Tank Inspection NDE Results for Fiscal Year 2007 Including Waste Tanks 35, 36, 37, 38 and 15

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1 EXECUTIVE SUMMARY

Ultrasonic (UT) nondestructive examinations (NDE) were performed on waste storage tanks 35, 36, 37, 38 and 15 at the Savannah River Site as a part of the "In-Service Inspection (ISI) Program for High Level Waste Tanks." [1] The inspections were performed from the annular space of the waste storage tanks. The inspections included thickness mapping and crack detection scans on specified areas of the tanks covering all present and historic interface levels and selected welds with particular emphasis on the vapor space regions. Including the tanks in this report, all of the 27 Type III tanks at SRS have been inspected in accordance with the ISI plan.

Of the four Type III tanks examined this year, all had areas of reportable thickness in either the Primary or Secondary tank. All of these areas on the primary tank are attributed to fabrication artifacts. None of the four Type III tanks examined this year showed evidence of service induced thinning on the primary wall. All four tanks had secondary wall and/or floor plates where the remaining thickness measured below the 10% wall loss criteria.

Tank 15, a Type II, non-stress relieved, waste tank was also inspected this fiscal year as part of the ISI program. The same examination techniques were used on Tank 15 as on the Type III tanks. Tank 15 has been out of service due to leakage from stress corrosion cracking (SCC). Inspections were performed to validate known corrosion models and determine if crack growth occurred since the previous examination five years ago. Several cracks were found to have increased in length perpendicular to the weld seam.

In the areas of the 27 Type III tanks inspected to date, ten tanks have reportable thickness in the primary wall and 17 have reportable thickness in the secondary tank walls or floor. All of the reportable thickness areas in the primary walls are from fabrication artifacts. Incipient pitting has been detected in five of the 27 Type III primary tanks. No cracking was detected in any of the areas examined in the Type III tanks.

2 NDE INSPECTION REQUIREMENTS

The ISI Program for HLW Tanks stipulates the frequency and extent of the areas to be examined, as well as the damage mechanism(s) to be detected. Five of the 27 Type III tanks were selected for routine full-scope inspections, while an augmented inspection was performed on the balance of the tanks. The tanks selected for the routine inspections will provide data for trending any active corrosion mechanisms that may occur during their remaining service life. The basis for selection of these tanks was presented within "Selection of Representative High Level Waste Tanks for Ultrasonic Examination (U)." [2] Categories were constructed to identify tanks with similar risks for corrosion. The features considered in the categorization were materials of construction, service history, tank function, and projected future use. A ranking system was developed that provided the selection of the tanks for the routine inspection. The augmented inspection is scheduled as a one-time inspection and will be utilized to verify that no unexpected accelerated corrosion is occurring in the remaining tanks.

The ISI Program for HLW Tanks calls for the following regions of a tank to be inspected in a full scope inspection:

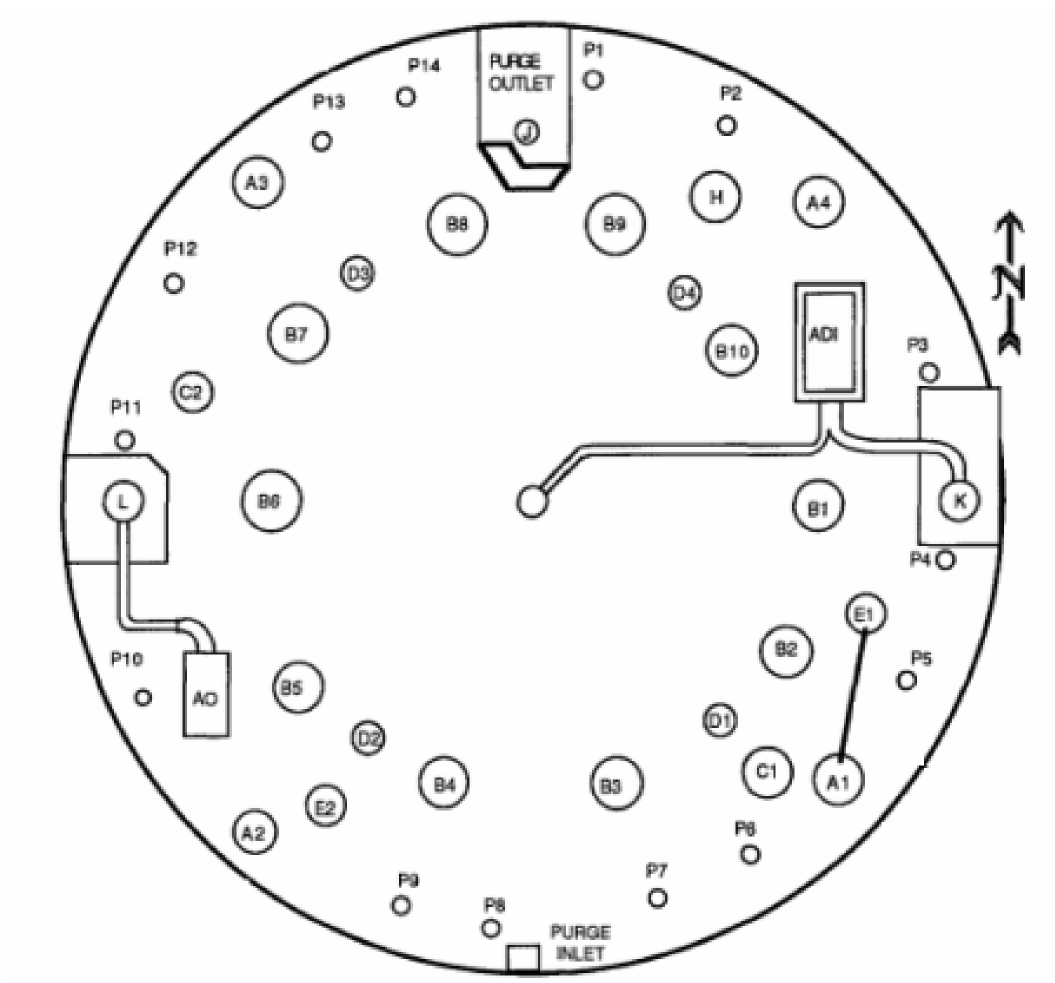
- Liquid Vapor Interface
- Liquid Sludge Interface
- Upper Weld of Lower Knuckle of Primary Tank (5% of accessible circumference)
- Lower Knuckle Base Material
- External surface of primary tank (includes vapor space)
- Vertical and horizontal welds other than the lower knuckle weld (one vertical course section and 5% of middle horizontal weld)

These general requirements are further delineated in an inspection plan for each specific tank to be inspected. As an example of a full scope inspection, Tank 29 was inspected in accordance with "Liquid Waste Division Program - UT Inspection Plan for Tank 29" [3] which stipulates the following inspections specific to Tank 29:

- Four 8.5 inch wide vertical strips for general corrosion, pitting and cracking under risers P-02, P-05, P-09 and P-12.
- A two square foot area on each accessible plate of the secondary liner will be scanned for thinning and pitting below one riser.
- Approximately 100 square inch area on the annulus floor below one riser for thinning and pitting if accessible.
- One full length vertical weld for parallel and perpendicular cracking.
- Bottom Knuckle Weld (top weld of the bottom knuckle) for parallel and perpendicular cracking for a length of 5% (~13 feet) of the circumference.
- Lower Plate Weld (middle plate to lower plate horizontal weld) for parallel and perpendicular cracking for a length of 5% (~13 feet) of the circumference.

Figure 1 provides the riser layout for Tank 29. The other Type III tanks have similar riser arrangements. Access to the annulus is though 8 inch diameter carbon steel risers that are four feet six inches long. Figure 9 shows a side view of a typical tank.

Figure 1: Typical Riser Layout Sketch - Tank 29



3 NDE TECHNIQUES

NDE inspections included remote automated ultrasonic (AUT) inspection supplemented by remote visual inspection. Ultrasonic inspections included the following techniques which are described in this section:

1. Thickness Mapping
2. Weld Inspection/Crack Detection
3. Ultrasonic Flaw Sizing
4. Though-wall bleed out

3.1 Inspection Equipment

All ultrasonic inspections were performed utilizing the P-scan, automated ultrasonic system and remotely operated magnetic wheel scanner known as the wall crawler. The prescribed regions were inspected utilizing two basic data collection techniques:

1. Vertical Strips – base material thickness mapping and crack detection scans, and
2. Weld Inspection - scans of weld and heat affected zones to detect and characterize cracking oriented parallel and/or perpendicular to the weld seam.

3.1.1 Ultrasonic System

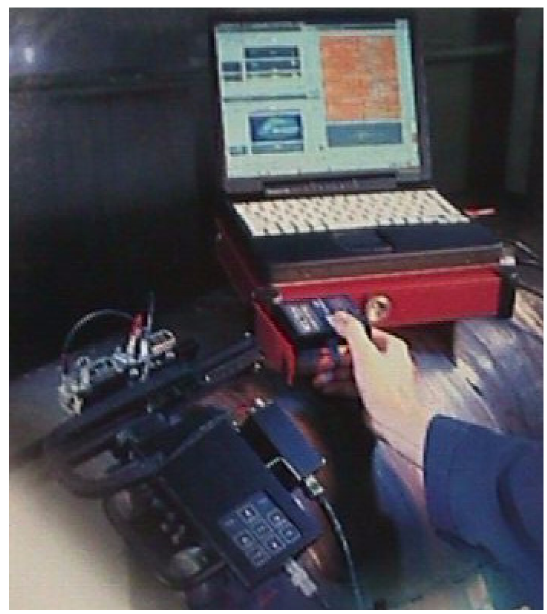
The UT system utilized for these inspections was the FORCE Technology, P-scan, PS4-Lite, automated, ultrasonic system. This system is capable of performing inspections with multiple transducers and techniques simultaneously. (Figure 2)

The PS4-Lite is capable of performing thickness mapping, weld inspection and A-scan recording simultaneously. It was used to operate 2 angle beam and 1 thickness mapping transducer or 4 angle beam probes simultaneously.

The PS4-Lite is operated through a laptop computer as the user interface.

The system also controls the wall crawler.

Figure 2: P-Scan Automated UT System



3.1.2 Wall Crawler

The wall crawler is a commercially available, FORCE Technology, P-scan, Automatic Modular Scanner (AMS) crawler. The crawler is attached to the steel tank wall by the strong, permanent magnetic wheels. (Figure 3)

The crawler is capable of being installed through a five inch carbon steel riser. It can scan with up to 4 transducers. The wall crawler is typically outfitted with a remote control pan and tilt camera system with auxiliary lighting.

The wall crawler included a pneumatically activated camera boom arm to lift the pan and tilt camera about 10 inches off the surface. It also has pneumatic lifting feet to de-couple it from the tank wall to allow removal from the annulus.

Figure 3: P-scan AMS Wall Crawler

3.2 Procedure and Equipment Qualification

The NDE procedures and equipment utilized for thickness mapping and weld inspection were qualified to the requirements of the ISI Program for HLW Tanks prior to performing inspections in the tank. The requirements stipulate that the UT system (instrument, transducer, scanning device, and cables) shall have the following detection limits (tested at ½ inch nominal thickness):

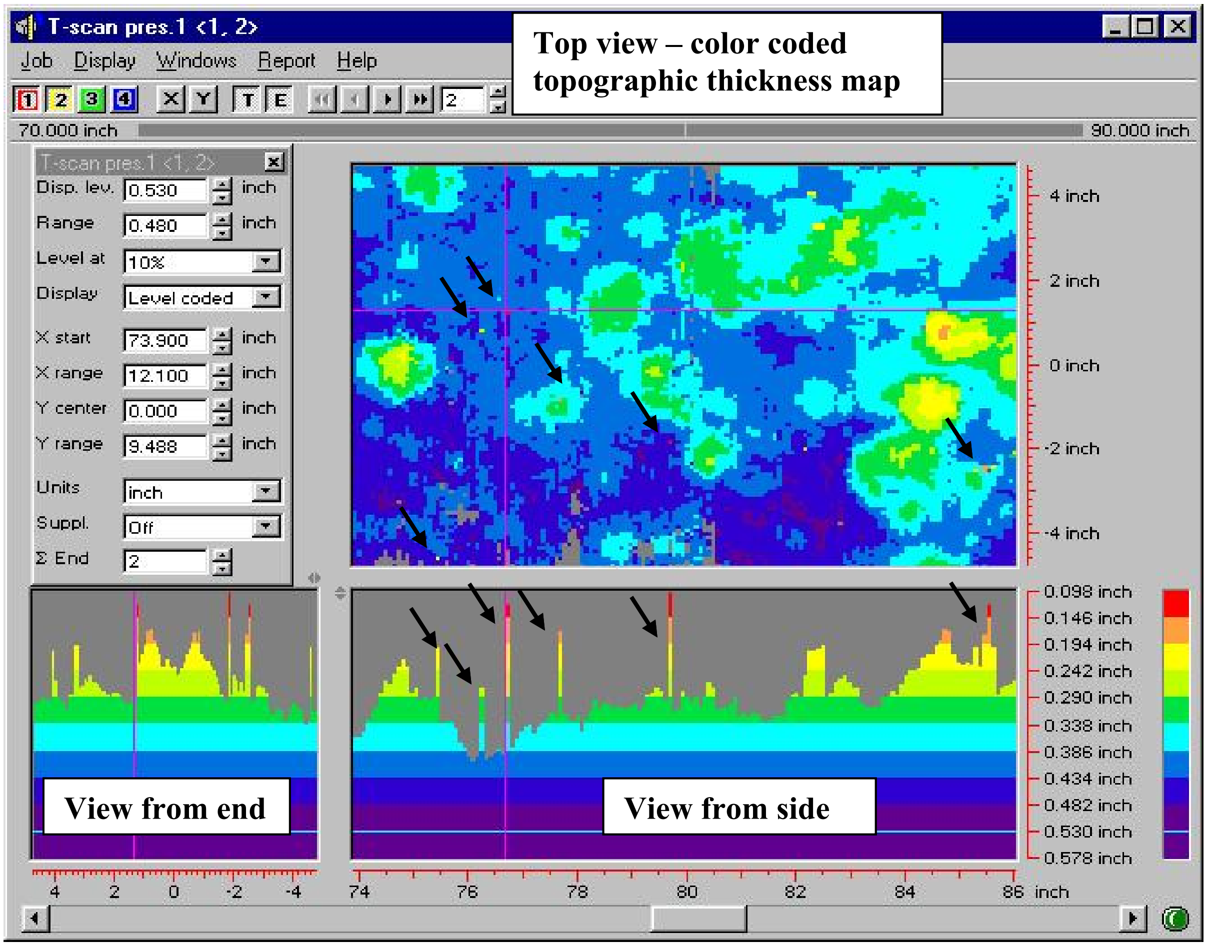
1. General corrosion/thinning detection within 0.020 inch.
2. Pitting detection within 0.050 inch. (elliptical or hemispherical)
3. Crack depth detection within 0.100 inch, $\geq$ 0.5 inch long, < 6 inches long. In the absence of an acceptable cracked sample, a machined notch 0.05 inch deep x 1 inch long can be used instead of a crack.

3.3 Thickness Mapping

Thickness mapping includes wall thickness measurement as well as the detection and sizing of corrosion, pitting, and interface attack. Thickness mapping was performed on 8.5 inch wide vertical strips. Thickness mapping data was collected over the entire accessible height of each tank to ensure coverage of all areas and environments in the tank. By collecting data in a continuous strip from top to bottom, all present and historic interface levels are examined as well as the vapor space of the tank.

The "T-scan" thickness mapping program was utilized to provide color-coded thickness plots from the top, side and end views. This data was collected utilizing a dual element, 0 degree, longitudinal wave transducer (Krautkramer MSEB5E) operating at 5 MHz. Figure 4 provides an explanation of the thickness mapping data.

Figure 4: Explanation of Thickness Mapping Image

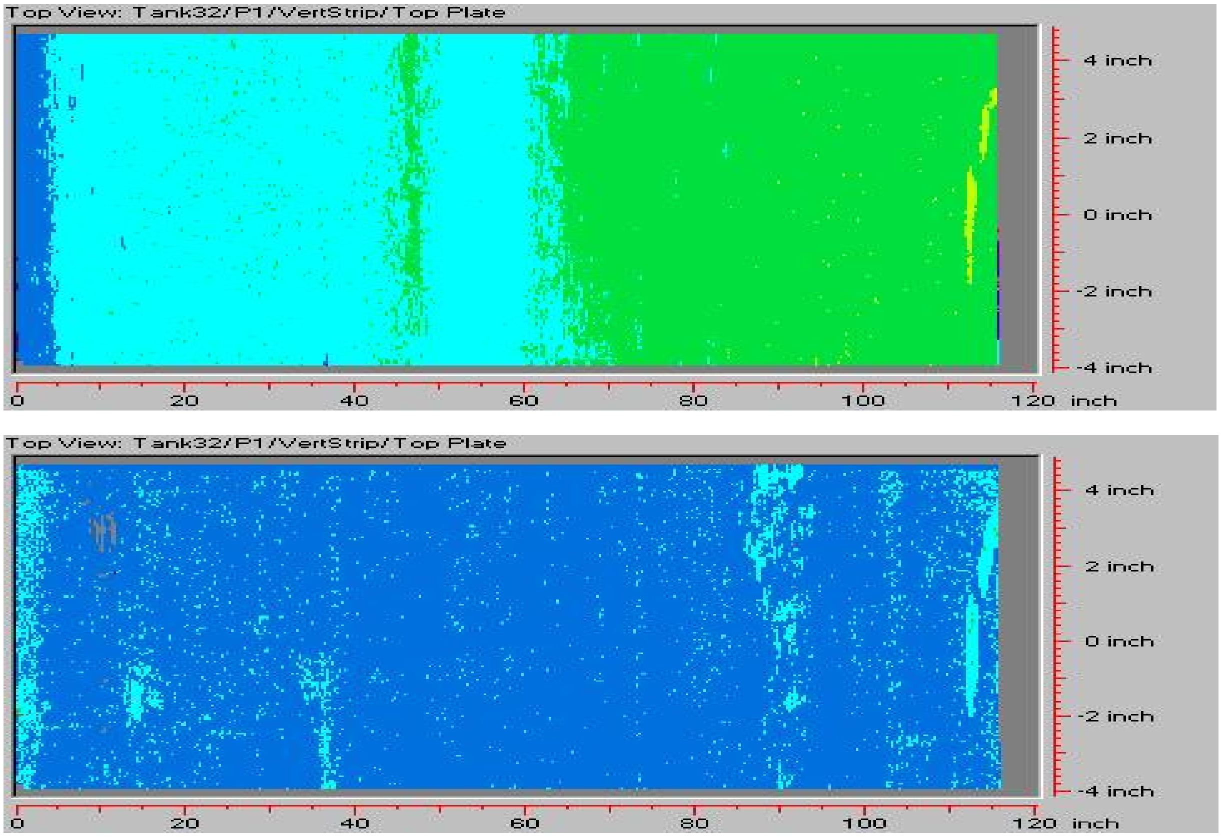


This figure shows thickness mapping data collected on a carbon steel sample. This sample data shows naturally occurring pitting corrosion in a carbon steel pipe sample at the liquid vapor interface. The image shows pitting and corrosion patterns typical of actual wall loss as well as noise spikes (also known as data dropout). The noise spikes are noted with arrows in the top and side views.

3.3.1 Thickness Mapping Techniques

Data analysis is typically performed by analyzing each 12 inch long section of data at a high sensitivity. The more sensitive, first-echo or contact, techniques are evaluated for detection of pitting and interface attack. The multiple echo technique is typically used to record the average and the minimum thickness for each section. Although only two numbers are presented for each 12 inch long area, thousands of data points were evaluated to determine those two numbers. The multiple echo technique was included in all thickness mapping examinations performed this fiscal year and will be included in all future tank inspection thickness mapping examinations. Historically, the multiple echo technique has been used only on painted surfaces to minimize the measurement error from the coating. The multiple echo technique was added primarily to provide for a better comparison to the historical spot reading “skate” data collected on waste tanks. In evaluating and utilizing the multiple echo technique on these uncoated tanks, we discovered that this technique is beneficial in minimizing the effects of temperature variations, inconsistent contact caused by surface debris and probe wear. Although the probes are mounted in probe holders with a slight stand-off from the wear-face to minimize wear, the probes may get knocked into a position where they can wear slightly. Figure 5 provides a thickness mapping image from the vertical strip of the top plate taken under riser P-01 of Tank 32. The figure includes two images from the same scan at the same display settings. The top image is one of the first echo techniques and the bottom image is from a multiple echo technique.

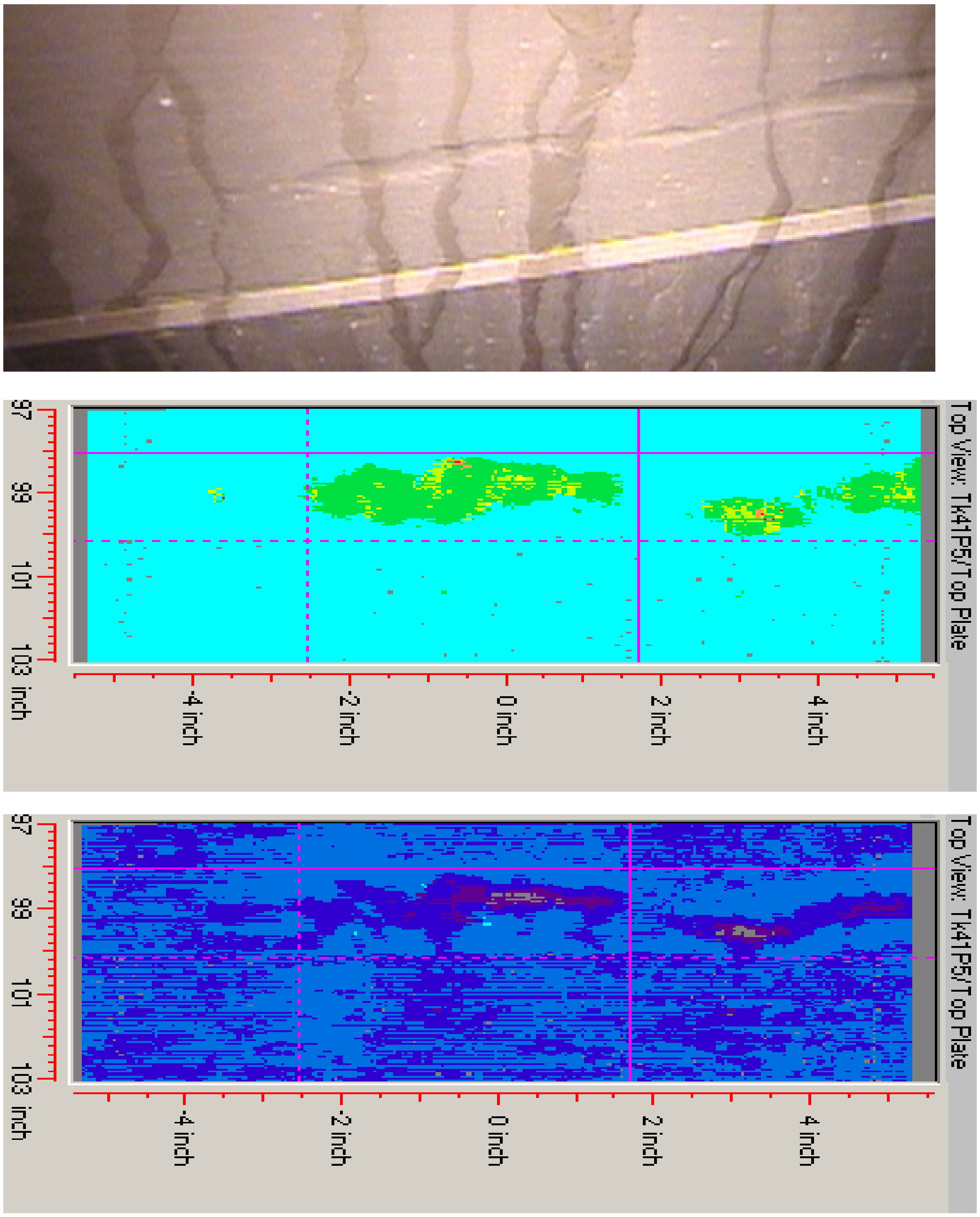
Figure 5: Comparison of First and Multiple Echo Techniques



The images in Figure 5 are of the same area shown with different techniques that were collected simultaneously with the same transducer. The top image appears to show thinning as the scan progresses, starting dark blue and changing to light blue, green and light green at the end. The bottom image shows that the thickness actually remained consistent over the length of the plate. The thinner ID grinding areas at the end are displayed in both images. In this case, the transducer position in the probe holder was apparently changed during deployment or while crossing a weld. The probe wore slightly as the scan progressed, thereby indicating thinner than actual readings. The technique used in the top image was found to be out of tolerance on the calibration check, but the multiple echo technique remained in calibration. The calibration check showed the first echo technique to read over 0.03 inches thinner than actual, but the multiple echo technique remained within 0.005 inches of the initial calibration. All thickness values are based on the multiple echo technique, which remained in calibration so no corrective action was required. The contact techniques are for information and increased sensitivity to pitting.

Another advantage of the multiple echo technique is its ability to help discriminate exterior surface conditions from interior surface conditions. Figure 6 provides a photograph of a grinding area on the exterior of the tank. The area is painted, proving it is pre-service. The images below the photograph show the multiple echo (top) and first echo data. The multiple echo data shows the OD grinding area with the same pattern as the photograph as thinner than the surrounding area. The bottom image is contact data and does not provide as clear a picture of the OD grinding area. In fact, the contact method actually provides thicker than actual readings due to the increased water gap in the grinding area.

Figure 6: OD Grinding With First and Multiple Echo Techniques



3.3.2 Thickness Mapping Measurement Uncertainty

A recent effort was made to evaluate and determine the measurement uncertainty of the current thickness mapping techniques and refine the uncertainty values for the historical data for more accurate comparison of all available thickness data.[4] Initial work to determine measurement uncertainty was performed on historic spot thickness reading (skate) measurements and extrapolated to the thickness mapping values. [5] This initial effort was known to be very conservative and provided for an uncertainty of 0.011 inches. In the initial approach "some of the variation attributed to a lack of precision for the skate system was actually due to true wall thickness differences around the nominal location." This led to a conservative estimate of skate uncertainty. This value was initially applied to the thickness mapping results understanding that there was still conservatism in the uncertainty. In an effort to determine a more representative value of actual uncertainties obtained in field conditions this issue was revisited.

Automated thickness mapping data was collected on samples and calibration blocks of known and traceable thickness values. While making an effort to reproduce field conditions, known samples were scanned and evaluated multiple times. Data was collected, analyzed and reported in the same manner as actual tank data. Additional work was also applied to the historical data to apply the same approach.

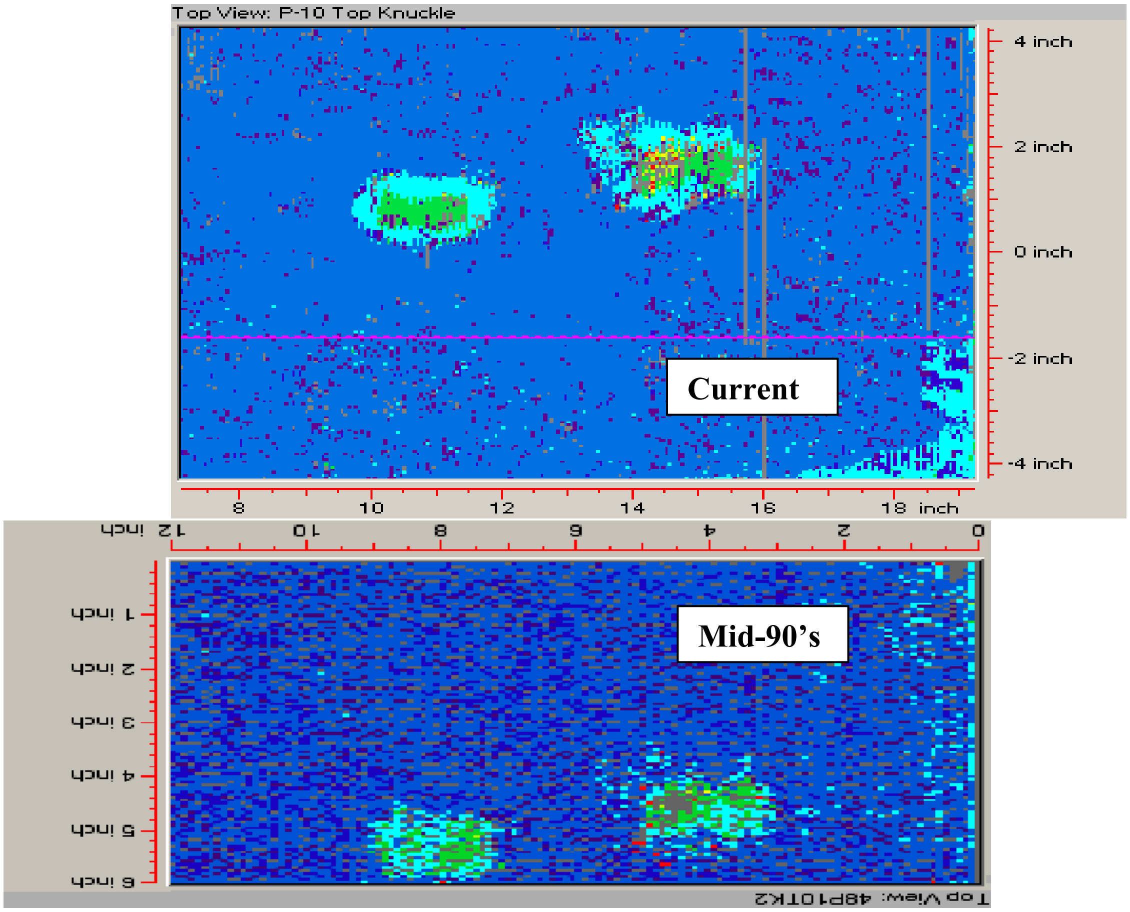
This study produced the following values which are more representative of actual uncertainties expected in field conditions:

- The 95% uncertainty for multiple echo method is 0.00553 inches. (typical reporting method)
- The 95% uncertainty for the contact method is 0.00797 inches. (Tanks 13 and 15 in 2002)
- The 95% uncertainty for historical skate method is 0.00233 inches.

3.3.3 Original Thickness Mapping Technique – Mid 1990's (T-scan)

The first instance of performing thickness mapping on an underground high level waste storage tank was performed on SRS Tank 50 in September 16, 1994. This performance demonstration was the first of many inspections performed on selected Type III tanks. During this period tanks 40, 42, 48, 49, 50 and 51 were examined at least once. These thickness mapping inspections have similarities with the examinations being performed as part of the current ISI program. The inspections were performed utilizing a site designed and fabricated magnetic wheel crawler and the commercially available P-scan automated UT system (PSP-3). The examinations were focused on detection of service induced thinning such as pitting and general wall thinning. The examinations included a thickness mapping scan in a vertical strip six inches wide for the entire accessible height of the tank. These examinations were typically performed on the same painted strips where the spot thickness readings were taken during the early 1980's. The acceptance criteria for these examinations was contained in "Performance and Acceptance Criteria for Pending HLW Tank Insitu Ultrasonic Examination (U)." [6] The reporting criteria stated to report pitting which exceeds 35% of the tank plate section being examined and to report general thinning in excess of 15% of nominal thickness. The inspections utilized a dual element transducer for the detection of pitting. The resolution, or pixel size, of the inspections was typically 0.075 to 0.10 inches compared to the 0.050 inch pixel size of the current inspections. Figure 7 provides a comparison of the current technique (top image) with the mid-90's era data (bottom image). The mid-90's era data shows the same indications, but the resolution and detail is not as good. Several of the mid-90's era images are presented later in this report. Due to different scanning devices being used and the Top Knuckle being scanned from the bottom up in the 90's, the 1996 data image was flipped vertically and horizontally to match the current data display. The current data includes 8.5 inches where the mid-90's vertical strips were 6 inches wide. The two sets of data, collected 9 years apart, are slightly offset, but the same indications are in both.

Figure 7: Comparison of Mid-90's era Data with Current Technique



3.4 Weld Inspection and Crack Detection

Weld inspection and crack detection were performed to detect stress corrosion cracking (SCC) oriented parallel and/or perpendicular to the weld seam for weld inspections and to look for vertically oriented SCC in the vertical strip inspections. Crack detection was performed with the same ultrasonic system utilizing the "P-scan" amplitude based weld inspection software. Stress corrosion cracking was determined to be the cause of leaks in Type I and II, non-stress-relieved tanks. Crack detection was performed utilizing single element, 45 degree shear wave transducers (Krautkramer MWB-45-4E) operating at 4 MHz.

3.5 Ultrasonic Flaw Sizing

When indications were detected with ultrasonic techniques, the extent of the indications were measured or "sized". The location and length/width in the X and Y directions were determined based on where the indication was discernable from the background noise or thickness.

1. Pitting indications were reported based on remaining, sound, metal (ligament) above the pit. The depth of any pit indication was determined by subtracting the minimum thickness reading obtained from the pit from the thickness of the area adjacent to the pit.

2. No cracking was detected in any of the Type III tanks inspected. Techniques for planar flaw sizing were utilized in sizing the cracks in Tank 15 and for discrimination and evaluation of other indications. Cracking lengths were reported to the point(s) where the indication was no longer

discernable from the noise. Crack depths were determined utilizing planar flaw sizing techniques. Utilizing the same transducer(s) that were used for detection, the amplitude was adjusted to locate the deepest point on the crack. When indications were less than 100 percent through wall, a measurement of the remaining metal (ligament) was made utilizing the Absolute Arrival Time Technique (AATT). AATT is a planar flaw sizing technique, used throughout industry that provides a direct reading of depth to the crack tip

3.6 Through-Wall Bleed-Out

Through-wall bleed-out is the term being used to describe the field implemented variation of a liquid penetrant surface inspection technique. It was noted that the water being used for UT couplant, would penetrate (through capillary action) surface cracks. Due to the elevated temperature of the tank wall (~120 degrees F), the wetted surface would dry after a few minutes. Where there was a crack open to the exterior surface, the water drawn into the crack would then bleed out providing a high contrast image of the open crack. Video cameras were utilized to view these indications and make crude measurements of length as the crawler was driven along the indication(s). Figure 8 provides an example of this technique on the crack in the middle horizontal weld at 192 feet.

Figure 8: Example of Through-Wall Bleed-Out

3.7 Vertical Strips

Vertical strip inspections include thickness mapping for the detection of thinning, pitting and interface attack and crack detection for cracking oriented vertically in the tank. The vertical strips are typically 8.5 inches wide (0.25% of the circumference) and cover the entire accessible height of the primary tank wall including top and bottom knuckles and all plate sections where accessible.

3.8 Secondary Wall

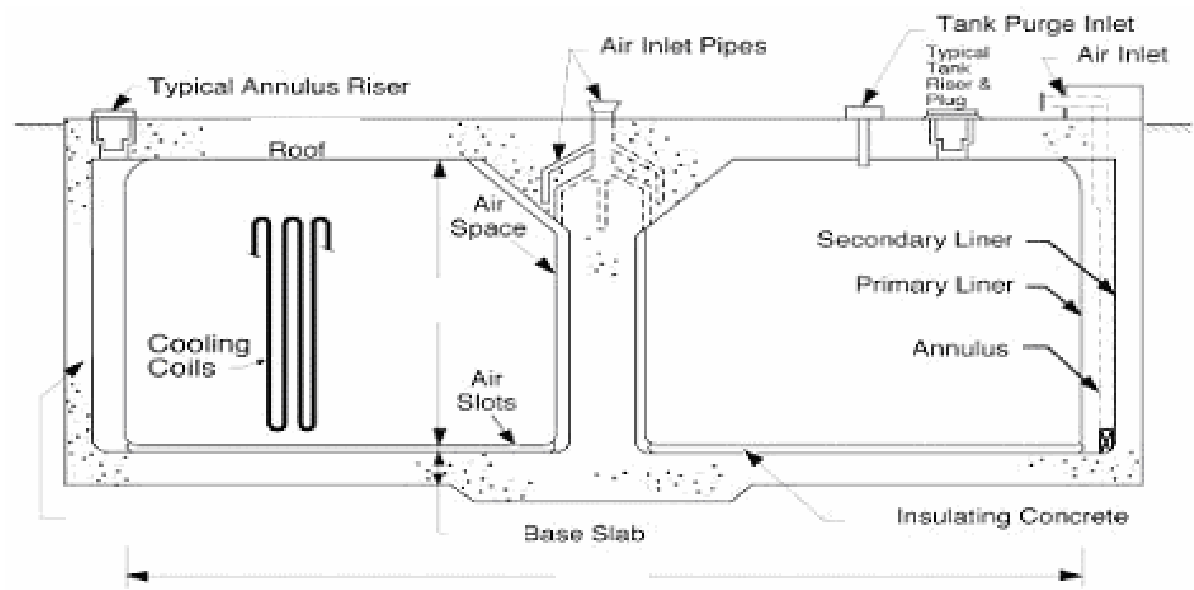
Secondary wall inspections include thickness mapping for detection of thinning and pitting. A two square foot area is scanned on each accessible plate/course section under one riser. This area us typically scanned as a 10 x 30 inch area which is over two square feet. A section of the secondary floor from the ventilation duct to the primary tank is also scanned.

4 NDE DATA COLLECTION

4.1 Tank Design and Service History

All Type III tanks are 1.3 million gallon capacity, double shell tanks with an annular space. All four Type III tanks covered in this report were fabricated to ASME BPV Section VIII. Tanks 35 - 37 were fabricated from A516, Grade 70 (normalized) carbon steel and tank 38 was fabricated from A537, Class 1 carbon steel. After all fabrication work was completed, the primary tanks of type III tanks were stress relieved by post weld heat treatment (PWHT). Access to the annular space and the exterior surface of the Type III primary tank is through 8 inch diameter carbon steel risers that are four feet six inches long. Figure 1 shows the riser layout, Figures 9 and 10 provide a side view of a typical Type III tank and a Type II tank. Table 1 provides a summary of fabrication, service and inspection history.

Figure 9: Type III Waste Tank



- Tank 15 is a Type II tank and has a 1.03 million gallon capacity. Tank 15 was fabricated from A285, Grade B carbon steel to ASME BPV 1952 in 1956 and was not (PWHT) stress relieved. Access to the annular space and the exterior surface of the primary tank is through 5-6 inch diameter risers.

Figure 10: Type II High Level Waste Tank

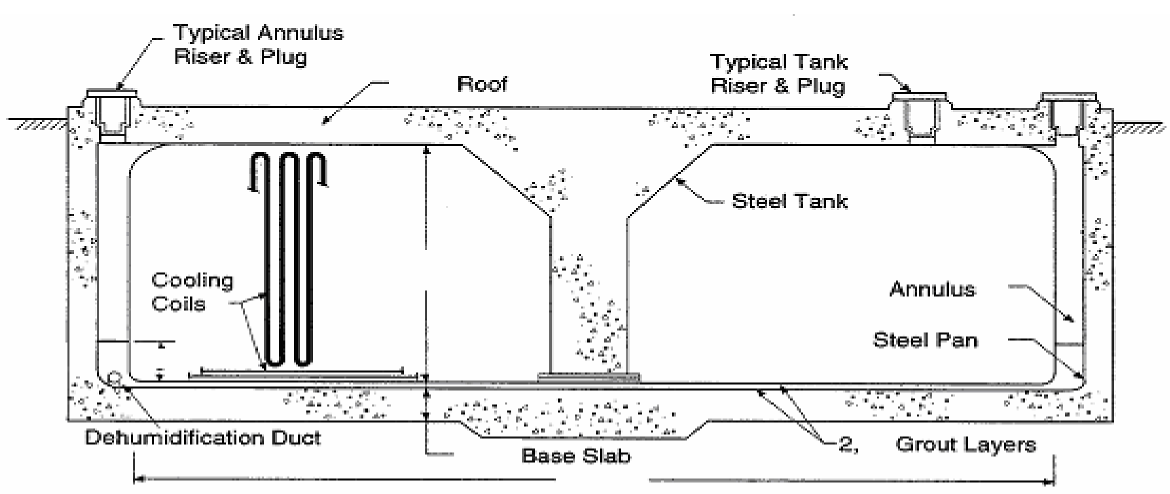


Table 1 Tank Fabrication, Service and Inspection Summary

	Tank 35	Tank 36	Tank 37	Tank 38	Tank 15
Year Entered Radioactive Service	1977 (~30 years service at time of inspection)	1977 (~30 years service at time of inspection)	1978 (~29 years service at time of inspection)	1981 (~26 years service at time of inspection)	1960 (~47 years service at time of inspection)
Service Condition	Fresh Waste Receivers (FWR)	Evaporator Bottoms Receiver (EBR)	Evaporator Bottoms Receiver (EBR)	Unconcentrated Supernate Storage (USS)	Out of Service
Top Knuckle	0.5”	0.5”	0.5”	0.5”	0.562”
Top Plate	0.5”	0.5”	0.5”	0.5”	0.625”
Middle Plate	0.625”	0.625”	0.625”	0.625”	Type II tank, No middle plate
Lower Plate	0.875”	0.875”	0.875”	0.875”	0.625”
Bottom Knuckle	0.875”	0.875”	0.875”	0.875”	0.875”
Previous UT Data /Spot Readings	Previous UT spot readings showed no detectable thinning.	Previous UT spot readings showed no detectable thinning.	Previous UT spot readings showed no detectable thinning.	Previous UT spot readings showed no detectable thinning.	Previous UT spot readings showed no detectable thinning. 2002 thickness mapping showed no reportable thinning, but incipient pitting was detected.
Inspection Performed in FY07	Augmented (1) Plus scans of secondary wall and floor	Augmented (1) Plus scans of secondary wall and floor	Augmented (1) Plus scans of secondary wall and floor	Augmented (1) Plus scans of secondary wall and floor	Full (2) Plus scans of previous cracks, No secondary
Job Number	H20070102	H20070482	H20070483	H20070156	H20070342
Scan Plan	LWO-LWE-2006-00119	LWO-LWE-2007-00121	LWO-LWE-2007-00155	LWO-LWE-2006-00151	LWO-LWE-2006-00112
Timeframe (see Table)	November 2006 Table 9	July – August 2007 Table 9	August 2007 Table 9	January 2007 Table 9	April – June 2007 Table 9
FY07 Thickness Summary	Table 3	Table 4	Table 5	Table 6	Table 7 / Cracks in Table 8

(1) Vertical strip for cracking, thinning and pitting for entire accessible height of tank. Thickness mapping was also performed on a two square foot area on all four secondary wall plates under one riser.
(2) Re-inspection including four vertical strips, one vertical weld and ten percent of the circumference of the middle horizontal weld.

4.2 Personnel

Nondestructive examination data was collected and analyzed by certified NDE personnel from the SRNL Materials NDE and Consultation group. Data collection was performed by James B. Elder III, ASNT ACCP Level III UT & VT and Rodney W. Vande Kamp, Level II UT & VT. All data analysis was performed by J. Elder and reviewed by R. Vande Kamp.

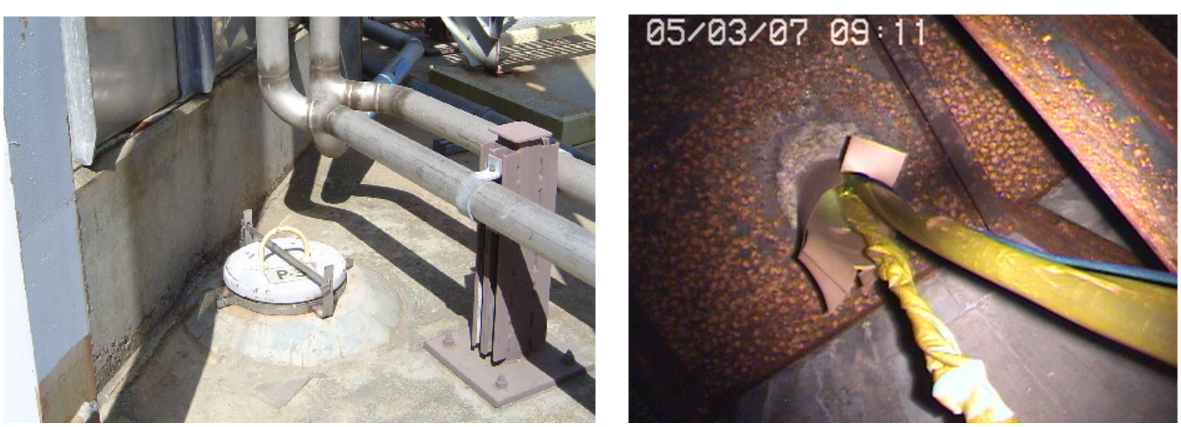
LWDP/Area Technical Project Services, LWDP INM group, LWDP Operations and Radiation Control personnel assisted in various ways.

4.3 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 11) which was up to 100 feet from the riser. Access to the annulus was through inspection ports or risers (see Figure 12). These risers are eight inch diameter carbon steel pipe four feet six inches long. A remote pan & tilt camera was also inserted into the annulus to monitor crawler movement. The Type III tank annuli are clean and therefore a contamination control hut was not required. Tank 15 is in a contamination area. During the inspection a certified hut was utilized for contamination control and the area was a radiation area. The inspections were performed in one or two pairs of protective clothing. Respiratory protection was typically not needed due to active contamination controls. The control trailer was in a clean area at 100 – 150 feet from the hut.

Figure 11: NDE Control Trailer and Generator

Figure 12: Typical P-Riser / Inspection Port



Left image is tank top view of typical Type III tank "P" riser. Image on right is from in the annulus looking back at a Tank 15 inspection port. Note paper sleeve in riser and yellow cable sleeve for contamination control.

4.4 Scan Plans and Inspection Areas

A tank specific scan plan describing required inspections was issued for each tank. All of the required inspections were performed by deploying the wall crawler through risers into the annulus. The scan plan and risers used for each tank are listed below:

4.4.1 Tank 35

Scan Plan LWO-LWE-2006-00119:
The scan plan called for an augmented scope inspection. Tank 35 had previous UT spot reading data under Risers A-01, A-02, A-03 & A-04 in 1977, 1981 and 1985. Prescribed inspections included one 8.5 inch wide vertical strip beneath the A-01 annulus riser along the accessible height for thinning, pitting and cracking. It also included a two square foot area on each accessible plate of the secondary liner for thinning and pitting and a 10 inch wide strip on the annulus floor for thinning and pitting.

Inspections:

- The crawler was deployed through Riser P-02 to perform the prescribed inspections. One vertical strip 8.5 inches wide was examined that included the top knuckle, top plate, middle plate, lower plate and bottom knuckle for thinning, pitting and cracking under Riser A-01.
- A two square foot area on each of four wall plates and a 10 inch wide strip on the floor of the secondary liner were examined for thinning and pitting under Riser P-02.

4.4.2 Tank 36

Scan Plan LWO-LWE-2007-00121:
The scan plan called for an augmented scope inspection. Tank 36 had previous UT spot reading data under Risers P-02, P-05, P-09 and P-12 in 1977, 1981 and 1985. Prescribed inspections included one 8.5 inch wide vertical strip beneath the P-02 annulus riser along the accessible height for thinning, pitting and cracking. It also included a two square foot area on each accessible plate of the secondary liner for thinning and pitting and a 10 inch wide strip on the annulus floor for thinning and pitting.

Inspections:

- The crawler was deployed through P-02 to perform the prescribed inspections. One vertical strip 8.5 inches wide was examined that included the top knuckle, top plate, middle plate, lower plate and bottom knuckle for thinning, pitting and cracking under Riser P-02.
- A two square foot area on each of four wall plates and a 10 inch wide strip on the floor of the secondary liner were examined for thinning and pitting under Riser P-02.

4.4.3 Tank 37

Scan Plan LWO-LWE-2007-00155:
The scan plan called for an augmented scope inspection. Tank 37 had previous UT spot reading data under Risers P-02, P-05, P-09 and P-12 in 1977, 1981 and 1985. Prescribed inspections included one 8.5 inch wide vertical strip beneath the P-02 annulus riser along the accessible height for thinning, pitting and cracking. It also included a two square foot area on each accessible plate of the secondary liner for thinning and pitting and a 10 inch wide strip on the annulus floor for thinning and pitting.

Inspections:

- The crawler was deployed through P-09 to perform the prescribed inspections. One vertical strip 8.5 inches wide was examined that included the top knuckle, top plate, middle plate, lower plate and bottom knuckle for thinning, pitting and cracking under Riser P-09.
- A two square foot area on each of four wall plates and a 10 inch wide strip on the floor of the secondary liner were examined for thinning and pitting under Riser P-09.

4.4.4 Tank 38

Scan Plan LWO-LWE-2006-00151:
The scan plan called for an augmented scope inspection. Tank 38 had previous UT spot reading data under Risers A-02, A-04, P-02, and P-09 in 1980 and 1984. Prescribed inspections included one 8.5 inch wide vertical strip beneath the P-09 annulus riser along the accessible height for thinning, pitting and cracking. It also included a two square foot area on each accessible plate of the secondary liner for thinning and pitting and a 10 inch wide strip on the annulus floor for thinning and pitting.

Inspections:

- The crawler was deployed through P-09 to perform the prescribed inspections. One vertical strip 8.5 inches wide was examined that included the top knuckle, top plate, middle plate, lower plate and bottom knuckle for thinning, pitting and cracking under Riser P-09.
- A two square foot area on each of four wall plates and a 10 inch wide strip on the floor of the secondary liner were examined for thinning and pitting under Riser P-09.

4.4.5 Tank 15

Scan Plan LWO-LWE-2006-00112:
The scan plan called for a re-inspection of areas examined in 2002. This was basically a full scope inspection plus the examination of 10 cracks. Due to the tank configuration, scanning of the secondary pan was not performed. Tank 15 had limited previous UT spot reading data from under the South riser from 1972, 1977, 1980 and 1984. P-scan UT thickness mapping was performed in the same locations in 2002. Prescribed inspections included one 8.5 inch wide vertical strip beneath four risers along the accessible height for thinning, pitting and cracking.

Inspections:

- Contamination control huts were built and the crawler was deployed through 3 inspection ports to perform the prescribed inspections. Four vertical strips, 8.5 inches wide, were examined that included both vertical wall sections of the tank. Inspections were performed under IP55, IP107, IP 182 and the East riser.
- 10 previously scanned crack indications were reexamined to document crack growth. These indications are detailed in Table 8.

5 NDE RESULTS

Inspection data was analyzed by certified ASNT, ACCP, NDE Level III personnel, reviewed by certified personnel then presented to the ISI Review Committee (ISIRC) for acceptance. The ISIRC included representatives from LWO Engineering, SRNL/Materials Science and Technology and DOE. A summary of NDE results was presented to the ISI Review Committee at the completion of data analysis. The function of the ISIRC was to review the data and determine if any additional data was required. ISI Review Committee Reports were written for each tank.

5.1 Data and Record Storage

NDE data sheets, P-scan data files and video tapes are stored by the MNDE&C group under the following NDE Job numbers:

Tank 35 - Job # H20070102	Tank 36 - Job # H20070482
Tank 37 - Job # H20070483	Tank 38 - Job # H20070156
Tank 15 - Job # H20070342	

5.2 Summary

Four Type III waste tanks were inspected. The inspections were performed from the annular space of the 1.3 million gallon waste storage tanks. A steerable, magnetic wheel wall crawler was used to simultaneously collect data with up to four UT transducers and two cameras. One Type II, non-stress relieved waste tank (Tank 15) was also inspected. The inspections were performed as part of the ISI Program for HLW Tanks and to gather additional data for material reliability studies.

5.2.1 Cracking

Examinations were performed to detect cracking in each of the tanks examined. Areas called for in the ISI Program were examined. No crack-like indications were detected in any of the Type III, stress relieved tanks. Tank 15 is a Type II tank so it was not stress relieved and was know to have leak-sites. In Tank 15, the previous indications were confirmed with excellent correlation using the typical crack detection setup used on all tanks. Specific results are provided later in this report.

5.2.2 Thickness Mapping

Thickness mapping was performed in each of the tanks examined. These thickness mapping examinations were performed to detect and measure any general wall loss, pitting or interface attack in all regions of the tank including the vapor space. Thickness mapping was performed as part of the vertical strip examination. A vertical strip was scanned for the entire accessible height of the tank. The strips were typically 8.5 inches wide and included crack detection and thickness mapping. Tanks 35, 36, 37 and 38 were examined for at least 0.25% of the circumference for the entire accessible height of the tank. In addition to the vertical strips, a two square foot area on each of four vertical plates of the secondary wall and a 10 inch wide strip on the secondary floor were examined for thinning and pitting. Tank 15 included four vertical strips for at least 1% of the circumference of the entire accessible height of the tank. Secondary containment scans were not performed on Tank 15 due to the configuration of the secondary pan.

The first reporting criteria for thickness measurements is nominal thickness minus 10%. On a 0.500 inch thick plate, a thickness of 0.450 inches or less would be reportable. For pitting the first reporting criteria is nominal thickness minus 25%. No reportable, service induced wall loss or reportable pitting was detected in any of the primary tanks. Several areas of fabrication grinding were reported that were less than nominal thickness minus 10%, but since they were fabrication related, they are not reportable. Non-reportable incipient pitting was noted in several tanks as listed in Table 2. Several small areas of reportable thickness were noted in secondary wall and floor scans.

The construction code allowed for plate to be 0.010 inches below nominal thickness. A 0.500 inch thick plate could have been 0.490 inch thick at installation. The measured average thickness was above the minimum design thickness in most areas. Thickness profiles of each vertical strip are included later in this section. The profiles include measured average and minimum thickness along with the nominal thickness, the minimum allowable thickness at construction and the 10% reporting level.

5.2.3 Thickness Mapping Results Comparison

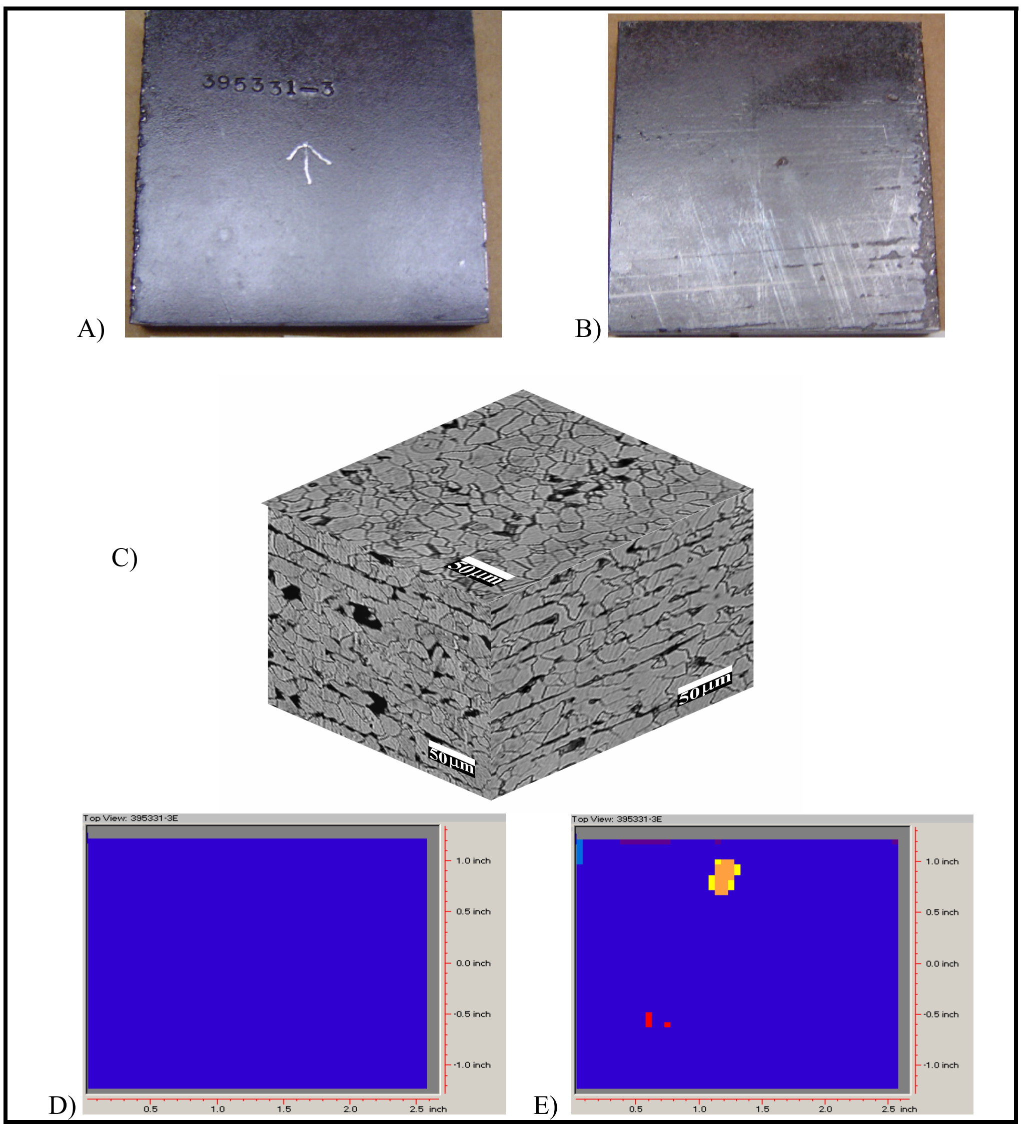
Thickness mapping was performed in a manner to provide for comparison with the historical spot thickness measurement data to the extent possible. Section 5.10 provides a detailed explanation of this comparison including graphs.

5.2.4 Thickness Mapping Indication Classification

Thickness mapping was performed utilizing multiple techniques. These techniques aid in the determination of whether an indication was service induced. The techniques utilized for thickness mapping are very sensitive and therefore capable of detecting indications from processing discontinuities to fabrication artifacts as well as service induced indications.

- Metallurgical Indications (Laminations and "Dirty Steel")
  While the steel is being fabricated, small impurities are sometimes caught in the metal. During the rolling process, larger impurities may become laminations. The following figure illustrates this condition and the type of indication that may be obtained during thickness mapping. Sample #395331-3 (A & B) was scanned utilizing the same technique as the tank inspection scans. The front and back surfaces of the sample show no pitting. The microstructure of this material is shown in image "C". The thickness mapping data in images "D" and "E" were collected simultaneously. "D" displays the multiple echo data with no indications. "E" shows the first echo, "Edge Contact" technique producing indications from small laminar reflectors within the material. These types of processing indications are not uncommon when examining the type, vintage and thickness' of steel used in the waste tanks. Detection of these metallurgical indications is due to the high sensitivity of the UT technique and is not uncommon in carbon steel.

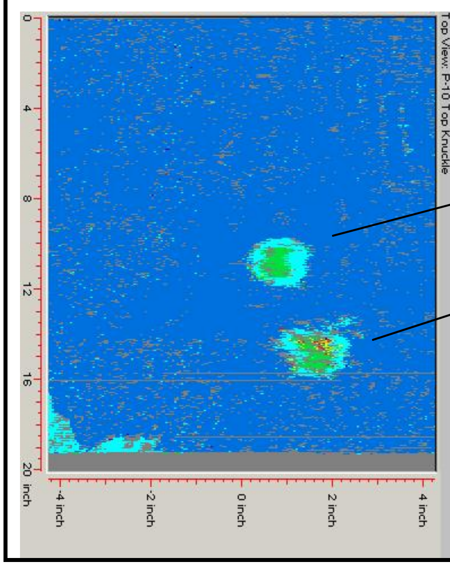
Figure 13: Typical Metallurgical Indication



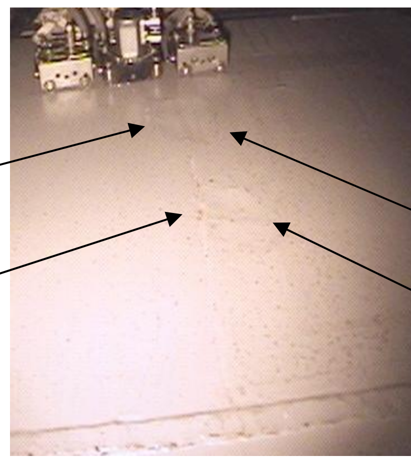
- Fabrication Artifacts
  During fabrication lifting lugs are temporarily attached to plates of steel to lift and align them during erection of the tank. After use the attachment is typically removed and that area smoothed out utilizing a grinder. This is common practice in tank fabrication. Many such fabrication artifacts have been encountered while inspecting waste tanks. Many of these areas have been encountered under the paint which was applied to the vertical strips prior to the tanks going into service, confirming that the indications are not service induced. The following figure illustrates a typical fabrication artifact. A photograph of the grinding areas in the top knuckle of Tank 48 under Riser P-10. The thickness mapping data collected in this area shows the indication in both the 2004 data and the data collected in 1996. These indications are not service induced and do not constitute reportable conditions.

Figure 14: Typical Fabrication Artifact

Thickness Mapping Data from Tank 48, Riser P-10 Top Knuckle - FY2004

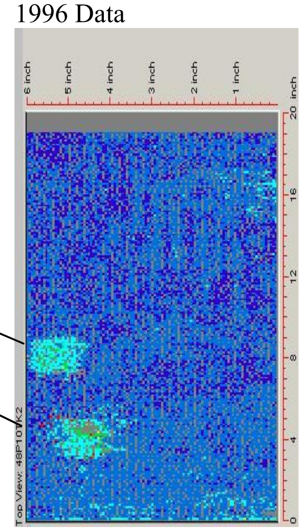


Photograph of FY2004 scan showing Fabrication Artifacts (OD Grinding Areas)



Top Knuckle to Top Plate Weld

1996 Data

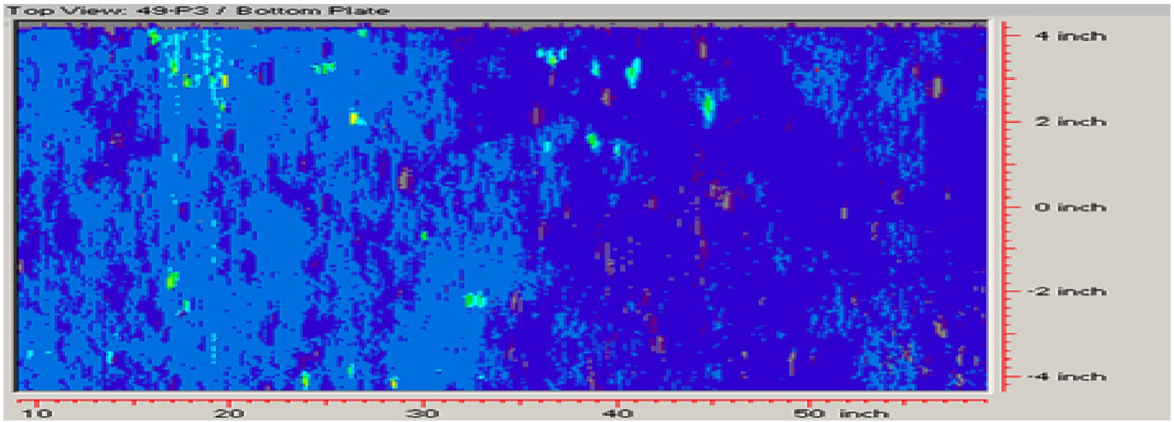


- Service Induced Indications
  Service induced indications are those indications that developed after the tank was put into service. The In-service Inspection program is focused on detecting these types of indications. Service induced indications include general thinning, corrosion, pitting, interface attack and stress corrosion cracking in all regions of the tank walls including the vapor space. In an effort to provide leading data, conditions may be noted which are not reportable by the acceptance criteria. An example of this type of condition is incipient pitting.

- Incipient Pitting
  Incipient pitting is the term being used to describe small pit-like indications prior to them being reportable or actionable. The term indicates that the indication is shallow, not that the pit has recently developed or that it is actively growing. Although incipient pits are classified as service induced indications, the pits may have developed prior to the material being used for fabrication or prior to the tank going into radioactive service and never actively grew during service. In addition to typically being detectable with multiple techniques, pit openings are often detectable with the 45 degree shear wave inspections. Figure 4 provides an example of pitting. The pitting depicted is beyond the incipient pitting stage, but provides a good example of pitting developed in field conditions in a carbon steel/aqueous – vapor-space environment. Figure 15 shows incipient pitting detected in FY2005 in the Lower Plate of Tank 49. The

indications (lighter blue & green) are up to 0.75” in diameter and 0.040” deep and are typical of the type of indication classified as incipient pitting.

Figure 15: Incipient Pitting FY2005 Data from Tank 49



To date, incipient pitting has been detected ultrasonically and reported in the following tanks:
Tank 15 in 2002, Tanks 31 and 32 in 2003, Tank 25 in 2004, Tank 49 in 2005 and Tank 29 in 2006. Table 2 provides a summary of the pitting. The pits listed for Tank 47 were pre-service pits detected and measured visually prior to the tank going into service.

Table 2 Pitting in Waste Tanks

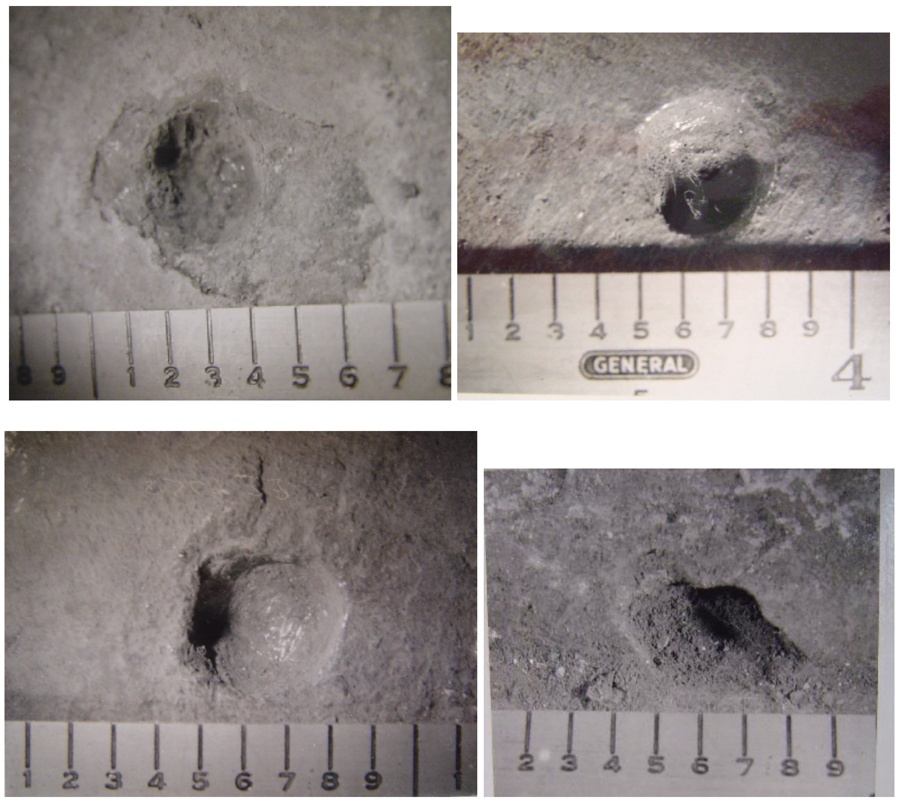
Tank	Year	Max Pit Depth	Est. Diameter	L/D Ratio *	Reportable
15	2002	0.030	0.35	11.7	No
31	2003	0.046	0.4	8.7	No
32	2003	0.041	0.6	14.6	No
32	2003	0.055	0.75	13.6	No
25	2004	0.036	0.35	9.7	No
49	2005	0.056	0.66	11.8	No
49	2005	0.059	0.7	11.9	No
29	2006	0.019	0.5	26.3	No
29	2006	0.035	0.5	14.3	No
29	2006	0.028	0.5	17.9	No
29	2006	0.065	0.5	7.7	No
47 *	1981	0.040	0.14	3.5	n/a
47 *	1981	0.046	0.15	3.3	n/a
47 *	1981	0.040	0.1	2.5	n/a
47 *	1981	0.055	0.15	2.7	n/a
47 *	1981	0.064	0.125	2.0	n/a
47 *	1981	0.070	0.2	2.9	n/a

* In calculating the diameter in 1981, the broken edge of the pit was not included in the diameter. In figure 14, the diameter of the top left pit would be reported as approximately 0.20 inches where the P-scan system would include to the detectable edges and report the diameter as approximately 0.60 inches.

- Pre-service Pitting
  In 1980, pitting was detected in some tanks during final inspections prior to going into service. These pre-service pits were found in 12 of 14 tanks under construction at the time. The pitting was found to be from the fire retardant plywood used to protect the tank bottom during construction. The ratios of depth-to-diameter for most of the pits ranged from 0.25 to 0.50 (2:1 to 4:1 diameter to depth). This pitting was primarily on the inside of the primary tank bottom. This discovery, lead to a more detailed inspection of the tank annulus. Seven of 14 tanks were found to have pitting in the annulus. Tank 38 was one of the tanks found to have pitting in the annulus.

Figure 16: Pre-service pitting

Photographs include scale which is in 0.1 inch increments.



5.3 Tank 35 Results

Tank 35 was scheduled for an augmented inspection which included one vertical strip for the entire accessible height under riser A-01. No service induced reportable areas were detected in the primary wall, but one grinding area was below the 10% reporting level. One of the Secondary wall plates and the secondary floor had reportable areas.

5.3.1 Vertical Strip

No service induced reportable areas were detected in the vertical strip on the primary wall. No cracking was detected. The measured average thickness was above nominal thickness in all areas of the primary wall that were examined. A grinding area at the bottom weld of the Top Plate that measured below the reportable thickness. The thickness mapping data is presented in Figure 17 and Table 3.

Figure 17: Thickness Mapping Data Summary Tank 35 Riser A-01

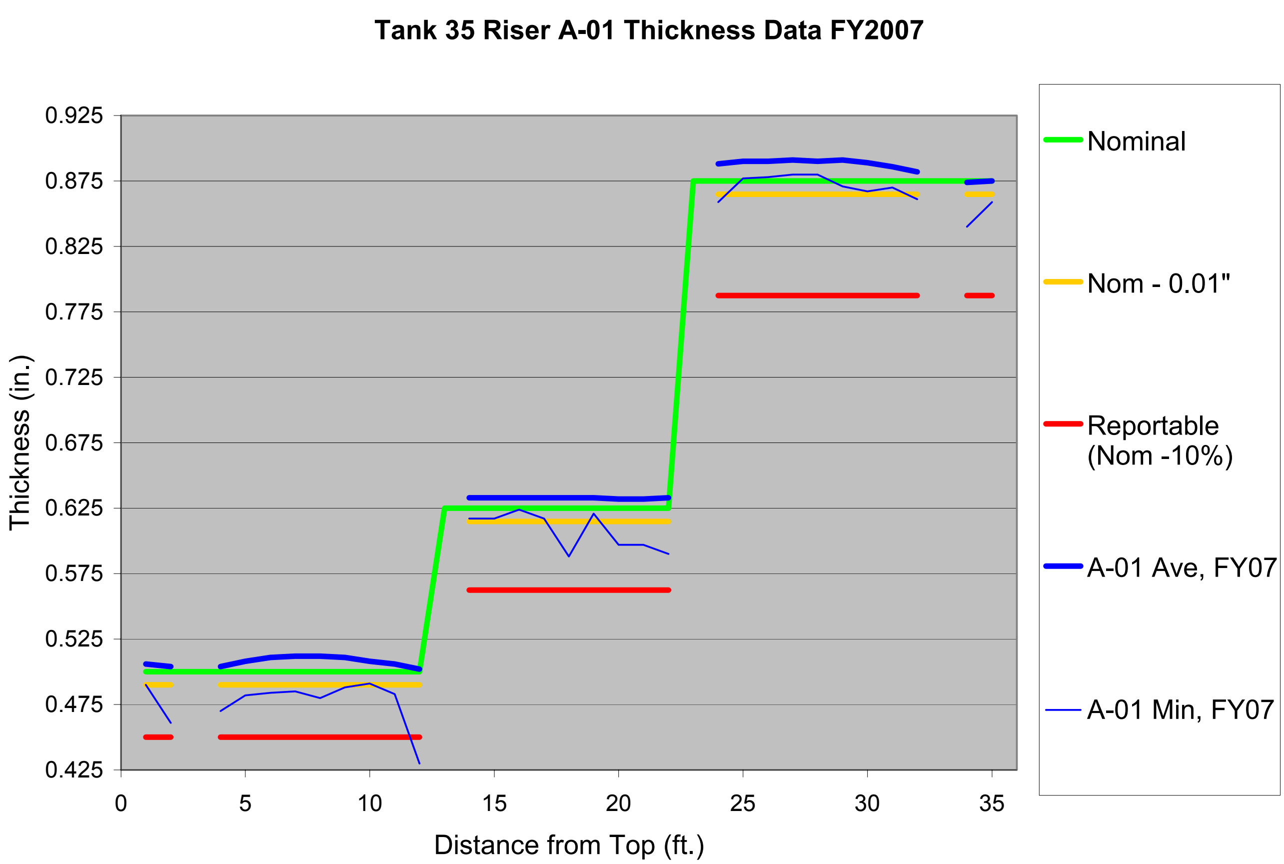


Table 3 Tank 35 Thickness Mapping Results FY 2007

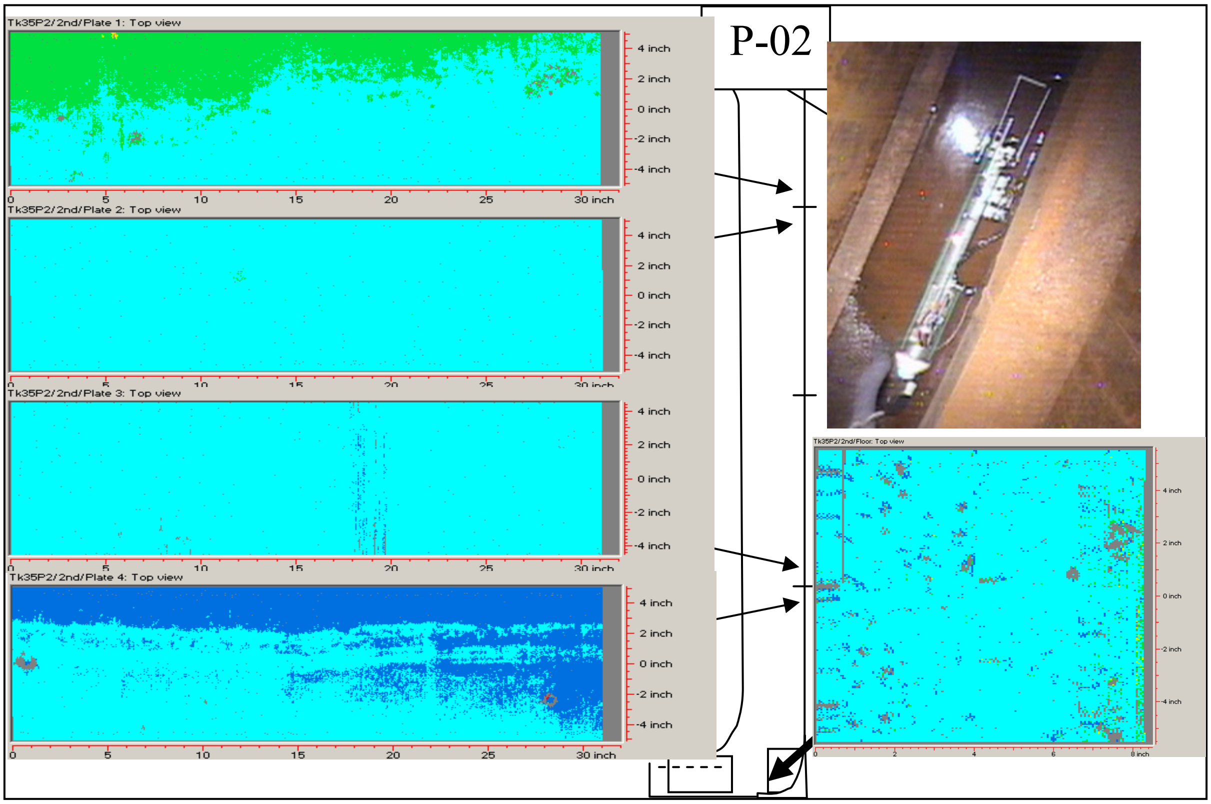
Plate / 12" interval	Nominal	Nom - 0.01"	Reportable (Nom -10%)	A-01 Ave, FY07	A-01 Min, FY07
Top Knuckle / 1	0.500	0.490	0.450	0.506	0.490
2	0.500	0.490	0.450	0.504	0.461
Top Plate / 1	0.500	0.490	0.450	0.504	0.470
2	0.500	0.490	0.450	0.508	0.482
3	0.500	0.490	0.450	0.511	0.484
4	0.500	0.490	0.450	0.512	0.485
5	0.500	0.490	0.450	0.512	0.480
6	0.500	0.490	0.450	0.511	0.488
7	0.500	0.490	0.450	0.508	0.491
8	0.500	0.490	0.450	0.506	0.483
9	0.500	0.490	0.450	0.502	**0.430**
Middle Plate / 1	0.625	0.615	0.563	0.633	0.617
2	0.625	0.615	0.563	0.633	0.617
3	0.625	0.615	0.563	0.633	0.624
4	0.625	0.615	0.563	0.633	0.617
5	0.625	0.615	0.563	0.633	0.588
6	0.625	0.615	0.563	0.633	0.621
7	0.625	0.615	0.563	0.632	0.597
8	0.625	0.615	0.563	0.632	0.597
9	0.625	0.615	0.563	0.633	0.590
Lower Plate / 1	0.875	0.865	0.788	0.888	0.859
2	0.875	0.865	0.788	0.890	0.877
3	0.875	0.865	0.788	0.890	0.878
4	0.875	0.865	0.788	0.891	0.880
5	0.875	0.865	0.788	0.890	0.880
6	0.875	0.865	0.788	0.891	0.871
7	0.875	0.865	0.788	0.889	0.867
8	0.875	0.865	0.788	0.886	0.870
9	0.875	0.865	0.788	0.882	0.861
Bottom Knuckle / 1	0.875	0.865	0.788	0.874	0.840
2	0.875	0.865	0.788	0.875	0.859
Secondary, Plate 1 / 1	0.375	0.365	0.338	0.370	**0.308**
2	0.375	0.365	0.338	0.372	0.363
3	0.375	0.365	0.338	0.373	0.346
Secondary, Plate 2 / 1	0.375	0.365	0.338	0.382	0.358
2	0.375	0.365	0.338	0.381	0.362
3	0.375	0.365	0.338	0.381	0.375
Secondary, Plate 3 / 1	0.375	0.365	0.338	0.384	0.379
2	0.375	0.365	0.338	0.383	0.371
3	0.375	0.365	0.338	0.382	0.371
Secondary, Plate 4 / 1	0.375	0.365	0.338	0.387	0.364
2	0.375	0.365	0.338	0.389	0.383
3	0.375	0.365	0.338	0.391	0.366
Secondary Floor 1	0.375	0.365	0.338	0.382	**0.332**

Values in **bold** type are reportable.

5.3.2 Secondary Wall and Floor Scans

Inspections of Tank 35 also included performing thickness mapping on the secondary wall and floor of the double shell waste tank beneath Riser P-02. A summary of the thickness mapping results is included in Table 3. Figure 18 includes P-scan Top View "C-scan" images of the secondary wall scans and their approximate location. The secondary floor scan was from the primary wall to the secondary wall in this tank.

Figure 18: Thickness Mapping Data Secondary Wall Scans Tank 35 Riser P-02



5.4 Tank 36 Results

Tank 36 was scheduled for an augmented inspection which included one vertical strip for the entire accessible height under riser P-02. No reportable areas were detected in the primary wall. The secondary floor had reportable areas.

5.4.1 Vertical Strip

No reportable areas were detected in the vertical strip on the primary wall. No cracking was detected. The measured average thickness was above nominal thickness in most areas and above the nominal minus 0.010” fabrication level in all areas of the primary wall that were examined. The thickness mapping data is presented in Figure 19 and Table 4.

Figure 19: Thickness Mapping Data Summary Tank 36 Riser P-02

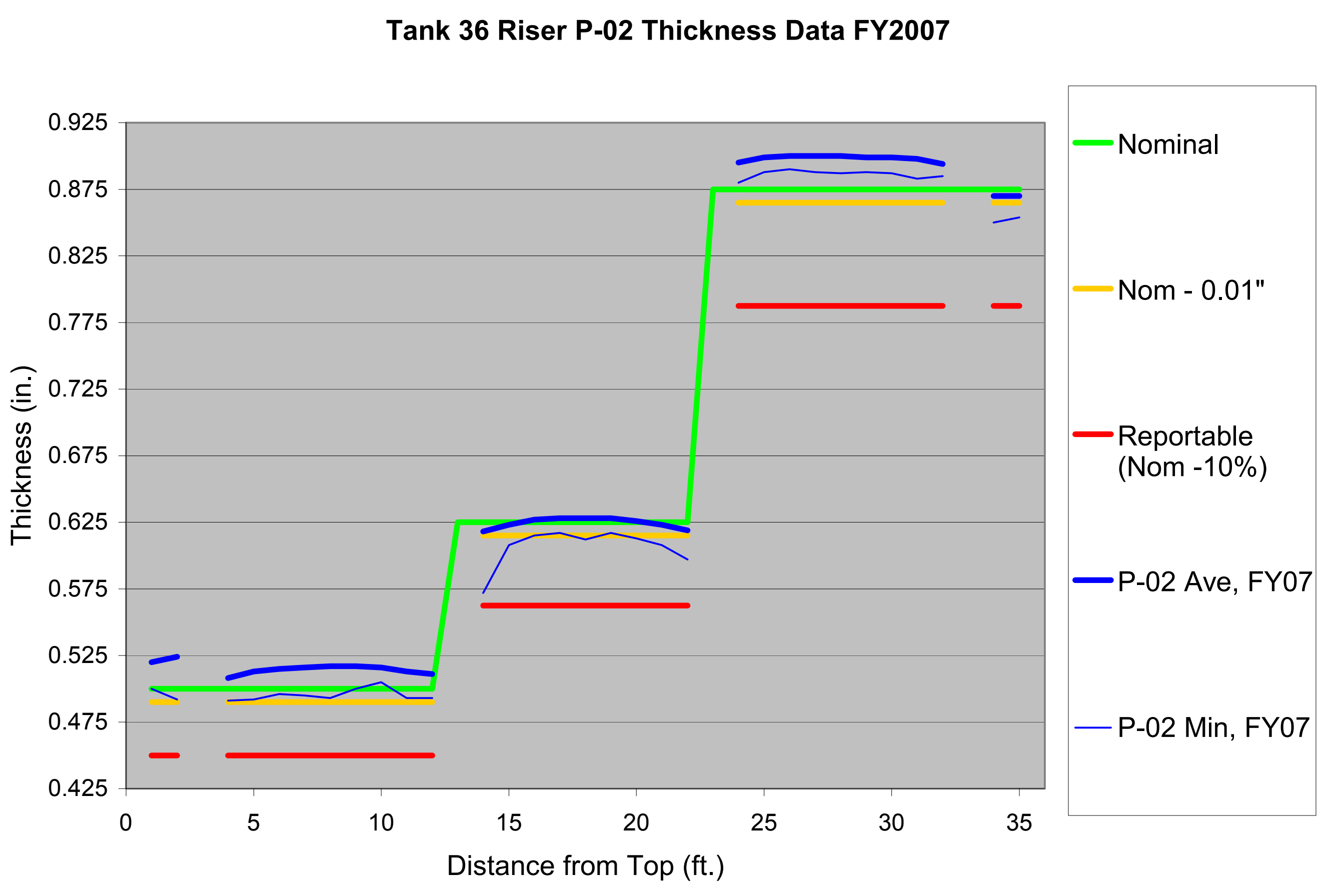


Table 4 Tank 36 Thickness Mapping Results FY 2007

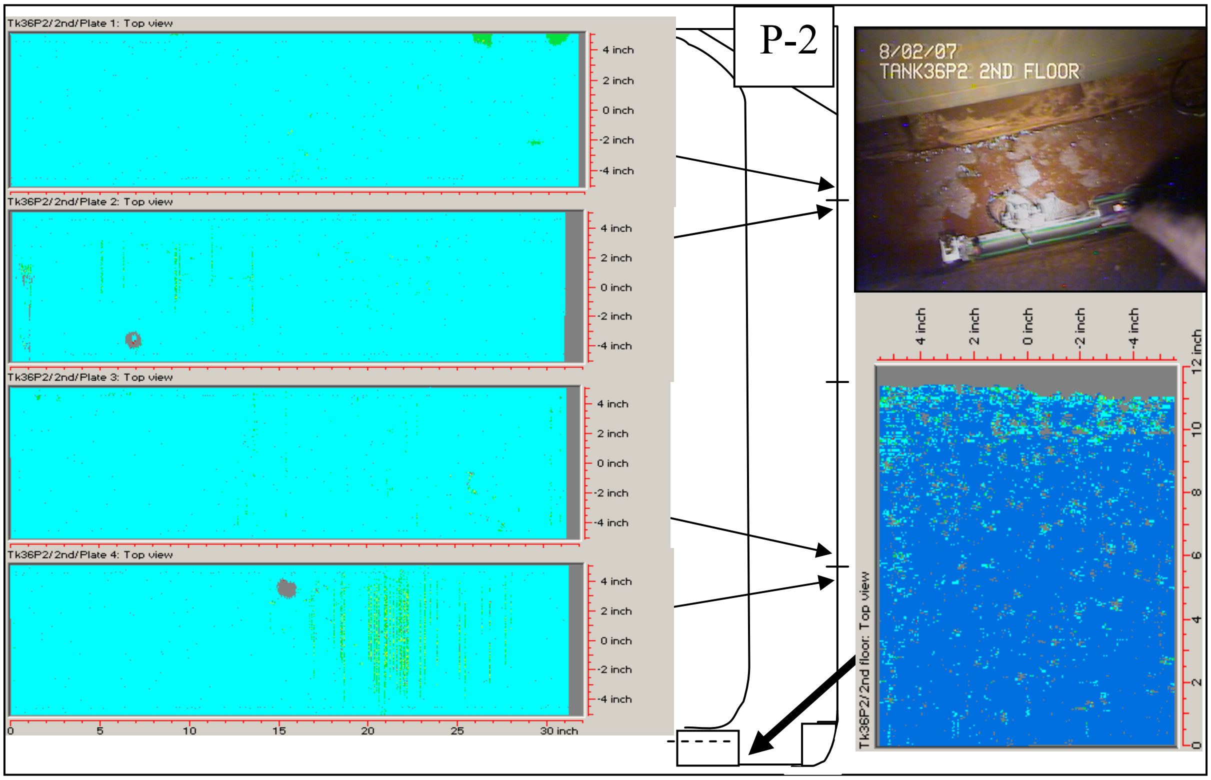
Plate / 12" interval	Nominal	Nom - 0.01"	Reportable (Nom -10%)	P-02 Ave, FY07	P-02 Min, FY07
Top Knuckle / 1	0.500	0.490	0.450	0.520	0.500
2	0.500	0.490	0.450	0.524	0.492
Top Plate / 1	0.500	0.490	0.450	0.508	0.491
2	0.500	0.490	0.450	0.513	0.492
3	0.500	0.490	0.450	0.515	0.496
4	0.500	0.490	0.450	0.516	0.495
5	0.500	0.490	0.450	0.517	0.493
6	0.500	0.490	0.450	0.517	0.500
7	0.500	0.490	0.450	0.516	0.505
8	0.500	0.490	0.450	0.513	0.493
9	0.500	0.490	0.450	0.511	0.493
Middle Plate / 1	0.625	0.615	0.563	0.618	0.572
2	0.625	0.615	0.563	0.623	0.608
3	0.625	0.615	0.563	0.627	0.615
4	0.625	0.615	0.563	0.628	0.617
5	0.625	0.615	0.563	0.628	0.612
6	0.625	0.615	0.563	0.628	0.617
7	0.625	0.615	0.563	0.626	0.613
8	0.625	0.615	0.563	0.623	0.608
9	0.625	0.615	0.563	0.619	0.597
Lower Plate / 1	0.875	0.865	0.788	0.895	0.880
2	0.875	0.865	0.788	0.899	0.888
3	0.875	0.865	0.788	0.900	0.890
4	0.875	0.865	0.788	0.900	0.888
5	0.875	0.865	0.788	0.900	0.887
6	0.875	0.865	0.788	0.899	0.888
7	0.875	0.865	0.788	0.899	0.887
8	0.875	0.865	0.788	0.898	0.883
9	0.875	0.865	0.788	0.894	0.885
Bottom Knuckle / 1	0.875	0.865	0.788	0.870	0.850
2	0.875	0.865	0.788	0.870	0.854
Secondary, Plate 1 / 1	0.375	0.365	0.338	0.378	0.368
2	0.375	0.365	0.338	0.378	0.359
3	0.375	0.365	0.338	0.378	0.350
Secondary, Plate 2 / 1	0.375	0.365	0.338	0.381	0.363
2	0.375	0.365	0.338	0.382	0.362
3	0.375	0.365	0.338	0.383	0.366
Secondary, Plate 3 / 1	0.375	0.365	0.338	0.375	0.355
2	0.375	0.365	0.338	0.376	0.362
3	0.375	0.365	0.338	0.379	0.358
Secondary, Plate 4 / 1	0.375	0.365	0.338	0.384	0.380
2	0.375	0.365	0.338	0.383	0.378
3	0.375	0.365	0.338	0.384	0.380
Secondary Floor 1	0.375	0.365	0.338	0.394	**0.337**

Values in **bold** type are reportable.

5.4.2 Secondary Wall and Floor Scans

Inspections of Tank 36 also included performing thickness mapping on the secondary wall and floor of the double shell waste tank beneath Riser P-02. A summary of the thickness mapping results is included in Table 4. Figure 20 includes P-scan Top View “C-scan” images of the secondary wall scans and their approximate location. The secondary floor scan was from the secondary wall to the primary wall in this tank.

Figure 20: Thickness Mapping Data Secondary Wall Scans Tank 36 Riser P-02



5.5 Tank 37 Results

Tank 37 was scheduled for an augmented inspection which included one vertical strip for the entire accessible height under riser P-09. No reportable areas were detected in the primary or secondary walls, but the secondary floor had reportable areas.

5.5.1 Vertical Strip

No reportable areas were detected in the vertical strip on the primary wall. No cracking was detected. The measured average thickness was above the nominal minus 0.010" fabrication level in all areas of the primary wall that were examined except for the end of the top plate near the welds. The thickness mapping data is presented in Figure 21 and Table 5.

Figure 21: Thickness Mapping Data Summary Tank 37 Riser P-09

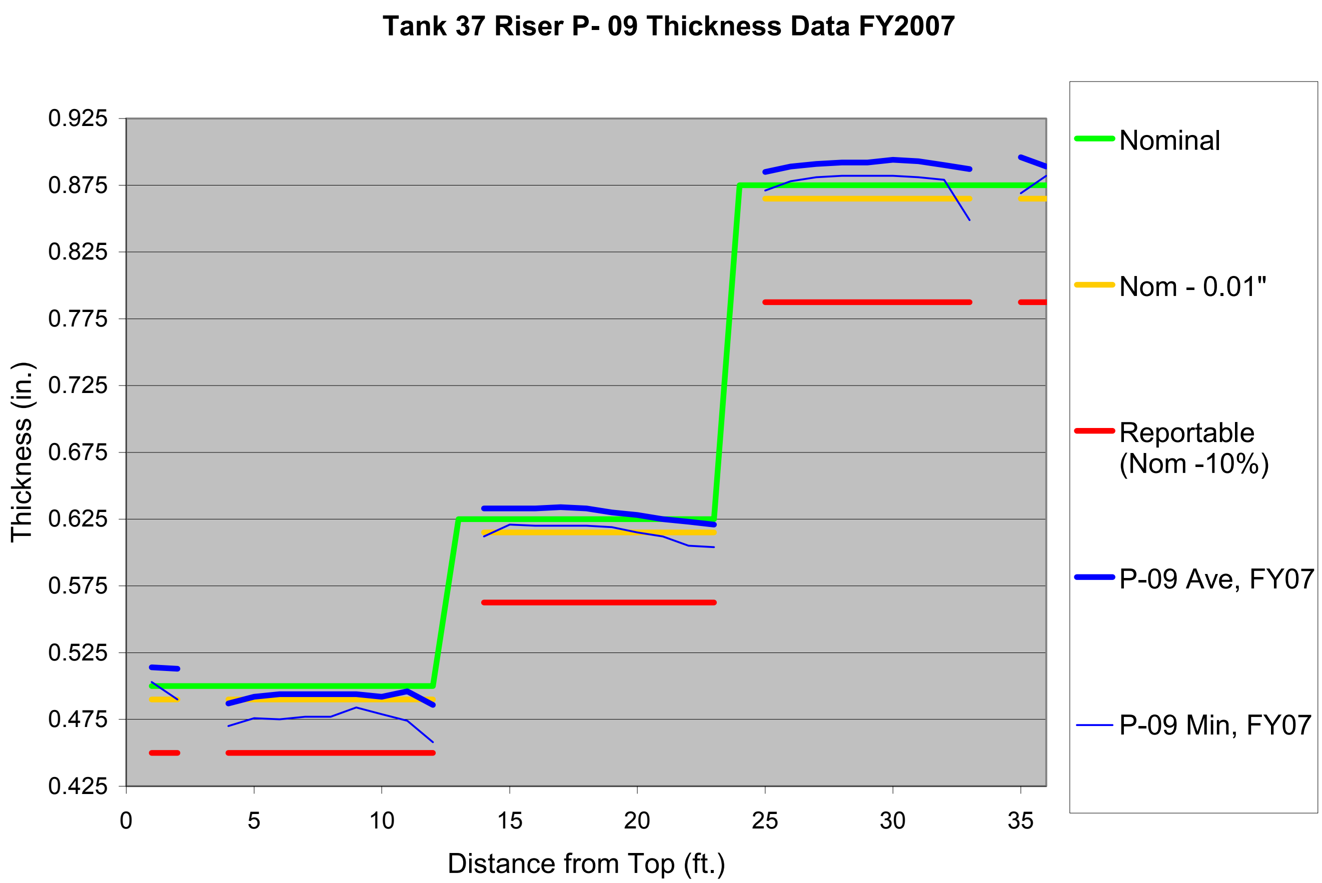


TABLE 5 TANK 37 THICKNESS MAPPING RESULTS FY 2007

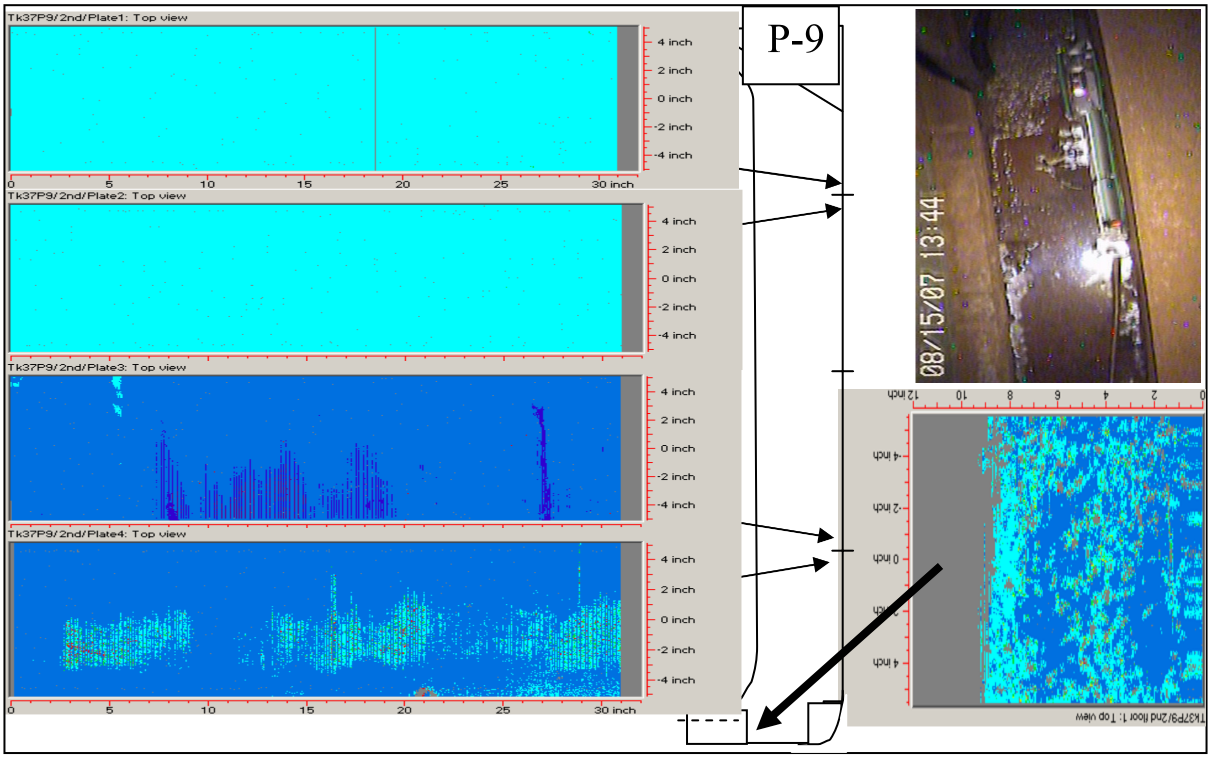
Plate / 12" interval	Nominal	Nom - 0.01"	Reportable (Nom -10%)	P-09 Ave, FY07	P-09 Min, FY07
Top Knuckle / 1	0.500	0.490	0.450	0.514	0.503
2	0.500	0.490	0.450	0.513	0.490
Top Plate / 1	0.500	0.490	0.450	0.487	0.470
2	0.500	0.490	0.450	0.492	0.476
3	0.500	0.490	0.450	0.494	0.475
4	0.500	0.490	0.450	0.494	0.477
5	0.500	0.490	0.450	0.494	0.477
6	0.500	0.490	0.450	0.494	0.484
7	0.500	0.490	0.450	0.492	0.479
8	0.500	0.490	0.450	0.496	0.474
9	0.500	0.490	0.450	0.486	0.458
Middle Plate / 1	0.625	0.615	0.563	0.633	0.612
2	0.625	0.615	0.563	0.633	0.621
3	0.625	0.615	0.563	0.633	0.620
4	0.625	0.615	0.563	0.634	0.620
5	0.625	0.615	0.563	0.634	0.620
6	0.625	0.615	0.563	0.630	0.619
7	0.625	0.615	0.563	0.628	0.615
8	0.625	0.615	0.563	0.625	0.612
9	0.625	0.615	0.563	0.623	0.605
10	0.625	0.615	0.563	0.621	0.604
Lower Plate / 1	0.875	0.865	0.788	0.885	0.871
2	0.875	0.865	0.788	0.889	0.878
3	0.875	0.865	0.788	0.891	0.881
4	0.875	0.865	0.788	0.892	0.882
5	0.875	0.865	0.788	0.892	0.882
6	0.875	0.865	0.788	0.894	0.882
7	0.875	0.865	0.788	0.893	0.881
8	0.875	0.865	0.788	0.890	0.879
9	0.875	0.865	0.788	0.887	0.849
Bottom Knuckle / 1	0.875	0.865	0.788	0.896	0.869
2	0.875	0.865	0.788	0.889	0.882
Secondary, Plate 1 / 1	0.375	0.365	0.338	0.383	0.372
2	0.375	0.365	0.338	0.383	0.372
3	0.375	0.365	0.338	0.382	0.365
Secondary, Plate 2 / 1	0.375	0.365	0.338	0.383	0.379
2	0.375	0.365	0.338	0.382	0.378
3	0.375	0.365	0.338	0.382	0.368
Secondary, Plate 3 / 1	0.375	0.365	0.338	0.378	0.344
2	0.375	0.365	0.338	0.381	0.345
3	0.375	0.365	0.338	0.382	0.378
Secondary, Plate 4 / 1	0.375	0.365	0.338	0.399	0.361
2	0.375	0.365	0.338	0.396	0.359
3	0.375	0.365	0.338	0.396	0.358
Secondary Floor 1	0.375	0.365	0.338	0.390	**0.320**

Values in **bold** type are reportable.

5.5.2 Secondary Wall and Floor Scans

Inspections of Tank 37 also included performing thickness mapping on the secondary wall and floor of the double shell waste tank beneath Riser P-09. A summary of the thickness mapping results is included in Table 5. Figure 22 includes P-scan Top View "C-scan" images of the secondary wall scans and their approximate location. The secondary floor scan was from the secondary wall to the primary wall in this tank.

Figure 22: Thickness Mapping Data Secondary Wall Scans Tank 37 Riser P-09



5.6 Tank 38 Results

Tank 38 was scheduled for an augmented inspection which included one vertical strip for the entire accessible height under riser P-09. No service induced reportable areas were detected in the primary wall. The secondary wall and floor had reportable areas.

5.6.1 Vertical Strip

No service induced reportable areas were detected in the vertical strip on the primary wall, but there were grinding areas in the top knuckle and top plate that were below the reporting level. No cracking was detected. The measured average thickness was above the nominal minus 0.010” fabrication level in all areas of the primary wall that were examined. The thickness mapping data is presented in Figure 23 and Table 6.

Figure 23: Thickness Mapping Data Summary Tank 38 Riser P-09

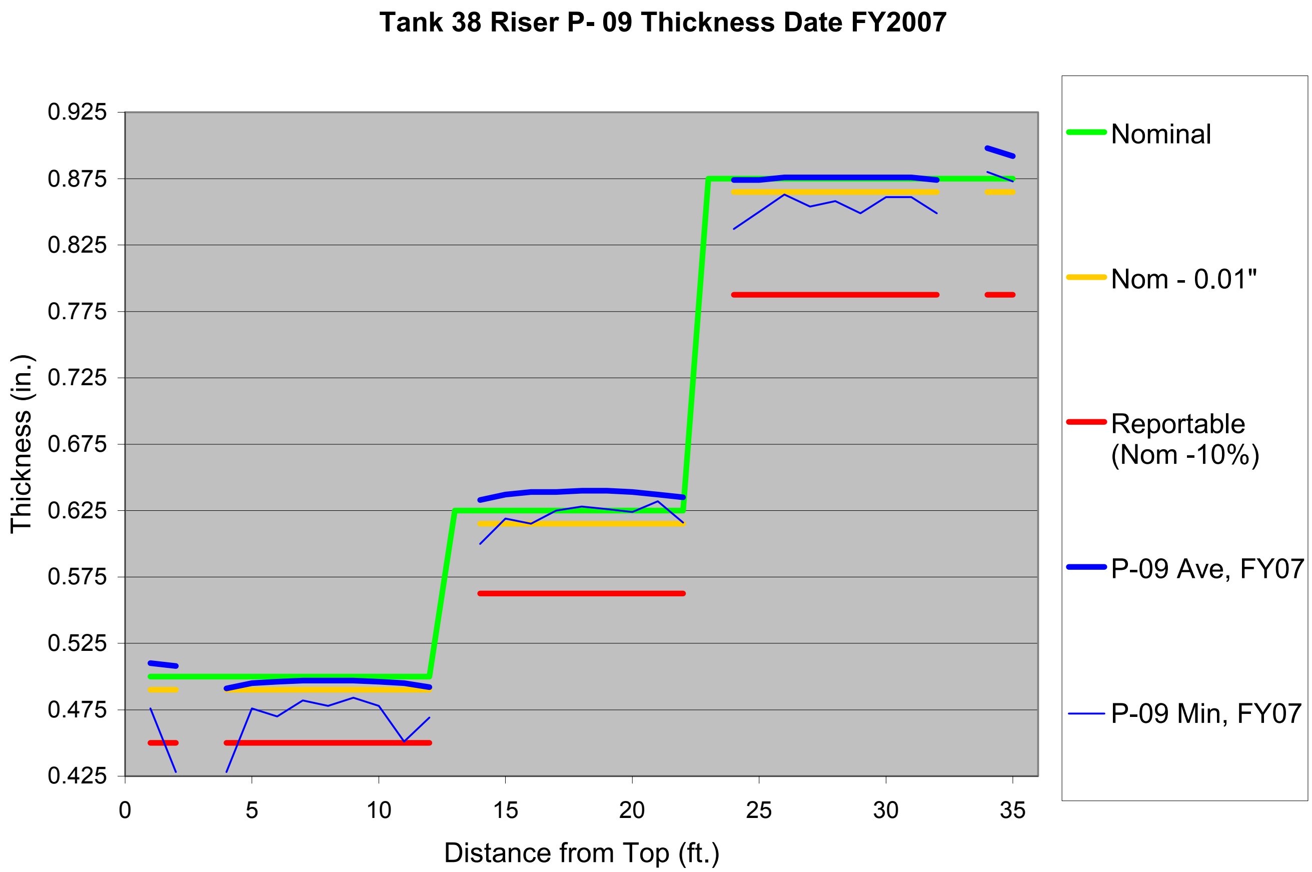


Table 6 Tank 38 Thickness Mapping Results FY 2007

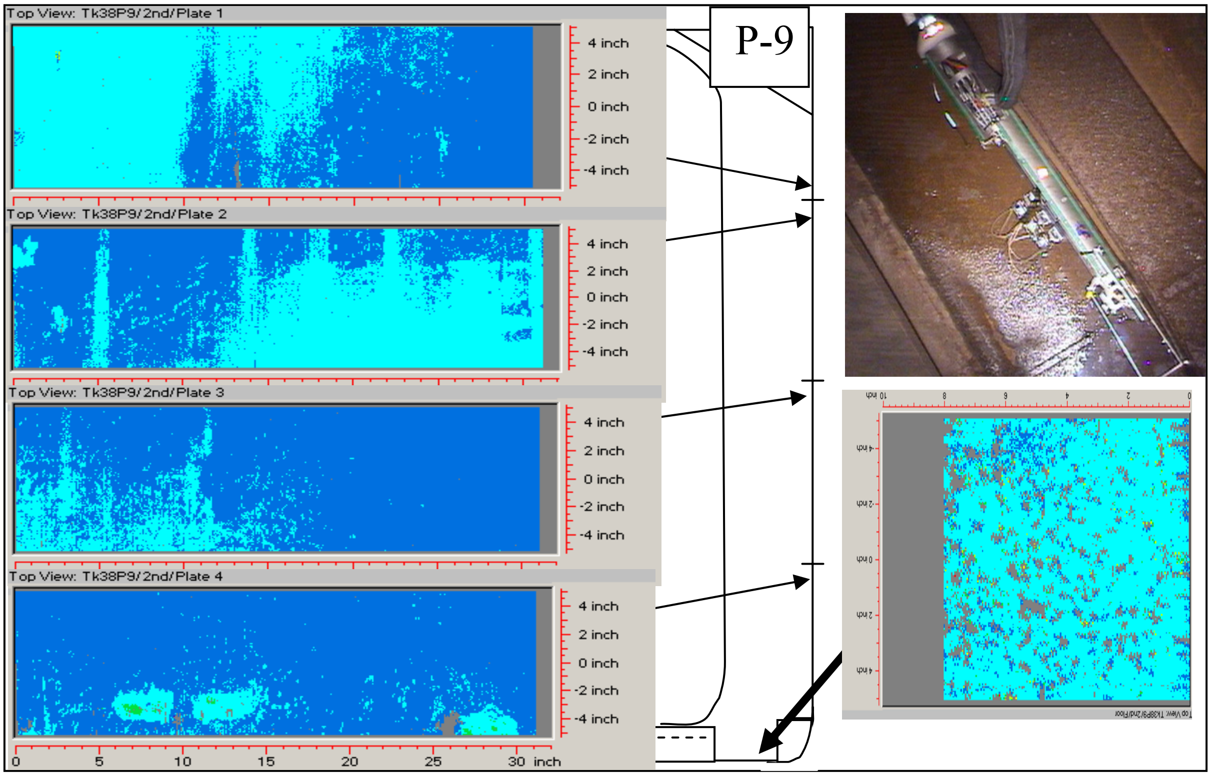
Plate / 12" interval	Nominal	Nom - 0.01"	Reportable (Nom -10%)	P-09 Ave, FY07	P-09 Min, FY07
Top Knuckle / 1	0.500	0.490	0.450	0.510	0.476
2	0.500	0.490	0.450	0.508	**0.428**
Top Plate / 1	0.500	0.490	0.450	0.491	**0.428**
2	0.500	0.490	0.450	0.495	0.476
3	0.500	0.490	0.450	0.496	0.470
4	0.500	0.490	0.450	0.497	0.482
5	0.500	0.490	0.450	0.497	0.478
6	0.500	0.490	0.450	0.497	0.484
7	0.500	0.490	0.450	0.496	0.478
8	0.500	0.490	0.450	0.495	0.451
9	0.500	0.490	0.450	0.492	0.469
Middle Plate / 1	0.625	0.615	0.563	0.633	0.600
2	0.625	0.615	0.563	0.637	0.619
3	0.625	0.615	0.563	0.639	0.615
4	0.625	0.615	0.563	0.639	0.625
5	0.625	0.615	0.563	0.640	0.628
6	0.625	0.615	0.563	0.640	0.626
7	0.625	0.615	0.563	0.639	0.624
8	0.625	0.615	0.563	0.637	0.632
9	0.625	0.615	0.563	0.635	0.616
Lower Plate / 1	0.875	0.865	0.788	0.874	0.837
2	0.875	0.865	0.788	0.874	0.850
3	0.875	0.865	0.788	0.876	0.863
4	0.875	0.865	0.788	0.876	0.854
5	0.875	0.865	0.788	0.876	0.858
6	0.875	0.865	0.788	0.876	0.849
7	0.875	0.865	0.788	0.876	0.861
8	0.875	0.865	0.788	0.876	0.861
9	0.875	0.865	0.788	0.874	0.849
Bottom Knuckle / 1	0.875	0.865	0.788	0.898	0.880
2	0.875	0.865	0.788	0.892	0.873
Secondary, Plate 1 / 1	0.375	0.365	0.338	0.373	0.362
2	0.375	0.365	0.338	0.374	0.364
3	0.375	0.365	0.338	0.375	0.363
Secondary, Plate 2 / 1	0.375	0.365	0.338	0.375	0.361
2	0.375	0.365	0.338	0.374	0.370
3	0.375	0.365	0.338	0.374	0.370
Secondary, Plate 3 / 1	0.375	0.365	0.338	0.375	0.363
2	0.375	0.365	0.338	0.377	0.368
3	0.375	0.365	0.338	0.378	0.374
Secondary, Plate 4 / 1	0.375	0.365	0.338	0.373	**0.336**
2	0.375	0.365	0.338	0.372	0.344
3	0.375	0.365	0.338	0.372	**0.333**
Secondary Floor 1	0.375	0.365	0.338	0.370	**0.318**

Values in **bold** type are reportable.

5.6.2 Secondary Wall and Floor Scans

Inspections of Tank 38 also included performing thickness mapping on the secondary wall and floor of the double shell waste tank beneath Riser P-09. A summary of the thickness mapping results is included in Table 6. Figure 24 includes P-scan Top View "C-scan" images of the secondary wall scans and their approximate location. The secondary floor scan was from the secondary wall to the primary wall in this tank.

Figure 24: Thickness Mapping Data Secondary Wall Scans Tank 38 Riser P-09



5.7 Tank 15 Results

Tank 15 is a Type II waste tank. The Type II waste tanks were not post weld heat treated and therefore are susceptible to stress corrosion cracking. Tank 15 was scheduled for a full scope inspection plus re-examination of previous crack locations. Thickness mapping examinations were performed beneath inspection ports IP55, IP107, IP182 and the East Riser. No reportable thickness areas were found. Table 7 provides a summary of thickness data.

Previously identified crack locations were examined to determine if crack growth is still occurring. Crack growth was measured in four cracks since the previous examination five years ago. In all four cracks, the growth was oriented perpendicular to the weld seam. The maximum growth was 1.8 inches. Table 8 provides a summary of crack data.

5.7.1 Vertical Strips

Inspections included four vertical strips for the entire accessible height of the tank under risers IP55, IP107, IP182 and the East riser. No reportable thickness areas were detected in any of the vertical wall scans. No new cracking was detected in the vertical strips.

The measured average thickness was above the nominal thickness in all areas examined. Figure 25 illustrates the thickness mapping locations in Tank 15. The thickness mapping data is presented in Figures 26 through 30. Table 7 includes the 2007 Multiple Echo thickness values for the vertical strips.

Figure 25: Tank Top Drawing / Scan Areas, Tank 15

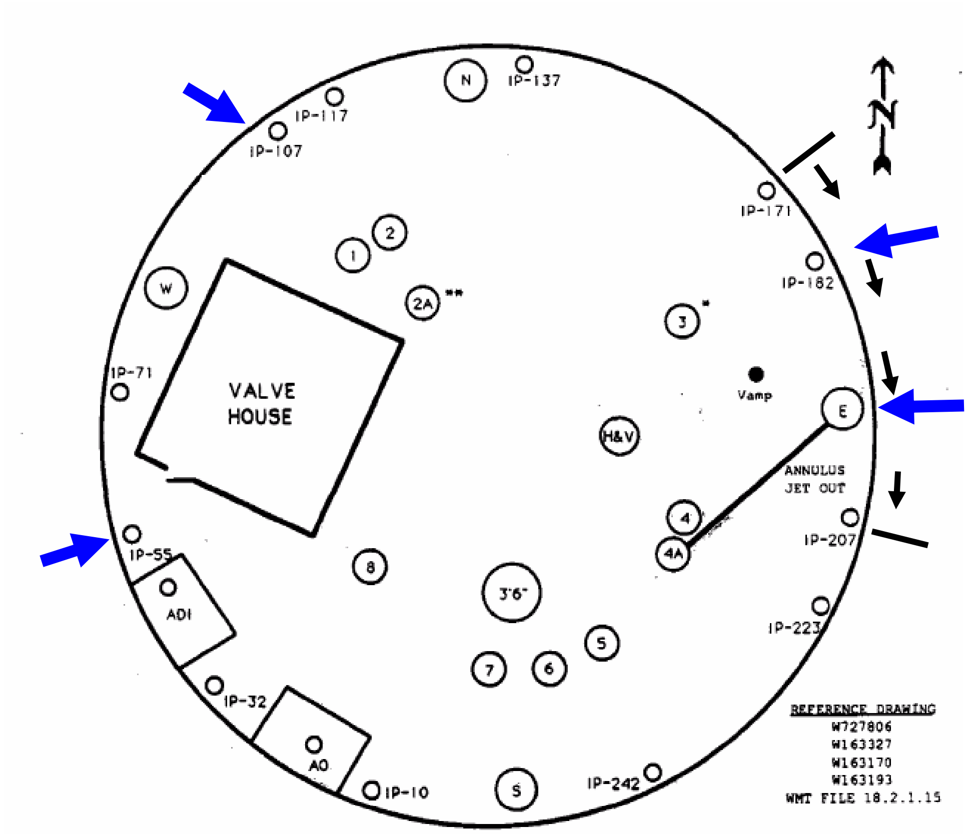
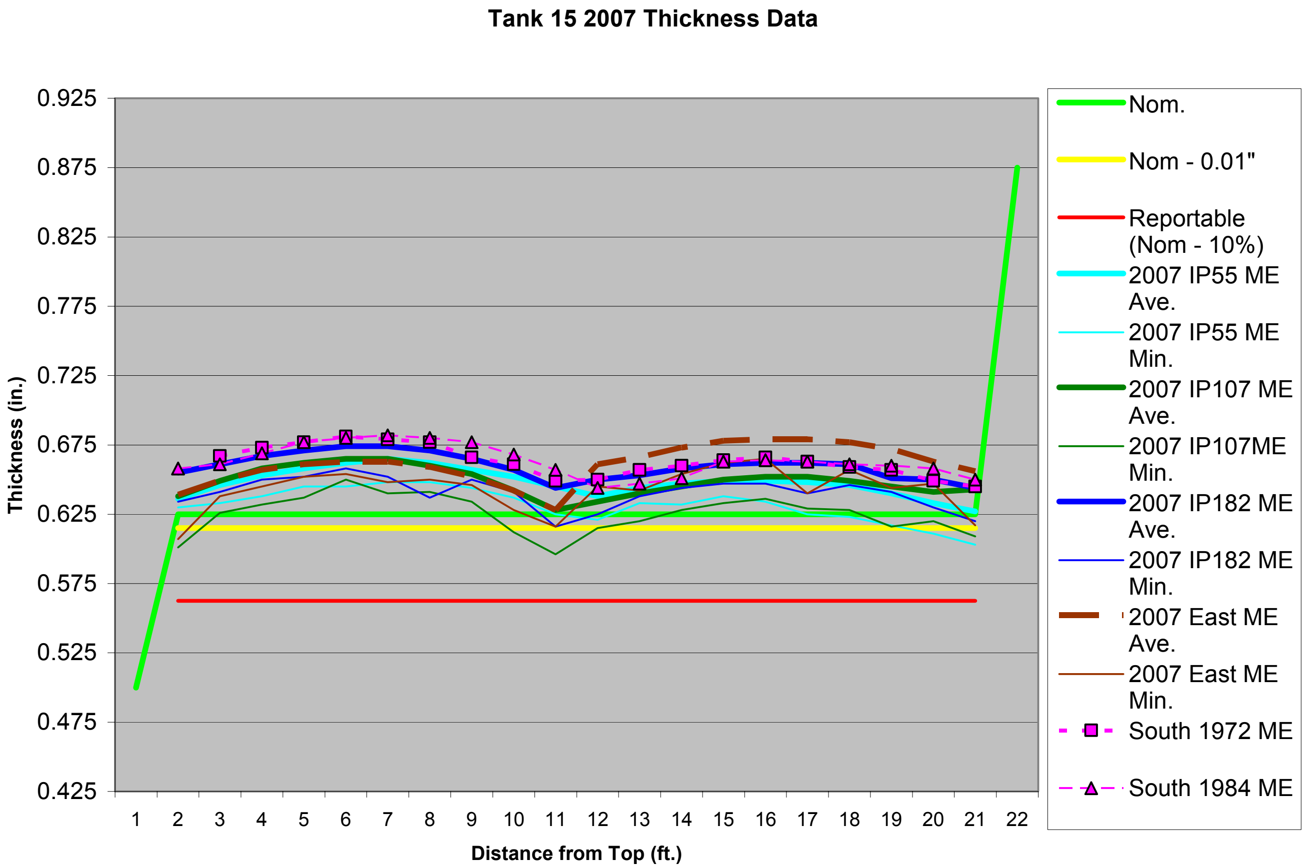


Figure 26: Tank 15 Thickness Data All Risers 2007

Chart shows average and minimum multiple echo data from 2007 on chart with same scale as other tanks.



The following figures show thickness data for each riser. Each graph includes the multiple echo spot reading data from 1972 and 1984. The 2007 multiple echo average and minimum thickness values are also included along with the 2002 and 2007 contact method data.

Figure 27: Tank 15 Thickness Data IP55

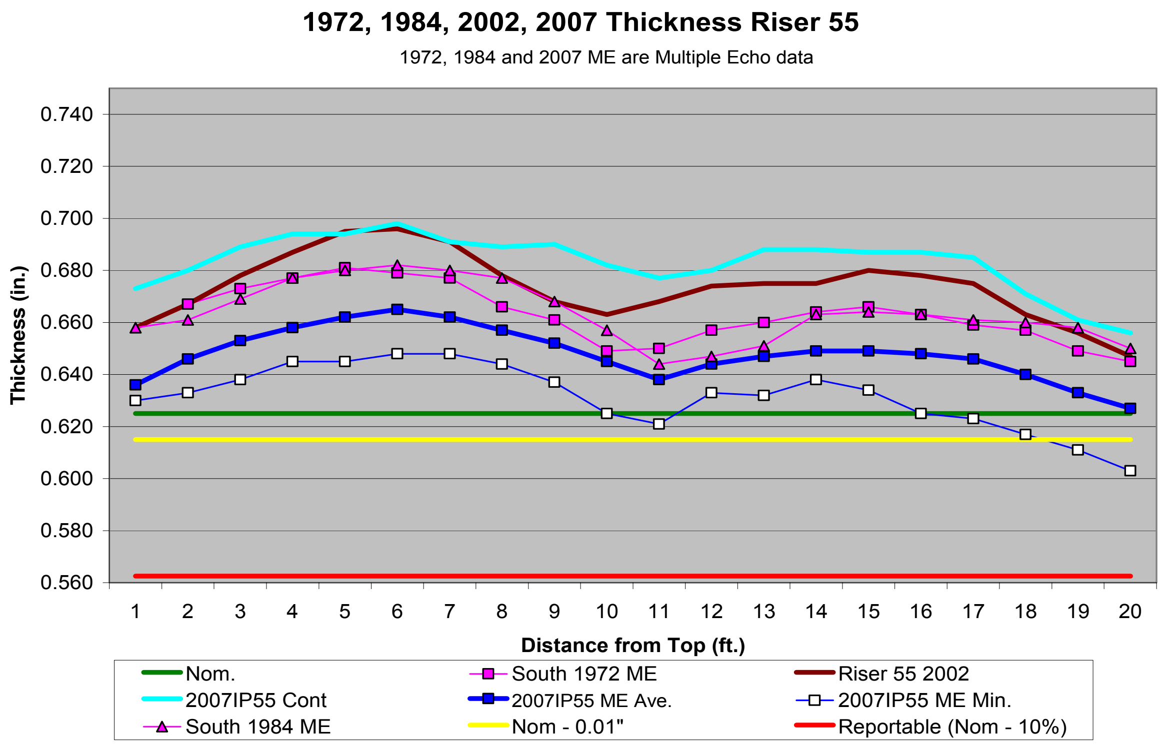


Figure 28: Tank 15 Thickness Data IP 107

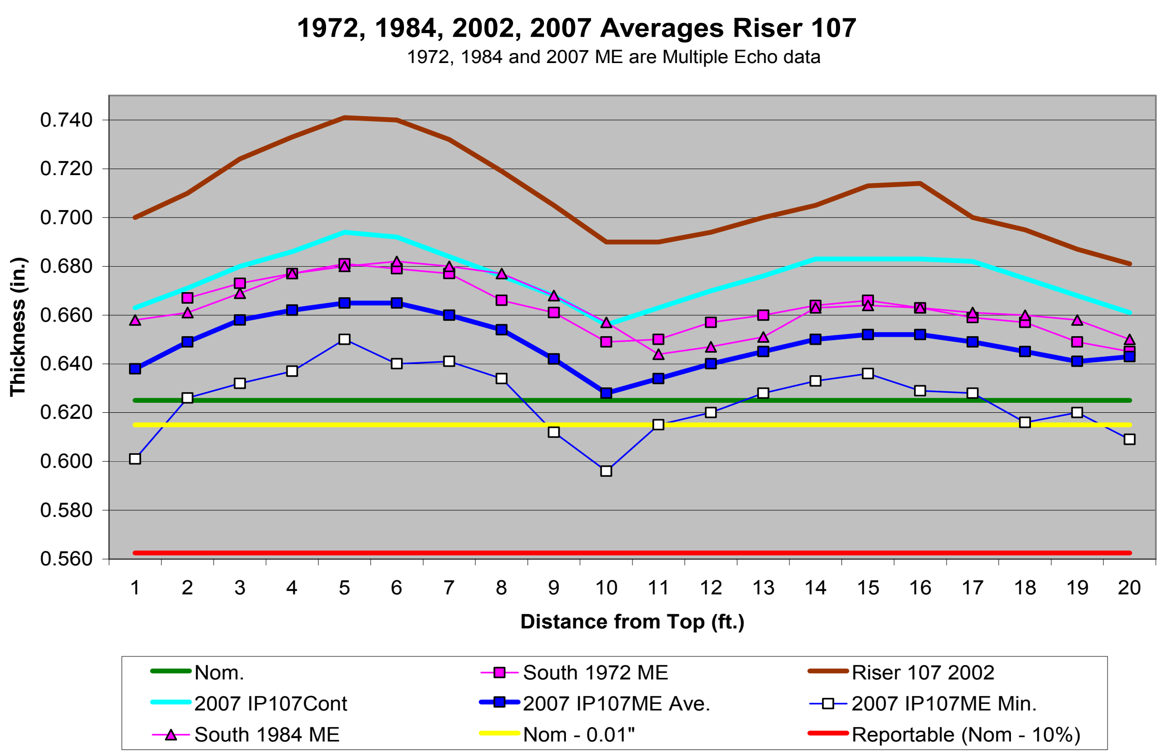


Figure 29: Tank 15 Thickness Data IP182

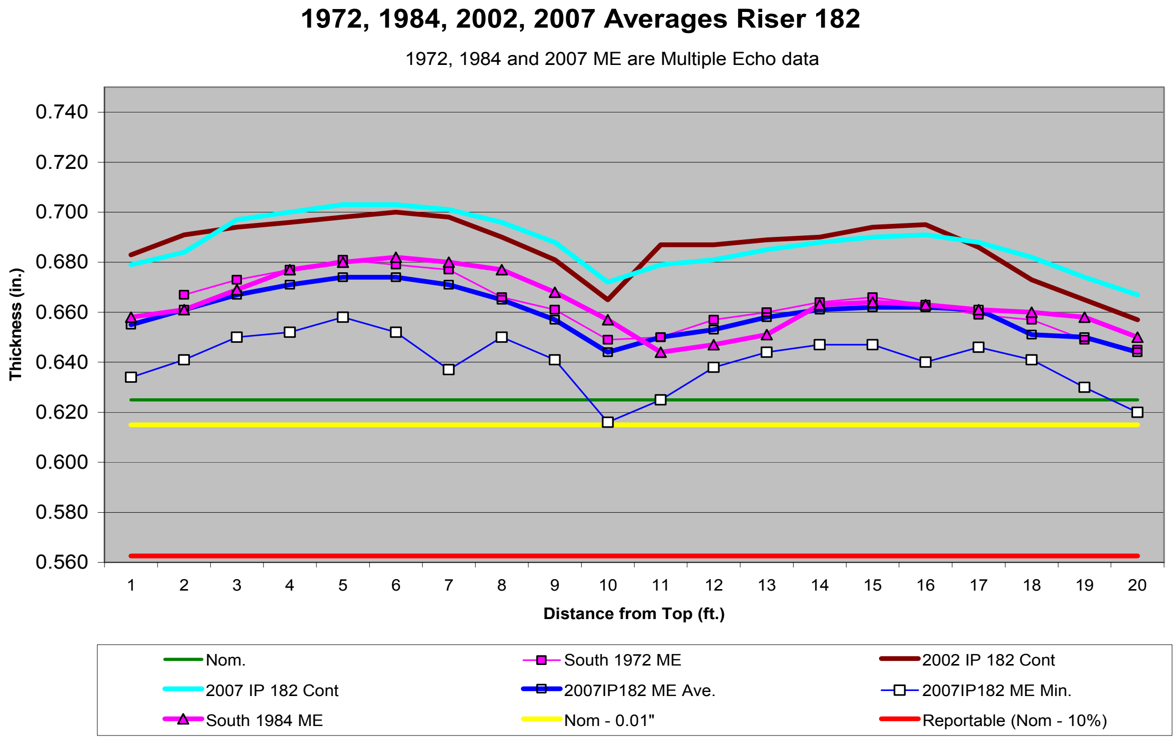


Figure 30: Tank 15 Thickness Data East Riser

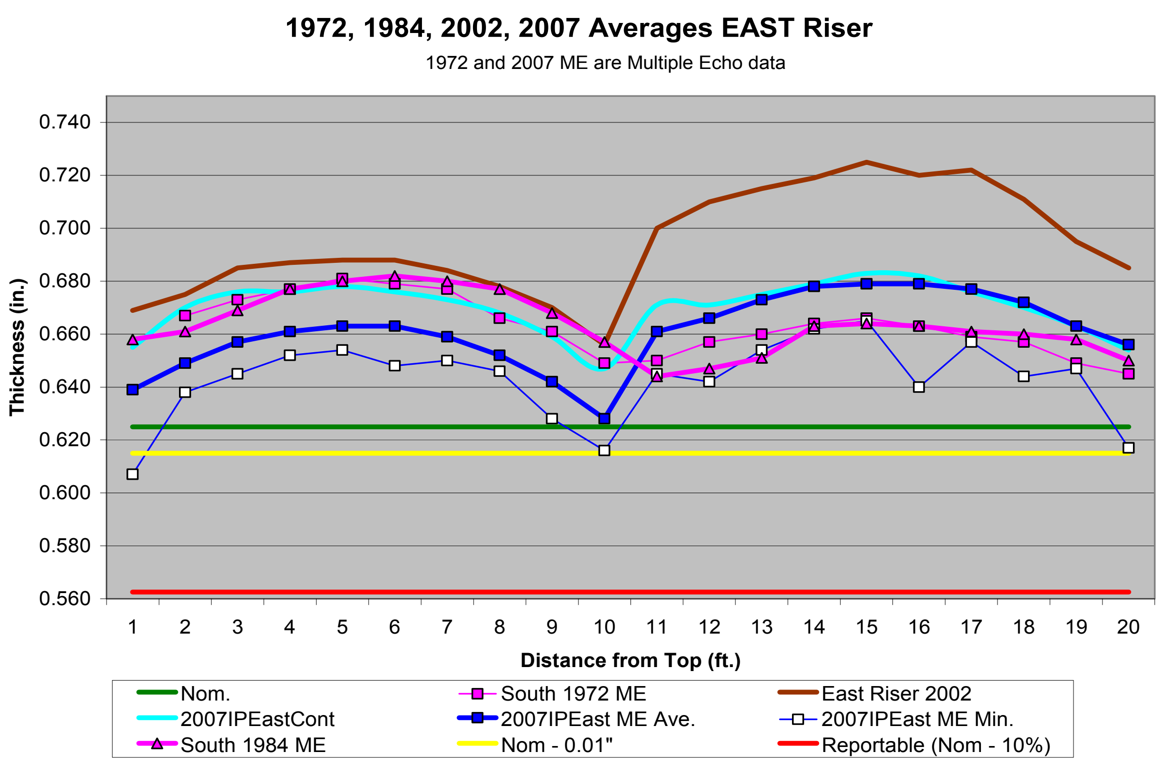


Table 7 Tank 15 Thickness Mapping Results FY 2007 (Multiple Echo Data)

Plate ID / Feet from edge of plate	Nominal	Nom - 0.01"	Reportable (Nom -10%)	IP55 ME Ave.	IP55 ME Min.	IP107 ME Ave.	IP107 ME Min.	IP182 ME Ave.	IP182 ME Min.	East ME Ave.	East ME Min.
Top Plate 1	0.625	0.615	0.563	0.636	0.630	0.638	0.601	0.655	0.634	0.639	0.607
2	0.625	0.615	0.563	0.646	0.633	0.649	0.626	0.661	0.641	0.649	0.638
3	0.625	0.615	0.563	0.653	0.638	0.658	0.632	0.667	0.650	0.657	0.645
4	0.625	0.615	0.563	0.658	0.645	0.662	0.637	0.671	0.652	0.661	0.652
5	0.625	0.615	0.563	0.662	0.645	0.665	0.650	0.674	0.658	0.663	0.654
6	0.625	0.615	0.563	0.665	0.648	0.665	0.640	0.674	0.652	0.663	0.648
7	0.625	0.615	0.563	0.662	0.648	0.660	0.641	0.671	0.637	0.659	0.650
8	0.625	0.615	0.563	0.657	0.644	0.654	0.634	0.665	0.650	0.652	0.646
9	0.625	0.615	0.563	0.652	0.637	0.642	0.612	0.657	0.641	0.642	0.628
10	0.625	0.615	0.563	0.645	0.625	0.628	0.596	0.644	0.616	0.628	0.616
Lower Plate 1	0.625	0.615	0.563	0.638	0.621	0.634	0.615	0.650	0.625	0.661	0.645
2	0.625	0.615	0.563	0.644	0.633	0.640	0.620	0.653	0.638	0.666	0.642
3	0.625	0.615	0.563	0.647	0.632	0.645	0.628	0.658	0.644	0.673	0.654
4	0.625	0.615	0.563	0.649	0.638	0.650	0.633	0.661	0.647	0.678	0.662
5	0.625	0.615	0.563	0.649	0.634	0.652	0.636	0.662	0.647	0.679	0.665
6	0.625	0.615	0.563	0.648	0.625	0.652	0.629	0.662	0.640	0.679	0.640
7	0.625	0.615	0.563	0.646	0.623	0.649	0.628	0.661	0.646	0.677	0.657
8	0.625	0.615	0.563	0.640	0.617	0.645	0.616	0.651	0.641	0.672	0.644
9	0.625	0.615	0.563	0.633	0.611	0.641	0.620	0.650	0.630	0.663	0.647
10	0.625	0.615	0.563	0.627	0.603	0.643	0.609	0.644	0.620	0.656	0.617

Table 8 Tank 15 Crack Detection and Sizing Results

Location Feet From South Riser, Crack #)	**Elevation** Height (in.) from Primary Tank Bottom	**Item**	**Indication Type**	**Through Wall** (TW) Wall Loss from ID	**Length** Measured dimension related to tank horizontal
53' 1)	200"	Top plate Vert. weld	Perpendicular crack	Leak Site 100% TW	4.3" on right side. 0.46" attributed to growth on right side. Total length including both sides 9.54"
115' 2)	88"	Bottom plate Attachment weld	Arched crack at external attachment	Leak Site 100% TW	No measurable growth. 2.3 x 3.7" arch.
172 3)	150"	Middle weld	Perpendicular crack	Leak Site 100% TW	10.5 total length. 0.25" attributed to growth on Near side.
175' 4)	139" (11")	Bottom plate Vert weld	Perpendicular crack-like indication	Previous indication called possible crack determined not to be crack.	
175' 5)	128" (22")	Bottom plate Vert weld	Perpendicular crack	Leak Site 100% TW	Total length 6.7". 1.8" attributed to growth on Near side.
175' new area)	104" (46")	Bottom plate Vert weld	Perpendicular crack	~ 25% TW	Total length 1.2" Near side only
175' new area)	72" (78")	Bottom plate Vert weld	Perpendicular crack	~ 30% TW	Total length 5"
175' new area)	70" (80")	Bottom plate Vert weld	Perpendicular crack	~ 40% TW	Total length 5.4"
175' 6)	48" (102")	Bottom plate Vert weld	Perpendicular crack-like indication	~ 60% TW	No measurable growth. Total length 5"
175' 7)	46" (104")	Bottom plate Vert weld	Perpendicular crack-like indication	~ 60% TW	No measurable growth. Total length 1.5"
181' 8)	31"	Just above Bottom knuckle weld	Perpendicular crack-like indication	~25% TW	No measurable growth. Total length 0.6"
192' 9)	150"	Middle weld	Arched parallel crack	Leak Site 100% through-wall TW	No measurable growth. Total length 20.4".
207 10)	150"	Middle weld	Arched parallel crack	Leak Site 100% through-wall TW	Total length 19". 9.6" vertically. Growth 1.7" perpendicular to weld on top plate.

5.7.2 Lower Plate Vertical Weld

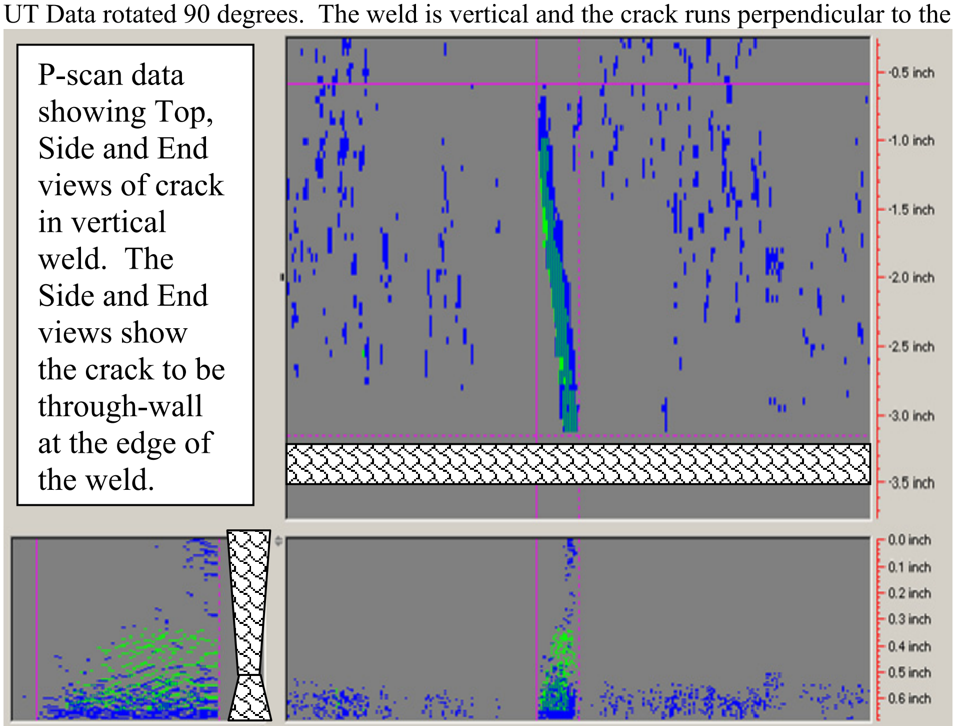
The lower plate vertical weld near IP182 was examined for cracking parallel and perpendicular to the weld. The inspection in 2002 was unable to scan portions of the weld due to a high weld crown in some areas that wouldn't allow the scanner to cross that area. This year, each side was examined independently so the entire length of weld was examined. Previously recorded indications were verified and three partially through wall cracks were detected in these previously un-inspected sections of the vertical weld. The through-wall crack at 129 inches tank elevation measured 6.7 inches long in total length.

Figure 31: IP182 Vertical Weld Salt Nodule

New salt nodule on right side of weld from indication first detected in 2002.

Figure 32: IP182 Vertical Weld P-scan Data from Crack under the Salt Nodule

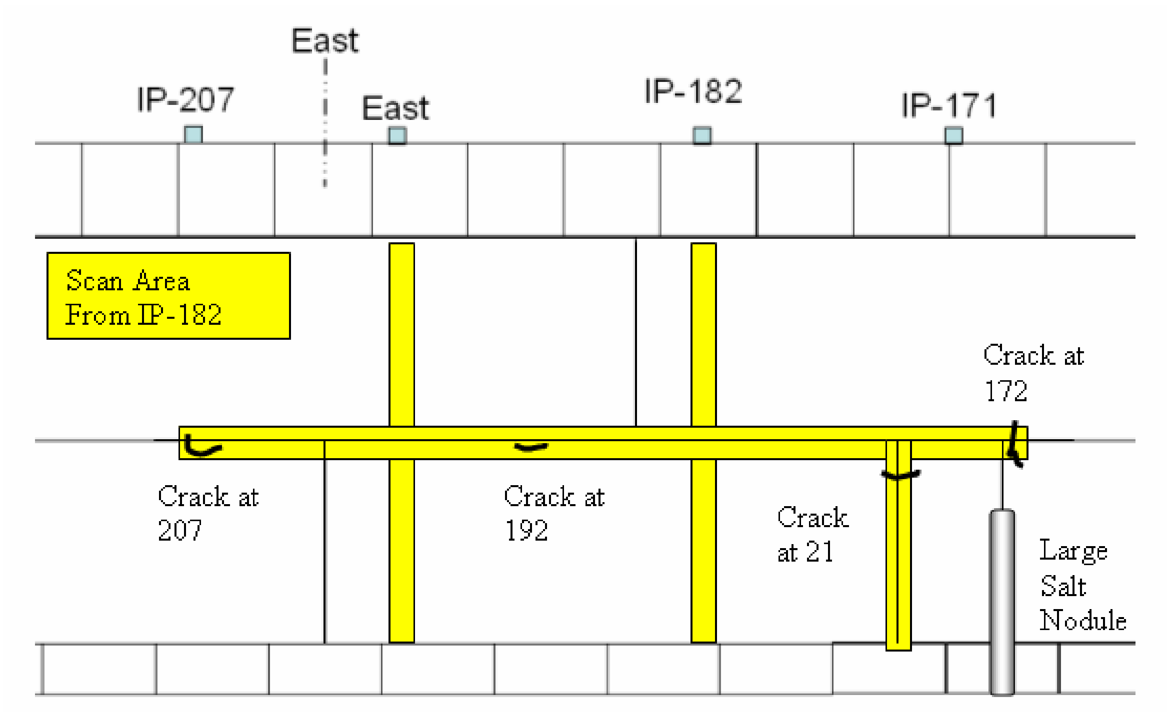
UT Data rotated 90 degrees. The weld is vertical and the crack runs perpendicular to the weld.



5.7.3 Middle Horizontal Weld

The lower plate weld connecting the middle plate to the lower plate was examined for cracking parallel and perpendicular to the weld for over 10% percent of the circumference. The area between IP171 and IP207 was scanned. Other than the 3 cracks noted previously, no additional cracking was detected in the middle horizontal weld. Weld examinations covered both sides of the weld and included several repair areas. Figure 33 depicts the scan locations performed via Riser IP182. The middle horizontal weld, lower plate vertical weld and several cracks were examined as shown.

Figure 33: Scan Locations Beneath Riser IP182



5.7.4 Crack Indication in Middle Horizontal Weld at 172

The crack length was evaluated and compared with the lengths reported in 2002. It was determined that the vertical crack in the top plate grew 0.25 inch. The total measured length of the crack is 10.5 inches. The images in the following figure show a bleed-out photograph of the crack and P-scan data from the top and bottom plate scans.

Figure 34: Images of Crack at 172 from 2007

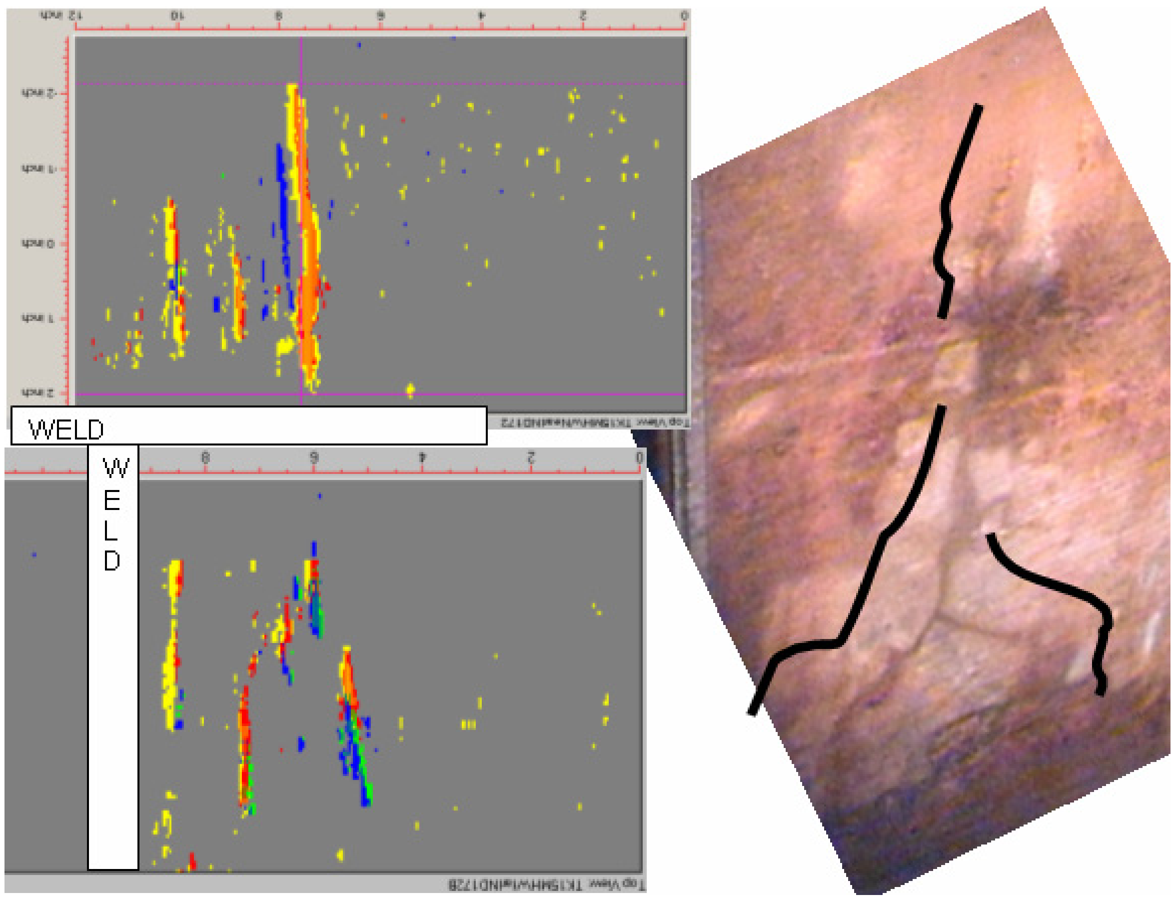
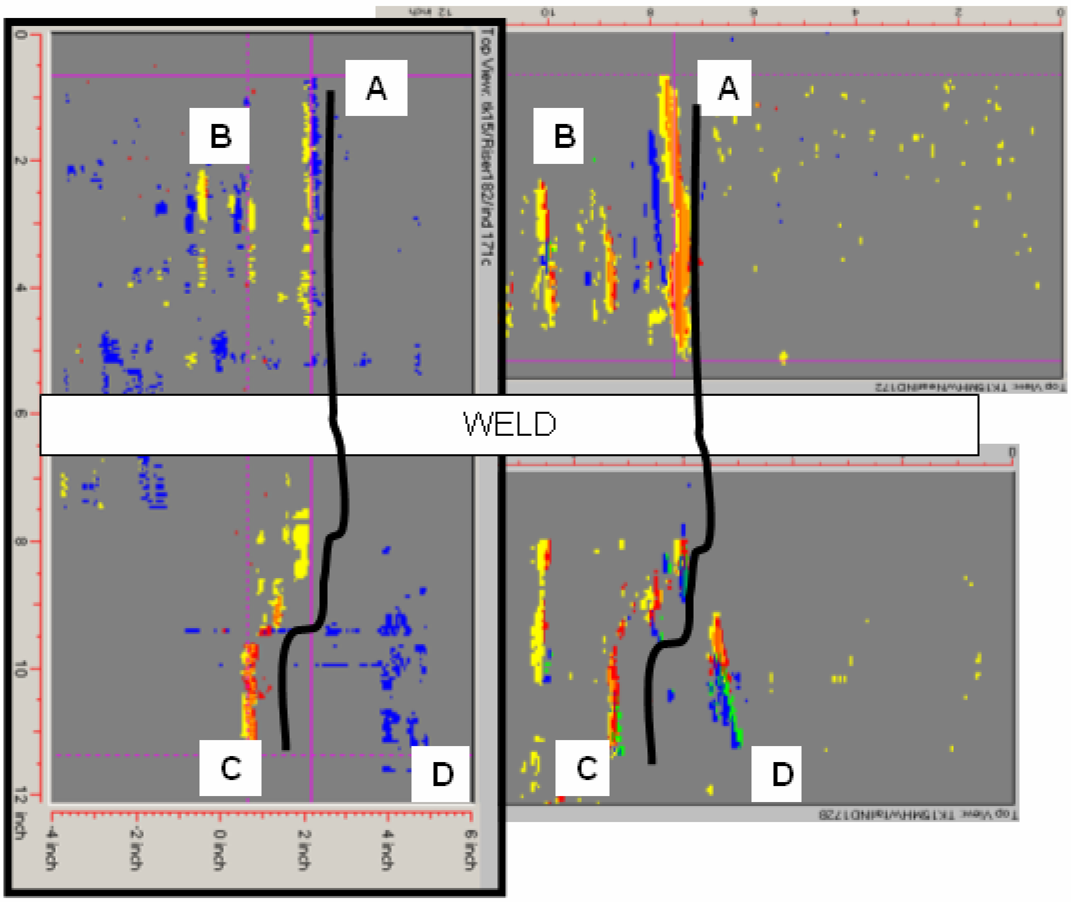


Figure 35: Images of Crack at 172 From 2002 Compared to 2007

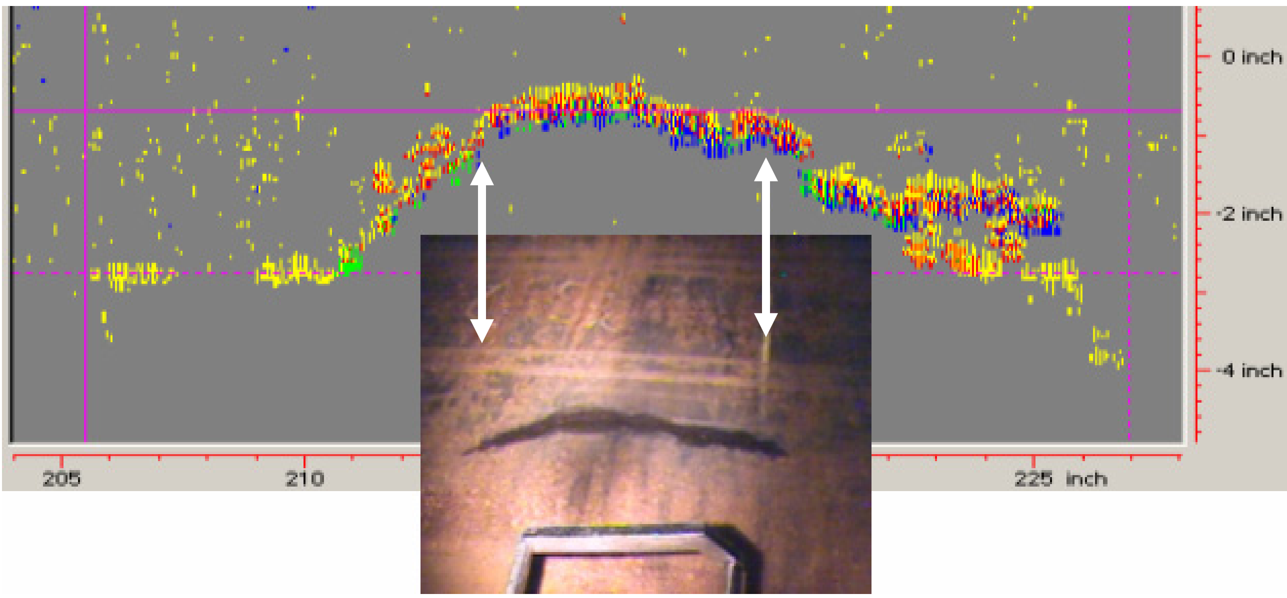
In the following figure, the left section is P-scan data collected in 2002 from the crack at 172 feet. The images on the right are from scans of the same area in 2007. Letters "A" through "D" are added as landmarks to note the same indications in both sets of data.



5.7.5 Crack Indication in Middle Horizontal Weld at 192

The crack at 192 was a previously identified leak site in 2002. The crack was determined to be at a weld repair. The crack length was evaluated and compared with the lengths reported in 2002 and determined to have increased do to improved scanning techniques. Total length measured to be 20.4 inches. This change is not attributed to growth. Figure 36 shows the bleed out image from the through wall portion of the crack and the P-scan data from 2007.

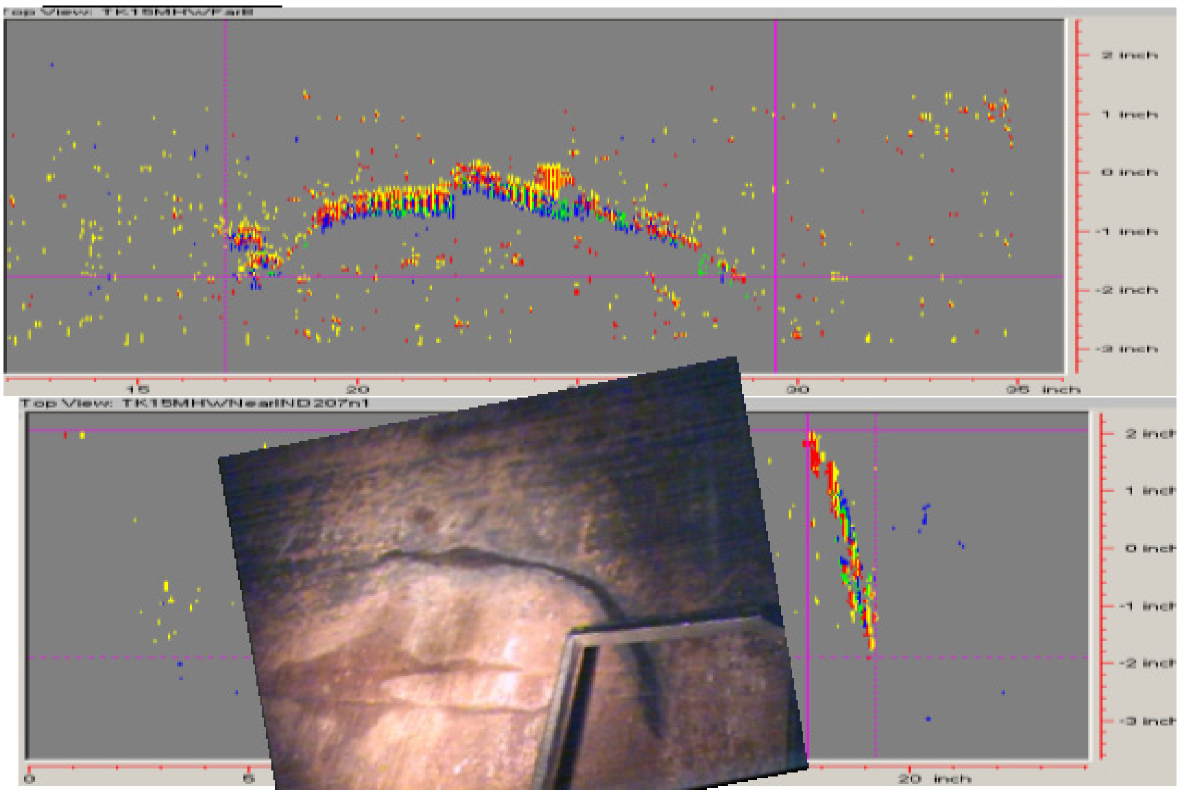
Figure 36: Images of Crack at 192 Feet



5.7.6 Crack Indication in Middle Horizontal Weld at 207

The crack at 207 was a previously identified leak site in 2002. The crack was determined to be at a weld repair. The crack length was evaluated and compared with the lengths reported in 2002 and determined to have increased on the top plate perpendicular to the weld. The total length was measured to be 19 inches long with 1.7 inches attributed to growth. Figure 37 shows the bleed out image from the through wall portion of the crack and the P-scan data from 2007.

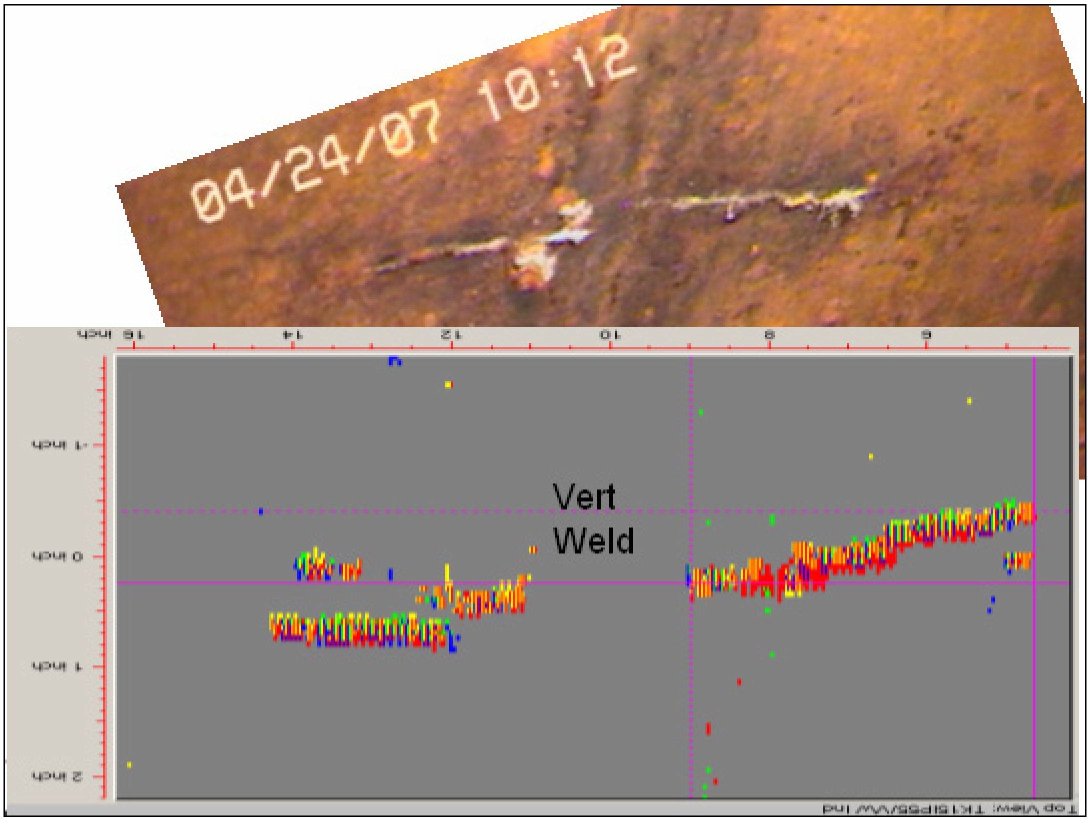
Figure 37: Images of Crack at 207



5.7.7 Crack Indication in Vertical Weld Beneath IP55

The crack in the top plate vertical weld at 53" was a previously identified leak site. In 2002 only the portion on the right side of the weld was examined. Due to improvements in probe holders and scanning techniques, the entire area was examined in 2007. The crack grew 0.46 inches on the right side. The total length of the crack was measured to be 9.54 inches. There is no previous data from the other side of the weld.

Figure 38: Images of Crack in Vertical Weld at IP55

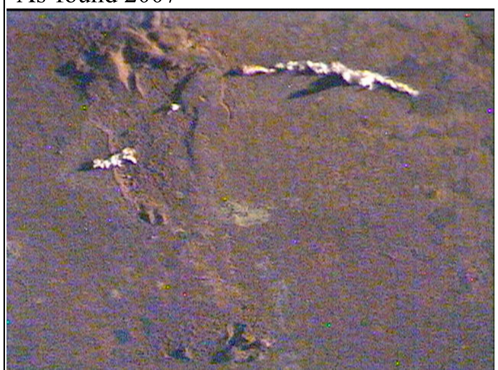


5.7.8 Crack Indication at Attachment Weld at 115 Feet

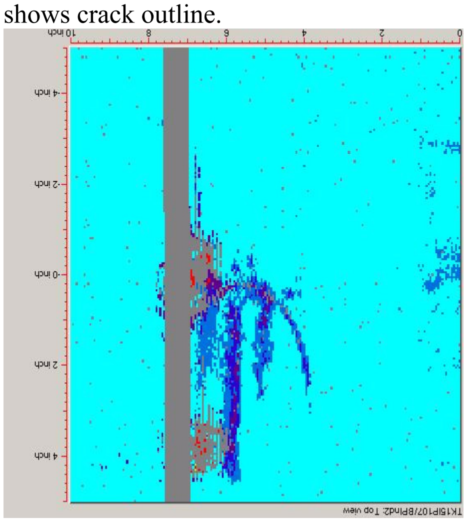
The crack at the attachment weld in the lower plate at 115 feet is pictured in figure 39. The images below include the "as-found" condition in 2007, the thickness mapping data from the 2007 horizontal scan and the bleed-out images from 2002 an 2007. Note the salt buildup showing the through-wall portion of the crack. The crack appears to have remained the same size at 2.3 inches x 3.7 inches.

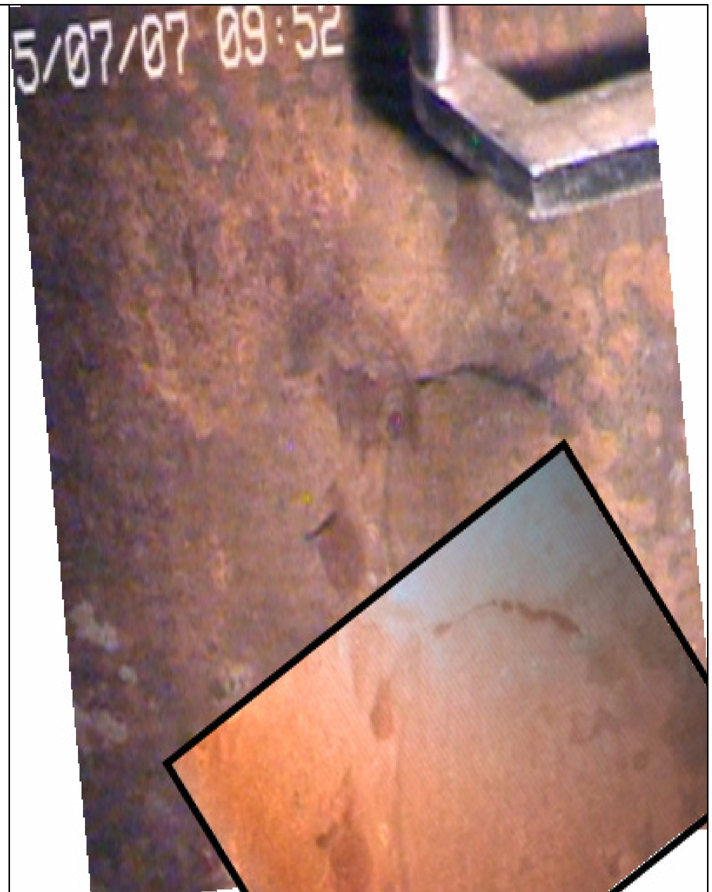
Figure 39: Images of Crack at Attachment Weld Near IP107

As-found 2007



Thickness mapping data, 2007, Dark blue shows crack outline.





Inspection Reports
Details of the inspections performed in fiscal year 2007 including dates and report numbers are included in Table 9.

TABLE 9 INSPECTION REPORT MATRIX FY2007

Tank	Inspection Item	Date	NDE Data Report 2007-IR-11- #	ISI Review Committee Report
35	Secondary Wall Scans	11/20/06	0559 - 563	LWO-LWE-2007-00199
35	Top Knuckle	11/28/06	0564	LWO-LWE-2007-00199
35	Top Plate	11/28/06	0565	LWO-LWE-2007-00199
35	Middle Plate	11/28/06	0566	LWO-LWE-2007-00199
35	Lower Plate	11/30/06	0567	LWO-LWE-2007-00199
35	Bottom Knuckle	11/30/06	0568	LWO-LWE-2007-00199
36	Secondary Wall Scans	8/1 - 2/07	0573 - 577	LWO-LWE-2007-00200
36	Top Knuckle	7/31/07	0578	LWO-LWE-2007-00200
36	Top Plate	7/31/07	0579	LWO-LWE-2007-00200
36	Middle Plate	8/1 - 2/07	0580	LWO-LWE-2007-00200
36	Lower Plate	8/2/07	0581	LWO-LWE-2007-00200
36	Bottom Knuckle	8/2/07	0582	LWO-LWE-2007-00200
37	Secondary Wall Scans	8/13 – 15/07	0599 - 603	LWO-LWE-2007-00201
37	Top Knuckle	8/14/07	0604	LWO-LWE-2007-00201
37	Top Plate	8/14/07	0605	LWO-LWE-2007-00201
37	Middle Plate	8/14/07	0606	LWO-LWE-2007-00201
37	Lower Plate	8/15/07	0607	LWO-LWE-2007-00201
37	Bottom Knuckle	8/15/07	0608	LWO-LWE-2007-00201
38	Secondary Wall Scans	1/10 – 11/07	0547 - 551	LWO-LWE-2007-00202
38	Top Knuckle	1/23/07	0552	LWO-LWE-2007-00202
38	Top Plate	1/17/07	0553	LWO-LWE-2007-00202
38	Middle Plate	1/23/07	0554	LWO-LWE-2007-00202
38	Lower Plate	1/24/07	0555	LWO-LWE-2007-00202
38	Bottom Knuckle	1/24/07	0556	LWO-LWE-2007-00202
15	Top Plate (55, 107, 182, East)	4/24 – 5/30/07	0642, 644, 646, 648	LWO-LWE-2007-00203
15	Lower Plate (55, 107, 182, East)	4/25 – 5/31/07	0643, 645, 647, 649	LWO-LWE-2007-00203
15	Lower Plate Vertical Weld	6/7/07	0650	LWO-LWE-2007-00203
15	Middle Horizontal Weld	5/22, 5/31, 6/5, 6/11, 6/12/07	0651	LWO-LWE-2007-00203

5.8 Historical Thickness Data Comparison

An ultrasonic thickness measurement program was implemented for all waste tanks in 1972. This program was discontinued after 1985 because no indications of service induced, general corrosion were detected. [7] The historical UT spot thickness readings (skate) were aimed at detecting and measuring wall loss from general corrosion. The ultrasonic technique that was used to make the spot thickness readings during that time was different than the current technique.

The previous or spot UT thickness program, was focused on detection of general corrosion. The spot thickness reading data were collected with a single element transducer and a multiple echo technique which provides a precise measurement of steel thickness while minimizing the error from any coating or changes in contact from pressure or surface debris. The current thickness mapping technique is configured to optimize the detection of pitting as well as other corrosion related wall loss and therefore a dual element transducer is utilized. The multiple echo technique is not as sensitive to pitting, but has been added to the other thickness mapping techniques to allow for better correlation with previous spot thickness reading data.

Historical UT spot thickness data were collected on most of the waste tanks at Savannah River Site. From 1972 until 1985, UT thickness measurements were made on 23 of the 27 Type III waste tanks. [8] This program also included all of the Type I and three of the four Type II Tanks. Most tanks have more than one set of data. All tanks examined this year had previous UT skate data.

The Type III tanks were all stress relieved by post weld heat treatment (PWHT). As a result of that field treatment, significant oxidation and loose scale remained on the surface of the tanks' plates. This surface condition was not conducive to transmitting ultrasound.[9] Tanks 29, 30, 31, 32, 33 and 34 were already in service when this condition was discovered early in the UT skate program. The decision was made to remove these tanks from the UT program due to the surface condition. Although these tanks were not included in the monitoring program, limited thickness data was collected on some of the tanks. Tank 29 has one set of spot thickness data under Riser A2 from 1973 and one set under Riser A1 from 1974. Tank 30 has one set of data under Risers A1 and A2 from 1975. Tank 33 had a few pre-service thickness readings taken in conjunction with strain gage activities in 1973. The remainder of the Type III tanks would have a two foot wide band prepared and painted to allow for future UT spot thickness readings with the skate. The current UT system is capable of collecting data on the unprepared surface of the tanks previously omitted from the program. Tanks 30, 31, 32 and 34 were examined in FY03. Tanks 29 and 33 were examined in FY06.

Figure 41 shows a graph of the results of the historical UT spot thickness readings from Tank 36, Riser P-02 taken in 1977 the year the tank went into service. Spot readings from 1981, 1985 and the thickness data from 2007 is also included. The data shows the typical pattern for SRS waste tank plates where the edges of the plates are slightly thinner from the rolling process at the steel mill. There is excellent correlation between the four sets of data available for Tank 36. Similar graphs are included for all available tanks covered by this report. Current thickness mapping data is graphed with at least one set of skate data from early in the spot measurement program.

When comparing historical skate data with data collected from the current inspections it should be noted that there is a disparity in the number of data points being compared. The skate data included a generous number of single spot UT thickness readings. Readings were typically taken at two to six inch intervals in a line for the entire accessible height of the tank resulting in approximately 50 or more readings. Typically no spot readings were obtainable on the top knuckle of any tank and readings on the bottom knuckle were limited. The thickness mapping data includes thickness measurements at 0.050 inch intervals over the entire 8.5 inch wide strip for the entire accessible height of the tank. This raster pattern scan results in the transducer traveling over one mile collecting well over one million thickness readings in each complete vertical strip.

Data analysis is typically performed and results reported in 12 inch long sections. During analysis, each 12 inch long section of the scan area is evaluated utilizing Top and Side views to evaluate the thickness data graphically. Thousands of thickness readings are evaluated to determine and report a single minimum and average thickness for each 12 inch section. In order to present this information in a simple format, the graphs were prepared where the recently reported values for each 12 inch section are plotted along with the spot thickness data. The spot thickness data values were input to provide one number for each 12 inch section. The following figures provide a comparison of the most recent UT thickness data with the historical spot UT thickness data.

For a valid comparison of the two sets of data, the average thickness mapping value is plotted along with the spot reading values.

Tank 15 data is not included in this section due to the fact that historical UT thickness data is only available from the South riser and subsequent thickness examinations could not be performed in the South riser. The South riser data is included for comparison in earlier figures for Tank 15.

Figure 40: Comparison Chart Tank 35 Skate vs. FY2007 Data

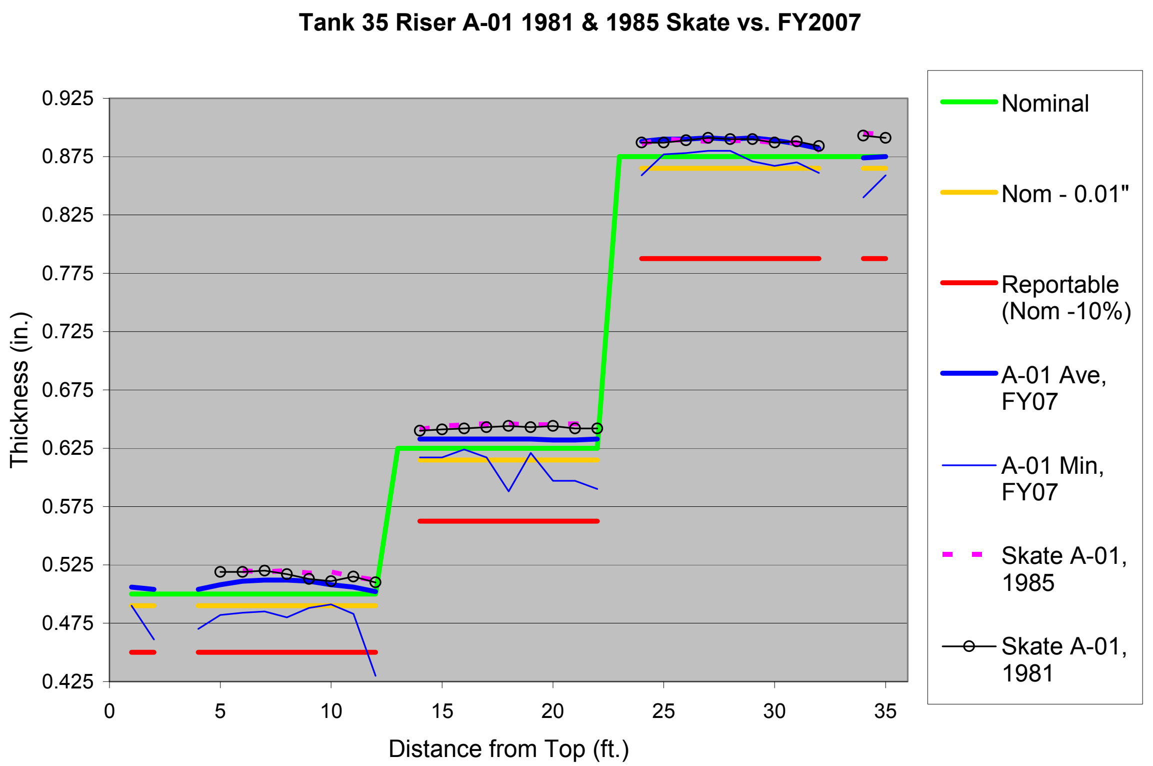


Figure 41: Comparison Chart Tank 36 Skate vs. FY2007 Data

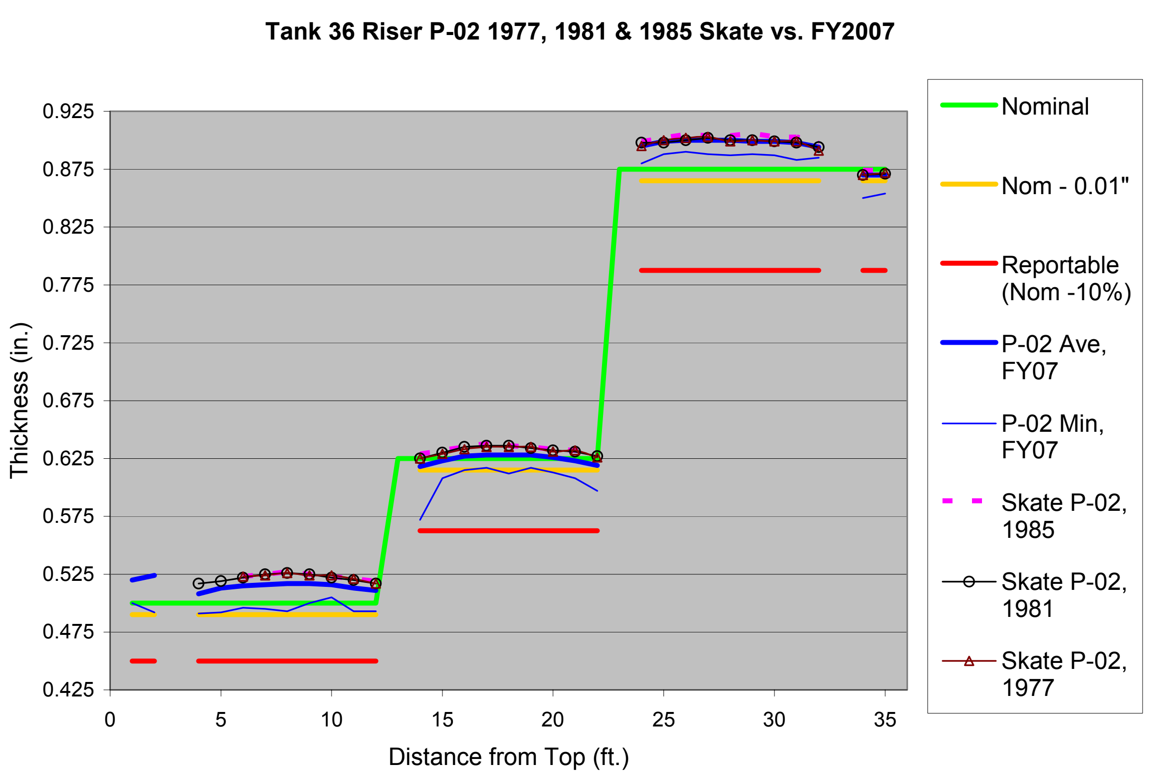


Figure 42: Comparison Chart Tank 37 Skate vs. FY2007 Data

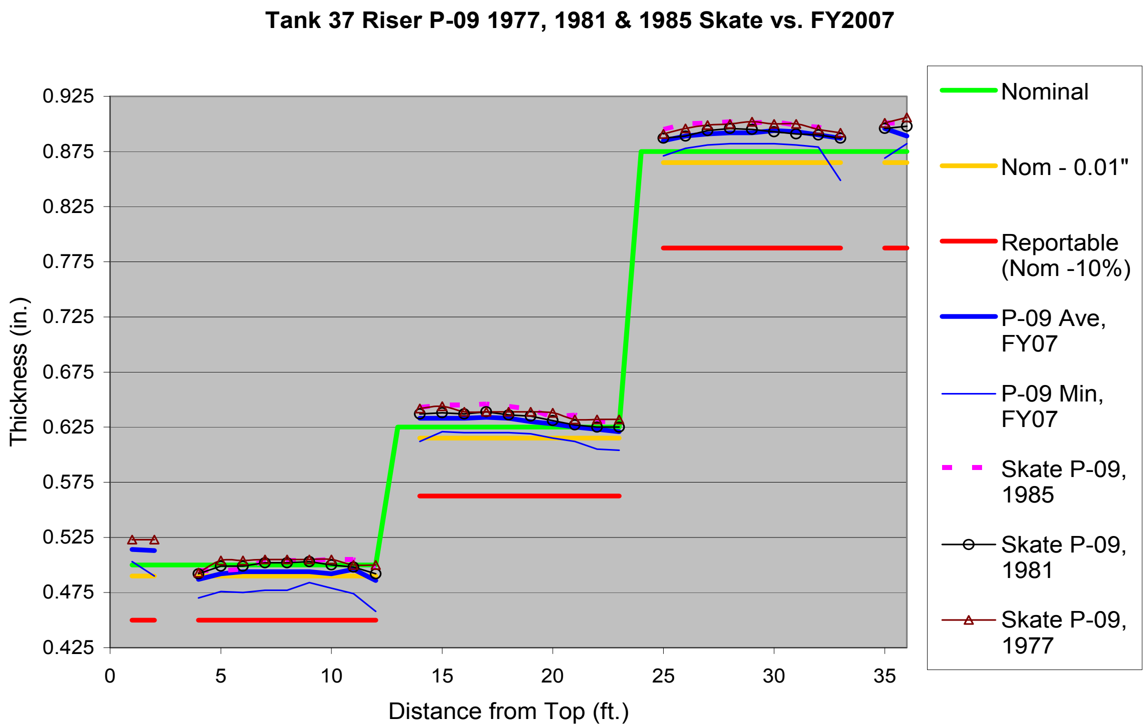
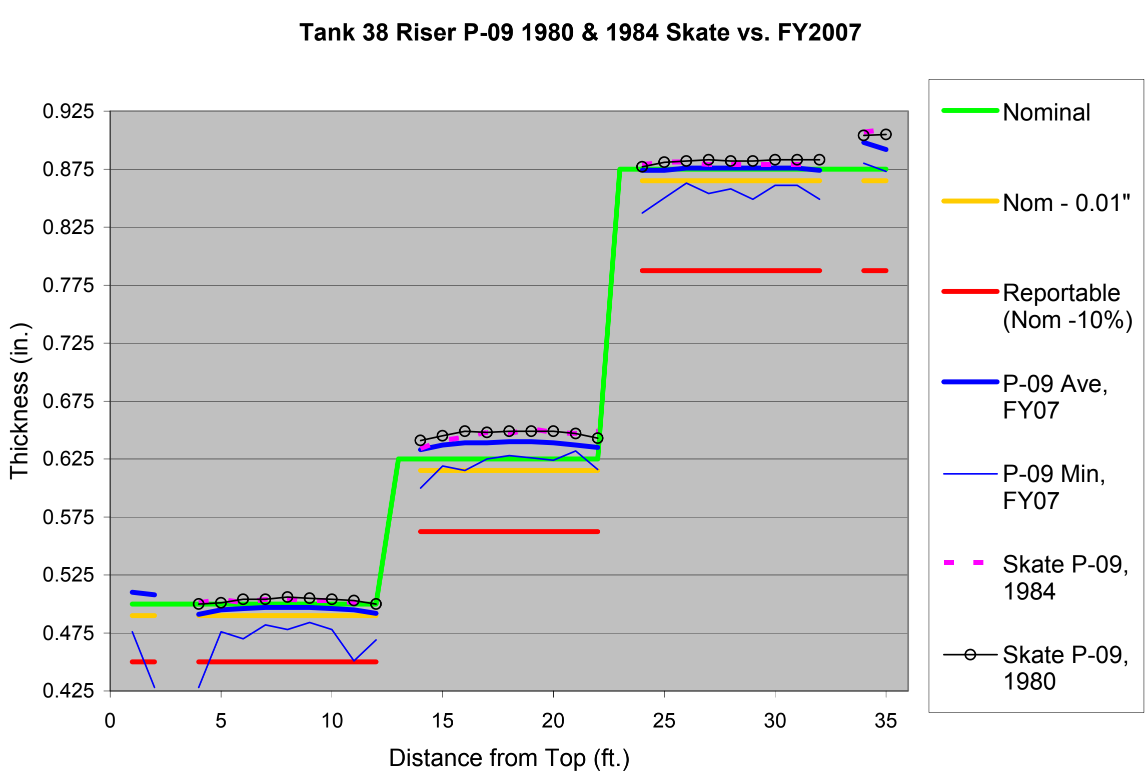


Figure 43: Comparison Chart Tank 38 Skate vs. FY2007 Data



5.9 Conclusion

Technical evaluation of the historic and current multiple echo thickness data shows that there is good correlation between the two sets of data. By understanding the two techniques and what the data represent, a valid comparison and evaluation can be performed utilizing the reported values. Every effort was made to perform measurements in the same manner and location as data previously collected to facilitate direct comparison. There is adequate correlation to perform a detailed analysis of corrosion rates which is presented in "Estimation of High Level Waste (HLW) Tank Remaining Service Life". [10]

No cracking or service induced reportable thinning or pitting was detected in any of the Type III primary tanks. A few areas were measured to be less than the reporting level for thinning (nominal thickness minus 10%), but these areas are attributed to fabrication artifacts. These grinding areas with reportable thicknesses were typically in the 0.50 inch sections for the tanks. Incipient pitting was detected in the primary walls of several Type III tanks.

In the secondary walls and floor plates there were small spots in several tanks where the thickness was reportable by the 10% wall loss criteria.

The re-examination of Tank 15, the non-stress relieved Type II tank, showed evidence of continued crack growth on several of the cracks. The cracks that showed growth since the previous examination five years ago are oriented perpendicular to vertical and horizontal welds. No service induced reportable thinning or pitting was detected in Tank 15, but previously reported incipient pitting was verified.

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[7] F. G. McNatt, “Steel Thickness Measurements of Waste Tanks" memo to W. B. Boore dated March 12, 1986.

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[9] R. L. Hooker, “Preparation for Wall Thickness Measurements of New Stress Relieved Waste Tanks" memo to D. B. Jett dated June 23, 1975

[10] B. J. Wiersma, “Estimation of High Level Waste (HLW) Tank Remaining Service Life” WSRC-TR-2005-00196, May 2005

APPENDIX A ISI PROGRAM STATUS

A summary of all ultrasonic examinations performed on Type III waste tanks is included in Table A1.

Table A1 Summary of Ultrasonic Inspection of Type III Tanks Through FY2007

Tank #	Inspection Year (FY) / Inspection Type *	Reportable Thickness in Primary Wall	Incipient Pitting	Reportable Thickness in Secondary Wall	Spot UT Thickness Readings	'90's T-scan (*2)
25	2004 / A	No	**Yes –** one 0.35" diameter pit 0.036" deep.	No	'79 & 83	-
26	2004 / FS	No	No	No	'79 & 83	-
27	2006 / A	No	No	No	'79 & 83	-
28	2005 / A	No	No	Local Thinning	'79 & 83	-
29	2006 / FS	Grinding P-12, TP	**Yes –** four 0.5" diameter pits 0.019 – 0.065" deep	Plate 1	'73 & 74 (*1)	-
30	2003 / A	No	No	No	'75 (*1)	-
31	2003 / A	No	**Yes –** one ~0.37" diameter pit 0.046" deep	No	(*1)	-
32	2003 / FS	No	**Yes -** three pits, max 0.75" diameter and 0.055" deep	Not examined, 1st tank inspected to new plan. Added to all other tanks.	(*1)	-
33	2006 /A	No	No	Floor	(*1)	-
34	2003 / A	No	No	Plate 1	(*1)	-
35	FY07 / A	Grinding A-1, TP	No	Plate 1 & floor	'77, 81 & 85	-
36	FY07 / A	No	No	Floor	'77, 81 & 85	-
37	FY07 / A	No	No	Floor	'77, 81 & 85	-
38	FY07 / A	Grinding P-9, TK & TP	No	Plate 4 & floor	'80, 81 & 84	-
39	2006 / A	Grinding P-5, TP	No	Plate 1, 2, 4 & floor	'80, 81,84 & 85	-
40	2006 / A	Grinding P-12, TP	No	Plate 3, 4 & floor	'80, 81 & 84	'96
41	2006 / A	Grinding P-5, TP	No	No	'80, 81 & 84	-
42	2005 / A	No	No	Plate 1, 2 & 3	'80, 81, 84, 85 & 90	'95, 96
43	2006 / A	Grinding P-12, TP	No	Plate 2, 4 & floor	'80, 81 & 84	-
44	2005 / A	No	No	Plate 1, 2, & 4	'80, 81 & 84	-
45	2005 / A	No	No	Plate 2	'80, 81 & 84	-
46	2005 / A	No	No	Plate 1	'80, 81 & 84	-
47	2005 / FS	No	No	Plate 4	'80, 81 & 84	-
48	2004 / FS	Grinding P-10 & 13, TK	No	No	'82	'94, 95, 96 & 97
49	2005 / A	Grinding P-3, TP	**Yes** – pitting ~85 to 114 inches tank elevation. Up to 0.75" diameter and 0.040" deep.	No	'82	'95
50	2004 / A	Grinding P-6, TK	No	No	'82	'94 & 95
51	2005 / A	No	No	Plate 1 & 2	'82	'96 & 97

* Inspection type A = Augmented, FS = Full Scope. "'90's T-scan" typically included four ea. 6" wide vertical strips for thinning and pitting.

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