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Pacific Northwest
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Ultrasonic Examination of Double-Shell Tank 241-AY-101 Examination Completed August 2003

AF Pardini
GJ Posakony

December 2003

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RL01830

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Pacific Northwest National Laboratory
Richland, Washington 99352

Summary

COGEMA Engineering Corporation (COGEMA), under a contract from CH2M Hill Hanford Group (CH2M Hill), has performed an ultrasonic nondestructive examination of selected portions of Double-Shell Tank 241-AY-101. The purpose of this examination was to provide information that could be used to evaluate the integrity of the wall of the secondary tank. The requirements for the ultrasonic examination of Tank 241-AY-101 were to detect, characterize (identify, size, and locate), and record measurements made of any wall thinning or pitting that might be present in the wall of the secondary tank. Any measurements that exceed the requirements set forth in the Engineering Task Plan (ETP), RPP-11832 (Jensen 2002) and summarized on page 1 of this document, are reported to CH2M Hill and the Pacific Northwest National Laboratory (PNNL) for further evaluation. Under the contract with CH2M Hill, all data is to be recorded on disk and paper copies of all measurements are provided to PNNL for third-party evaluation. PNNL is responsible for preparing a report that describes the results of the COGEMA ultrasonic examinations.

Examination Results

The results of the examination of Tank 241-AY-101 have been evaluated by PNNL personnel. The examination consisted of one 15-in. wide by 12-in. long scan on each of Plates #1, #2, #3, and #4 of the secondary tank wall. The examination was performed to detect any wall thinning or pitting, in the secondary tank wall.

Secondary Tank Wall Vertical Scan Paths

One 15-in. wide by 12-in. long scan was performed on each of Plates #1, #2, #3, and #4 of the secondary tank of 241-AY-101. The plates were examined for wall thinning and pitting on the secondary tank wall above and below the Plate #1 to Plate #2 circumferential weld and above and below the Plate #3 to Plate #4 circumferential weld. The results indicated one area near the bottom of Plate #1 that exceeded the reportable level of 10% of the nominal thickness. There were also two small areas located near the top of Plate #2. There were no other areas of wall thinning in Plates #3, or #4 that exceeded the reportable level of 10% of the nominal thickness. No pitting indications were detected in Plates #1, #2, #3, or #4.

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Figures

1.0 Introduction

COGEMA Engineering Corporation (COGEMA), under a contract from CH2M Hill Hanford Group (CH2M Hill), has performed an ultrasonic nondestructive examination (UT) of selected portions of Double-Shell Tank (DST) 241-AY-101. The purpose of this examination was to provide information that could be used to evaluate the integrity of the DST. The requirements for the UT of Tank 241-AY-101 were to detect, characterize (identify, size, and locate), and record measurements made of any wall thinning or pitting that might be present in the wall of the secondary tank. Any measurements that exceed the requirements set forth in the Engineering Task Plan (ETP), RPP-11832 (Jensen 2002), are reported to CH2M Hill and the Pacific Northwest National Laboratory (PNNL) for further evaluation. Specific measurements that are reported include the following:

- Wall thinning that exceeds 10% of the nominal thickness of the plate.
- Pits with depths that exceed 25% of the nominal plate thickness.

The accuracy requirements for ultrasonic measurements for the different types of defects are as follows:

- Wall thinning – measure thickness within ±0.020-in.
- Pits – size depths within ±0.050-in.
- Location – locate all reportable indications within ±1.0-in.

Under the contract with CH2M Hill, all data is to be recorded on disk and paper copies of all measurements are provided to PNNL for third-party evaluation. PNNL is responsible for preparing a report that describes the results of the COGEMA UT.

2.0 Qualified Personnel, Equipment, and Procedure

Qualification of personnel participating in the DST inspection program, the UT equipment (instrument and mechanical scanning fixture), and the UT procedure that will be used in the examination of the current DST is required by CH2M Hill. Personnel participating in the examinations are to be certified in accordance with the American Society for Nondestructive Testing (ASNT) Guideline SNT-TC-1A-92 and associated documentation is to be provided. The capability of the UT system is to be validated through a performance demonstration test (PDT) administered by PNNL on a mock-up simulating the actual DST. The current procedure for the UT is to be based on the Section V, Article 4, *Boiler and Pressure Vessel Code* defined by the American Society for Mechanical Engineers (ASME).

2.1 Personnel Qualifications

The following individuals were qualified and certified to perform UT of the Hanford DST 241-AY-101:

- **Mr. Wesley Nelson**, ASNT Level III (#LM-1874) in UT, has been identified as COGEMA's UT Level III authority for this project. Mr. Nelson has been certified by COGEMA as a UT Level III in accordance with COGEMA procedure COGEMA-SVCP-PRC-014, latest revision. Further documentation has been provided to establish his qualifications. Reference: Letter from PNNL to C.E. Jensen dated August 22, 2000, "Report on Performance Demonstration Test – PDT, May 2000".

- **Mr. James B. Elder**, ASNT Level III (#JM-1891) in UT, has been contracted by COGEMA to provide peer review of all DST UT data. Mr. Elder has been certified by JBNDT as a UT Level III in accordance with JBNDT written practice JBNDT-WP-1, latest revision. Further documentation has been provided to establish his qualifications. Reference: PNNL-11971, *Final Report - Ultrasonic Examination of Double-Shell Tank 241-AN-107.*

- **Mr. William D. Purdy**, COGEMA UT Level II limited (for P-Scan data acquisition only). Mr. Purdy has been certified in accordance with COGEMA procedure COGEMA-SVCP-PRC-014, latest revision. Further documentation has been provided to establish his qualifications. Reference: Letter from PNNL to C.E. Jensen dated October 5, 2001, "Purdy Performance Demonstration Test (PDT) Report."

2.2 Ultrasonic Examination Equipment

CH2M Hill has provided the UT equipment for the examination of Tank 241-AY-101. This equipment consists of a Force Institute P-Scan ultrasonic test instrument and a Force Institute AWS-5D remote-controlled, magnetic-wheel crawler for examining the secondary tank wall. Ultrasonic transducers used for the examinations are commercial off the shelf. The P-Scan ultrasonic system has been qualified through a PDT administered by PNNL. Reference: PNNL-11971, *Final Report-Ultrasonic Examination of Double-Shell Tank 241-AN-107*.

2.3 Ultrasonic Examination Procedure

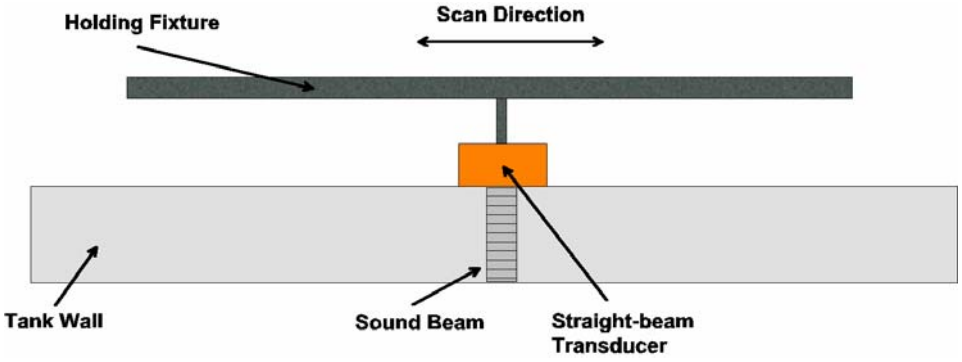
COGEMA has provided the UT procedure for the examination of Tank 241-AY-101. This procedure, COGEMA-SVUT-INS-007.3, Revision 1, outlines the type of UT and mechanical equipment that are to be used as well as the types of transducers. Only straight-beam transducers were used for the examination of the secondary tank wall. The examination procedures include full documentation on methods for calibration, examination, and reporting. Hard copies of the T-Scan (thickness) of all areas scanned are made available for analysis. The UT procedure requires the use of specific UT transducers for the examinations. A calibration performed before and after the examinations insures that each transducer used in the inspection is adjusted and that the entire system is performing correctly. The COGEMA UT procedure has been qualified through a PDT. Reference: PNNL-11971, *Final Report - Ultrasonic Examination of Double-Shell Tank 241-AN-107*.

3.0 Ultrasonic Examination Configuration

COGEMA is typically required to inspect selected portions of the DSTs which may include the primary and secondary tank walls, the HAZ of the primary tank vertical and horizontal welds, and the tank knuckle and bottoms. The P-Scan system has been configured to perform these examinations and has been performance tested. The examination of Tank 241-AY-101 only included UT of the secondary tank wall for wall thinning and pitting.

3.1 Secondary Tank Wall Transducer Configuration

Figure 3.1 provides an example of the scanning configuration used during the examination of the secondary tank wall of 241-AY-101. For this examination, only the straight-beam transducer was used. The functional diagram in Figure 3.1 shows one straight-beam transducer for examining the secondary tank wall. The straight beam is designed to detect and record wall thinning and pits that may be present. Information is captured every 0.035-in. (or as set by the NDE inspector) as the assembly is scanned across a line. At the end of each scan line the fixture is indexed 0.035-in. (or as set by the NDE inspector) and the scan is repeated. The mechanical scanning fixture is designed to scan a maximum of 15-in. and then index for the next scan. The hard copy provides a permanent record that is used for the subsequent analysis.



Transducer Specifications:

Straight-Beam
Type: MSEB 5B
Frequency: 5 MHz
Size: Dual - 2 X 8 mm
Manufacturer: Krautkramer

Figure 3.1. Transducer Configuration for Examining the Secondary Tank Wall

4.0 Ultrasonic Examination Location

Tank 241-AY-101 is located in the Hanford 200 East area in AY Tank Farm. The crawler and associated scanner that hold the transducers were lowered into the 24-in. riser located on the east side of 241-AY-101 and designated as Riser 88. Riser 88 was originally called out as Riser 18 East. Figure 4.1 provides a graphic of the location of this riser.

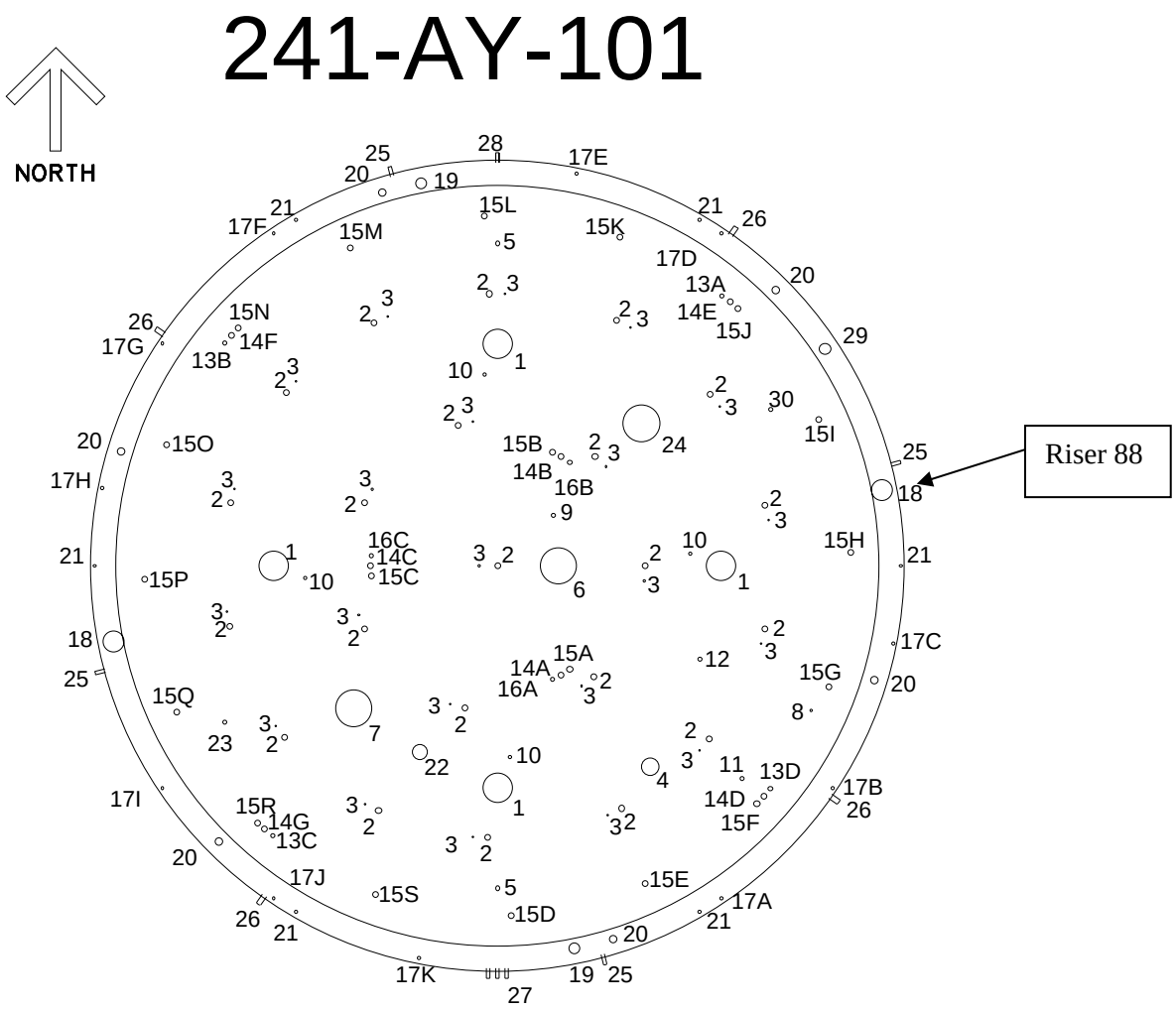


Figure 4.1. UT of 241-AY-101 from Riser 88

Figure 4.2 describes the areas on the secondary wall of Tank 241-AY-101 that were ultrasonically examined. Short 15-in.-wide by 12-in.-long vertical scan paths were performed on Plates #1, #2, #3, and #4 below the entrance to Riser 88.

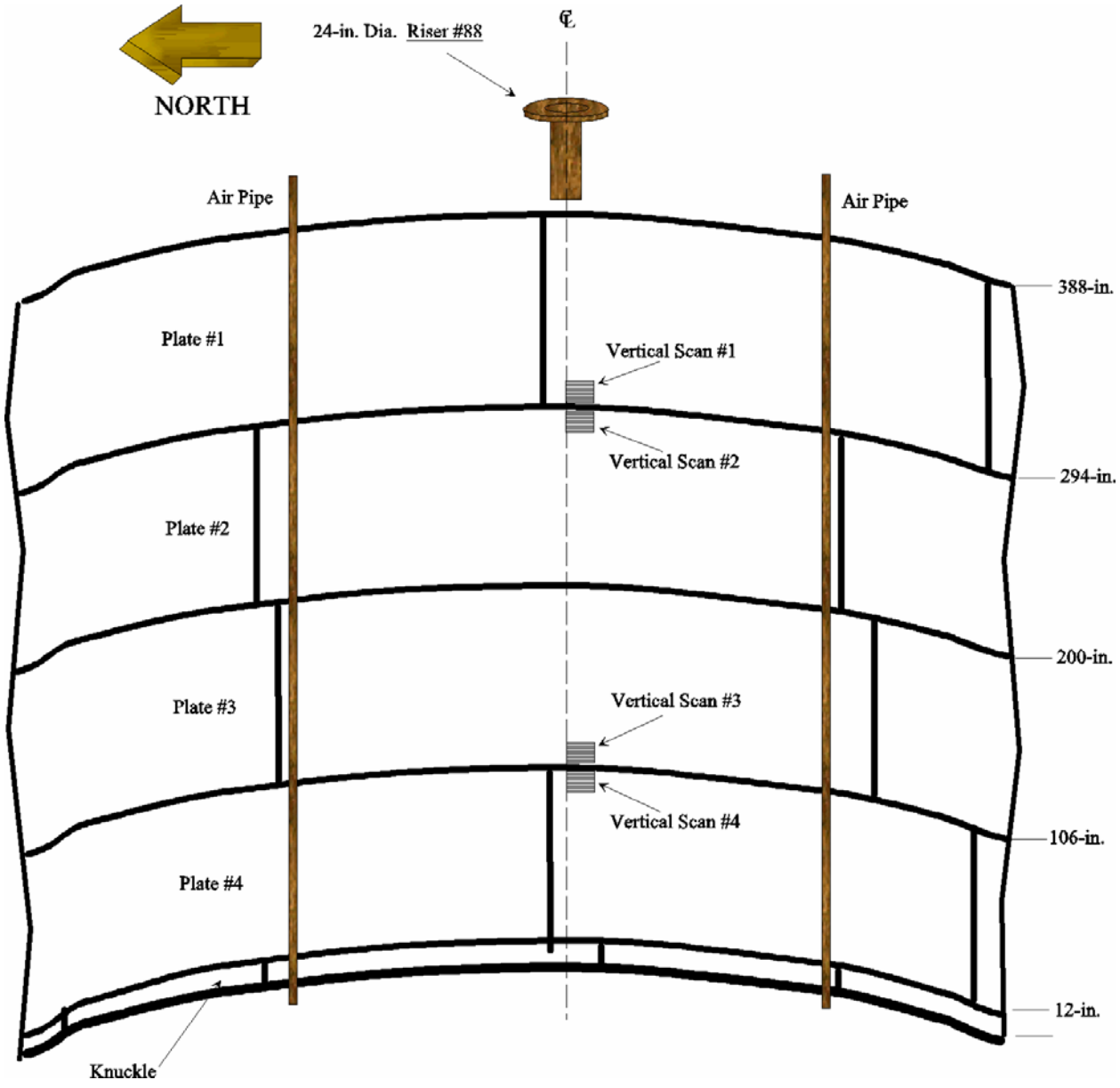


Figure 4.2. Sketch of Areas Scanned on Secondary Wall of Tank 241-AY-101

5.0 Ultrasonic Examination Results

COGEMA has provided detailed reports including T-Scan (thickness) hard copies of all areas that were ultrasonically examined to PNNL for third-party review. The data was analyzed by COGEMA Level III Mr. Wes Nelson and peer reviewed by JBNDT Level III Mr. Jim Elder. The results of the examination of Tank 241-AY-101 are presented in Figures 5.1 and 5.2.

Figures 5.1 and 5.2 show the wall thickness examination results for the secondary tank wall. The examination consisted of short vertical paths beneath the 24-in. diameter riser. Vertical scan #1 was 15-in. wide and 12-in. long on the bottom portion of Plate #1. Vertical scan #2 was 15-in. wide and 12-in. long on the top portion of Plate #2. Vertical scan #3 was 15-in. wide and 12-in. long on the bottom portion of Plate #3. Vertical scan #4 was 15-in. wide and 12-in. long on the top of Plate #4. Figures 5.1 and 5.2 display the minimum readings taken in each 15-in. wide by 12-in. long area of the scan. Highlighted areas in Plate #1 and Plate #2 show minimum wall thickness exceeded the reportable level of 10% of the nominal thickness.

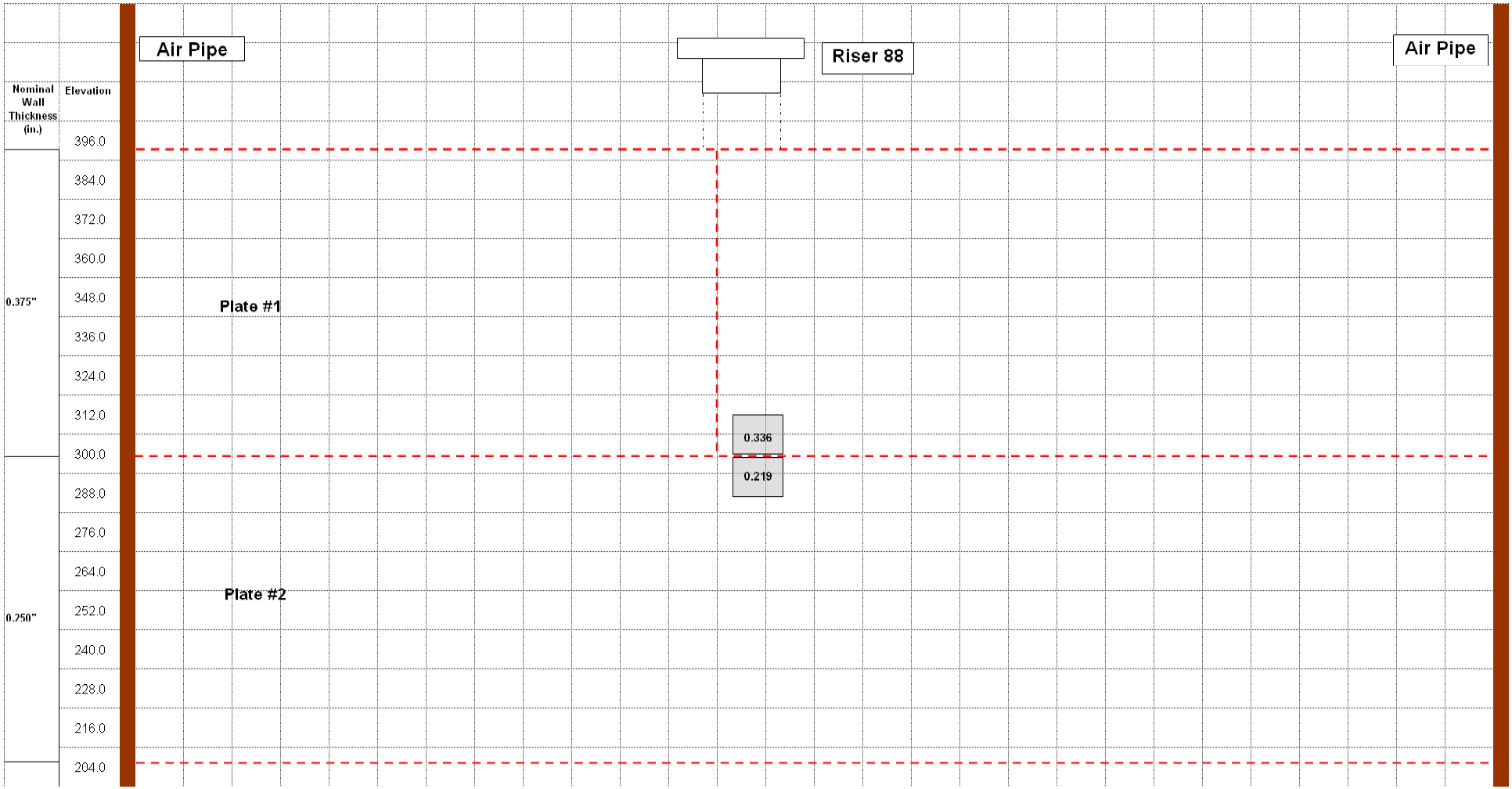


Figure 5.1. UT Data from Secondary Wall of Tank 241-AY-101

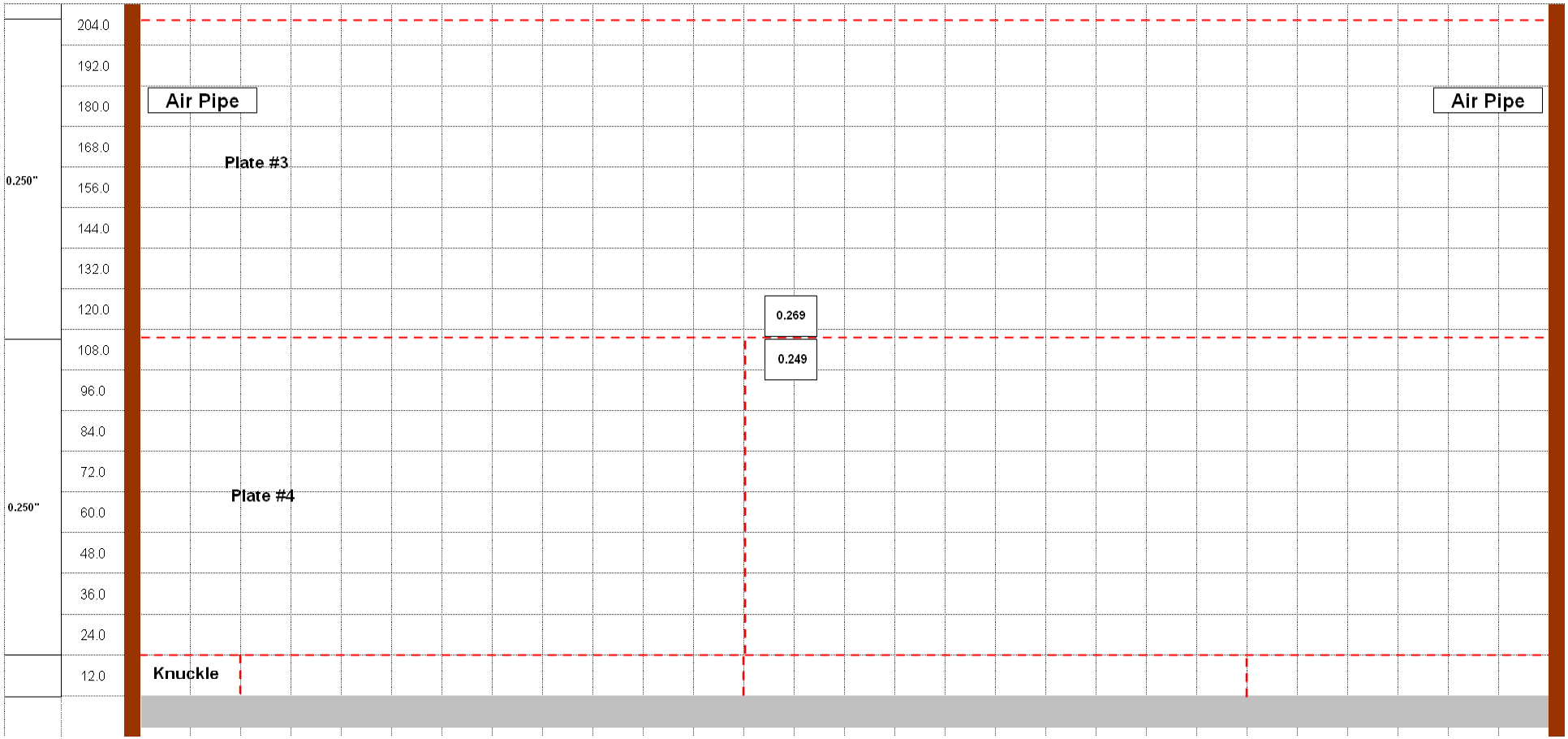


Figure 5.2 UT Data from Secondary Wall of Tank 241-AY-101 cont.

6.0 Conclusions

The results of the examination of Tank 241-AY-101 have been evaluated by PNNL personnel. The examination consisted of one 15-in. wide by 12-in. long scan on each of Plates #1, #2, #3, and #4 of the secondary tank wall.

6.1 Secondary Tank Wall Vertical Scan Paths

One 15-in. wide by 12-in. long scan was performed on each of Plates #1, #2, #3, and #4 of the secondary tank of 241-AY-101. The plates were examined for wall thinning and pitting on the secondary tank wall above and below the Plate #1 to Plate #2 circumferential weld and above and below the Plate #3 to Plate #4 circumferential weld. The results indicated that the nominal thickness in Plate #1 is 0.375-in. and the minimum thickness in this area was 0.336-in. This one area of wall thinning that exceeded the reportable level of 10% of the nominal thickness was located near the bottom of Plate #1. The minimum thicknesses in the areas scanned with nominal thickness of 0.250-in. were as follows; Plate #2 was 0.219-in., Plate #3 was 0.269-in. and Plate #4 was 0.249-in. There were two areas of wall thinning that exceeded the reportable level of 10% of the nominal thickness in Plate #2. The areas were located near the top of Plate #2. No pitting was detected in Plates #1, #2, #3, or #4.

7.0 References

Jensen, C. E., 2002, *Engineering Task Plan for the Ultrasonic Inspection of Hanford Double-Shell Tanks FY2003*, RPP-11832, Rev 0, September 2002, CH2M Hill Hanford Group, Inc., Richland, Washington.

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