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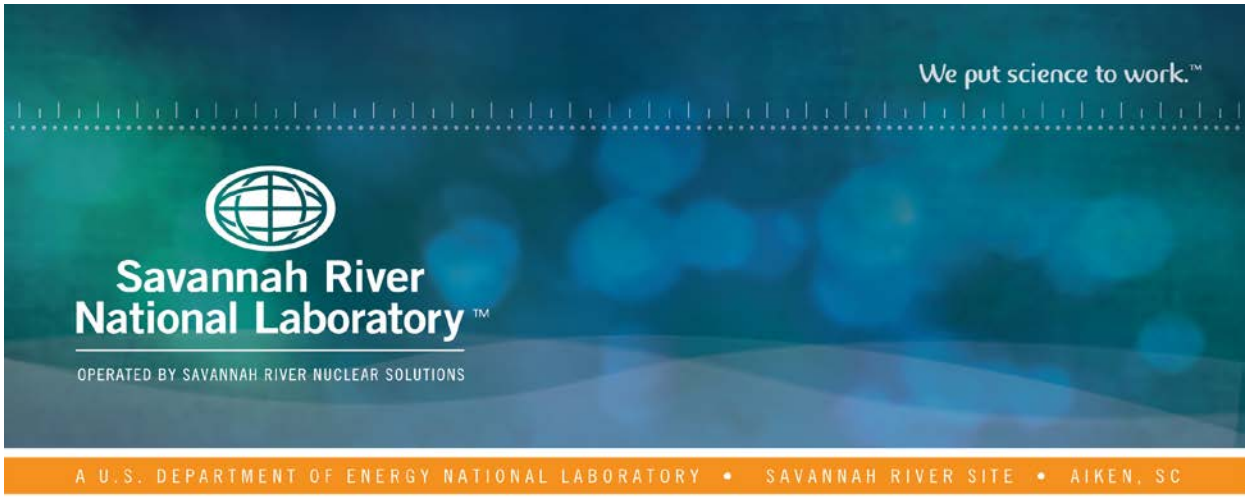

Tank Inspection NDE Results for Fiscal Year 2019, Waste Tanks 25, 26, 33, 34, 41 & 50

James B. Elder III and Rodney W. Vande Kamp

October 28, 2019

SRNL-STI-2019-00519

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Prepared for
U.S. Department of Energy

Keywords: *Waste Tank, Inspection*

Retention: *Permanent*

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EXECUTIVE SUMMARY

Ultrasonic nondestructive examinations (NDE) were performed on waste storage tanks 25, 26, 33, 34, 41 and 50 at the Savannah River Site as a part of the "In-Service Inspection (ISI) Program for High Level Waste Tanks." No service induced reportable conditions were identified during the inspection. The results indicate that the implemented Corrosion Control Program continues to effectively mitigate corrosion in the SRS waste tanks.

Ultrasonic inspection (UT) is used to detect general wall thinning, pitting and interface attack, as well as vertically oriented cracks through inspection of an 8.5 inch wide strip extending over the accessible height of the primary tank wall and accessible knuckle regions. Welds and sections of the secondary walls and floor were also examined in four tanks.

In a Type III/IIIA primary tank, a complete vertical strip includes scans of five plates (including knuckles) such that five "plate/strips" would be completed at each vertical strip location. In FY 2019, a combined total of 103 plate/strips were examined using thickness mapping, equating to over 60,000 square inches of area inspected on the primary tank wall. All but eight of the 103 plate/strips examined in FY 2019 have average thicknesses that remain at or above the construction minimum thickness which is nominal thickness minus 0.010 inches. Although, there were no service induced reportable thicknesses or cracking encountered, there were several fabrication artifacts encountered that were below the 10% wall loss criteria.

Thickness mapping on the secondary wall and secondary floor have been part of the ISI program, but this year a special emphasis was continued to evaluate the thickness and condition of the secondary floor where it intersects the secondary leak detection slots. Sections of the secondary floor were examined in 25, 26, 33 and 34. Tank 41 was inspected due to the chemistry control provision in the ISI plan. The inspections on Tank 41 included two full height vertical strips for thinning, pitting and cracking. One strip was a repeat inspection for thickness trending and one was randomly selected as prescribed in the ISI plan. A section of the secondary wall in Tank 50 was examined to evaluate the wall thickness in an area of interest noted in the visual examination. The wall thickness was still above the construction minimum thickness in the areas inspected.

Inspection results were presented to the In-service Inspection Review Committee (ISIRC) where it was determined that the inspections contained sufficient usable data and had been performed in accordance with the In-Service Inspection Program and the scan plans. The committee agreed that no further data gathering was required. The committee also concurred that the results did not exceed the acceptance criteria defined in the In-Service Inspection Program (C-ESR-G-00006).

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1 Introduction

In-service inspection is an essential element of a comprehensive structural integrity program for the carbon steel waste tanks at the Savannah River Site. Inspection confirms the effectiveness of corrosion controls used to preclude localized and general corrosion of the tanks. Ultrasonic inspection (UT) is used to detect general wall thinning, pitting and interface attack, as well as vertically oriented cracks through inspection of an 8.5inch wide strip extending over the accessible height of the primary tank wall and knuckle regions. Selected welds are also inspected for cracking parallel or perpendicular to the weld. The inspections were performed from the annular space of the Type III/IIIA waste storage tanks. The ISI Program calls for thickness mapping and crack detection scans on specified areas of the tank covering all present and historic waste interface levels and selected welds with particular emphasis on the highest stress region of the tank.

In FY2019 ultrasonic (UT) nondestructive examinations (NDE) were performed on waste storage tanks 25, 26, 33, 34, 41 and 50 at the Savannah River Site as a part of the "In-Service Inspection (ISI) Program for High Level Waste Tanks." [1] Tanks 25, 26, 33 and 34 received the full extent of the ISI inspection. The ISI program also requires any tank that had a chemistry outside the chemistry control limits for longer than 90 days be inspected within a year. Tank 41 was outside the chemistry control limits during the latter part of 2018 and received the prescribed UT inspection. The Tank 50 inspection involved an area of secondary wall as a follow-up to visual inspections. With the completion of the FY17 schedule, all of the Type III/IIIA tanks have been inspected at least twice. The FY 19 scope completes the second year of the 3rd. cycle of inspections. No service induced, reportable conditions were identified during these inspections. The results indicate that the implemented Corrosion Control Program continues to effectively mitigate corrosion in the SRS waste tanks.

2 NDE Inspection Requirements

Results of the previous round of ultrasonic inspections utilizing continuous P-scan techniques on the tanks inspected this year are documented in the following report:

- Tank 33 is in – WSRC-TR-2006-00002 [2]
- Tanks 25, 26, 34 and 41 are in – SRNL-STI-2011-00495 [3]
- Tank 41 Previous special examination is in – SRNL-STI-2016-00454 [4]
- Tank 50 is in – SRNL-STI-2012-00749 [5]

For type III/IIIA waste tanks, the current revision of the ISI Program (C-ESR-G-00006, Rev. 4) includes a randomly selected vertical strip in each quadrant of the primary tank to further address the issue of circumferential uniformity and statistical evaluation of the program. Up to four random strips, in separate quadrants are examined in each tank. In addition to the random strips a baseline strip is completed to compare against results from the previous inspection.

The ISI Program calls for the following regions of Type III/IIIA tanks to be inspected:

- Liquid vapor interfaces for thinning, pitting and cracking
- Liquid sludge interfaces for thinning, pitting and cracking
- Upper weld of lower knuckle of primary tank (5% of accessible circumference) for cracking
- Lower knuckle base material for cracking (in select tanks – one this year)
- External surface of primary tank (includes vapor space) for thinning, pitting and cracking
- Random vertical strips for thinning and pitting
- Air channel/bottom plate of the tank for thinning and pitting (would require further development)
- Vertical weld for cracking
- Secondary tank for thinning and pitting
- High stress areas of primary tank for cracking

A tank specific scan plan describing the inspections required this year was issued for each tank. These inspection details are listed in Section 4.5.

3 NDE TECHNIQUES

NDE inspections included remote automated ultrasonic (AUT) inspection utilizing longitudinal waves for thickness mapping and pit detection and 45° shear waves for crack detection.

4 NDE DATA COLLECTION AND ANALYSIS

4.1 Tank Design and Service History

All Type III/IIIA tanks are double shell tanks with an annular space and were fabricated to ASME BPVC Section VIII from carbon steel as detailed in Table 1. After all fabrication work was completed, the primary tank was stress relieved. Access to the annular space and the exterior surface of the primary tank is through 8 inch diameter, vertical, carbon steel risers that are four feet six inches long. Figure 1 provides a side view of a typical Type III/IIIA tank while Figure 2 shows the riser layout for Tank 26.

Face maps providing the tank layout, plate heights and riser location for each tank inspected this year are available later in this section.

Figure 1: Side View of a Typical Type III/IIIA Tank

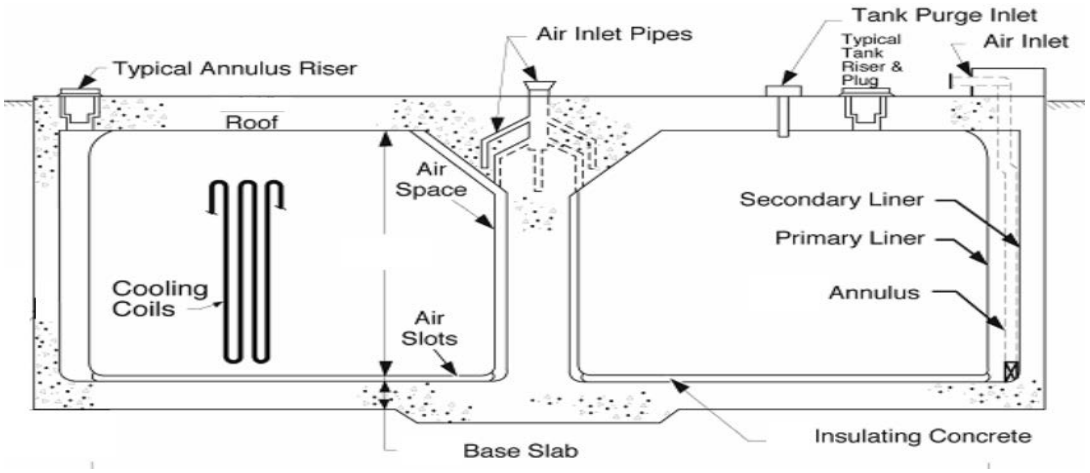


Figure 2: Typical Type III/IIIA Waste Tank Riser Layout – Tank 26

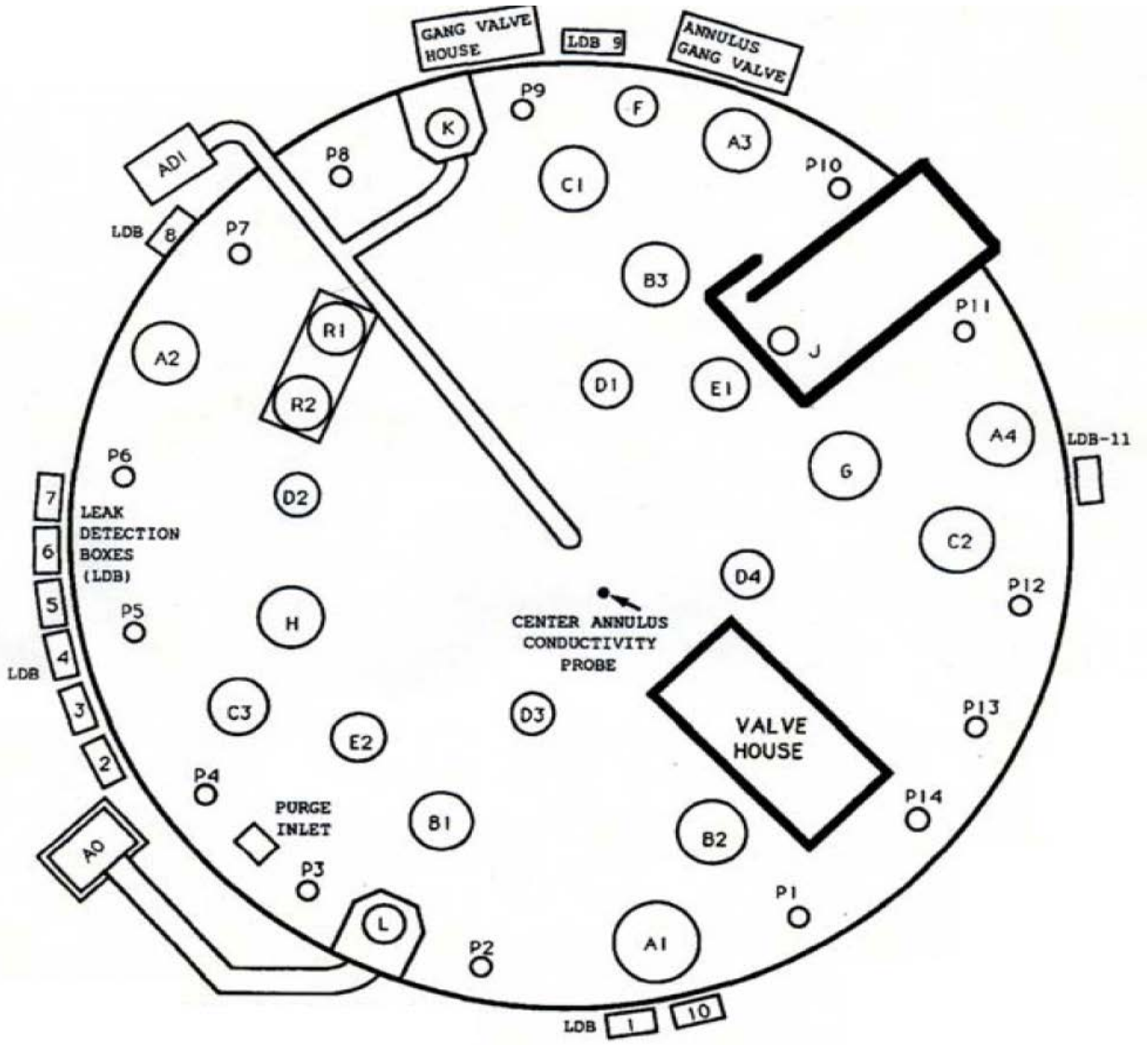


Table 1 Tank Fabrication, Service and Inspection Summary

Tank #	Tank 25	Tank 26	Tank 33	Tank 34	Tank 41	Tank 50
Tank Farm	F-Area/FTF	F-Area/FTF	F-Area/FTF	F-Area/FTF	H-Area/HTF	H-Area/HTF
Entered Radioactive Service	1980 (39 years of service at time of inspection)	1980 (39 years of service at time of inspection)	1969 (50 years of service at time of inspection)	1972 (47 years of service at time of inspection)	1982 (37 years of service at time of inspection)	1983 (36 years of service at time of inspection)
Top Knuckle Design Thickness	0.500”	0.500”	0.500”	0.500”	0.500”	0.500”
Top Plate Design Thickness	0.500”	0.500”	0.500”	0.500”	0.500”	0.500”
Middle Plate Design Thickness	0.625”	0.625”	0.625”	0.625”	0.625”	0.625”
Lower Plate Design Thickness	0.875”	0.875”	0.750”	0.750”	0.875”	0.875”
Bottom Knuckle Design Thickness	0.875”	0.875”	0.875”	0.875”	0.875”	0.875”
Secondary Tank Wall and Floor Design Thickness	0.375”	0.375”	0.375”	0.375”	0.375”	0.375”
Inspections Performed in FY19	* Standard ISI	* Standard ISI and extended knuckle exam on bottom knuckle	* Standard ISI	* Standard ISI	Special – 1 repeat strip and one random strip	1 Vertical on Secondary Wall
Scan Plan	SRR-LWE-2018-00133	SRR-LWE-2019-00034	SRR-LWE-2019-00042	SRR-LWE-2019-00068	SRR-LWE-2018-00099	SRR-LWE-2018-00119
Job Number	F20190141	F20190142	F20190143	F20190144	H20190014	H20190041

* Standard ISI = 1 repeat strip (thinning, pitting and cracking), up to 4 random strips for thinning and pitting, welds in highest stress areas, secondary walls and floor.

4.2 Personnel

Nondestructive examination data was collected and analyzed by certified NDE personnel from the SRNL Material Science and Engineering. Data collection was performed by James B. Elder, an American Society for Nondestructive Testing, ASNT Level III UT & VT and Rodney W. Vande Kamp, Level II UT & VT. All data analysis was performed by J. B. Elder and reviewed by R. W. Vande Kamp.

4.3 Data and Record Storage

NDE data and calibration sheets, P-scan data files are stored by the SRNL Materials Evaluation group under the following job numbers. ISIRC reports for each tank are listed below:

- Tank 25 - NDE Job numbers F20190141 and ISIRC Report # SRR-LWE-2018- 00133
- Tank 26 - NDE Job numbers F20190142 and ISIRC Report # SRR-LWE-2019- 00034
- Tank 33 - NDE Job numbers F20190143 and ISIRC Report # SRR-LWE-2019- 00042
- Tank 34 - NDE Job numbers F20190144 and ISIRC Report # SRR-LWE-2019- 00068
- Tank 41 - NDE Job numbers H20190014 and ISIRC Report # SRR-LWE-2018- 00099
- Tank 50 - NDE Job numbers H20190041 and ISIRC Report # SRR-LWE-2018- 00119

4.4 Field Conditions

Inspections were performed from the annular space of the waste tanks. The wall crawler and cameras were installed in the annulus and operated from the NDE control trailer (see Figure 3) which was up to 100 feet from the riser. Access to the annulus was through 8 inch diameter inspection ports or risers (see Figure 4). A remote pan & tilt camera was also inserted into the annulus to monitor crawler movement. In the Type III/IIIA tanks, the annuli are radiologically clean and therefore contamination control huts were not required.

Figure 3: NDE Control Trailer and Generator

Figure 4: Typical Inspection Port / P-Riser

4.5 Scan Plans and Inspection Areas

A tank specific scan plan describing prescribed inspections was issued for each tank. A summary of the inspections performed is listed below. Any deviation from the initially prescribed inspections or locations due to field conditions were documented in a revision to the scan plan after the inspections.

4.5.1 Tank 25 Examinations

Scan Plan SRR-LWE-2018-00133 [6]:
The following inspections were performed in accordance with the scan plan:

One 8.5-inch wide vertical strip beneath P12. The vertical strip along the accessible height of the tank wall to detect thinning, pitting and stress corrosion cracking. The UT resolution was comparable to previous inspections (approximately 50 mil pixel size).

A two square foot area on plates 1, 2, 3 and 4 of the secondary liner was scanned for thinning and pitting beneath the P12 riser.

A 10-inch wide strip on the annulus floor between the refractory pad and ventilation duct was inspected for thinning and pitting beneath the P12 riser.

A 10-inch wide strip on the annulus floor between the refractory pad and ventilation duct was inspected for thinning and pitting beneath the P7 riser above the leak detection slot.

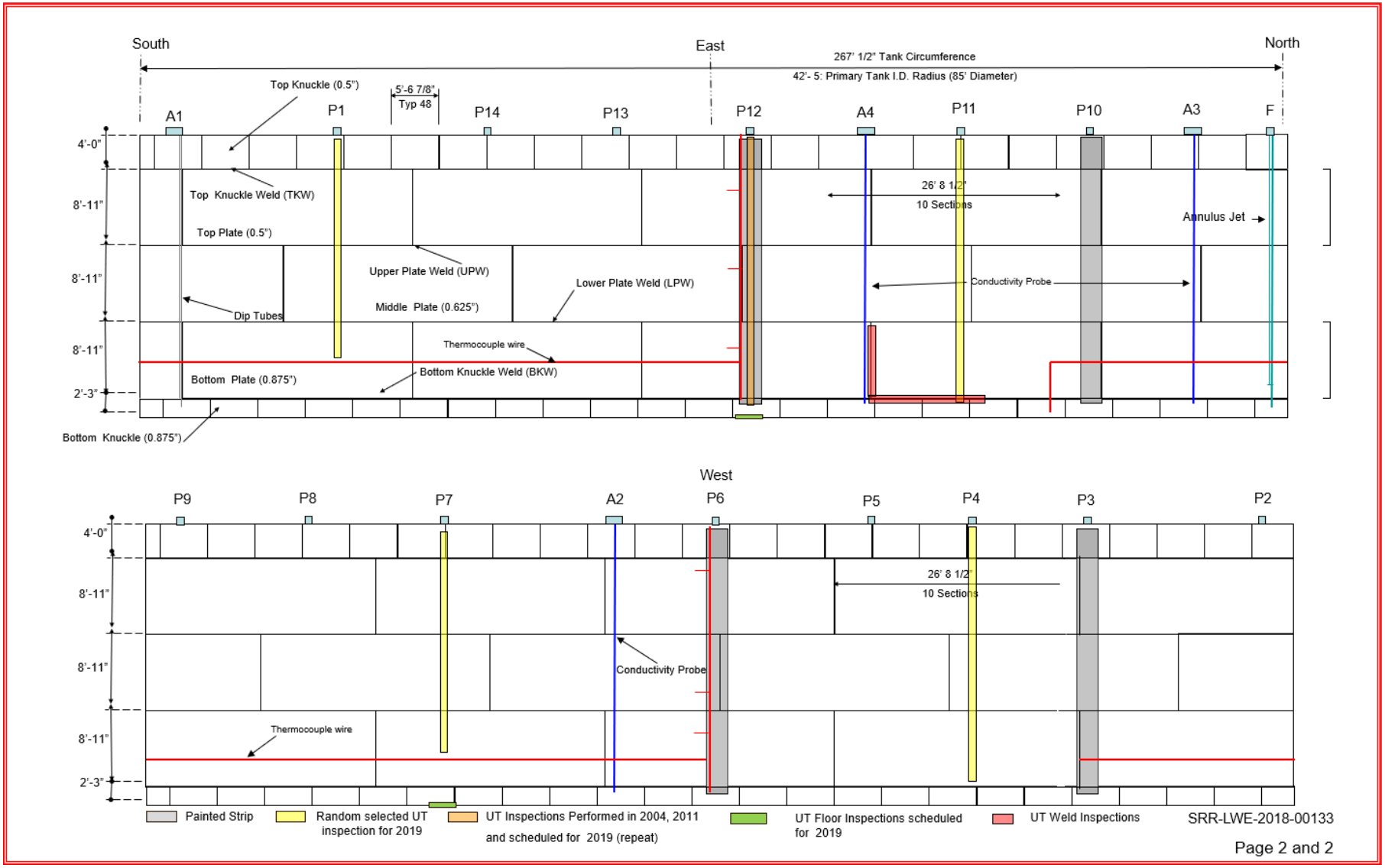
A vertical weld on the lower plate as well as 5% (over 13 feet) of the bottom girth weld were scanned for cracking beneath the P11 riser.

Four 8.5-inch wide vertical strips were inspected at randomly selected areas, one in each quadrant of the tank. These inspections had a UT pixel size of 100 mils. The vertical strips were along the accessible height of the tank to detect and measure thinning and pitting. The following areas were randomly selected:

a. QI – P4
b. QII – P7
c. QIII – P11
d. QIV – P1

Figure 5 shows a face map for illustration purposes. The face map indicates the approximate locations for the scans.

Figure 5: Scan Locations Tank 25



4.5.2 Tank 26 Examinations

Scan Plan SRR-LWE-2019-00034 [7]:
The following inspections were performed in accordance with the scan plan:

One 8.5 inch wide vertical strip beneath P5. The vertical strip along the accessible height of the tank to detect and measure thinning, pitting and stress corrosion cracking. UT resolution was comparable to previous inspections (approximately 50 mil pixel size).

A two square foot area on plates 1, 2, 3 and 4 of the secondary liner was scanned for thinning and pitting beneath the P5 riser.

A vertical weld on the lower plate and 5% (over 13 feet) of the bottom girth weld was scanned for cracking beneath the P5 riser.

A 10 inch wide strip on the annulus floor between the refractory pad and ventilation duct was inspected for thinning and pitting beneath the P5 riser

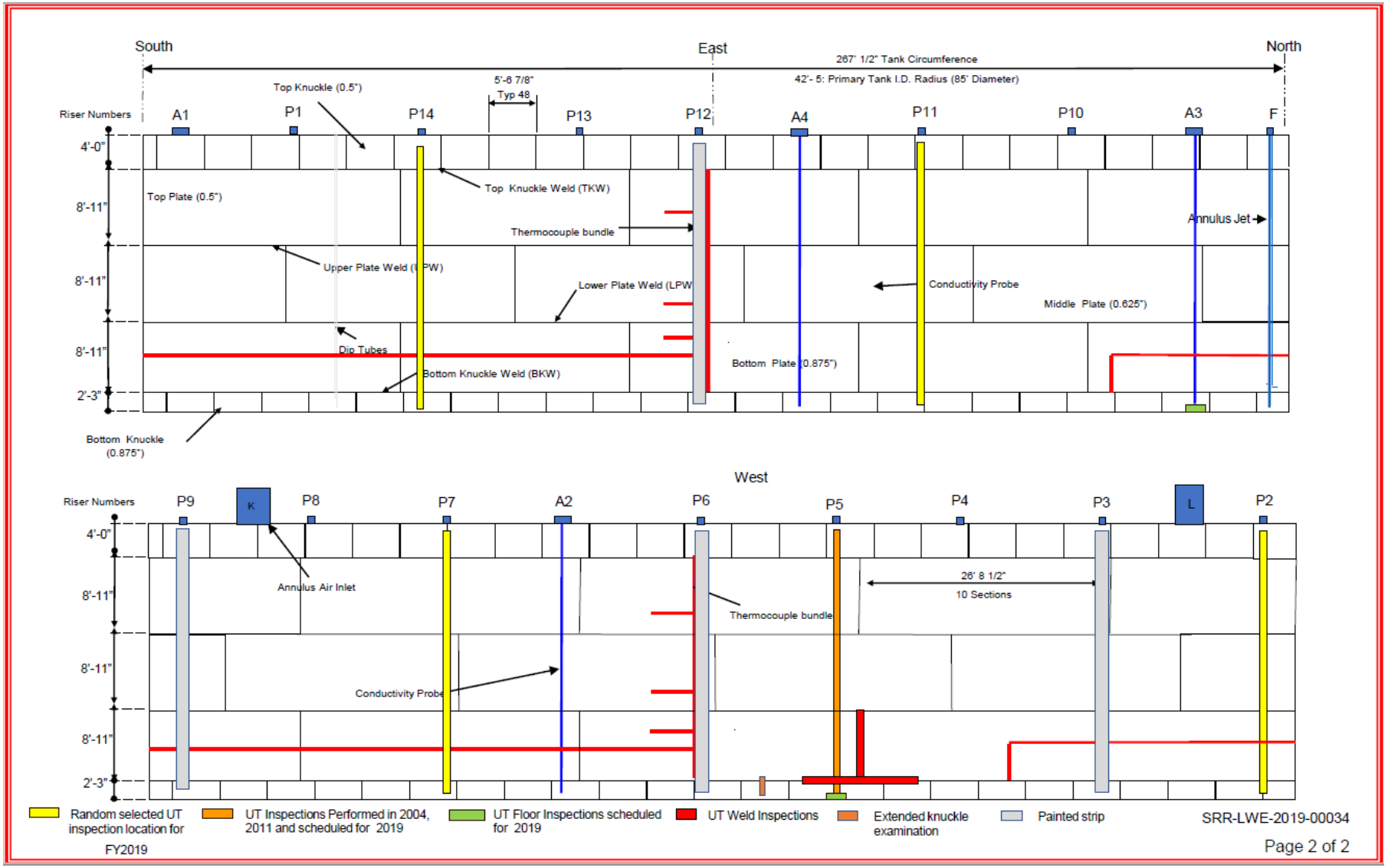
A 10 inch wide strip on the annulus floor between the refractory pad and ventilation duct was inspected for thinning and pitting beneath the A3 riser above the leak detection slot.

Four 8.5 inch wide vertical strips were inspected at randomly selected areas, one in each quadrant of the tank. These inspections had a UT pixel size of 100 mils. The vertical strips were along the accessible height of the tank to detect and measure thinning and pitting. The following areas were randomly selected:

a. QI – P2
b. QII- P7
c. QIII – P11
d. QIV – P14

Figure 6 shows a face map for illustration purposes. The face map indicates the approximate locations for the scans.

Figure 6: Scan Locations Tank 26



4.5.3 Tank 33 Examinations

Scan Plan SRR-LWE-2019-00042 [8]:
The following inspections were performed in accordance with the scan plan:

One 8.5 inch wide vertical strip beneath P10, (area under P11 was used to complete scan as in 2005 and 2014). The vertical strip along the accessible height of the tank to detect and measure thinning, pitting and stress corrosion cracking. UT resolution was comparable to previous inspections (approximately 50 mil pixel size).

A two square foot area on plates 1, 2, 3 and 4 of the secondary liner was scanned for thinning and pitting beneath the P12 riser.

A vertical weld (located ~ 2' clockwise from P9) on the lower plate and 5% (over 13 feet) of the bottom girth weld was scanned for cracking beneath the P9 riser.

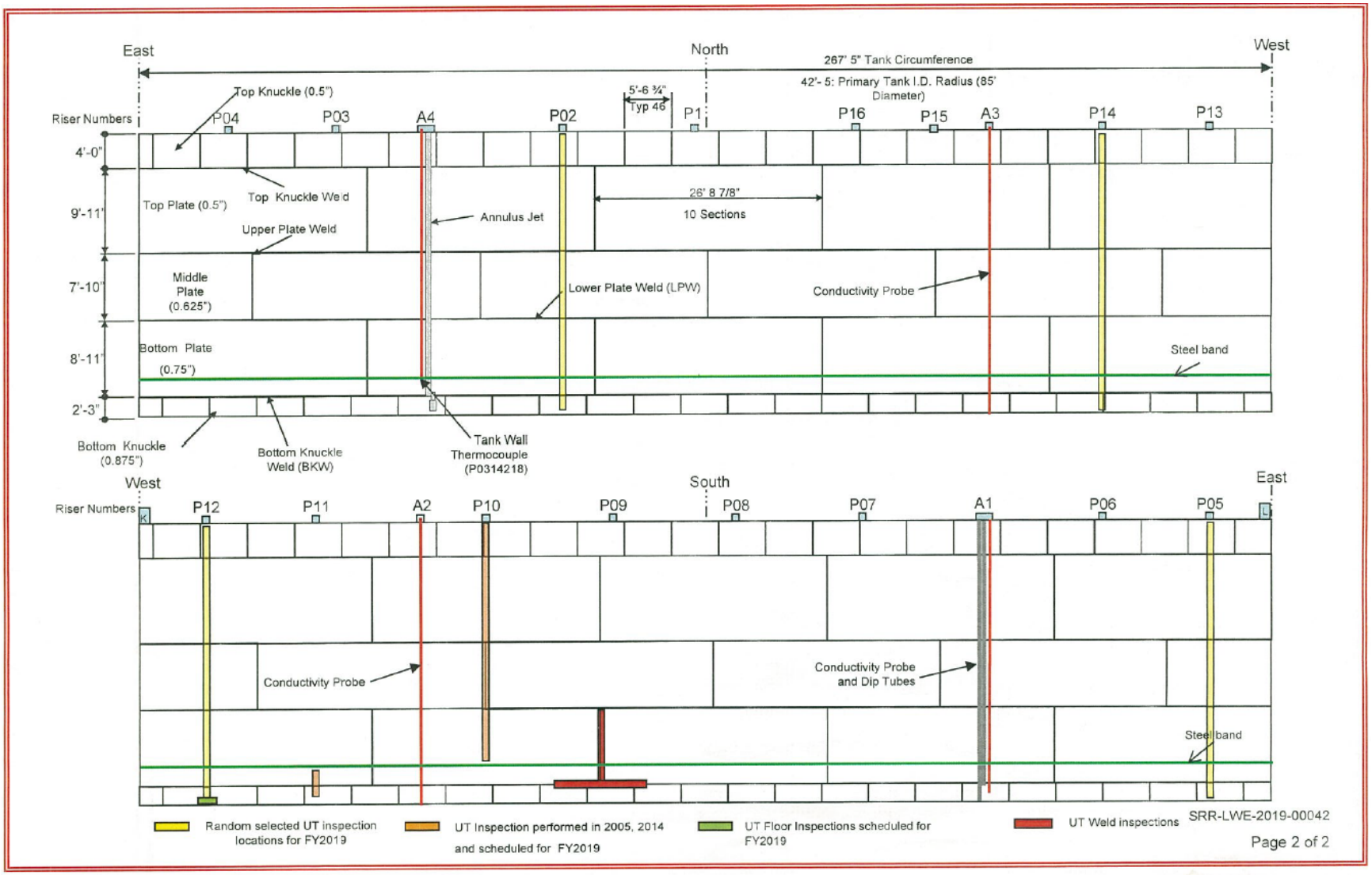
A 10-inch wide strip on the annulus floor between the refractory pad and ventilation duct was inspected for thinning and pitting beneath the P12 riser.

Four 8.5-inch wide vertical strips were inspected at randomly selected areas, one in each quadrant of the tank. These inspections had a UT pixel size of 100 mils. The vertical strips were along the accessible height of the tank to detect and measure thinning and pitting. The following areas were randomly selected:

a. QI – P2
b. QII – P5
c. QIII - P12
d. QIV – P14

Figure 7 shows a face map for illustration purposes. The face map indicates the approximate locations for the scans.

Figure 7: Scan Locations Tank 33



4.5.4 Tank 34 Examinations

Scan Plan SRR-LWE-2019-00068 [9]:
The following inspections were performed in accordance with the scan plan:

One 8.5-inch wide vertical strip beneath P9. The vertical strip along the accessible height of the tank to detect and measure thinning, pitting and stress corrosion cracking. The UT resolution was comparable to previous inspections (approximately 50 mil pixel size).

A two square foot area on plates 1, 2, 3 and 4 of the secondary liner was scanned for thinning and pitting beneath the P9 riser.

A vertical weld (located 4' clockwise from P11) on the lower plate and 5% (over 13 feet) of the bottom girth weld was scanned for cracking beneath the P11 riser.

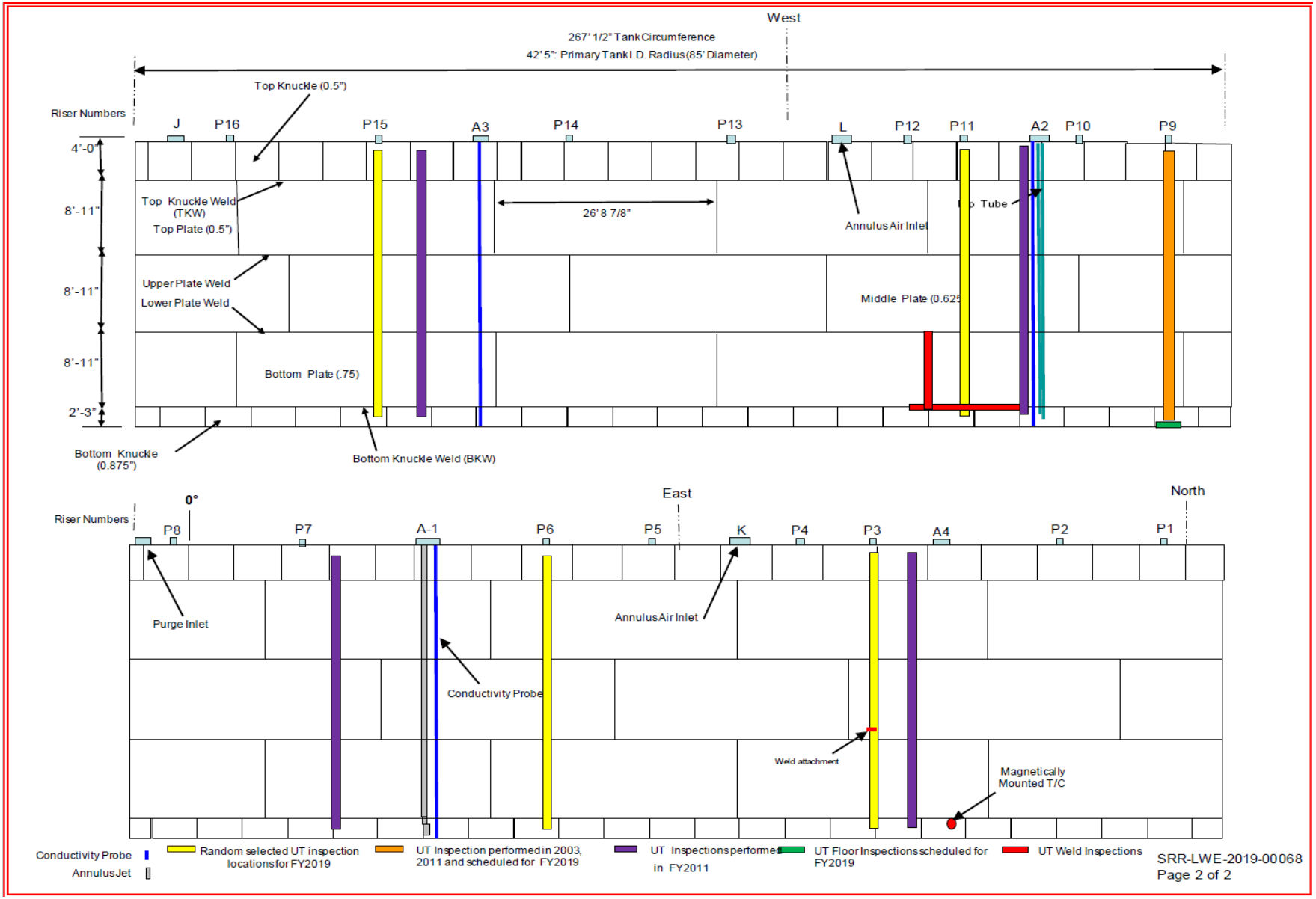
A 10-inch wide strip on the annulus floor between the refractory pad and ventilation duct was inspected for thinning and pitting beneath the P9 riser.

Four 8.5-inch wide vertical strips were inspected at randomly selected areas, one in each quadrant of the tank. These inspections had a UT pixel size of 100 mils. The vertical strips were along the accessible height of the tank to detect and measure thinning and pitting. The following areas were randomly selected:

a. QI - P11
b. QII- P15
c. QIII – P3
d. QIV – P6

Figure 8 shows a face map for illustration purposes. The face map indicates the approximate locations for the scans.

Figure 8: Scan Locations Tank 34



4.5.5 Tank 41 Examinations

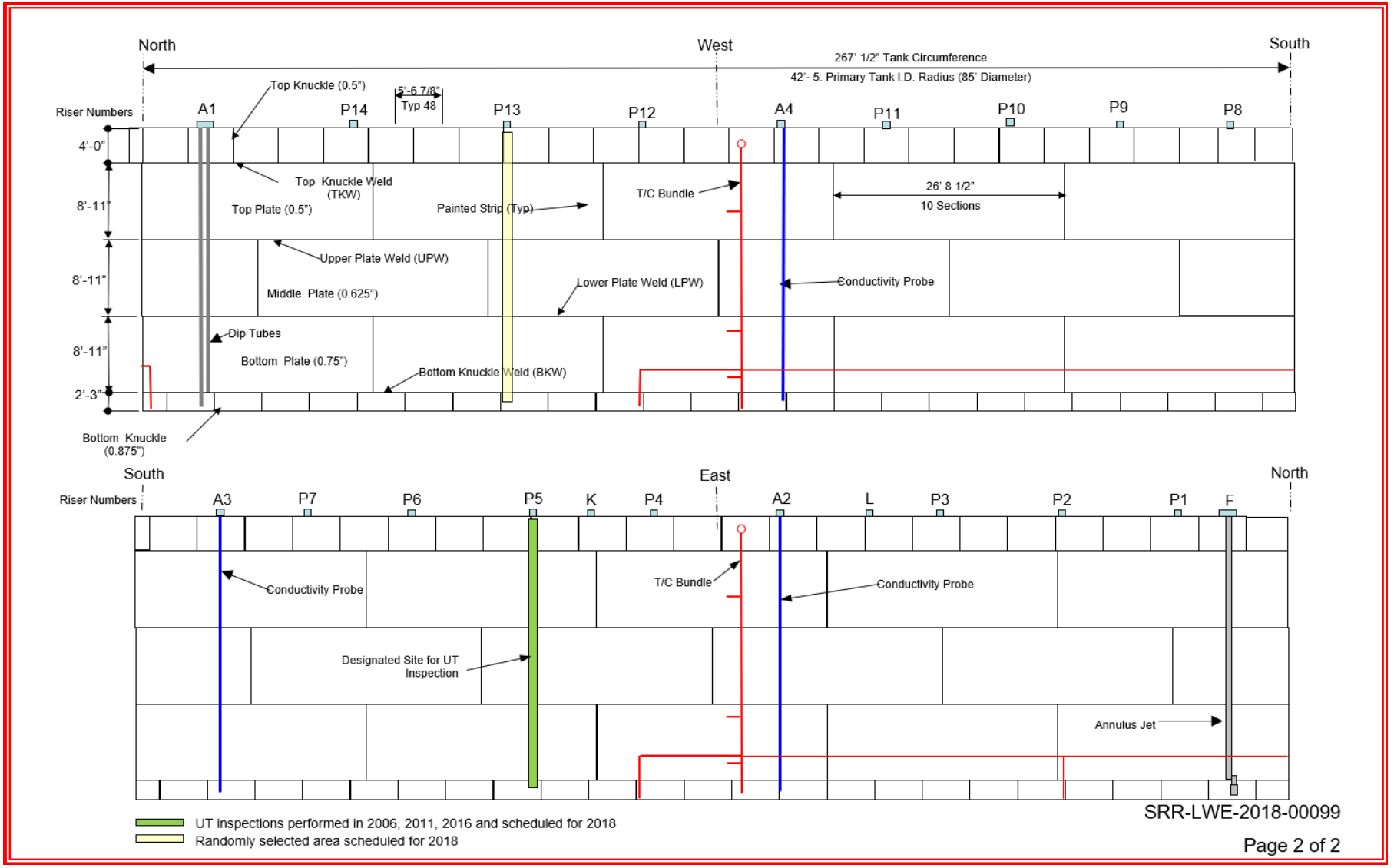
Scan Plan SRR-LWE-2018-00099 [10]:
The following inspections were performed in accordance with the scan plan:

One 8.5-inch wide vertical strip beneath P5. The vertical strip along the accessible height of the tank to detect and measure thinning, pitting and stress corrosion cracking. The UT resolution was comparable to previous inspections (approximately 50 mil pixel size).

One 8.5-inch wide vertical strip beneath P13. This is a randomly selected area. The vertical strip along the accessible height of the tank to detect and measure thinning and pitting. The UT resolution was 100 mils pixel size.

Figure 9 shows a face map for illustration purposes. The face map indicates the approximate locations for the scans.

Figure 9: Scan Locations Tank 41



4.5.6 Tank 50 Examinations

Scan Plan SRR-LWE-2018-00119 [11]:
The following inspections were performed in accordance with the scan plan:

One 8.5-inch wide vertical strip at the A2 riser beneath the penetration line entering the annulus. The vertical strip along the accessible height of the secondary tank wall to detect and measure thinning and pitting. The UT resolution will be approximately 50 mil pixel size.

4.6 Data Review and Acceptance

4.6.1 Data Analysis Average and Minimum Values

Inspection data is typically analyzed in 12-inch segments to provide high resolution. For each 12-inch segment typically over 40,000 individual thickness measurements are evaluated and used to determine an average and a minimum thickness. The average value is used for comparison with the reportable acceptance criteria and historical wall loss calculations. The minimum thickness value is utilized to identify areas that need to be evaluated by the inspector and members of the ISIRC to determine if pitting, localized thinning, or fabrication artifacts are the cause of wall loss and their validity for application to the acceptance criteria. ISIRC validated minimum thickness values would be applied to the acceptance criteria.

4.6.2 Data Analysis and Review

Inspection data was analyzed by certified ASNT, NDE Level III personnel, reviewed by certified personnel then presented to the ISI Review Committee (ISIRC) for acceptance. The ISIRC meeting was attended by representatives from Liquid Waste Structural Authority and Inspection Engineering, SRNL/Materials Science and Engineering and DOE. The function of the ISIRC was to review the data and determine if any additional data was required. ISI Review Committee reports were completed by the ISIRC chairman. The committee concluded that sufficient data was collected and that no additional data collection was required.

4.7 Acceptance Criteria

Acceptance criteria for the primary tank are referenced within the ISI Program (C-ESR-G-00006), but detailed in WSRC-TR-2002-00063.[12] Applicable sections and the first reporting threshold are summarized below:

4.7.1 Indications Within the Weld and Geometric Reflectors

Any UT signal that is interpreted by the Level II or III inspector as a lamination or as a reflector due to weld geometry or a discontinuity that is embedded entirely within the weld, and does not penetrate the tank wall inside or outside surface and is shorter than 9 inches in length is acceptable.

4.7.2 General and Local Thinning

Local thinning is an area 2 inches to 24 inches in the maximum direction. General thinning areas have a major dimension greater than 2 feet. Indications where there is a reduction from nominal plate thickness ≥ 10% are subject to the acceptance criteria. Validated minimum thickness values and reported average thickness values can be used to calculate the percentage reduction from design nominal thickness or previously reported, measured average thickness.

4.7.3 Pitting

Pitting in the carbon steel waste tanks is exhibited as broad, shallow depressions up to 2 inches in diameter. Pitting indications where there is a reduction from nominal plate thickness ≥ 25% are subject to the acceptance criteria. Validated minimum thickness values would be used to calculate the percentage reduction from design nominal thickness or previously reported, measured average thickness.

4.7.4 Service Induced Flaws (cracks)

A flaw with a depth that is ≥25% of the nominal plate thickness or ≥20% of the nominal plate thickness and six inches long are subject to the acceptance criteria.

5 NDE RESULTS

5.1 Summary

In a Type III/IIIA primary tank, a complete vertical strip includes scans of five plates (including knuckles) such that five "plate/strips" would be completed at each vertical strip location. In FY 2019, a combined total of 103 plate/strips were examined using thickness mapping, equating to over 60,000 square inches of area inspected on the primary tank wall. All but eight of the 103 plate/strips examined in FY 2019 have average thicknesses that remain at or above the construction minimum thickness which is nominal thickness minus 0.010 inches. Although, there were no service induced reportable thicknesses or cracking encountered, there were several fabrication artifacts encountered that were below the 10% wall loss criteria. The repeat measurements showed good correlation between the data collected in 2019 and the previous data.

Thickness mapping on the secondary wall and secondary floor have been part of the ISI program, but this year a special emphasis was continued to evaluate the thickness and condition of the secondary floor where it intersects the secondary leak detection slots. Sections of the secondary floor were examined in 25, 26, 33 and 34. A section of the secondary wall in Tank 50 was examined to evaluate the wall thickness in an area of interest noted in the visual examination. The wall thickness remained approximately at construction minimum thickness in the areas inspected.

5.1.1 Thickness Mapping

Vertical strip measurements for the entire accessible height of the tank were examined in Tanks 25, 26, 33, 34 and 41. These examinations were completed as prescribed to the extent possible as indicated in figures 5 through 9. In addition to the vertical strips on the primary tank walls, areas of the secondary wall and floor were also examined as prescribed.

In the areas of the primary tanks examined this year, all but eight plates have average thicknesses that remain at or above the construction minimum thickness which is nominal thickness minus 0.010 inches.

All but two of the secondary wall and floor plates examined this year, have average thicknesses that are at or above the construction minimum thickness of nominal minus 0.010 inches.

5.1.2 Thickness Mapping - Pitting

There was no reportable pitting detected in any of the areas examined in FY2019. In fact, there has never been any reportable pitting detected in any of the Type III/IIIA primary tanks at SRS. The deepest pit to date was non-reportable (approximately 8% of the nominal thickness vs. a reportable condition of 25% loss from nominal thickness for pitting and 10% for thinning). Indications noted

as incipient pits have been detected and noted in previous reports. In tank 29 the maximum pit depth was reported as 0.065 inches in 2006. That same indication was re-examined in 2009 and in 2018. It was reported as 0.063 inches in 2009 and measures 0.061 inches in the 2018 data.

5.1.3 Cracking

No cracking was detected in any of the examinations performed in FY 2019. Examinations were performed as required to detect cracking in the repeat vertical strips in each tank. Crack detection was also performed on a lower plate vertical weld and the bottom horizontal weld in all four tanks.

5.2 Tank 25 Results

Primary tank completed with no service induced, reportable thinning or pitting and no cracking detected. The FY 2019 average thicknesses were at or above the construction minimum thickness in all but one plate. One plate has an average thickness below the construction minimum:

- The Middle Plate (QIV P1) has an average thickness that is below the construction minimum (0.604" vs. 0.615")

The vertical strip beneath Riser P12 was re-examined in FY 2019. The average thickness values reported in FY 2019 are within minus 0.001 to 0.006 inches of the FY04 data. Figure 10 provides a plot of this data.

Four high speed randomized vertical strips – were completed with no service induced reportable thinning or pitting.

Figure 11 provides a plot of the FY 2019 average thickness data from all risers examined while Table 2 provides average thickness values for all vertical strips collected on the primary wall of Tank 25 in 2019. Minimum measured thickness values are shown in Table 3.

Welds – welds completed, no crack-like indications detected

Secondary wall and floor (riser P12) – were completed with all average thicknesses above the construction minimum thickness. The secondary floor above leak detection slot (riser P7) – completed with no thinning or pitting detected. The secondary wall thickness data is provided in Table 4.

No reportable pitting was noted in any of the primary wall plates examined.

Figure 10: Tank 25 Thickness Data Comparison Over 40 Years

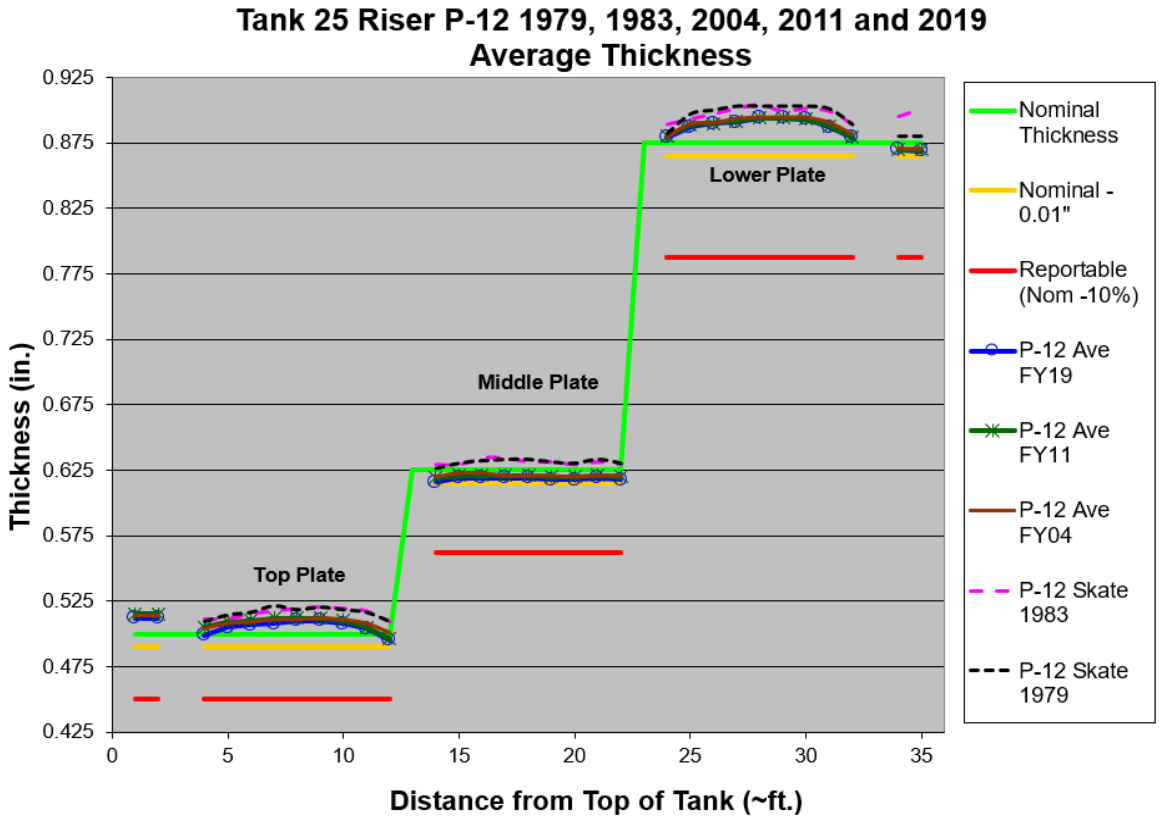


Figure 11: Tank 25 Average Thickness Data FY 2019

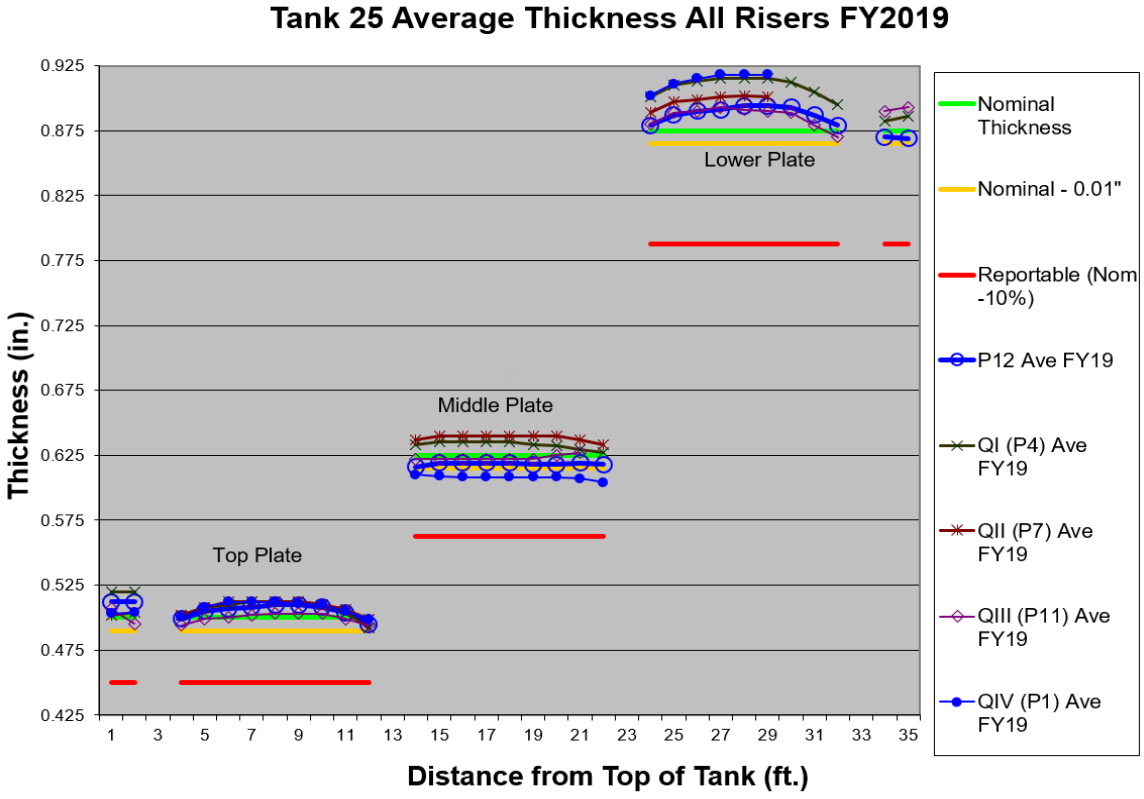


Table 2 Tank 25 Primary Wall Average Thickness Values

Tank 25 Plate / 12-inch segment	Nominal Thickness	Nominal - 0.01"	Reportable (Nom - 10%)	P12 Ave FY19	QI (P4) Ave FY19	QII (P7) Ave FY19	QIII (P11) Ave FY19	QIV (P1) Ave FY19
Top Knuckle 1	0.500	0.490	0.450	0.512	0.520	0.502	0.507	0.503
2	0.500	0.490	0.450	0.512	0.520	0.504	0.495	0.504
Top Plate 1	0.500	0.490	0.450	0.499	0.502	0.502	0.494	0.500
2	0.500	0.490	0.450	0.505	0.508	0.508	0.499	0.508
3	0.500	0.490	0.450	0.507	0.510	0.512	0.500	0.512
4	0.500	0.490	0.450	0.508	0.512	0.512	0.502	0.512
5	0.500	0.490	0.450	0.510	0.512	0.512	0.503	0.512
6	0.500	0.490	0.450	0.510	0.512	0.512	0.503	0.511
7	0.500	0.490	0.450	0.508	0.510	0.510	0.503	0.510
8	0.500	0.490	0.450	0.504	0.504	0.506	0.499	0.505
9	0.500	0.490	0.450	0.495	0.492	0.499	0.494	0.499
Middle Plate 1	0.625	0.615	0.563	0.616	0.633	0.637	0.622	0.610
2	0.625	0.615	0.563	0.619	0.635	0.640	0.622	0.609
3	0.625	0.615	0.563	0.619	0.635	0.640	0.622	0.608
4	0.625	0.615	0.563	0.619	0.635	0.640	0.622	0.608
5	0.625	0.615	0.563	0.619	0.635	0.640	0.622	0.608
6	0.625	0.615	0.563	0.618	0.633	0.640	0.622	0.608
7	0.625	0.615	0.563	0.618	0.632	0.640	0.625	0.608
8	0.625	0.615	0.563	0.619	0.629	0.637	0.627	0.607
9	0.625	0.615	0.563	0.618	0.627	0.633	N/A	0.604
Lower Plate 1	0.875	0.865	0.788	0.879	0.901	0.889	0.880	0.902
2	0.875	0.865	0.788	0.887	0.910	0.897	0.889	0.911
3	0.875	0.865	0.788	0.890	0.913	0.899	0.890	0.915
4	0.875	0.865	0.788	0.891	0.915	0.901	0.893	0.918
5	0.875	0.865	0.788	0.894	0.915	0.902	0.891	0.918
6	0.875	0.865	0.788	0.894	0.915	0.901	0.890	0.918
7	0.875	0.865	0.788	0.893	0.912	N/A	0.889	N/A
8	0.875	0.865	0.788	0.887	0.905	N/A	0.879	N/A
9	0.875	0.865	0.788	0.879	0.895	N/A	0.870	N/A
Bottom Knuckle 1	0.875	0.865	0.788	0.870	0.882	N/A	0.890	N/A
2	0.875	0.865	0.788	0.869	0.886	N/A	0.893	N/A

5.2.1 Tank 25 Primary Wall Minimum Thickness Values

A summary of the minimum thickness values is included in Table 3. Prior to being reported as a minimum thickness value, indications are analyzed and evaluated to report only valid thickness values. All the minimum values have been evaluated and no service induced reportable thickness areas were detected in Tank 25. No service induced thinning or pitting patterns were noted in any of the primary tank areas examined.

Table 3 Tank 25 Primary Wall Minimum Thickness Values

Tank 25 Plate / 12-inch segment	Nominal Thickness	Nominal - 0.01"	Reportable (Nom - 10%)	P12 Min FY19	QI (P4) Min FY19	QII (P7) Min FY19	QIII (P11) Min FY19	QIV (P1) Min FY19
Top Knuckle 1	0.500	0.490	0.450	0.487	0.496	0.495	0.455	0.480
2	0.500	0.490	0.450	0.492	0.491	0.496	0.455	0.474
Top Plate 1	0.500	0.490	0.450	0.466	0.464	0.457	0.450	0.466
2	0.500	0.490	0.450	0.482	0.487	0.500	0.464	0.487
3	0.500	0.490	0.450	0.486	0.451	0.504	0.488	0.491
4	0.500	0.490	0.450	0.483	0.495	0.507	0.486	0.490
5	0.500	0.490	0.450	0.485	0.492	0.498	0.483	0.480
6	0.500	0.490	0.450	0.491	0.491	0.498	0.480	0.490
7	0.500	0.490	0.450	0.487	0.499	0.506	0.479	0.488
8	0.500	0.490	0.450	0.484	0.482	0.490	0.478	0.485
9	0.500	0.490	0.450	0.463	0.470	0.479	0.480	0.482
Middle Plate 1	0.625	0.615	0.563	0.588	0.591	0.612	0.595	0.588
2	0.625	0.615	0.563	0.596	0.619	0.624	0.600	0.597
3	0.625	0.615	0.563	0.596	0.607	0.636	0.603	0.580
4	0.625	0.615	0.563	0.595	0.590	0.634	0.594	0.596
5	0.625	0.615	0.563	0.595	0.603	0.636	0.608	0.596
6	0.625	0.615	0.563	0.571	0.596	0.624	0.603	0.604
7	0.625	0.615	0.563	0.577	0.597	0.619	0.595	0.596
8	0.625	0.615	0.563	0.593	0.595	0.620	0.603	0.595
9	0.625	0.615	0.563	0.592	0.590	0.613	N/A	0.567
Lower Plate 1	0.875	0.865	0.788	0.841	0.888	0.850	0.850	0.883
2	0.875	0.865	0.788	0.862	0.899	0.875	0.880	0.902
3	0.875	0.865	0.788	0.867	0.888	0.877	0.883	0.911
4	0.875	0.865	0.788	0.873	0.909	0.880	0.887	0.908
5	0.875	0.865	0.788	0.875	0.885	0.881	0.880	0.909
6	0.875	0.865	0.788	0.875	0.903	0.880	0.874	0.908
7	0.875	0.865	0.788	0.871	0.898	N/A	0.877	N/A
8	0.875	0.865	0.788	0.865	0.895	N/A	0.867	N/A
9	0.875	0.865	0.788	0.853	0.875	N/A	0.844	N/A
Bottom Knuckle 1	0.875	0.865	0.788	0.844	0.850	N/A	0.867	N/A
2	0.875	0.865	0.788	0.849	0.875	N/A	0.880	N/A

5.2.2 Tank 25 Secondary Wall

A summary of the thickness mapping results is included in Table 4. No thinning patterns were noted in the secondary wall scans. The average thickness measured in all of the areas inspected on the secondary wall was above the construction minimum thickness. Two areas of the secondary floor were examined. The area below P12 was repeated and a new area beneath P7 was selected to intersect the secondary leak detection slot.

Table 4 Tank 25 Secondary Wall Average Thickness Values

Tank 25 Plate / 12-inch segment	Nominal Thickness (in.)	Nominal - 0.01" *	P-12 Ave 2019	P-12 Min 2019
P5 Plate 1 / 1	0.375	0.365	0.374	0.347
2	0.375	0.365	0.374	0.353
3	0.375	0.365	0.374	0.354
P5 Plate 2 / 1	0.375	0.365	0.390	0.349
2	0.375	0.365	0.390	0.365
3	0.375	0.365	0.389	0.371
P5 Plate 3 / 1	0.375	0.365	0.372	0.351
2	0.375	0.365	0.372	0.351
3	0.375	0.365	0.372	0.350
P5 Plate 4 / 1	0.375	0.365	0.379	0.354
2	0.375	0.365	0.380	0.341
3	0.375	0.365	0.380	0.343
P12 Secondary Floor	0.375	0.365	0.386	0.349
P7 Secondary Floor over slot	0.375	0.365	.384	.346

* Construction minimum thickness

5.3 Tank 26 Results

Primary tank completed with no service induced, reportable thinning or pitting and no cracking detected. The FY 2019 average thicknesses were at or above the construction minimum thickness in all but two plates. Two plates have an average thickness that is below the construction minimum and three areas with a minimum thickness below the 10% value.

- The Top Knuckle QIII (P11) has a minimum thickness area that is 0.405 inches remaining wall (vs. 0.450")
- The Top Knuckle QI (P2) has a minimum thickness area that is 0.449 inches remaining wall. (vs. 0.450")
- The Middle Plate (QIV P14) has minimum thickness area that is 0.561 inches remaining wall. (vs. 0.563")
- The Top plate (P5) has an average thickness that is below the construction minimum (0.487" vs. 0.490")
- The Lower Plate (QIII P11) has an average thickness that is below the construction minimum (0.860" vs. 0.865")
- The Middle Plate (QIV P14) Nonreportable pits at bottom of Top Plate and top of Middle Plate. (0.038 to 0.046 inches deep)

The vertical strip beneath Riser P5 was re-examined in FY 2019. The average thickness values reported in FY 2019 are within minus 0.010 to 0.001 inches of the FY04 data. Figure 12 provides a plot of this data.

Four high speed randomized vertical strips – were completed with no service induced reportable thinning or pitting.

Three indications were noted in random strip QIV that look like pits, but the shape and location of the indications suggests that they are actually fabrication artifacts. The areas rage in depth from 0.038 to 0.046 inches deep.

Figure 13 provides a plot of the FY 2019 average thickness data from all risers examined while Table 5 provides average thickness values for all vertical strips collected on the primary wall of Tank 26 in 2019. Minimum measured thickness values are in Table 6.

Weld areas were completed with no crack-like indications detected. A non-reportable indication was detected in bottom knuckle vertical weld.

Extended knuckle – inspection was completed, with no crack-like indications detected

Secondary wall and floor (riser P5) – areas were completed with the wall plates' average thicknesses above the construction minimum thickness. The floor has an average thickness that is below the construction minimum (0.359" vs. 0.365"). The secondary wall thickness data is provided in Table 7.

No reportable pitting was noted in any of the primary wall plates examined.

Figure 12: Tank 26 Thickness Data Comparison Over 15 Years

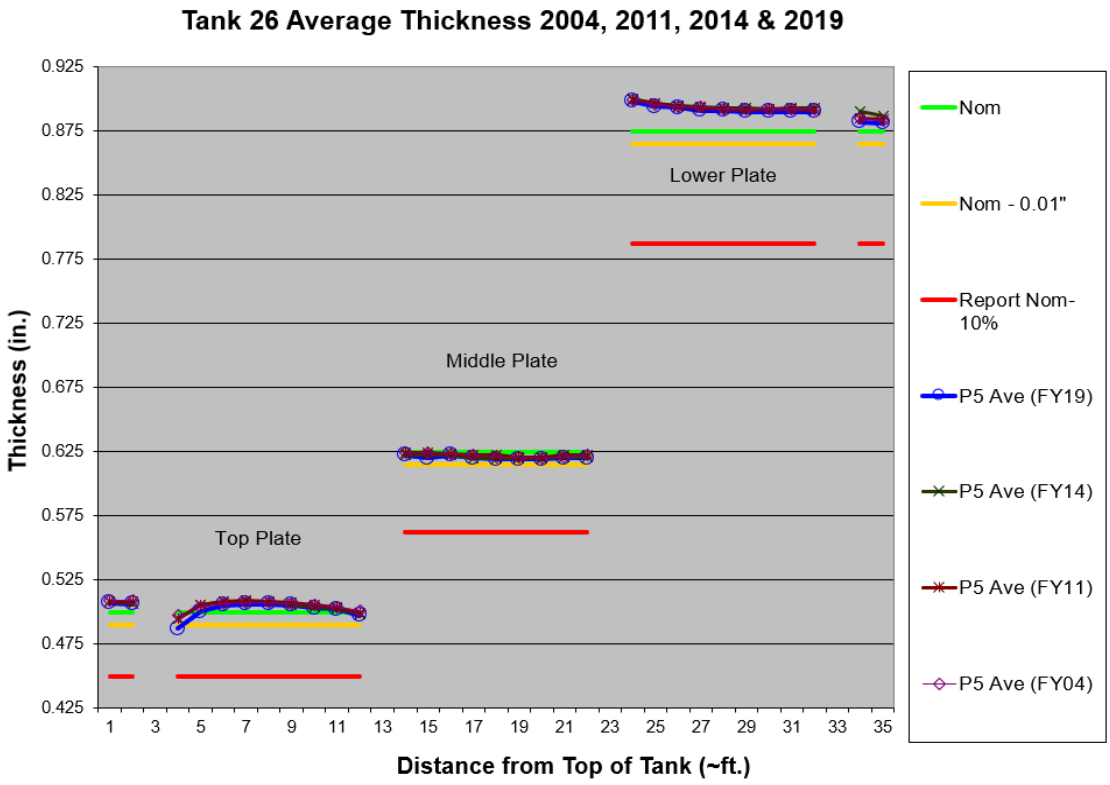


Figure 13: Tank 26 Average Thickness Data FY 2019

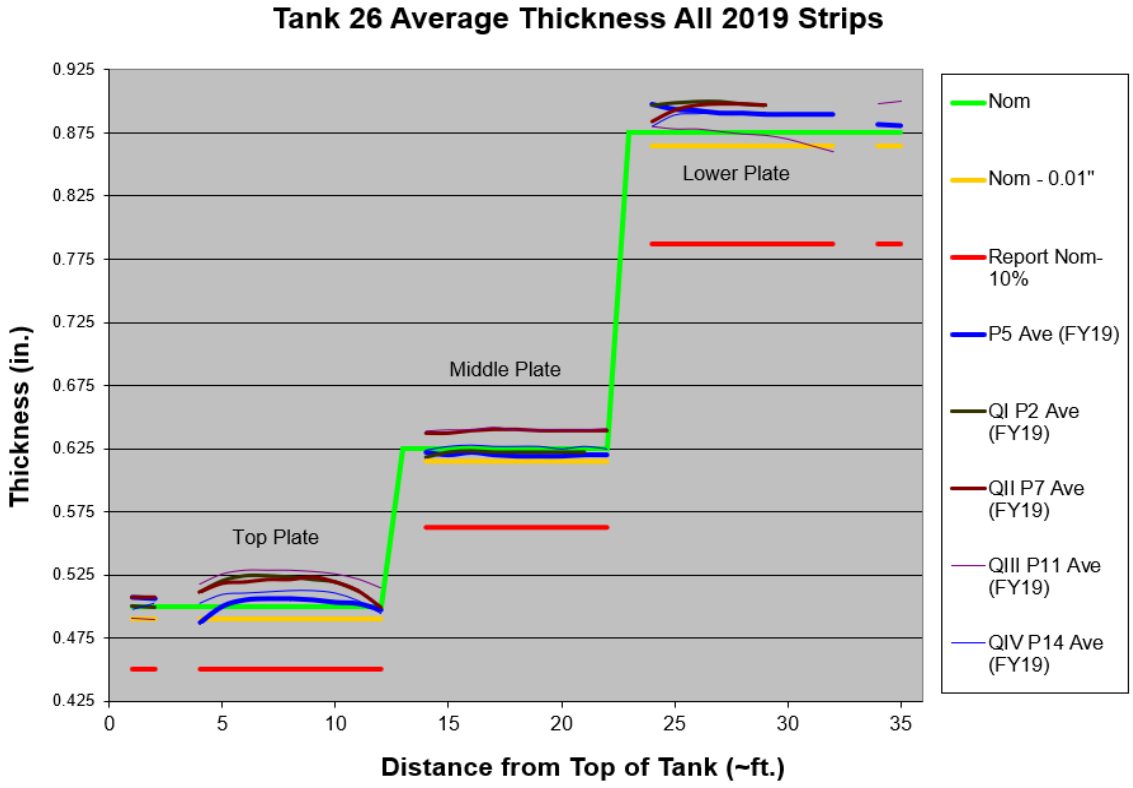


Table 5 Tank 26 Primary Wall Average Thickness Values

Tank 26 Plate / 12-inch segment	Nominal	Nom - 0.01"	Reportable (Nom - 10%)	P5 Ave (FY19)	QI P2 Ave (FY19)	QII P7 Ave (FY19)	QIII P11 Ave (FY19)	QIV P14 Ave (FY19)
Top Knuckle 1	0.500	0.490	0.450	0.507	0.500	0.507	0.491	0.498
2	0.500	0.490	0.450	0.506	0.499	0.507	0.490	0.503
Top Plate 1	0.500	0.490	0.450	0.487	0.511	0.511	0.518	0.503
2	0.500	0.490	0.450	0.500	0.520	0.518	0.526	0.510
3	0.500	0.490	0.450	0.505	0.524	0.519	0.529	0.511
4	0.500	0.490	0.450	0.506	0.524	0.521	0.529	0.512
5	0.500	0.490	0.450	0.506	0.523	0.521	0.529	0.513
6	0.500	0.490	0.450	0.505	0.521	0.523	0.528	0.513
7	0.500	0.490	0.450	0.503	0.519	0.519	0.526	0.511
8	0.500	0.490	0.450	0.502	0.512	0.512	0.522	0.505
9	0.500	0.490	0.450	0.497	N/A	0.499	0.515	0.495
Middle Plate 1	0.625	0.615	0.563	0.622	0.618	0.637	0.639	0.624
2	0.625	0.615	0.563	0.620	0.622	0.637	0.640	0.627
3	0.625	0.615	0.563	0.622	0.623	0.639	0.640	0.628
4	0.625	0.615	0.563	0.620	0.622	0.640	0.642	0.627
5	0.625	0.615	0.563	0.619	0.622	0.640	0.640	0.627
6	0.625	0.615	0.563	0.619	0.622	0.639	0.640	0.627
7	0.625	0.615	0.563	0.619	0.622	0.639	0.640	0.625
8	0.625	0.615	0.563	0.620	0.622	0.639	0.640	0.627
9	0.625	0.615	0.563	0.620	N/A	0.639	0.641	0.625
Lower Plate 1	0.875	0.865	0.788	0.898	0.897	0.884	0.880	0.880
2	0.875	0.865	0.788	0.894	0.899	0.893	0.878	0.889
3	0.875	0.865	0.788	0.893	0.900	0.897	0.878	0.890
4	0.875	0.865	0.788	0.891	0.900	0.898	0.876	0.891
5	0.875	0.865	0.788	0.891	0.898	0.898	0.874	0.891
6	0.875	0.865	0.788	0.890	0.897	0.897	0.873	0.891
7	0.875	0.865	0.788	0.890	N/A	N/A	0.870	N/A
8	0.875	0.865	0.788	0.890	N/A	N/A	0.865	N/A
9	0.875	0.865	0.788	0.890	N/A	N/A	0.860	N/A
Bottom Knuckle 1	0.875	0.865	0.788	0.882	N/A	N/A	0.898	N/A
2	0.875	0.865	0.788	0.881	N/A	N/A	0.900	N/A

5.3.1 Tank 26 Primary Wall Minimum Thickness Values

A summary of the minimum thickness values is included in Table 6. Prior to being reported as a minimum thickness value, indications are analyzed and evaluated to report only valid thickness values. All of the minimum values have been evaluated and no service induced reportable thickness areas were detected in Tank 26. No service induced thinning or pitting patterns were noted in any of the primary tank areas examined.

Table 6 Tank 26 Primary Wall Minimum Thickness Values

Tank 26 Plate / 12-inch segment	Nominal	Nom - 0.01"	Reportable (Nom - 10%)	P-05 Min (FY19)	QI P2 Min (FY19)	QII P7 Min (FY19)	QIII P11 Min (FY19)	QIV P14 Min (FY19)
Top Knuckle 1	0.500	0.490	0.450	0.464	0.469	0.484	0.450	0.467
2	0.500	0.490	0.450	0.472	0.449	0.462	0.405	0.477
Top Plate 1	0.500	0.490	0.450	0.450	0.463	0.470	0.490	0.476
2	0.500	0.490	0.450	0.475	0.492	0.483	0.475	0.484
3	0.500	0.490	0.450	0.486	0.491	0.493	0.503	0.476
4	0.500	0.490	0.450	0.483	0.498	0.498	0.504	0.490
5	0.500	0.490	0.450	0.480	0.498	0.498	0.504	0.488
6	0.500	0.490	0.450	0.483	0.490	0.498	0.507	0.490
7	0.500	0.490	0.450	0.484	0.491	0.495	0.503	0.490
8	0.500	0.490	0.450	0.495	0.462	0.486	0.482	0.467
9	0.500	0.490	0.450	0.487	N/A	0.450	0.491	0.457
Middle Plate 1	0.625	0.615	0.563	0.603	0.582	0.597	0.607	0.561
2	0.625	0.615	0.563	0.604	0.591	0.917	0.616	0.586
3	0.625	0.615	0.563	0.601	0.590	0.915	0.604	0.603
4	0.625	0.615	0.563	0.603	0.578	0.913	0.595	0.607
5	0.625	0.615	0.563	0.600	0.586	0.619	0.592	0.605
6	0.625	0.615	0.563	0.600	0.587	0.613	0.604	0.606
7	0.625	0.615	0.563	0.590	0.584	0.619	0.587	0.603
8	0.625	0.615	0.563	0.596	0.591	0.619	0.607	0.607
9	0.625	0.615	0.563	0.575	N/A	0.608	0.607	0.595
Lower Plate 1	0.875	0.865	0.788	0.875	0.870	0.859	0.862	0.850
2	0.875	0.865	0.788	0.879	0.873	0.874	0.869	0.863
3	0.875	0.865	0.788	0.885	0.874	0.877	0.871	0.870
4	0.875	0.865	0.788	0.869	0.875	0.878	0.840	0.869
5	0.875	0.865	0.788	0.875	0.871	0.878	0.848	0.873
6	0.875	0.865	0.788	0.866	0.874	0.878	0.856	0.886
7	0.875	0.865	0.788	0.882	N/A	N/A	0.849	N/A
8	0.875	0.865	0.788	0.838	N/A	N/A	0.842	N/A
9	0.875	0.865	0.788	0.863	N/A	N/A	0.841	N/A
Bottom Knuckle 1	0.875	0.865	0.788	0.869	N/A	N/A	0.879	N/A
2	0.875	0.865	0.788	0.873	N/A	N/A	0.877	N/A

5.3.2 Tank 26 Secondary Wall

Inspections of Tank 26 also included performing thickness mapping on the secondary wall and floor of the double shell waste tank. A summary of the thickness mapping results is included in Table 7. The average thickness measured in all but one of the areas inspected on the secondary wall was at or above the construction minimum thickness.

Table 7 Tank 26 Secondary Wall Average Thickness Values

Tank 26 Plate / 12-inch segment	Nominal	Nominal - 0.01" *	2019 Riser P-5 Pk-Edge ME Ave	2019 Riser P-5 Pk-Edge ME Min
Plate 1 / 1	0.375	0.365	0.384	0.345
2	0.375	0.365	0.383	0.346
3	0.375	0.365	0.383	0.344
Plate 2 / 1	0.375	0.365	0.384	0.344
2	0.375	0.365	0.384	0.345
3	0.375	0.365	0.386	0.346
Plate 3 / 1	0.375	0.365	0.382	0.344
2	0.375	0.365	0.380	0.342
3	0.375	0.365	0.380	0.339
Plate 4 / 1	0.375	0.365	0.371	0.345
2	0.375	0.365	0.371	0.347
3	0.375	0.365	0.370	0.347
P5 Secondary Floor	0.375	0.365	0.359	0.335

* Construction minimum thickness

5.4 Tank 33 Results

Primary tank completed with no service induced, reportable thinning or pitting, and no cracking detected. The FY 2019 average thicknesses were at or above the construction minimum thickness in all but three plates. Three plates have an average thickness below the construction minimum and one has a minimum thickness below the 10% value.

- The Middle Plate (P10) has an average thickness that is below the construction minimum (0.614" vs. 0.615").
- The Lower Plate (P10) has an average thickness that is below the construction minimum (0.737" vs. 0.740")
- The Top Knuckle (QIV P14) has an average thickness that is below the construction minimum (0.489" vs. 0.490")
- The Top Knuckle (QIV P14) has a minimum thickness area from ID grinding at edge of vertical weld that is below the 10% wall loss criteria (0.404" vs. 0.450")

Four high speed randomized vertical strips – were completed with no service induced reportable thinning or pitting.

Weld areas were completed with no crack-like indications detected.

Secondary wall and floor (riser P12) areas were completed with all average thicknesses above the construction minimum thickness.

The vertical strip beneath Riser P10 was re-examined in 2006, 2014 and 2019. The average thickness values reported in FY 2019 are within minus 0.001 to plus 0.004 inches of the FY06 data which did not include the bottom knuckles and minus 0.000 to plus 0.007 inches including the bottom knuckle data of 2014. Figure 14 provides a plot of this data.

Figure 15 provides a plot of the FY 2019 average thickness data while Table 8 provides average thickness values for all vertical strips collected on the primary wall of Tank 33 in FY 2019. Minimum measured thickness values are in Table 9.

The secondary wall thickness data is provided in Table 10.

No reportable pitting was noted in any of the primary wall plates examined.

Figure 14: Tank 33 Thickness Data Comparison Over 13 Years

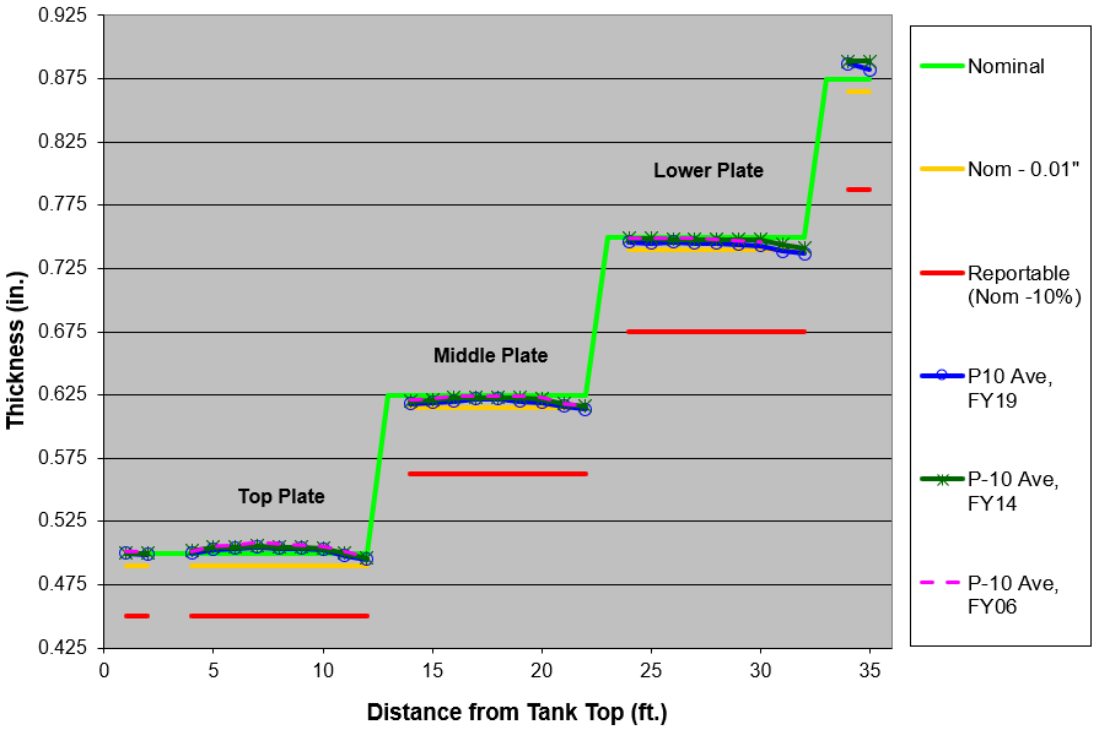


Figure 15: Tank 33 Average Thickness Data FY 2019

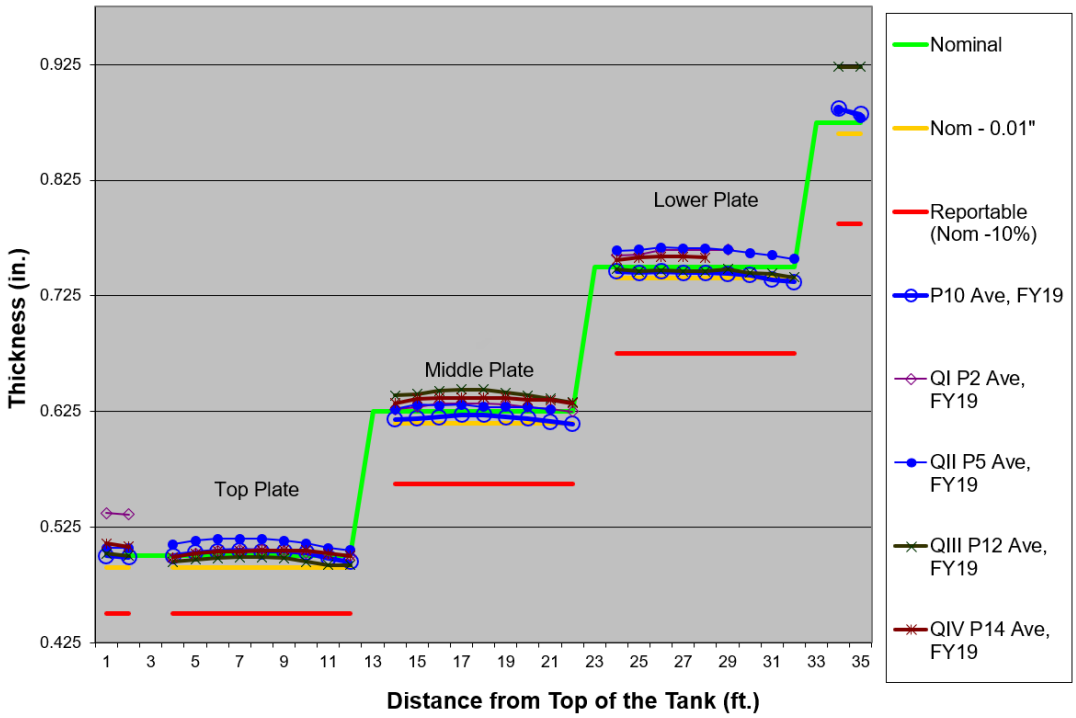


Table 8 Tank 33 Primary Wall Average Thickness Values

Tank 33 Plate / 12 inch	Nominal	Nom - 0.01"	Reportable (Nom - 10%)	P10 Ave, FY19	QI P2 Ave, FY19	QII P5 Ave, FY19	QIII P12 Ave, FY19	QIV P14 Ave, FY19
Top Knuckle 1	0.500	0.490	0.450	0.500	0.537	0.507	0.502	0.511
2	0.500	0.490	0.450	0.499	0.536	0.507	0.500	0.508
Top Plate 1	0.500	0.490	0.450	0.500	0.498	0.510	0.495	0.499
2	0.500	0.490	0.450	0.503	0.502	0.513	0.497	0.502
3	0.500	0.490	0.450	0.504	0.504	0.515	0.498	0.504
4	0.500	0.490	0.450	0.505	0.505	0.515	0.499	0.504
5	0.500	0.490	0.450	0.504	0.506	0.515	0.499	0.505
6	0.500	0.490	0.450	0.504	0.504	0.513	0.498	0.505
7	0.500	0.490	0.450	0.503	0.503	0.511	0.495	0.505
8	0.500	0.490	0.450	0.498	0.502	0.507	0.492	0.502
9	0.500	0.490	0.450	0.495	0.500	0.505	0.492	0.500
Middle Plate 1	0.625	0.615	0.563	0.618	0.627	0.627	0.639	0.632
2	0.625	0.615	0.563	0.619	0.629	0.631	0.640	0.636
3	0.625	0.615	0.563	0.620	0.632	0.630	0.643	0.637
4	0.625	0.615	0.563	0.622	0.632	0.631	0.644	0.637
5	0.625	0.615	0.563	0.622	0.632	0.629	0.644	0.637
6	0.625	0.615	0.563	0.620	0.631	0.629	0.641	0.637
7	0.625	0.615	0.563	0.619	0.629	0.629	0.639	0.635
8	0.625	0.615	0.563	0.616	0.627	0.627	0.636	0.635
9	0.625	0.615	0.563	0.614	0.625	N/A	0.633	0.632
Lower Plate 1	0.750	0.740	0.675	0.746	0.760	0.764	0.748	0.756
2	0.750	0.740	0.675	0.745	0.761	0.765	0.746	0.758
3	0.750	0.740	0.675	0.746	0.765	0.767	0.747	0.759
4	0.750	0.740	0.675	0.745	0.765	0.766	0.746	0.759
5	0.750	0.740	0.675	0.745	0.765	0.766	0.746	0.758
6 (strap)	0.750	0.740	0.675	0.744	0.765	0.765	0.748	N/A
7	0.750	0.740	0.675	0.743	N/A	0.762	0.745	N/A
8	0.750	0.740	0.675	0.739	N/A	0.760	0.744	N/A
9	0.750	0.740	0.675	0.737	N/A	0.757	0.741	N/A
Bottom Knuckle 1	0.875	0.865	0.788	0.887	N/A	0.886	0.923	N/A
	0.875	0.865	0.788	0.882	N/A	0.879	0.923	N/A

5.4.1 Tank 33 Primary Wall Minimum Thickness Values

A summary of the minimum thickness values is included in Table 9. Prior to being reported as a minimum thickness value, indications are analyzed and evaluated to report only valid thickness values. All of the minimum values have been evaluated and no service induced reportable thickness areas were detected in Tank 33. No service induced thinning or pitting patterns were noted in any of the primary tank areas examined.

Table 9 Tank 33 Primary Wall Minimum Thickness Values

Tank 33 Plate / 12-inch segment	Nominal	Nom - 0.01"	Reportable (Nom - 10%)	P-10 Min, FY19	QI P2 Min, FY19	QII P5 Min, FY19	QIII P12 Min, FY19	QIV P14 Min, FY19
Top Knuckle 1	0.500	0.490	0.450	0.457	0.522	0.483	0.496	0.404
2	0.500	0.490	0.450	0.488	0.507	0.471	0.495	0.476
Top Plate 1	0.500	0.490	0.450	0.462	0.471	0.491	0.479	0.483
2	0.500	0.490	0.450	0.498	0.493	0.505	0.480	0.467
3	0.500	0.490	0.450	0.498	0.500	0.503	0.490	0.485
4	0.500	0.490	0.450	0.498	0.503	0.500	0.478	0.486
5	0.500	0.490	0.450	0.496	0.487	0.504	0.492	0.485
6	0.500	0.490	0.450	0.498	0.487	0.504	0.493	0.490
7	0.500	0.490	0.450	0.495	0.486	0.504	0.490	0.482
8	0.500	0.490	0.450	0.490	0.486	0.498	0.480	0.480
9	0.500	0.490	0.450	0.483	0.478	0.486	0.487	0.483
Middle Plate 1	0.625	0.615	0.563	0.612	0.613	0.617	0.625	0.619
2	0.625	0.615	0.563	0.615	0.615	0.628	0.637	0.624
3	0.625	0.615	0.563	0.615	0.617	0.626	0.640	0.630
4	0.625	0.615	0.563	0.616	0.617	0.620	0.636	0.629
5	0.625	0.615	0.563	0.617	0.613	0.626	0.632	0.624
6	0.625	0.615	0.563	0.616	0.617	0.619	0.634	0.625
7	0.625	0.615	0.563	0.609	0.613	0.619	0.634	0.620
8	0.625	0.615	0.563	0.590	0.612	0.611	0.624	0.617
9	0.625	0.615	0.563	0.595	0.613	N/A	0.612	0.617
Lower Plate 1	0.750	0.740	0.675	0.731	0.739	0.760	0.734	0.740
2	0.750	0.740	0.675	0.734	0.741	0.754	0.734	0.745
3	0.750	0.740	0.675	0.731	0.741	0.760	0.742	0.742
4	0.750	0.740	0.675	0.733	0.741	0.763	0.742	0.749
5	0.750	0.740	0.675	0.739	0.734	0.759	0.742	0.741
6	0.750	0.740	0.675	0.736	0.744	0.759	0.731	N/A
7	0.750	0.740	0.675	0.738	N/A	0.755	0.738	N/A
8	0.750	0.740	0.675	0.734	N/A	0.755	0.729	N/A
9	0.750	0.740	0.675	0.715	N/A	0.749	0.724	N/A
Bottom Knuckle 1	0.875	0.865	0.788	0.865	N/A	0.827	0.891	N/A
2	0.875	0.865	0.788	0.866	N/A	0.865	0.903	N/A

5.4.2 Tank 33 Secondary Wall

Inspections of Tank 33 also included performing thickness mapping on the secondary wall and floor of the double shell waste tank. A summary of the thickness mapping results is included in Table 10. The average thickness measured in all of the areas inspected on the secondary wall was above the construction minimum thickness.

Table 10 Tank 33 Secondary Wall Average Thickness Values

Tank 33 Plate / 12 inch segment	Nominal	Nominal - 0.01" *	P-12 Ave 2019	P-12 Min 2019
Plate 1 / 1	0.375	0.365	0.378	0.346
2	0.375	0.365	0.377	0.358
3	0.375	0.365	0.377	0.346
Plate 2 / 1	0.375	0.365	0.374	0.357
2	0.375	0.365	0.375	0.358
3	0.375	0.365	0.376	0.354
Plate 3 / 1	0.375	0.365	0.384	0.370
2	0.375	0.365	0.384	0.370
3	0.375	0.365	0.384	0.369
Plate 4 / 1	0.375	0.365	0.366	0.349
2	0.375	0.365	0.367	0.362
3	0.375	0.365	0.367	0.348
P6 Secondary Floor	0.375	0.365	0.385	0.344

* Construction minimum thickness

5.5 Tank 34 Results

Primary tank completed with no service induced, reportable thinning or pitting, and no cracking detected. The FY 2019 average thicknesses were at or above the construction minimum thickness in all but one plate.

- The Lower Plate beneath P9 has an average thickness below the construction minimum (0.738” vs. 0.740”)

The vertical strip beneath Riser P9 was re-examined in 2003, 2011 and 2019. The average thickness values reported in FY 2019 are within plus 0.003 and minus 0.001 inches of the FY03 data. Figure 16 provides a plot of this data.

Four high speed randomized vertical strips were completed with no service induced reportable thinning or pitting. Figure 17 provides a plot of the FY 2019 average thickness data while Table 11 provides average thickness values for all vertical strips collected on the primary wall of Tank 34 in 2019. Minimum measured thickness values are in Table 12.

Weld areas were completed with no crack-like indications detected.

Secondary wall and floor (riser P9) – areas were completed with all but one plate having average thicknesses above the construction minimum thickness. The secondary wall thickness data is provided in Table 13.

Figure 16: Tank 34 Thickness Data Comparison Over 16 Years

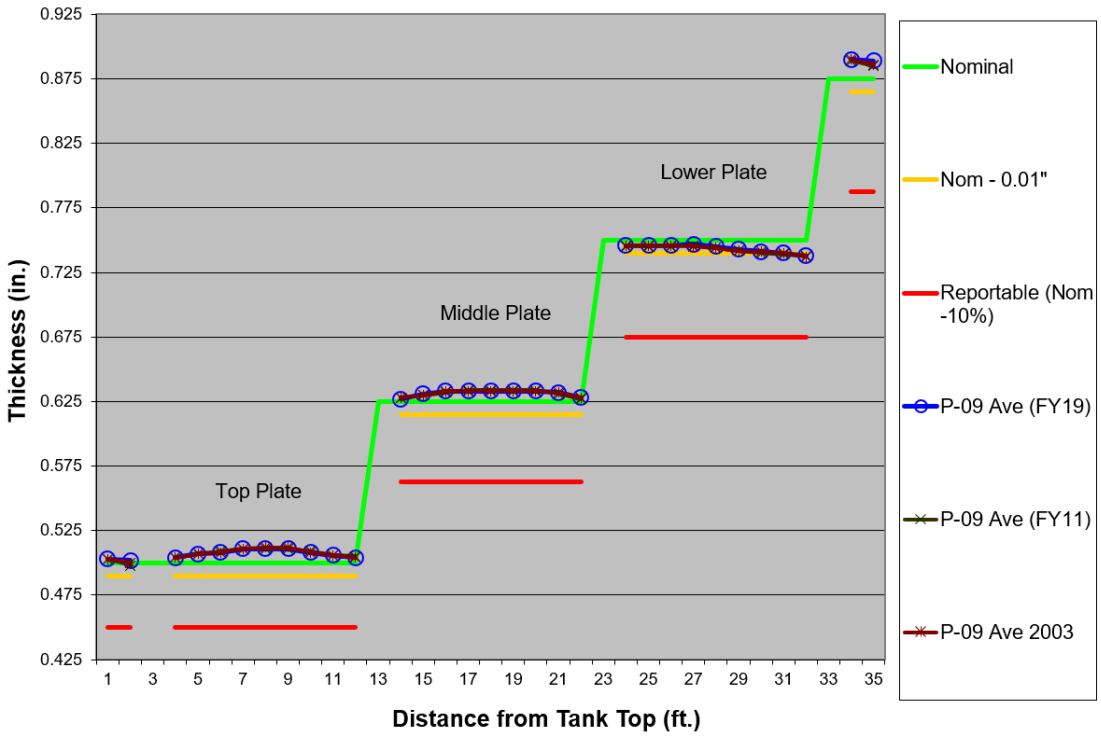


Figure 17: Tank 34 Average Thickness Data FY 2019

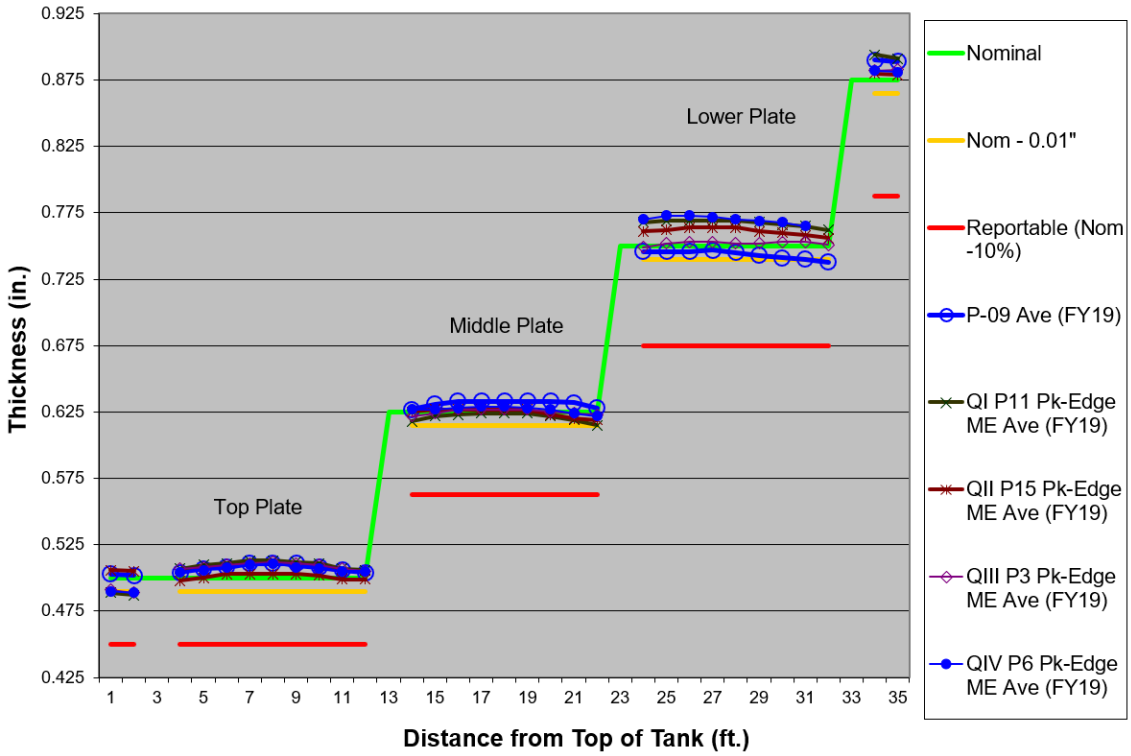


Table 11 Tank 34 Primary Wall Average Thickness Values

Tank 34 Plate / 12 inch	Nominal	Nom - 0.01"	Reportable (Nom - 10%)	P-09 Ave (FY19)	QI P11 Pk-Edge ME Ave (FY19)	QII P15 Pk-Edge ME Ave (FY19)	QIII P3 Pk-Edge ME Ave (FY19)	QIV P6 Pk-Edge ME Ave (FY19)
Top Knuckle 1	0.500	0.490	0.450	0.503	0.489	0.506	0.491	0.490
2	0.500	0.490	0.450	0.502	0.487	0.505	0.489	0.489
Top Plate 1	0.500	0.490	0.450	0.504	0.507	0.498	0.507	0.504
2	0.500	0.490	0.450	0.507	0.510	0.500	0.508	0.506
3	0.500	0.490	0.450	0.508	0.511	0.503	0.510	0.508
4	0.500	0.490	0.450	0.511	0.513	0.503	0.511	0.510
5	0.500	0.490	0.450	0.511	0.513	0.503	0.512	0.511
6	0.500	0.490	0.450	0.511	0.512	0.503	0.511	0.508
7	0.500	0.490	0.450	0.508	0.511	0.502	0.510	0.507
8	0.500	0.490	0.450	0.506	0.507	0.499	0.507	0.505
9	0.500	0.490	0.450	0.504	0.506	0.499	0.505	0.505
Middle Plate 1	0.625	0.615	0.563	0.627	0.618	0.625	0.622	0.627
2	0.625	0.615	0.563	0.631	0.622	0.627	0.624	0.627
3	0.625	0.615	0.563	0.633	0.623	0.627	0.627	0.628
4	0.625	0.615	0.563	0.633	0.624	0.627	0.627	0.629
5	0.625	0.615	0.563	0.633	0.624	0.627	0.627	0.629
6	0.625	0.615	0.563	0.633	0.624	0.627	0.627	0.628
7	0.625	0.615	0.563	0.633	0.622	0.623	0.625	0.627
8	0.625	0.615	0.563	0.632	0.619	0.620	0.624	0.624
9	0.625	0.615	0.563	0.628	0.615	0.619	0.623	0.622
Lower Plate 1	0.750	0.740	0.675	0.746	0.768	0.761	0.749	0.770
2	0.750	0.740	0.675	0.746	0.769	0.762	0.752	0.773
3	0.750	0.740	0.675	0.746	0.769	0.764	0.753	0.773
4	0.750	0.740	0.675	0.747	0.769	0.764	0.753	0.772
5	0.750	0.740	0.675	0.745	0.769	0.764	0.752	0.770
6	0.750	0.740	0.675	0.743	0.768	0.761	0.752	0.769
7	0.750	0.740	0.675	0.741	0.766	0.760	0.753	0.768
8	0.750	0.740	0.675	0.740	0.765	0.758	0.753	0.765
9	0.750	0.740	0.675	0.738	0.762	0.756	0.751	N/A
Bottom Knuckle 1	0.875	0.865	0.788	0.890	0.894	0.880	0.882	0.882
	0.875	0.865	0.788	0.889	0.891	0.879	0.883	0.881

5.5.1 Tank 34 Primary Wall Minimum Thickness Values

A summary of the minimum thickness values is included in Table 12. Prior to being reported as a minimum thickness value, indications are analyzed and evaluated to report only valid thickness values. All of the minimum values have been evaluated and no service induced reportable thickness areas were detected in Tank 34. No service induced thinning or pitting patterns were noted in any of the primary tank areas examined.

Table 12 Tank 34 Primary Wall Minimum Thickness Values

Tank 34 Plate / 12-inch segment	Nominal	Nom - 0.01"	Reportable (Nom - 10%)	P-09 Min (FY19)	QI P11 Min (FY19)	QII P15 Min (FY19)	QIII P3 Min (FY19)	QIV P6 Min (FY19)
Top Knuckle 1	0.500	0.490	0.450	0.486	0.474	0.466	0.466	0.467
2	0.500	0.490	0.450	0.466	0.469	0.480	0.467	0.470
Top Plate 1	0.500	0.490	0.450	0.486	0.484	0.469	0.486	0.480
2	0.500	0.490	0.450	0.487	0.490	0.485	0.479	0.488
3	0.500	0.490	0.450	0.495	0.490	0.480	0.491	0.492
4	0.500	0.490	0.450	0.495	0.493	0.485	0.492	0.496
5	0.500	0.490	0.450	0.507	0.511	0.482	0.493	0.495
6	0.500	0.490	0.450	0.505	0.496	0.482	0.491	0.493
7	0.500	0.490	0.450	0.492	0.495	0.482	0.492	0.493
8	0.500	0.490	0.450	0.488	0.490	0.479	0.488	0.490
9	0.500	0.490	0.450	0.482	0.488	0.482	0.486	0.484
Middle Plate 1	0.625	0.615	0.563	0.623	0.601	0.609	0.594	0.607
2	0.625	0.615	0.563	0.616	0.613	0.609	0.609	0.613
3	0.625	0.615	0.563	0.617	0.607	0.612	0.609	0.625
4	0.625	0.615	0.563	0.617	0.616	0.603	0.616	0.615
5	0.625	0.615	0.563	0.617	0.620	0.597	0.624	0.616
6	0.625	0.615	0.563	0.619	0.608	0.612	0.623	0.613
7	0.625	0.615	0.563	0.630	0.611	0.607	0.619	0.611
8	0.625	0.615	0.563	0.628	0.603	0.607	0.620	0.611
9	0.625	0.615	0.563	0.609	0.580	0.596	0.607	0.592
Lower Plate 1	0.750	0.740	0.675	0.728	0.745	0.742	0.732	0.755
2	0.750	0.740	0.675	0.737	0.755	0.749	0.742	0.758
3	0.750	0.740	0.675	0.741	0.753	0.744	0.738	0.760
4	0.750	0.740	0.675	0.736	0.752	0.752	0.744	0.760
5	0.750	0.740	0.675	0.728	0.752	0.746	0.728	0.758
6	0.750	0.740	0.675	0.732	0.752	0.746	0.734	0.754
7	0.750	0.740	0.675	0.737	0.747	0.742	0.734	0.750
8	0.750	0.740	0.675	0.725	0.746	0.739	0.725	0.745
9	0.750	0.740	0.675	0.720	0.740	0.720	0.703	N/A
Bottom Knuckle 1	0.875	0.865	0.788	0.873	0.880	0.841	0.859	0.836
2	0.875	0.865	0.788	0.881	0.878	0.811	0.874	0.861

5.5.2 Tank 34 Secondary Wall

Inspections of Tank 34 also included performing thickness mapping on the secondary wall and floor of the double shell waste tank. A summary of the thickness mapping results is included in Table 13. The average thickness measured in all but one of the areas inspected on the secondary wall and floor was above the construction minimum thickness.

Table 13 Tank 34 Secondary Wall Average Thickness Values

Tank 34 Plate / 12 inch segment	Nominal	Nominal - 0.01" *	2019 Ave	2019 Min
Plate 1 / 1	0.375	0.365	0.362	0.341
2	0.375	0.365	0.357	0.340
3	0.375	0.365	0.362	0.341
Plate 2 / 1	0.375	0.365	0.379	0.361
2	0.375	0.365	0.382	0.377
3	0.375	0.365	0.383	0.371
Plate 3 / 1	0.375	0.365	0.366	0.350
2	0.375	0.365	0.367	0.362
3	0.375	0.365	0.368	0.360
Plate 4 / 1	0.375	0.365	0.394	0.377
2	0.375	0.365	0.396	0.381
3	0.375	0.365	0.396	0.381
Secondary Floor	0.375	0.365	0.404	0.382

* Construction minimum thickness

5.6 Tank 41 Results

Vertical strip scans beneath P5 and P13 completed with no reportable thinning, pitting or cracking detected.

The Lower Plate (P5) has an average thickness that is below the construction minimum (0.864” vs. 0.865”).

The vertical strip beneath Riser P5 was re-examined in FY 2019. The average thickness values reported in FY 2019 are within minus 0.003 and plus 0.002 inches of the 2016 data. Figure 18 provides a plot of this data.

Figure 19 provides a plot of the average thickness data from all risers examined in FY 2019. Table 14 provides average thickness values for all vertical strips collected on the primary wall of Tank 41 in 2019. Minimum measured thickness values are in Table 15.

No signs of accelerated corrosion, pitting or cracking were detected in either strip.

Figure 18: Tank 41 Thickness Data Comparison Over 13 Years

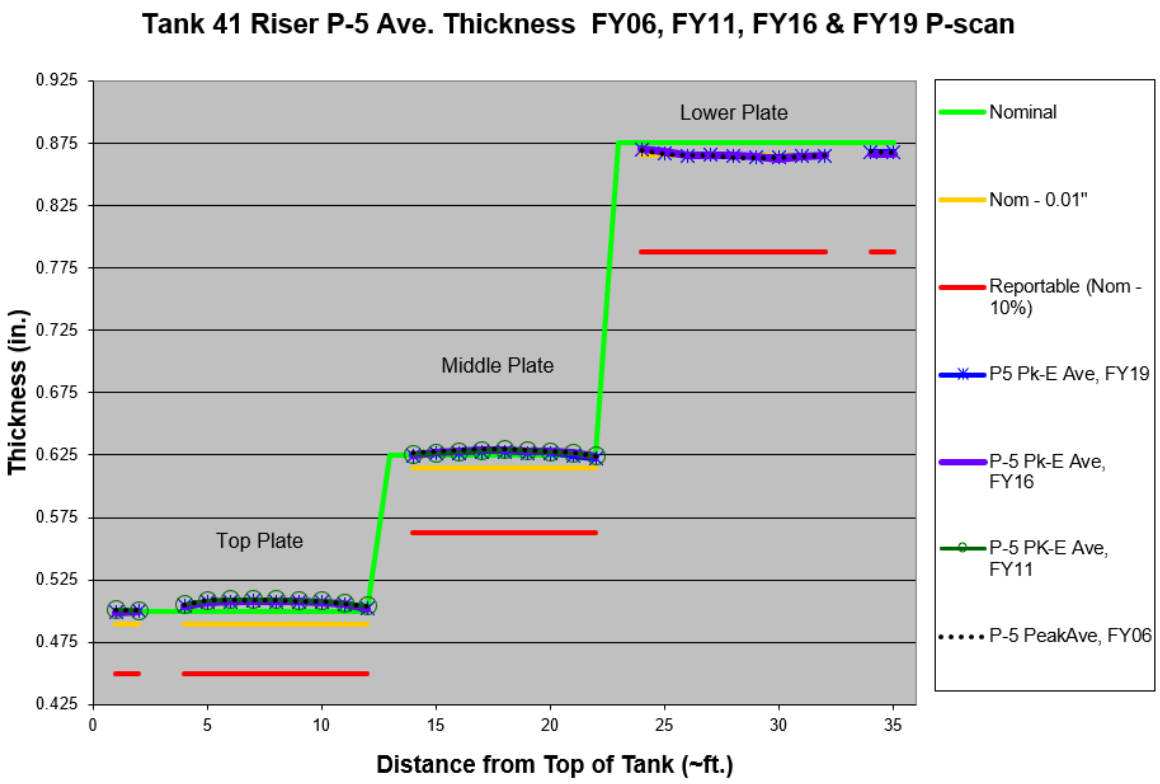


Figure 19: Tank 41 Average Thickness Data FY 2019

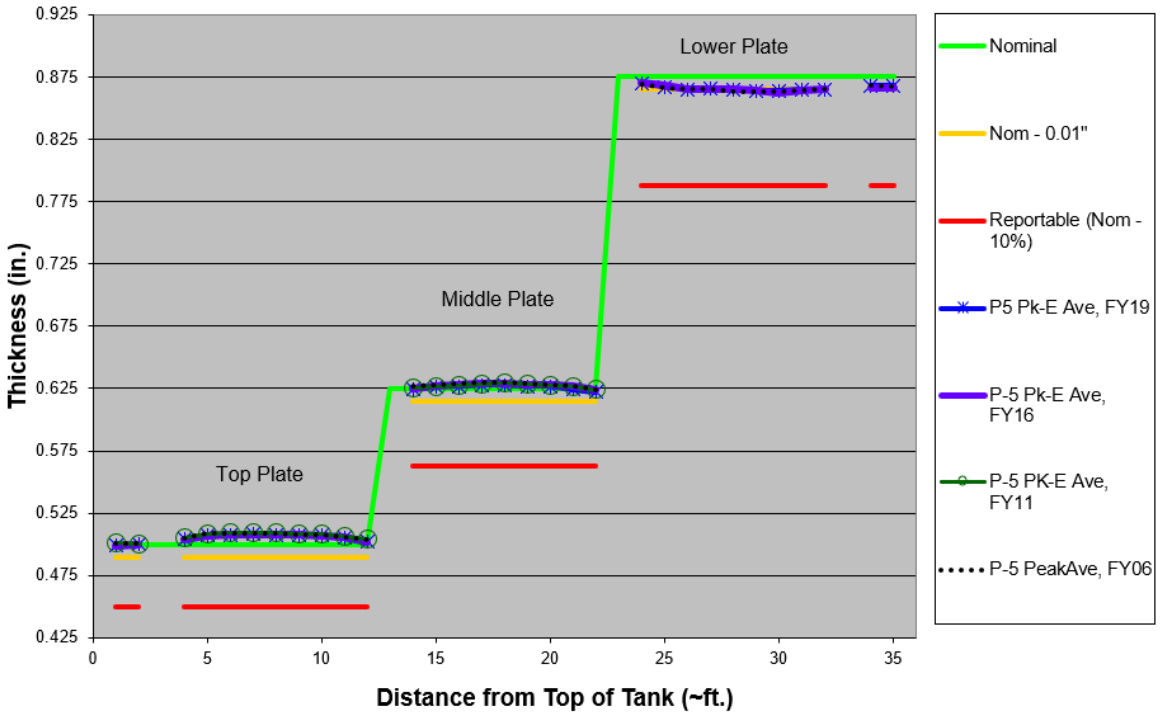


Table 14 Tank 41 Primary Wall Average Thickness Values

Tank 41 Plate / 12 inch	Nominal	Nom - 0.01"	Reportable (Nom -10%)	P5 Ave FY19	P13 Ave FY19
Top Knuckle 1	0.500	0.490	0.450	0.499	0.516
2	0.500	0.490	0.450	0.500	0.519
Top Plate 1	0.500	0.490	0.450	0.504	0.494
2	0.500	0.490	0.450	0.507	0.497
3	0.500	0.490	0.450	0.507	0.499
4	0.500	0.490	0.450	0.508	0.500
5	0.500	0.490	0.450	0.507	0.500
6	0.500	0.490	0.450	0.507	0.499
7	0.500	0.490	0.450	0.507	0.499
8	0.500	0.490	0.450	0.505	0.498
9	0.500	0.490	0.450	0.502	0.495
Middle Plate 1	0.625	0.615	0.563	0.624	0.616
2	0.625	0.615	0.563	0.627	0.619
3	0.625	0.615	0.563	0.627	0.620
4	0.625	0.615	0.563	0.628	0.622
5	0.625	0.615	0.563	0.628	0.622
6	0.625	0.615	0.563	0.627	0.622
7	0.625	0.615	0.563	0.627	0.620
8	0.625	0.615	0.563	0.624	0.618
9	0.625	0.615	0.563	0.622	0.616
Lower Plate 1	0.875	0.865	0.788	0.870	0.880
2	0.875	0.865	0.788	0.867	0.881
3	0.875	0.865	0.788	0.865	0.882
4	0.875	0.865	0.788	0.866	0.884
5	0.875	0.865	0.788	0.865	0.884
6	0.875	0.865	0.788	0.864	0.882
7	0.875	0.865	0.788	0.864	0.881
8	0.875	0.865	0.788	0.865	0.881
9	0.875	0.865	0.788	0.865	0.879
Bottom Knuckle 1	0.875	0.865	0.788	0.868	0.899
	0.875	0.865	0.788	0.868	0.890

5.6.1 Tank 41 Primary Wall Minimum Thickness Values

A summary of the minimum thickness values is included in Table 15. Prior to being reported as a minimum thickness value, indications are analyzed and evaluated to report only valid thickness values. All of the minimum values have been evaluated and no service induced reportable thickness areas were detected in Tank 41. No service induced thinning or pitting patterns were noted in any of the primary tank areas examined.

Table 15 Tank 41 Primary Wall Minimum Thickness Values

Tank 41 Plate / 12-inch segment	Nominal	Nom - 0.01"	Reportable (Nom -10%)	P-5 Min FY19	P13 Min FY19
Top Knuckle 1	0.500	0.490	0.450	0.472	0.492
2	0.500	0.490	0.450	0.461	0.453
Top Plate 1	0.500	0.490	0.450	0.490	0.455
2	0.500	0.490	0.450	0.492	0.495
3	0.500	0.490	0.450	0.462	0.484
4	0.500	0.490	0.450	0.491	0.479
5	0.500	0.490	0.450	0.479	0.487
6	0.500	0.490	0.450	0.492	0.496
7	0.500	0.490	0.450	0.495	0.479
8	0.500	0.490	0.450	0.478	0.480
9	0.500	0.490	0.450	0.485	0.470
Middle Plate 1	0.625	0.615	0.563	0.591	0.587
2	0.625	0.615	0.563	0.603	0.594
3	0.625	0.615	0.563	0.611	0.598
4	0.625	0.615	0.563	0.607	0.598
5	0.625	0.615	0.563	0.599	0.600
6	0.625	0.615	0.563	0.612	0.596
7	0.625	0.615	0.563	0.598	0.597
8	0.625	0.615	0.563	0.607	0.594
9	0.625	0.615	0.563	0.607	0.584
Lower Plate 1	0.875	0.865	0.788	0.852	0.857
2	0.875	0.865	0.788	0.854	0.874
3	0.875	0.865	0.788	0.850	0.874
4	0.875	0.865	0.788	0.850	0.880
5	0.875	0.865	0.788	0.812	0.874
6	0.875	0.865	0.788	0.852	0.878
7	0.875	0.865	0.788	0.848	0.878
8	0.875	0.865	0.788	0.850	0.866
9	0.875	0.865	0.788	0.853	0.844
Bottom Knuckle 1	0.875	0.865	0.788	0.845	0.873
2	0.875	0.865	0.788	0.850	0.874

5.7 Tank 50 Results

During a routine visual examination in the annulus of Tank 50, surface corrosion was noted on the secondary wall beneath the A2 riser. An ultrasonic thickness inspection was requested to be performed in the area beneath riser A2 to determine the extent of corrosion and the remaining wall thickness in the area. Although there was heavy corrosion and sheets of material fell off the wall during scanning, the remaining wall thickness is at or above the construction minimum thickness.

Due to the heavy surface corrosion product on the surface the crawler was unable to drive up the secondary wall on the top plate. Figure 20 shows a comparison of the wall crawler wheels. The image on the left shows the normal wheel fenders during a typical inspection and the image on the right shows the corrosion product collected on the wheels during the inspection in Tank 50. Figure 21 shows and image of the wall crawler wheels being completely engulfed during the vertical strip scan. This surface condition prevented the crawler from backing up the top plate and from scanning the lower plate. A vertical strip was scanned beneath the A2 riser. The strip started at the bottom of the top plate. The scan included the second and third plates and a small section of plate 4, the lower plate.

The secondary wall thickness data is provided in Table 16. The average thickness measured in of the areas inspected on the secondary wall and floor was at or above the construction minimum thickness.

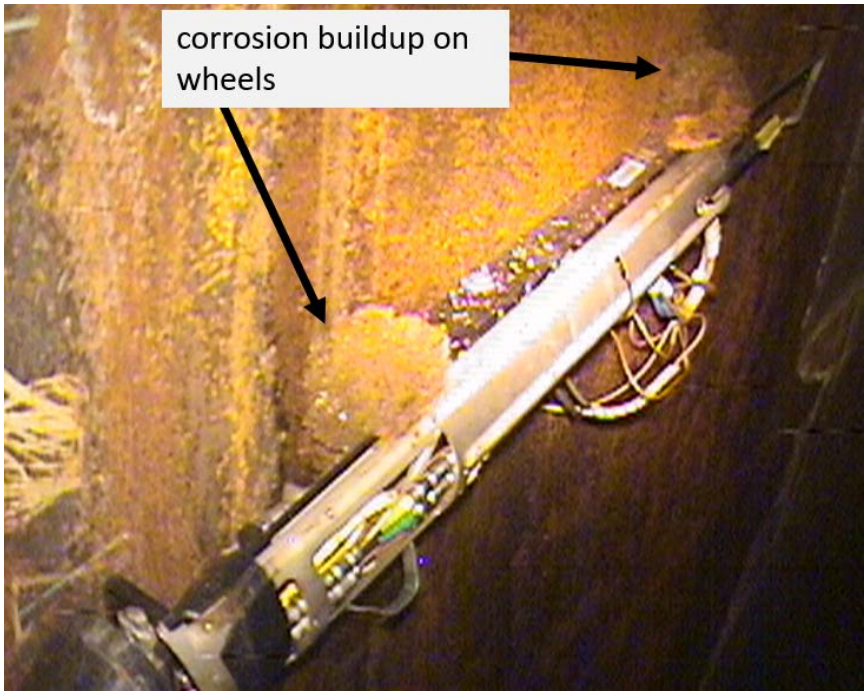
Table 16 Tank 50 Secondary Wall Measured Thickness Values

Tank 50 Plate / 12-inch segment	Nominal Thickness	Nominal - 0.01"	2nd A2 Average 2018	2nd A2 Minimum 2018
Secondary Plate 1	0.375	0.365	0.418	0.378
	0.375	0.365	0.418	0.378
Secondary Plate 2 - 1	0.375	0.365	0.396	0.352
2	0.375	0.365	0.394	0.355
3	0.375	0.365	0.390	0.352
4	0.375	0.365	0.388	0.356
5	0.375	0.365	0.392	0.364
6	0.375	0.365	0.389	0.362
7	0.375	0.365	0.386	0.363
8	0.375	0.365	0.388	0.354
Secondary Plate 3 - 1	0.375	0.365	0.370	0.336
2	0.375	0.365	0.367	0.341
3	0.375	0.365	0.368	0.340
4	0.375	0.365	0.365	0.343
5	0.375	0.365	0.370	0.341
6	0.375	0.365	0.374	0.343
7	0.375	0.365	0.368	0.324
8	0.375	0.365	0.369	0.336
Secondary Plate 4	0.375	0.365	0.378	0.339
	0.375	0.365	0.378	0.339

* Construction minimum thickness

Figure 20: Comparison of buildup on wall crawler wheels

Figure 21: Corrosion product buildup on wall crawler wheels



5.8 Conclusions

This is the second year of the third cycle of UT inspections on SRS Type III/IIIA tanks.

In FY 2019, ultrasonic inspections were performed in six waste tanks at Savannah River Site. Tanks 25, 26, 33 and 34 were scheduled for and received the standard, full ISI inspection. Tanks 41 and 50 were a specially defined scope examinations. A combined total of 103 plate/strips were examined for thickness mapping, equating to over 60,000 square inches of area inspected on the primary walls in FY 2019. Secondary walls and the annulus floor were also examined in Tanks 25, 26, 33 & 34. Previous examinations were repeated with very comparable results.

There were no service induced reportable thicknesses or pitting encountered.

The results indicate that the implemented Corrosion Control Program continues to effectively mitigate corrosion in the SRS waste tanks.

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