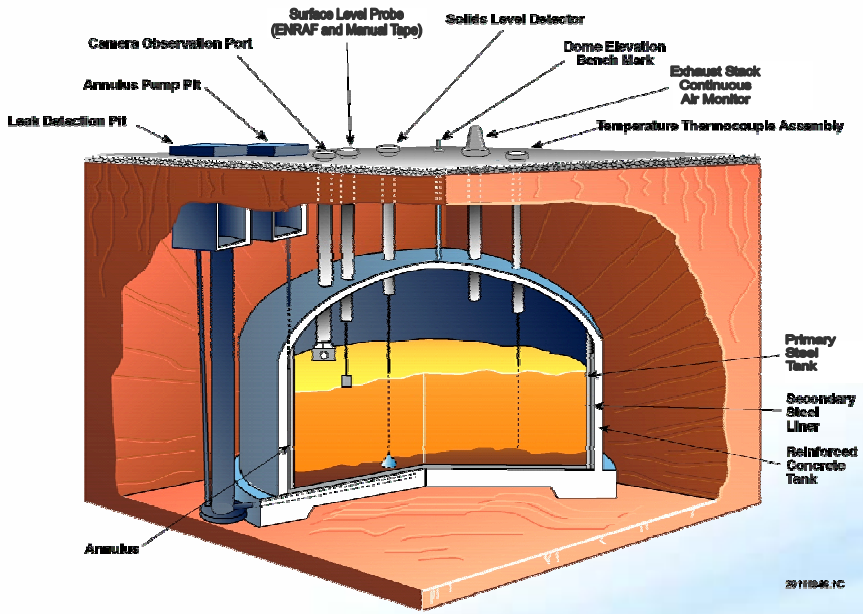
Acknowledgements

- Bruce Wiersma (SRNL)
- Kayle Boomer (Hanford)
- Michael T. Terry (Facilitator)
- SRS - Liquid Waste Organization
- Hanford Tank Farms
- DOE-EM

Background

- **High level radioactive waste (HLW) tanks provide critical interim confinement for waste prior to processing and permanent disposal**
- **Maintaining structural integrity (SI) of the tanks is a critical component of operations**





Tank Integrity Workshop - 2008

- *Discuss the HLW tank integrity technology needs based upon the evolving waste processing and tank closure requirements along with its continued storage mission*

- **Investigate on-going waste tank integrity and life extension activities**
- **Identify opportunities and recommend solutions to improve these areas at the Savannah River and Hanford sites**
- **Basis**
  - **Integrate SI programs across DOE complex**
  - **Increase confidence in continued safe tank farm operations**
- **Establish groundwork for collaborative efforts**
  - **Develop action plans**
  - **Improve networking**

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Attendees and Agenda

- Savannah River National Laboratory (SRNL)
- Savannah River Site – Liquid Waste Operations (SRS-LWO)
- CH2M Hill – Hanford
- DOE – SR/ORP/EM-21
- ARES Corporation
- PNNL
- CC Technologies
- DNFSB
- Academia

- Series of technical presentations to update the participants on the status of tank structural integrity related activities
  - Overview
  - Corrosion
  - Inspection & Monitoring
  - Structural Analyses
- Facilitator led working sessions

Facilitated Sessions

- Three small groups were set up to determine enablers, inhibitors, barriers, and solutions
- Technical
  - Intimate knowledge of safe operations/processes including all key elements of SI
  - Need for improved understanding of corrosion chemistry/controls for evolving conditions, inspection methodologies
- Programmatic
  - Sound technical team with consistent open communication with stakeholders
  - Need for improved communication/integration of overall mission goals

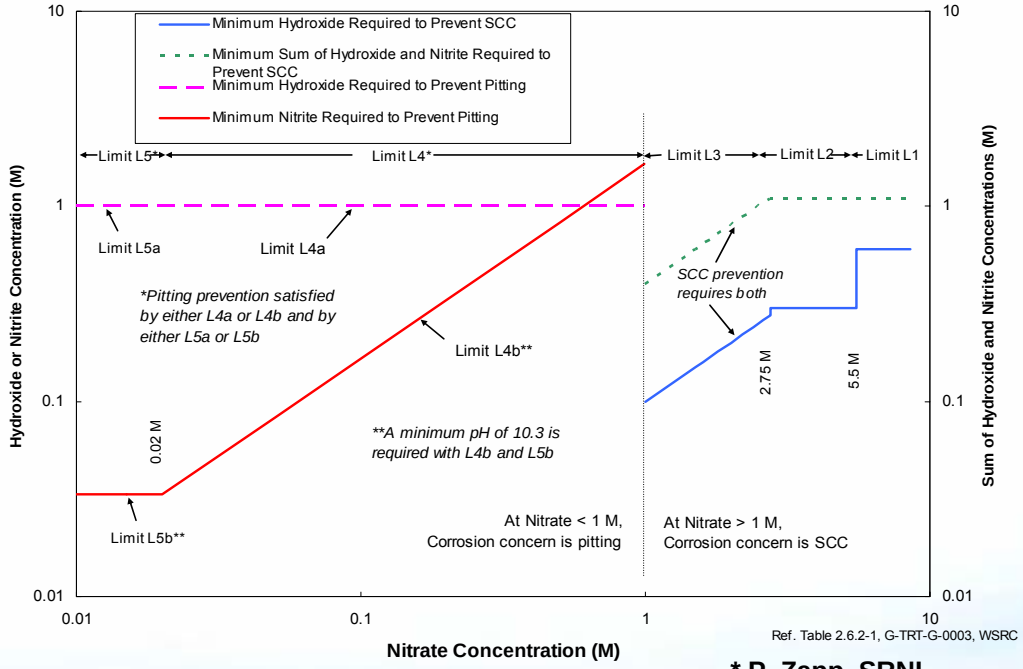
Barriers and Solutions

Year 2018 Vision: "We have a complete technical basis for optimizing risk reduction for safe extension of mission duration of high level waste tanks at Hanford and SRS"

- **Improve understanding of the corrosion mechanisms and optimization of corrosion controls**
- **Improve understanding of in-tank conditions**
- **Improve non-destructive evaluation (NDE) techniques for primary/secondary tank wall and concrete**
- ***Develop tank integrity roadmap and execution plan including knowledge retention plan***

Improve Knowledge of Corrosion Mechanisms & Controls Optimization

- **Critical review of existing literature**
- **Establish chemistry regimes and define controls**
- **Determine vapor space and liquid/air interfacial chemistries potentially leading to corrosion**
- **In-tank monitoring to validate laboratory results**



Ref. Table 2.6.2-1, G-TRT-G-0003, WSRC

*** P. Zapp, SRNL**

Champions

- **Bruce Wiersma (SRNL)**
- **Rich Wyrwas (Hanford)**

Improve Knowledge of In-Tank Conditions

- New sampling technology/technical bases
- Corrosion monitoring
- Iterative modeling/experiments for analyses
- Identify bounding tank chemistries
- Optimize corrosion probes

AN 102 Corrosion Probe Fabrication ⇨ Installation

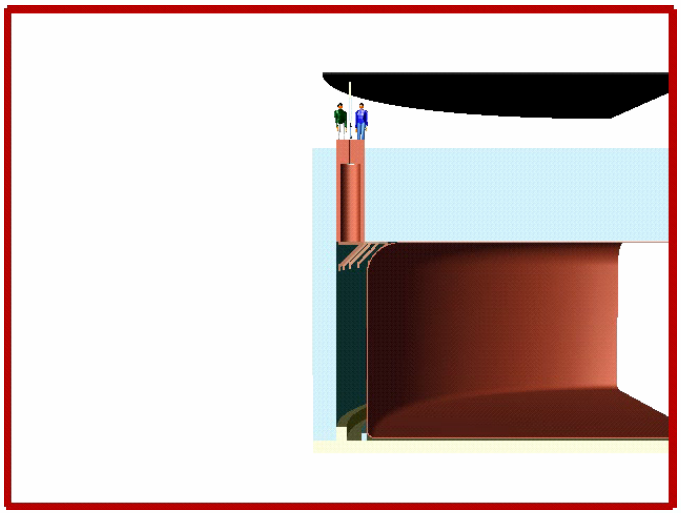
*V. Anda, Ares Corporation

Champions

- Philip Zapp (SRNL)
- Vanessa Anda (Ares Corp)
- John Beavers (CC Technologies)

Improve NDE Techniques

- Concrete NDE
- Statistical analyses to validate data
- Workshop to review ultrasonic testing data/inspection programs
- Comprehensive review of NDE technologies for deployment



* J. Elder, SRNL

Champions

- Jim Elder (SRNL)
- Jason Engeman (Hanford)

Develop Tank Integrity Roadmap

- **Roadmap to include key elements of SI programs at SRS and Hanford**
- **Provide technical and programmatic direction to achieve vision**
- **Integrate programs as appropriate**

Champions

- **Karthik Subramanian (SRNL)**
- **Chris Burke and Kayle Boomer (Hanford)**

CORROSION CHEMISTRY

- **Vapor Space and Liquid/Air Interface Corrosion**
- **Evolution of chemistry control to support site-specific goals**

INSPECTION & MONITORING

- **Corrosion probe optimization**
- **Volumetric inspection of DST tank steel liner**
- **Inspection of concrete**

STRUCTURAL ANALYSES

- **Fracture mechanics based analyses for flawed tanks**
- **Seismic analyses**

Path Forward

Path Forward	Status
Proceedings of Workshop	"Proceedings of the High-Level Liquid Waste Integrity Workshop – 2008, WSRC-STI-2008-00340, July 2008
Develop Roadmap	Roadmap development underway
Conduct a Review Meeting	Review meeting to be in January 2009

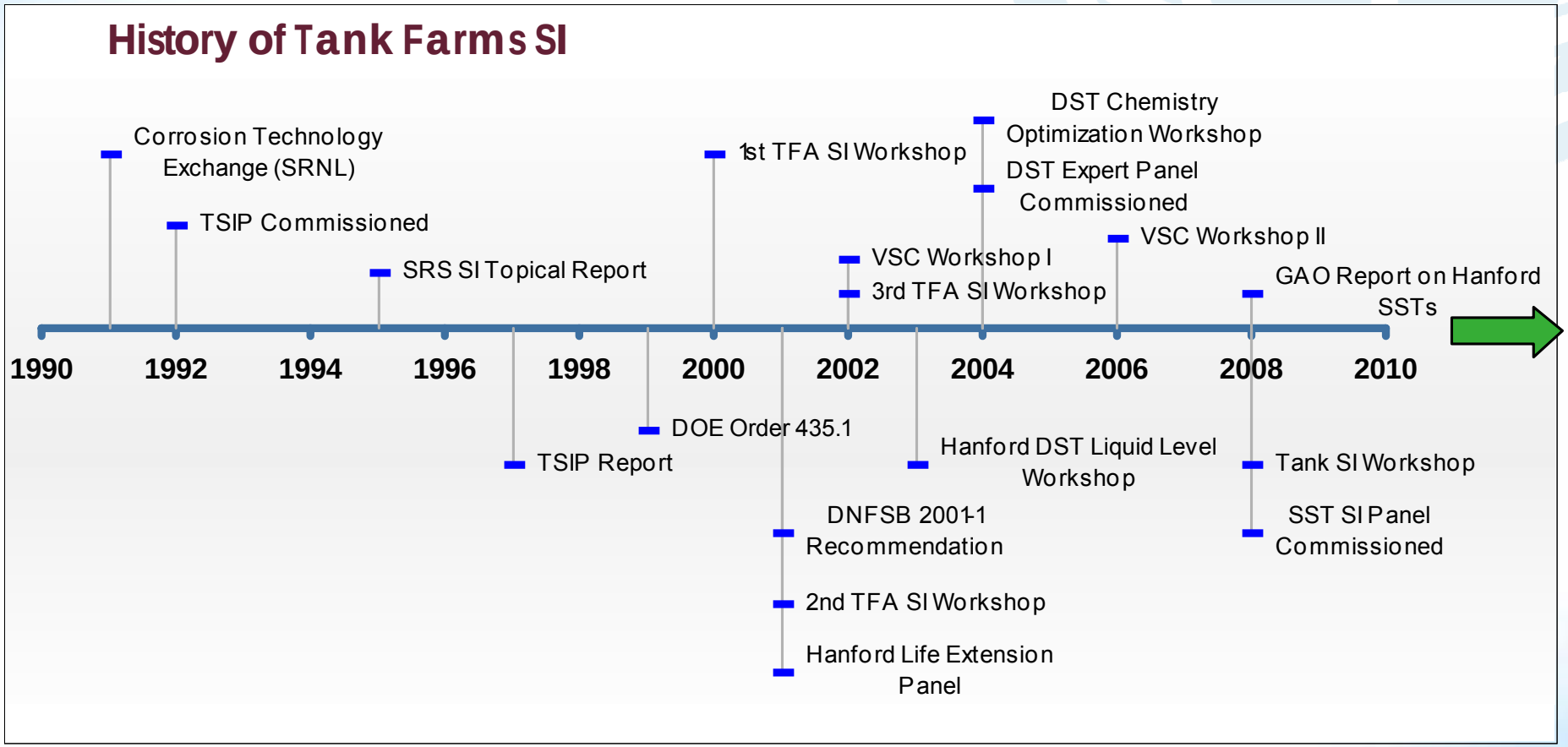
Integrate, Integrate, Integrate

- **SI programs are SRS and Hanford are primarily similar**
- **Site specific regulatory drivers require some fundamental variances in SI programs**
- **The technological elements of the programs can be integrated**

Questions

Backup

SI Roadmap Development



Comparison of Programs

Element	Savannah River Program	Savannah River Basis/Driver	Hanford Program	Hanford Basis/Driver
Aging Mechanism				
Steel Wall	Pitting - L/A Interface	WSRC-TR-96-0076	Pitting - L/A Interface	WHC-SD-WM-ER414
Concrete	No degradation identified	WSRC-TR-96-0076	Degradation Evaluated	RPP-RPT-28968
Corrosion Mitigation				
Supernate	Sample - Quarterly to 4 years	WSRC-TR-2002-00327	Sample - 10 years	RPP-RPT-7795
Solids	Same chemistry - supernate	WSRC-TR-96-0076	Sample - 10 years	RPP-RPT-7795
Chemistry Control	See Next Sheet	See Next Sheet	See Next Sheet	See Next Sheet
Leak Tightness	Annulus Leak Detection	FFA	Annulus Leak Detection	HFFACO
Inspections				
Visual	All DST, once per year	FFA	All DSTs, 5-7 years	HFFACO
NDE - Wall Thickness	1 strip, (0.27%)	TSIP	4 strips (2.1%)	HFFACO
NDE - Vertical Welds	1 vertical strip	TSIP	4 vertical strips	HFFACO
NDE - Horizontal Welds	5% (rev 3)	TSIP	8.50%	HFFACO
NDE - Liquid/Air Interface	1 tank (5%) rev 3	TSIP	6 tanks (8.5%)	HFFACO
NDE - Knuckle	5 tanks (5%) rev 3	TSIP	6 tanks (8.5%)	HFFACO
NDE - Primary Floor	6 tanks (10' per tank) rev 3	TSIP	Discontinued	HFFACO
NDE - Secondary Wall	All tanks	TSIP	3 tanks	TSIP
NDE - Secondary Floor	All tanks	TSIP	3 tanks	TSIP
Corrosion Monitoring				
Liquid	Not Performed	WSRC-TR-96-0076	Developing Program	Expert Panel
Liquid/Air Interface	Not Performed	WSRC-TR-96-0076	Developing Program	Expert Panel
Vapor Space	Developing Program	SRNL	Developing Program	Expert Panel

•All HFFACO milestones have been met, permitting underway

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Comparison of Programs: Chemistry Control

Applicability	Parameter	SRS [Minimum Inhibitor M]		Hanford [M]
$5.5 \le [NO_3^-] \le 8.5$	$[OH^-]$	0.6		Not Allowed
	$[OH^-] + [NO_2^-]$	1.1		
2.75 (3.0 Hanford) $\le [NO_3^-] < 5.5$	$[OH^-]$	0.3		0.3 but not > 10 for Waste Temp < 100°C 0.3 but not > 4 for Waste Temp ≥ 100°C
	$[OH^-] + [NO_2^-]$	1.1		1.2
$1.0 \le [NO_3^-] \le 2.75$ (3.0 Hanford)	$[OH^-]$	$0.1*[NO_3^-]$		$0.1*[NO_3^-]$ but not >10 for Waste Temp < 100°C $0.1*[NO_3^-]$ but not >4 for Waste Temp > 100°C
	$[OH^-] + [NO_2^-]$	$0.4*[NO_3^-]$		$> 0.4*[NO_3^-]$
$[NO_3^-] < 1.0$ (Hanford) $0.02 \le [NO_3^-] < 1.0$ (SRS)	$[OH^-]$	1.0M	pH > 10.3	pH > 12 but not > 8M for Waste Temp < 75°C pH > 12 but not > 5M for Waste Temp < 100°C pH > 12 but not > 4M for Waste Temp > 100°C
		OR	AND	
	$[NO_2^-]$	n/a	1.66* $[NO_3^-]$ for Temp ≤ 40 °C plus limits based on chloride and sulfate	0.01 but not > 5.5
	$[OH^-] + [NO_2^-]$			$[NO_3^-] < 2.5 * ([OH^-] + [NO_2^-])$
$[NO_3^-] < 0.02$	$[OH^-]$	1.0M	pH > 10.3	None defined
		OR	AND	
	$[NO_2^-]$	n/a	0.033 Temp ≤ 40 °C plus limits based on chloride and sulfate	

Workshop Presentations

- **Overview of Sites**

Introductory Remarks • DOE-SR • DOE-ORP • WSRC-Liquid Waste • CH2M HILL - Operations	M. Mikolanis C. K. Liu R. Salizzoni R. Tucker
Opening Remarks - Environmental Management	S. Krahn
Savannah River Site Tank History and Integrity Assessment	B. Wiersma
Hanford Tank History and Integrity Assessment	K. Boomer

- **Structural Analysis**

Seismic and Thermal Operating Load Analyses at Hanford	M. Rinker
Seismic Analysis at the Savannah River Site	N. Kennedy
Structural Analysis at the Savannah River Site – Residual Stresses	P-S. Lam
Structural Analysis at the Savannah River Site – Fracture Mechanics	Y. J. Chao

Workshop Presentations

- **Corrosion**

Corrosion Work at the Savannah River Site – Pitting Studies	P. Zapp E. Hoffman
Corrosion Work at the Savannah River Site – Stress Corrosion Cracking	B. Wiersma
Vapor Space Corrosion Investigations at the Savannah River Site	K. Subramanian
Hanford Corrosion Testing at CC Technologies, Inc.	C. Scott

- **Inspection and Monitoring**

Recent Advancements in Ultrasonic Testing at the Savannah River Site	J. Elder
Latest Hanford Corrosion Probe and Preliminary Data	V. Anda