





DEPARTMENT OF ENERGY

Office of River Protection

HANFORD SITE

Double-Shell Tank Integrity Project

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Date

Overview of Double-Shell Tank (DST) Integrity Project

- Brief Update of AY-102
- Double-Shell Tank Integrity Project
  - Objectives
  - Inspections
  - Chemistry Control
- FY 2012 Work Scope

AY-102

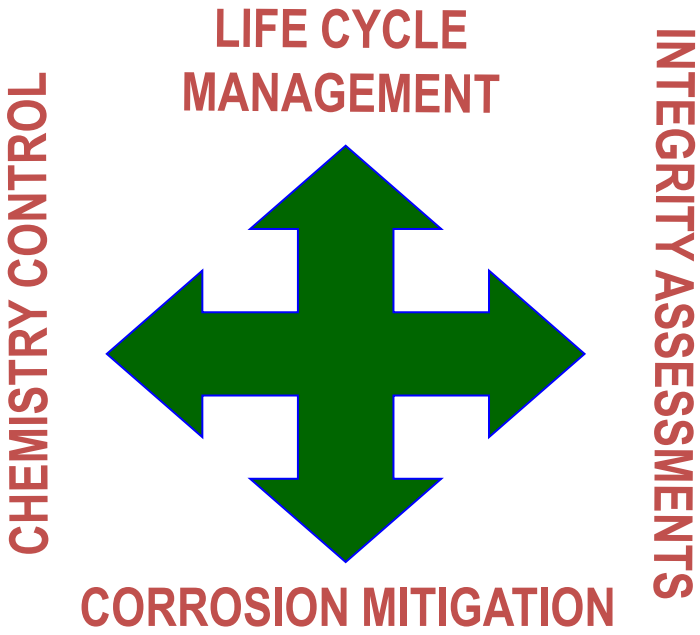
- Sampling progress
- Schedule for completing leak assessment

Double-Shell Tank Integrity Project – Objectives

- 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 to support Waste Treatment Plant (WTP) operation
  - Provide sufficient assurance of tank integrity to allow for repair or replacement
  - Prevent the need for replacement tanks (up to $100 M per tank)
- Monitor/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 requirements

Double-Shell Tank Integrity Project (DSTIP)

- Regulatory Certification of DST System
- Expert Panel Recommendations
- Structural Analysis using Finite Element Analysis



•Chemical Additions
•Tank Chemistry Sampling
•Corrosion Testing
•Corrosion Probe Data Collection and Analysis

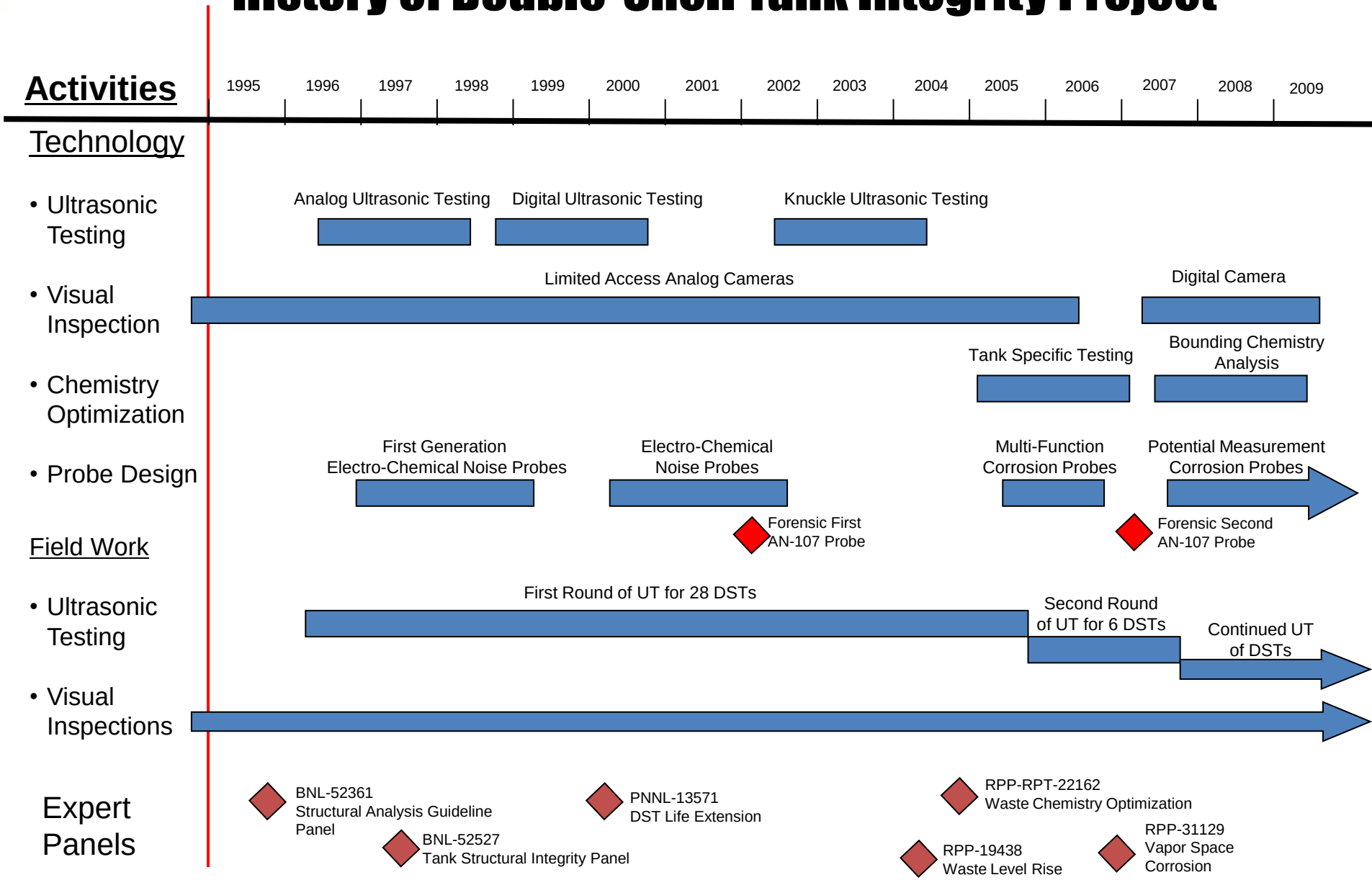
•DST UT/Visual
•DST System Videos

•Operating Specifications for Chemistry Control
•Annulus Ventilation System Operation
•Corrosion Probe Development
•Laboratory Testing

Status of Double-Shell Tank Integrity Project

- Completed Ultrasonic Testing (UT) and Visual Inspection Baseline of Double-Shell Tanks (DSTs)
- Completing UT examination of tanks for a second time
- Assessed DSTs structural integrity using modern finite element structural analysis to provide an new Analysis of Record (RPP-RPT-28968), which evaluated the DST through 2028 for the bounding tank and 2046 for AP Farm Tanks
- Independent Qualified Registered Professional Engineer has certified the DST systems as fit for use until 2016 (RPP-28538)
- Developed and implemented new technologies for examining tanks and monitoring corrosion
- Improved waste chemistry requirements using laboratory waste chemistry corrosion testing to minimize the need for sodium hydroxide additions
- Extensive use of international expertise through expert panels, academia, and corporate involvement

History of Double-Shell Tank Integrity Project

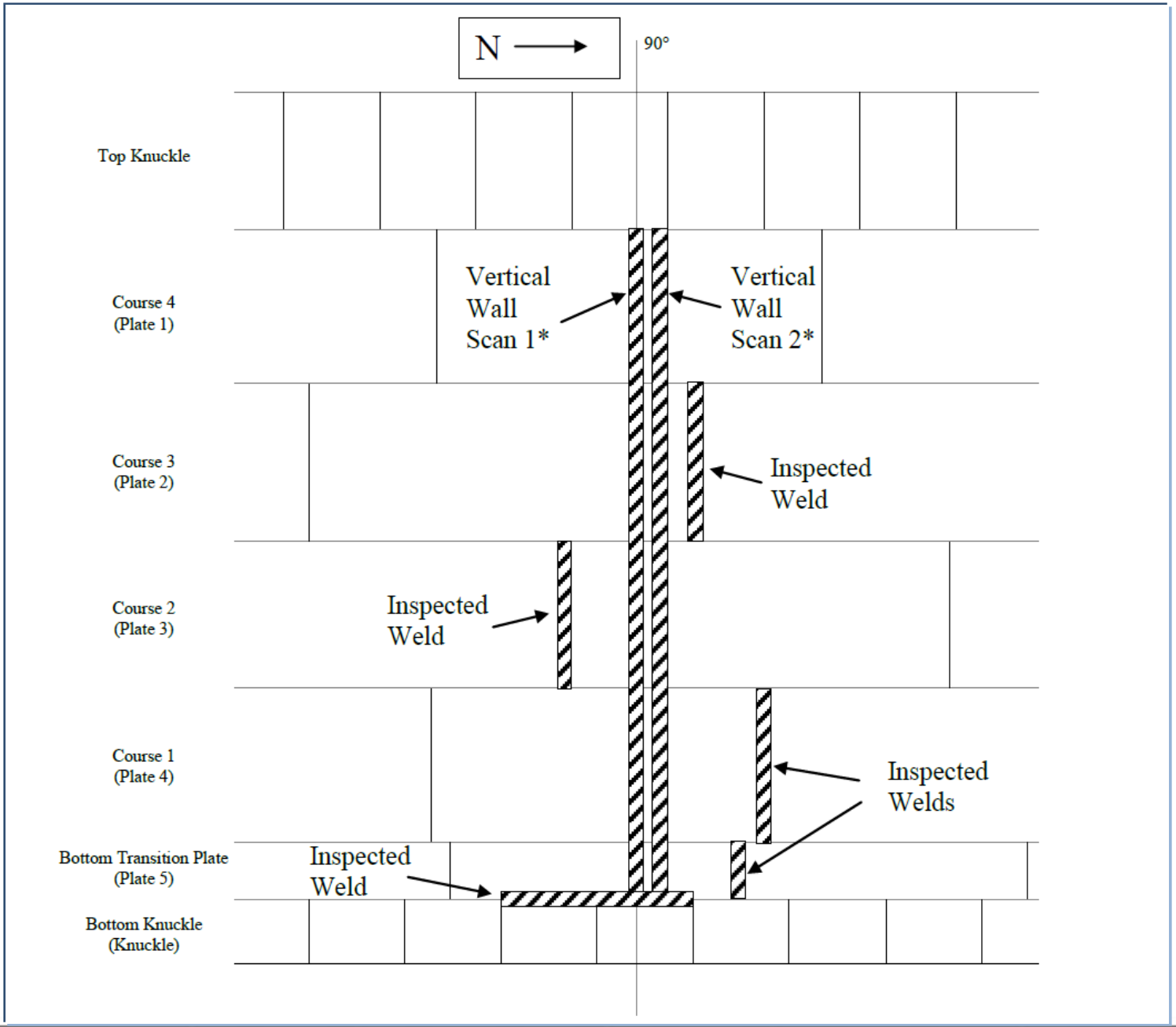


Double-Shell Tank Ultrasonic Testing

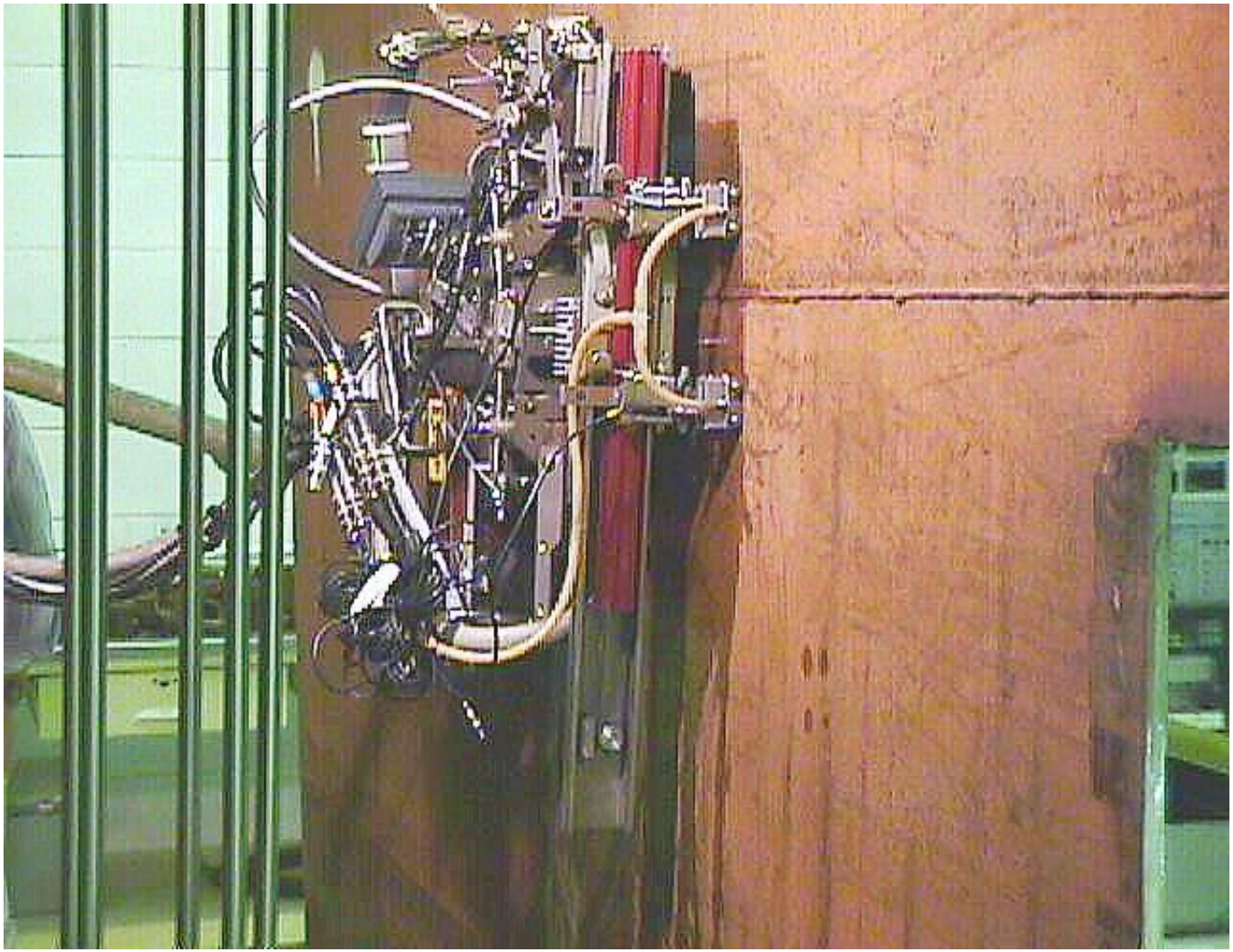
- Developed guidelines based on:
  - BNL 52527 *Guidelines for Development of Structural Integrity Programs for DOE High-Level Waste Storage Tanks Seismic*
  - Tri-Party Agreement Milestone 48-14, which was completed in 2006
- Additional scans conducted if indications of pitting or cracking detected
- Conducting second round of testing with 8 to 10 years between inspections

Location	Scan	Length	Comment
Side Wall	Two scans in two risers	Four fifteen-inch 40 feet in length	Based extreme value statistics to bound loss based area measured
Liquid Air Interface	One P scan in one riser	Twenty feet in length	At areas where the LAI was constant for five years or more or indication of pitting. Performed on six tanks, found on one. If LAI is found/suspected, scan would be performed
Vertical Weld	P scan in one riser	At least twenty feet in length	
Horizontal Weld	P scan in one riser	Twenty feet in length	
Lower Knuckle	Tandem Synthetic Aperture Focusing Technique (TSAFT)	Twenty feet in length	Required for six tanks

Typical UT Scanning Paths



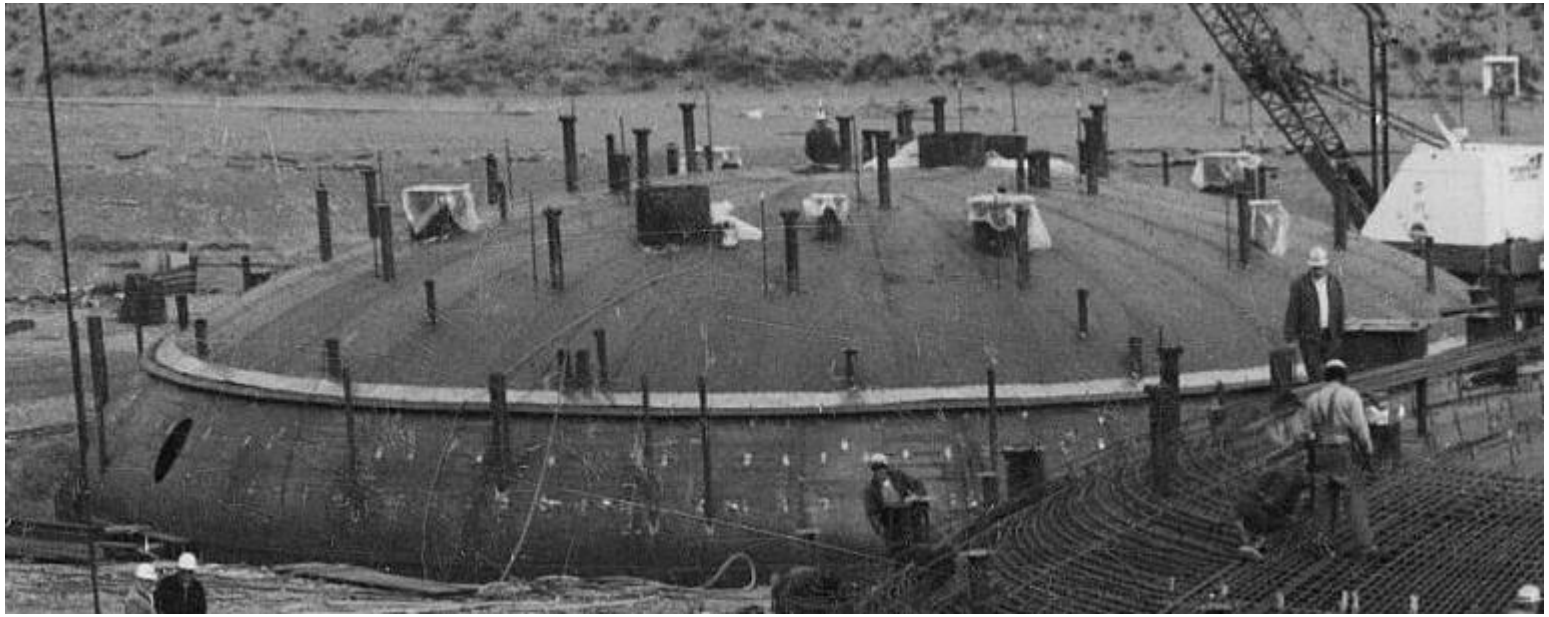
Ultrasonic Equipment and Crawler



Visual Examinations

- Annulus between primary tank and secondary liner
  - Integrity
    - Conducted on a five to seven year interval
    - Examine entire height of annulus in four risers with one riser located in each quadrant of the tank
    - Riser selection will consider re-examine previously examined area of interest
  - Operating Specifications Document for water intrusion
    - Conducted in one tank in each farm every two years
    - Examine convergence of primary tank and secondary liner in four risers
- Primary integrity only
  - Conducted on a five to seven year interval
  - Interior of the primary tank above the waste examined as part of the visual examination in one riser located in the primary tank
  - Riser selection will consider re-examination of previous examined areas of interest

Water Intrusion Inspection



Interface between primary tank and secondary liner inspected because this interface wasn't welded. The secondary liner rides on top of the primary tank and the interface is covered with lead flashing, which was tack welded into place.

Visual Inspection

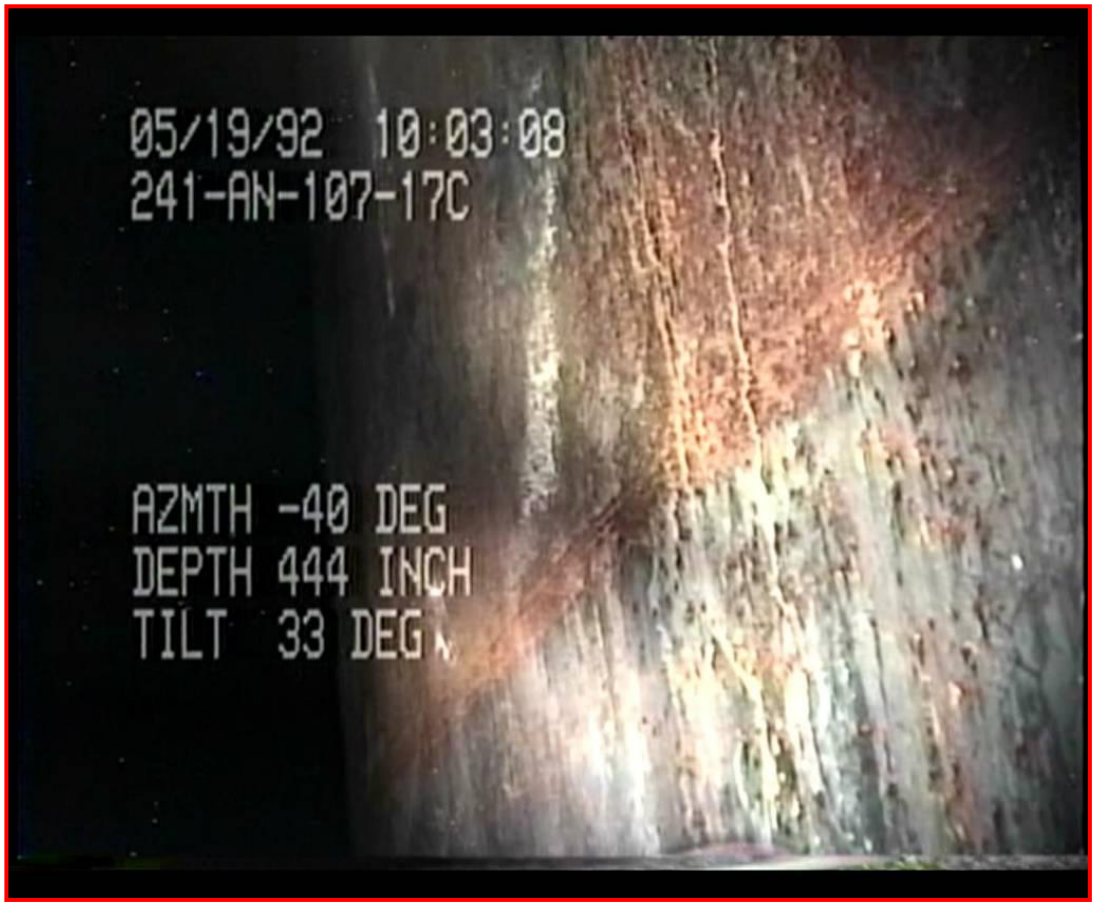


Photo Identification	AN-107-03
Date of Inspection	May 19, 1992
Date of Review	FY 2006
Location	Exterior of primary tanks shell, along Course 3 and 2, joining the bottom edge of the primary shell plate F7301M2 number 5A and primary shell plate F7301M2 number 5B viewed through Riser 46.
Description	DVDID# 10258 Corrosion along circumferential weld joining Course 2 and 3. Noticeable corrosion product directly above weld continues to Course 1. Possible surface condensation on the outside of primary shell has accelerated corrosion in this area.

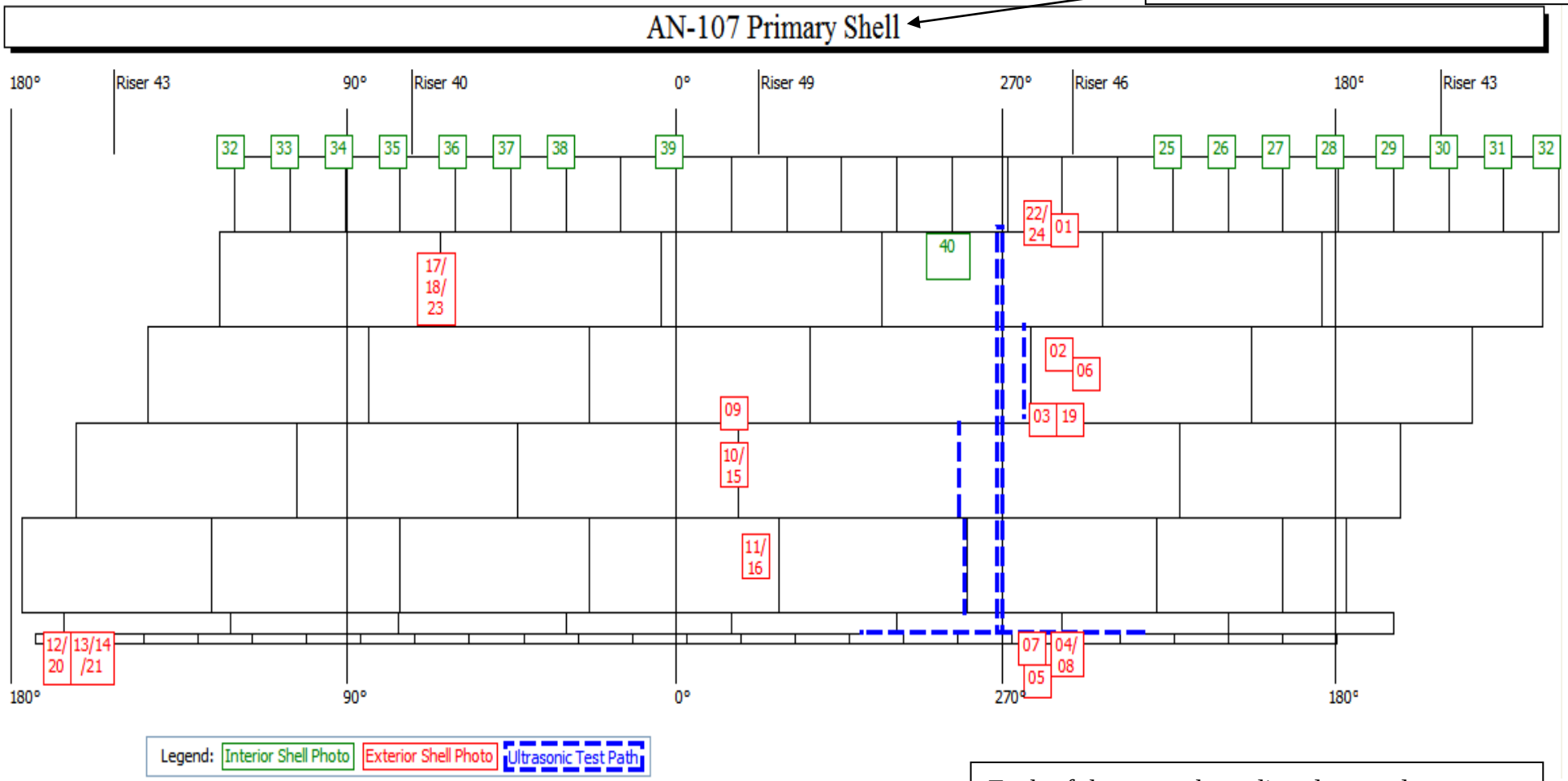
Shipping Mark	Heat Number	Ingot and Cut	Nominal Thickness
F7301M2	3G5922	0400C	0.500
F7301M2	3G5922	0600C	0.500

Tank Integrity Inspection Guides

- Developed to improve the mapping of areas of interest within the tanks
- Improved stakeholders confidence in the quality of inspections
- Each farm has a dedicated documented that is updated as new inspections are performed

Tank Integrity Inspection Guide

This label annotates which tank and containment wall is being displayed.



The legend explains the color code for Ultrasonic Testing scan paths, and which colors represent an image from the interior side of the primary tank wall, or the exterior side of the primary wall as seen in the annulus.

Each of these numbers directly correlates to an image in the Tank Inspection Integrity Guide. For instance, number 03, shows the relative location of Photo ID# AN-107-03.

Chemistry Control

- Control the chemistry within the DSTs OSD-T-151-00007
- Optimizing chemistry to protect the DSTs
  - Maintain established pH and nitrite ranges
  - Implement refined pH and nitrite ranges as they are proven
  - Determined carbonate ranges for protective environments
  - Define requirements for corrosion probe surveillance
- Optimization
  - Reduces treatment costs of unnecessary sodium hydroxide additions
  - Enhance use of tank space by eliminating chemical additions

Inspections -- 2012

- Four tanks visually inspected
  - 241-AP-105
  - 241-AP-108
  - 241-AW-101
  - 241-AY-102
- Three tanks UT inspected
  - Tank 241-AP-105
  - Tank 241-AZ-102
  - Tank 241-SY-101

Corrosion Probe -- 2012

- Corrosion coupon strings were removed from Tank 241-AY-101 and 241-AN-102
- Design of new corrosion 241-AW-105
  - Retractable corrosion probe design
  - Design completed

Corrosion Testing 2012

- Three tanks were tested in the 222-S Laboratory
  - 241-AN-106
    - Account for chemical and temperature changes during retrieval operations from tanks 241-C-107 and 241-C-105
    - Tested at DNV last year
  - 241-AN-101
    - Account for chemical and temperature changes during retrieval operations from tanks 241-C-112 and 241-C-104
    - Showed no propensity for corrosion below a temperature of 40 °C to a pH of 10.4
  - 241-AN-102
    - Account for caustic depletion from waste
    - Tested at DNV to provide basis for specification change

Caustic Additions in 2012

- Caustic was added to Tank 241-AN-106
  - Amend caustic depletion caused by retrieval of solids from 241-C-107
  - Sixteen thousand gallons of 19 M sodium hydroxide
- Scheduled to add caustic to 241-AN-102
  - Adjust tank composition because hydroxide concentration below 0.3 M
  - Required when nitrate concentration > 3.0 M
  - Planning to add 20,000 gallons of 19 M sodium hydroxide
- Scheduled to sample and adjust 241-AN-101

Backup Slides

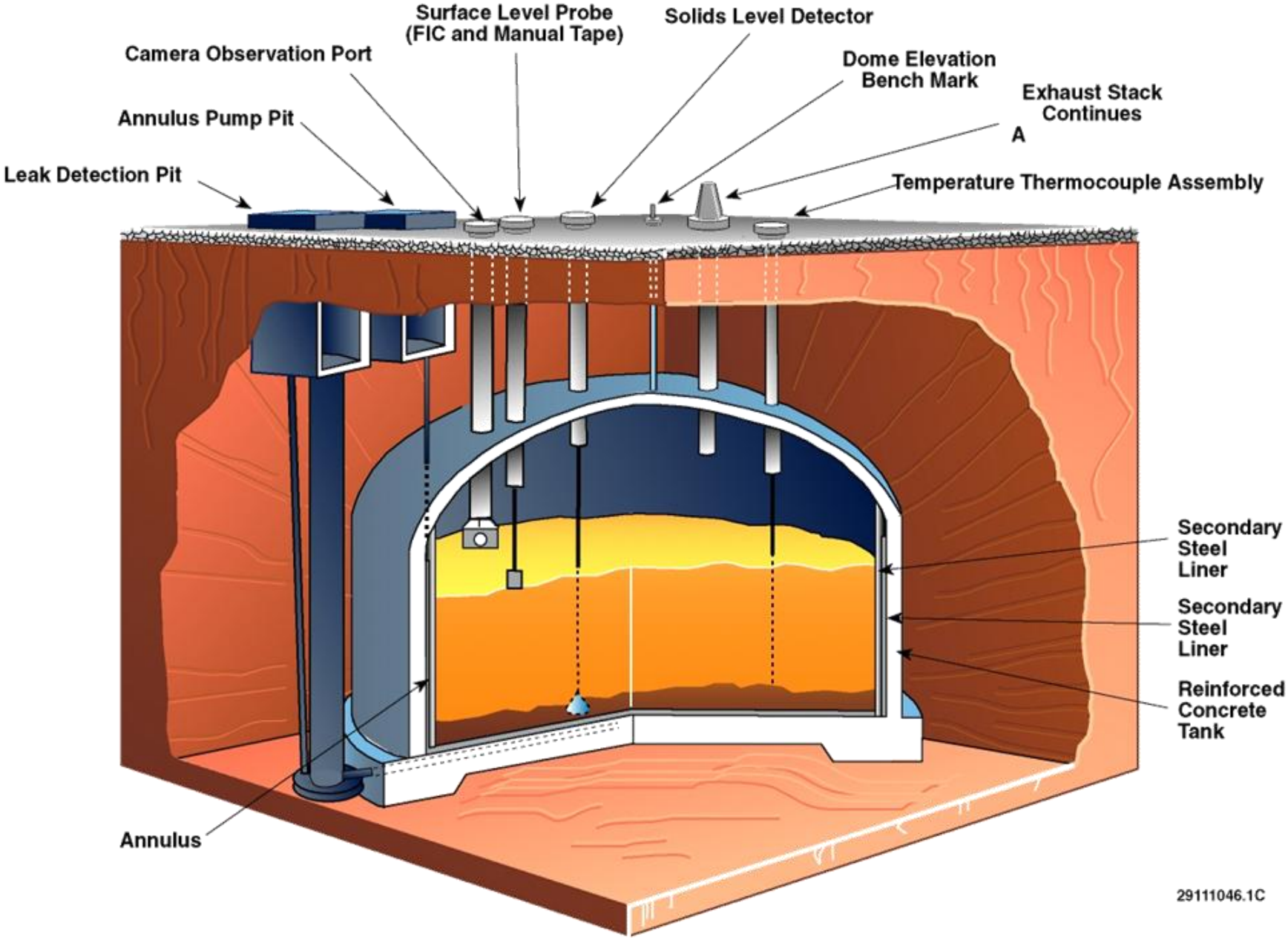
Hanford Double-Shell Tanks

- Twenty-eight tanks
- Located in six tank farms
  - Five are located in 200 East Area 241-AY, AZ, AW, AN, and AP
  - 241-SY is located in 200 West Area
- Constructed between 1968 and 1986

Double-Shell Tank Farms

Tank Farm	241-AY	241-AZ	241-SY	241-AW	241-AN	241-AP
Constructed	1968-70	1971-74	1974-76	1977-80	1978-81	1983-86
Number of Tanks	2	2	3	6	7	8
Design Life (years)	25	20	50	50	50	50
Initial Service	mid-1971	late-1976	1977	mid-1980	1981	1986
Years in Service as of 2012	41	36	35	32	31	26
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
Maximum Specific Gravity	1.77	1.77	1.77	1.77	1.77	1.84

Double-Shell Tank Design and Construction



Construction 241-AP Tank Farm in 1984

March

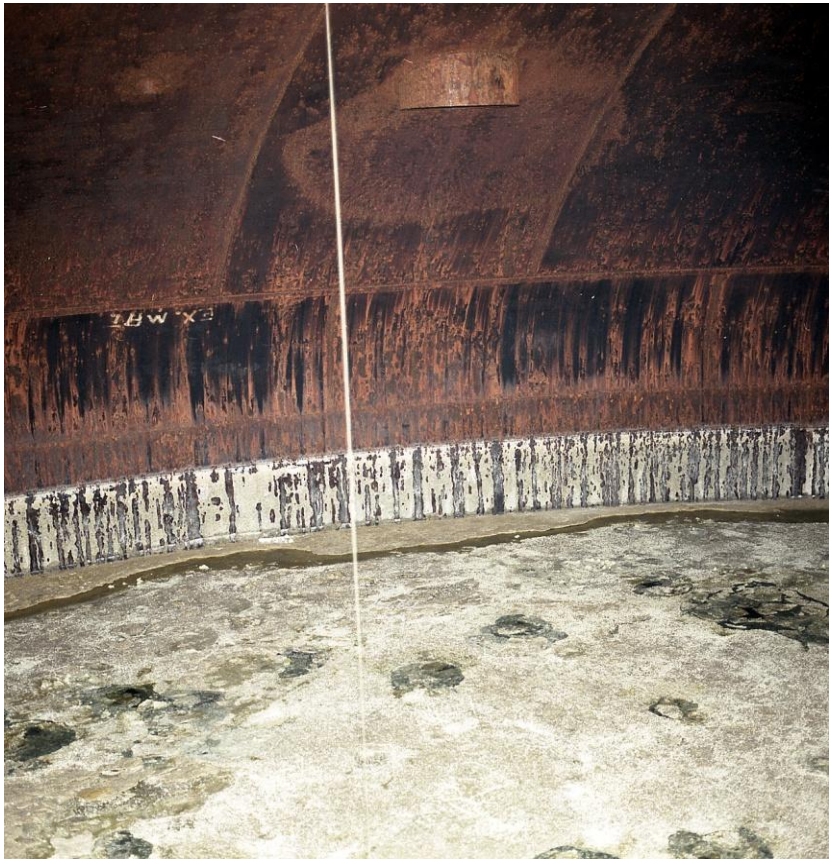
June

September

December

Operational 241-AP Tank Farm

Primary and Annulus Photographs



In-Tank Photograph Tank 241-AN-107

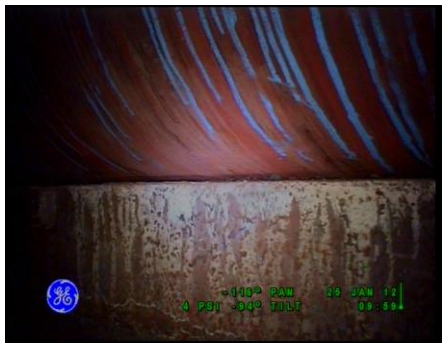
Tank 241-AY-101 Annulus

DST Waste Chemistry Limits*

FOR $[NO_3^-]$ RANGE	VARIABLE	FOR WASTE TEMPERATURE (T) RANGE		
		T < 167°F	**167°F ≤ T ≤ 212°F**	**T > 212°F**
$[NO_3^-] \leq 1.0M$	$[OH^-]$	$0.010M \leq [OH^-] \leq 8.0M$	$0.010M \leq [OH^-] \leq 5.0M$	$0.010M \leq [OH^-] \leq 4.0M$
	$[NO_2^-]$	$0.011M \leq [NO_2^-] \leq 5.5M$	$0.011M \leq [NO_2^-] \leq 5.5M$	$0.011M \leq [NO_2^-] \leq 5.5M$
	$[NO_3^-] / ([OH^-] + [NO_2^-])$	< 2.5	< 2.5	< 2.5
$1.0M < [NO_3^-] \leq 3.0M$	$[OH^-]$	$0.1 ([NO_3^-]) \leq [OH^-] < 10M$	$0.1 ([NO_3^-]) \leq [OH^-] < 10M$	$0.1 ([NO_3^-]) \leq [OH^-] < 4.0M$
	$[OH^-] + [NO_2^-]$	$\geq 0.4 ([NO_3^-])$	$\geq 0.4 ([NO_3^-])$	$\geq 0.4 ([NO_3^-])$
$[NO_3^-] > 3.0M$	$[OH^-]$	$0.3M \leq [OH^-] < 10M$	$0.3M \leq [OH^-] < 10M$	$0.3M \leq [OH^-] < 4.0M$
	$[OH^-] + [NO_2^-]$	$\geq 1.2M$	$\geq 1.2M$	$\geq 1.2M$
	$[NO_3^-]$	$\leq 5.5M$	$\leq 5.5M$	$\leq 5.5M$

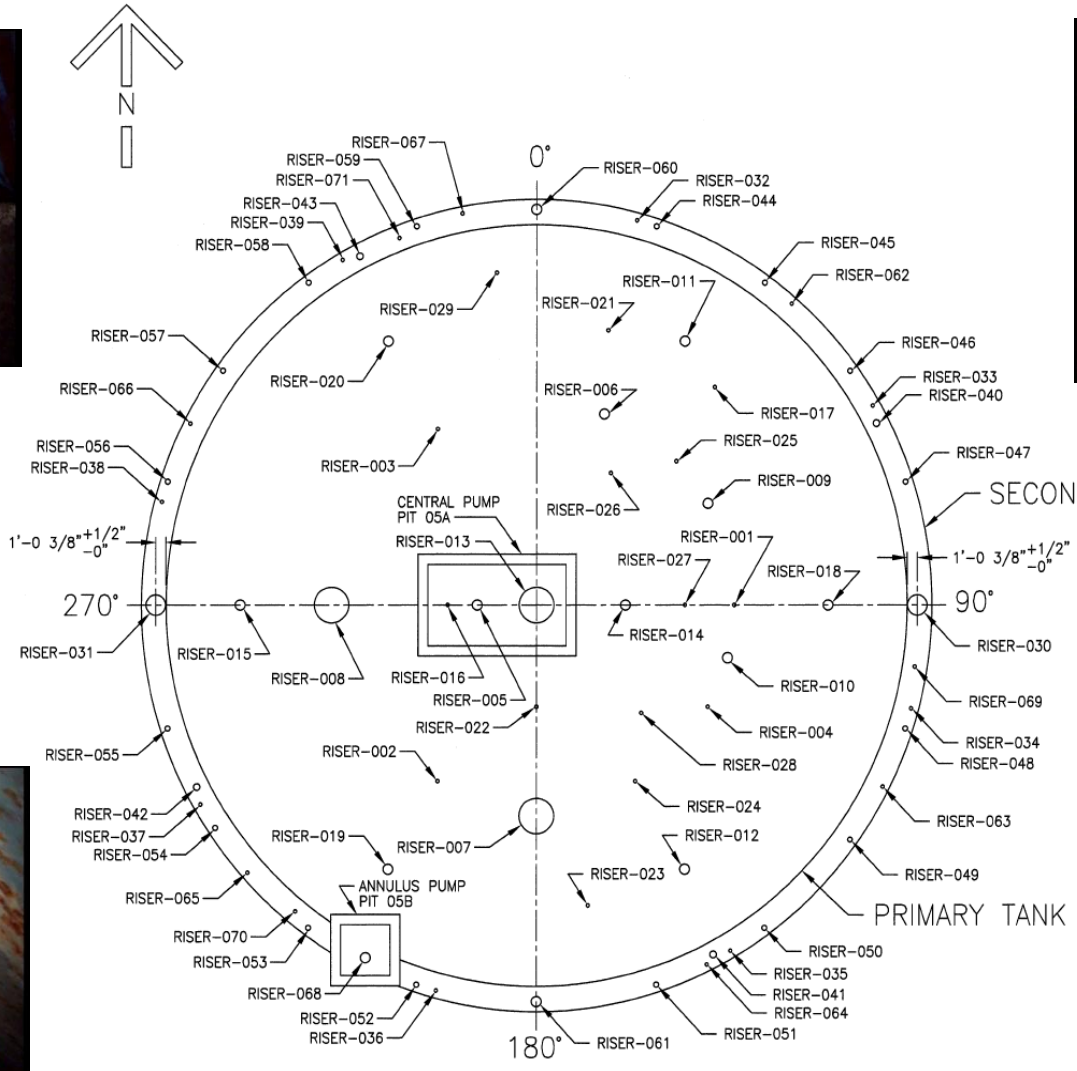
* Except for 241-AN-102 and 241-AN-107 Interstitial Liquid

Tank 241-AP-105. April 2012



Riser 57

Riser 46



PLAN VIEW TANK 241-AP-105

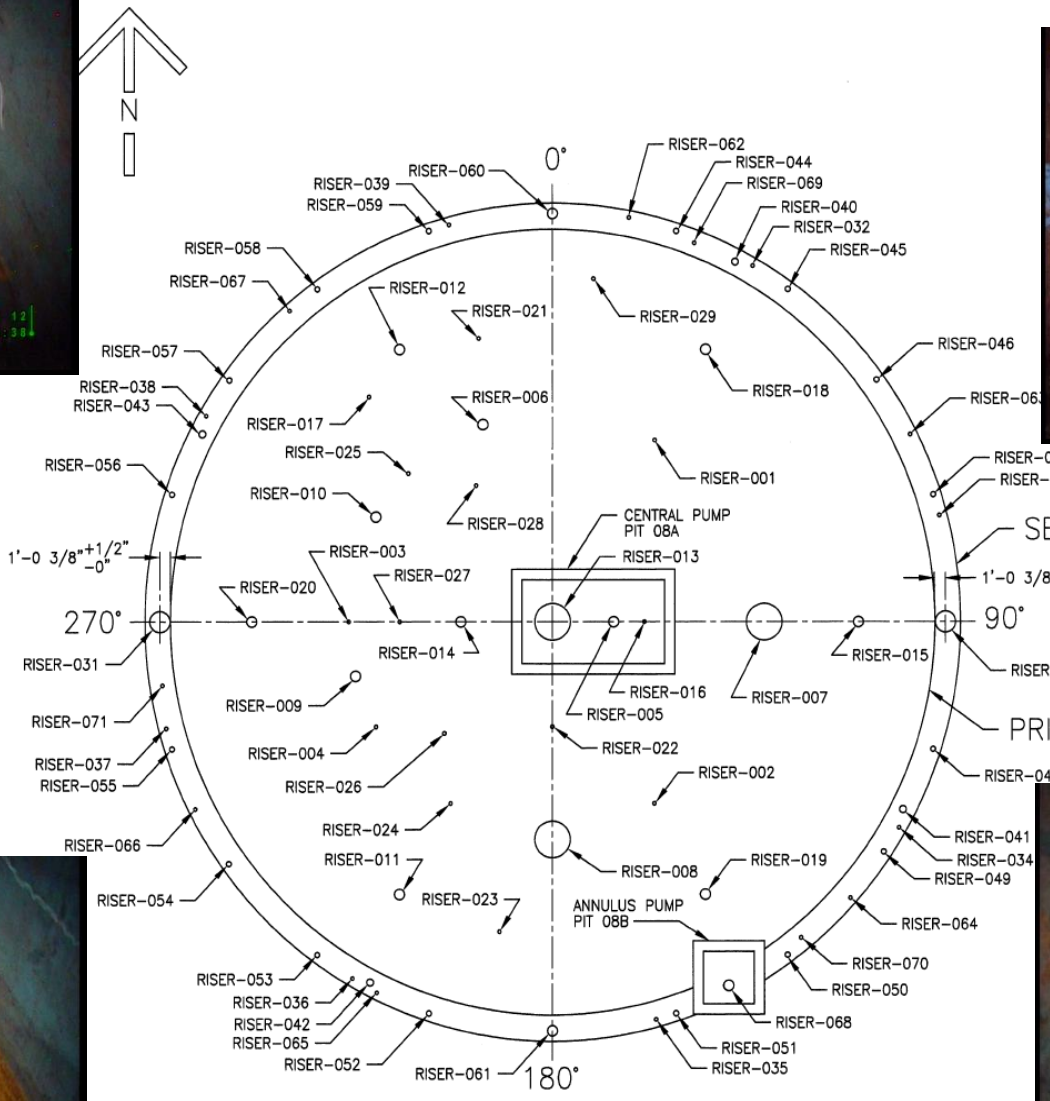
Riser 54

Riser 49

Tank 241-AP-108, May 2012

Riser 57

Riser 46



PLAN VIEW TANK 241-AP-108

Riser 54

Riser 49

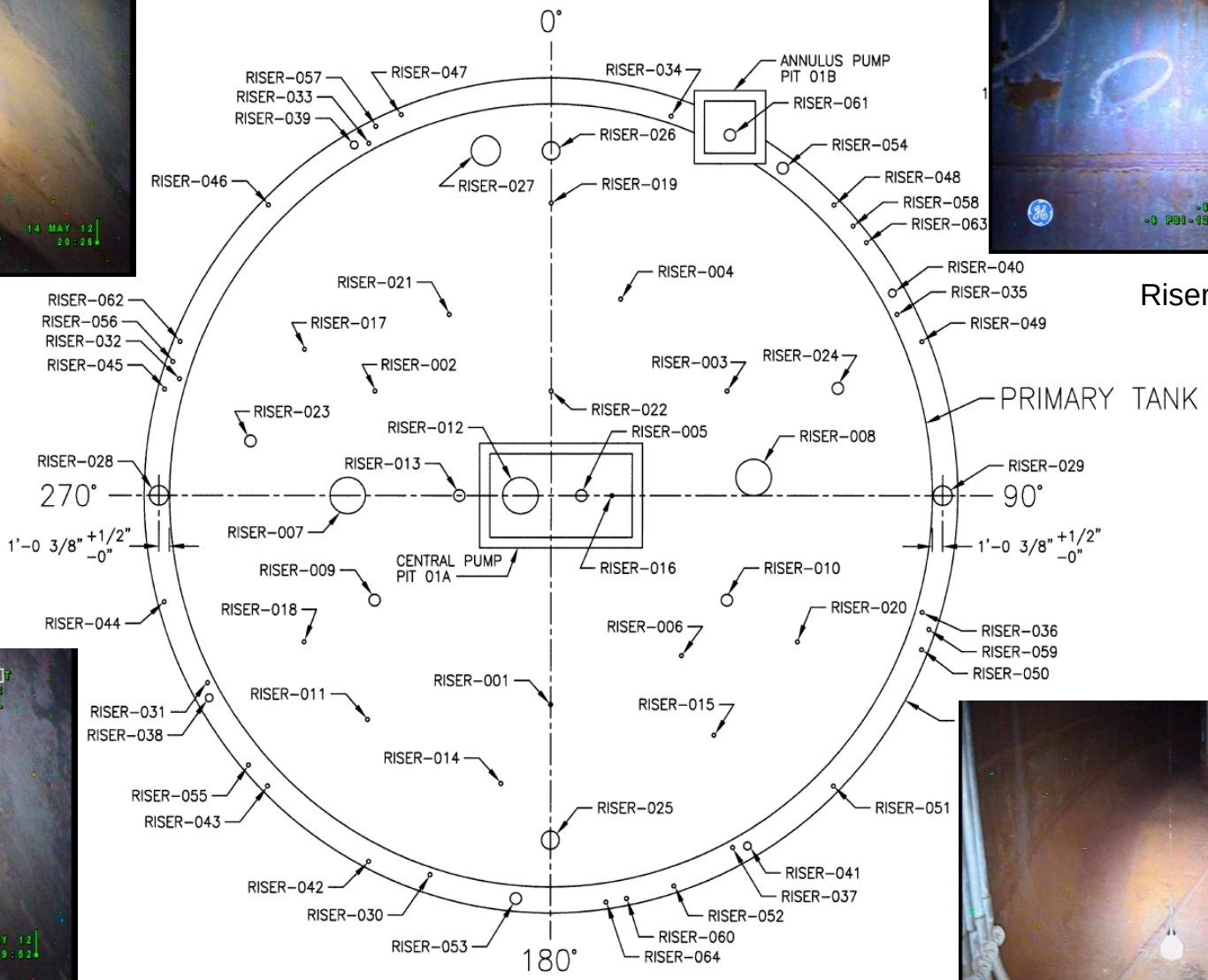
Tank 241-AW-101

Riser 45

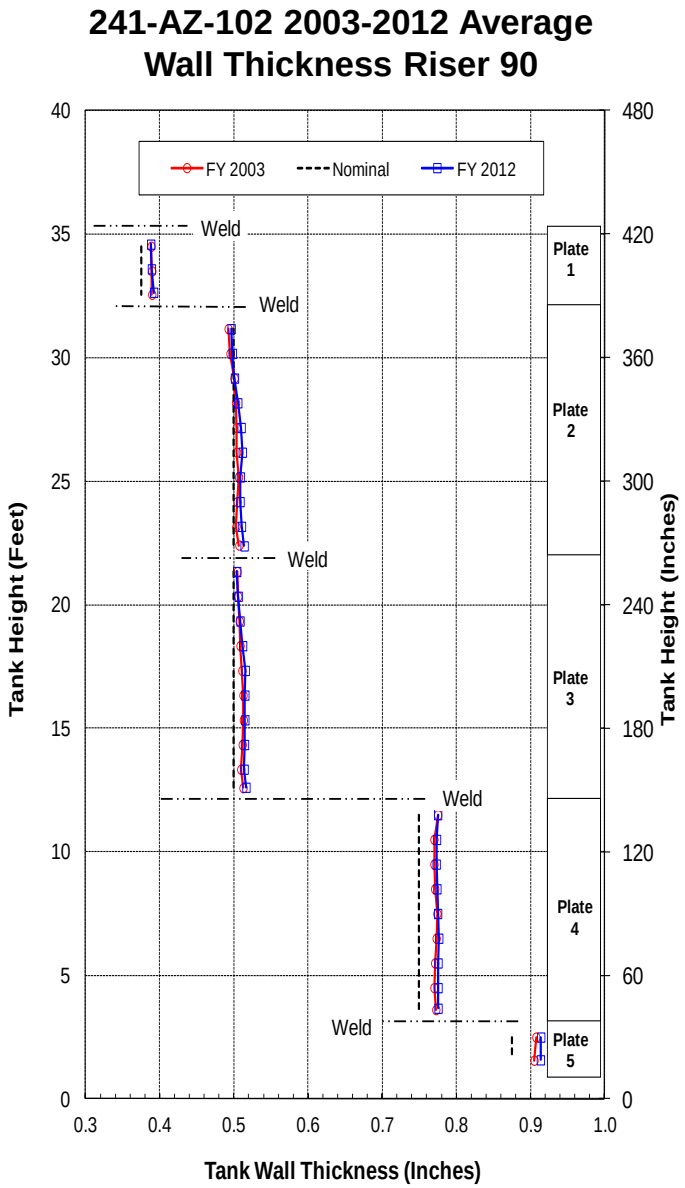
Riser 48

Riser 42

Riser 51



Tank 241-AZ-102, December 2011



RPP-RPT-51020, *Ultrasonic Inspection Results for Double-Shell Tank 241-AZ-102 – FY2012*

Ultrasonic testing was performed in:

- Riser 90 which was also examined in 2003
- Riser 89 which hasn't been examined before

Walls

- Three areas of reportable wall thinning
  - Total area < 10 square inches
  - Thinnest area 0.413 inches
  - Plate 2 in Riser 90
- No reportable pitting or linear indications

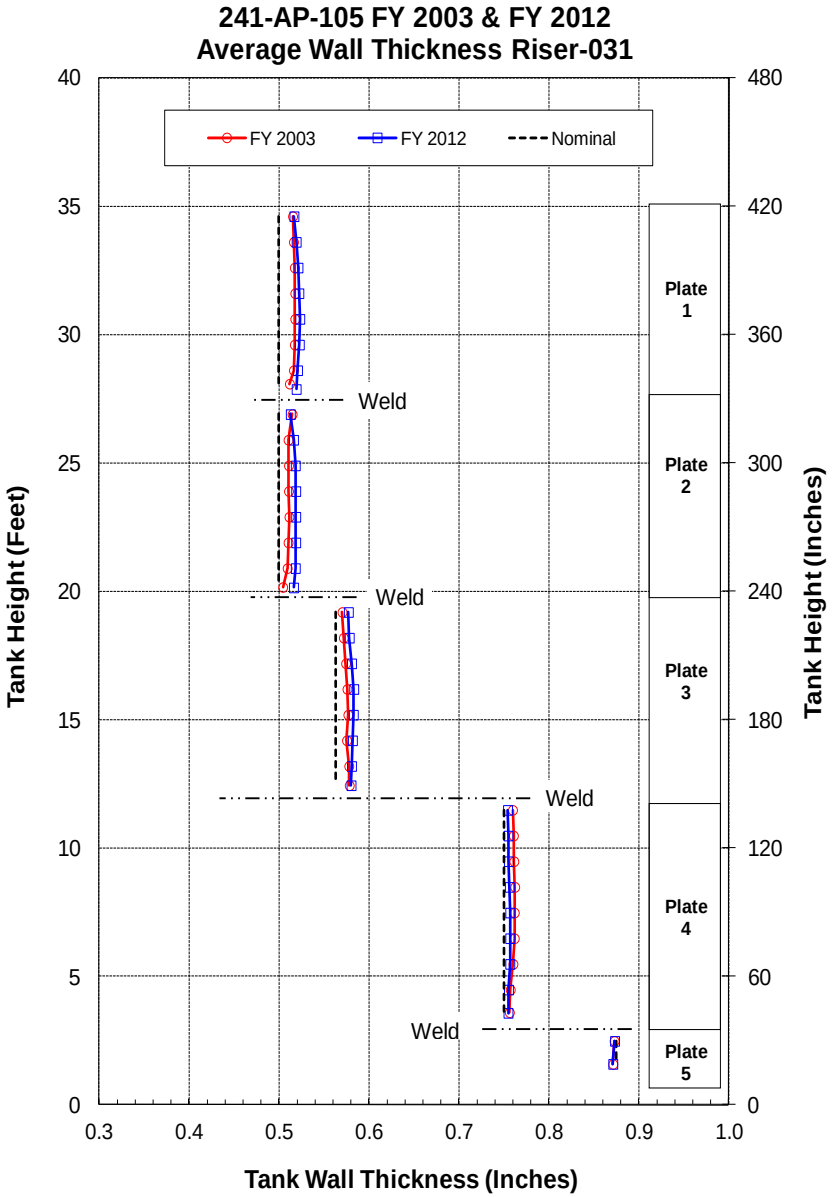
Lower Knuckle

- No reportable wall thinning
- No reportable pitting
- No linear indications

Heat affected zones

- No reportable wall thinning
- No reportable pitting
- No linear indications

241-AP-105, February 2012



RPP-RPT-51735, *Ultrasonic Inspection Results for Double-Shell Tank 241-AP-105 – FY2012*

Ultrasonic testing was performed in:

- Riser 31 which was also examined in 2003
- Riser 30 which hasn't examined before

Walls

- No reportable wall thinning
- One pit > 10 percent
- No reportable linear indications

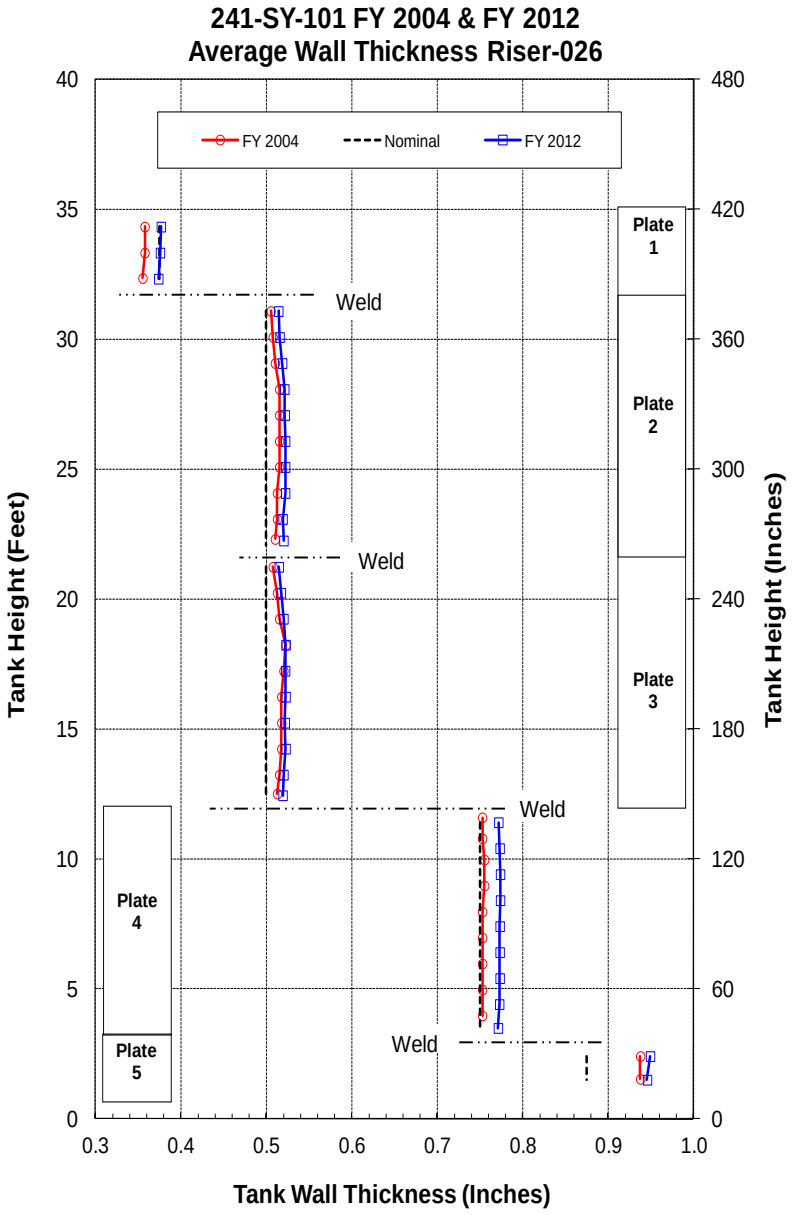
Liquid Air Interface

- No reportable wall thinning
- No reportable pitting
- No linear indications

Heat affected zones

- No reportable wall thinning
- No reportable pitting
- No linear indications

241-SY-101, May 2012



RPP-RPT-52572, *Ultrasonic Inspection Results for Double-Shell Tank 241-SY-101 – FY2012*

Ultrasonic testing was performed in:

- Riser 26 which was also examined in 2004
- Riser 27 which hasn't been examined before

Walls

- Two areas of reportable wall thinning
- Two pits > 10%
- No reportable linear indications

Liquid Air Interface

- Six areas of reportable wall thinning
- Six pits > 10%
- No reportable linear indications

Lower Knuckle

- No reportable wall thinning
- No reportable pitting
- No linear indications

Heat affected zones

- No reportable wall thinning
- No reportable pitting
- No linear indications88