Field Trial Activities

This section contains a day-by-day description of field trial activities from June 5, 2009 through June 18, 2009.

Friday June 5, 2009

EWI Project Engineer Perry White organized and led the field trial activities. Assisting Perry was Michael Eff, a Welding Engineering student from The Ohio State University who is currently working for EWI as a Technician. On June 5, 2009, Mr. White and Mr. Eff left Columbus, Ohio and arrived in Edmonton, Alberta, Canada.

Upon entry in Canada, Mr. White and Mr. Eff presented the Canadian Border Services Agency representative with documentation to justify their 2-week stay as "business visitors" conducting field trials on behalf of the U.S. DOT. The documentation package was prepared by Bruce Allen of Allen and Hodgman, Barristers and Solicitors (Canada), in accordance with NAFTA and Section 187 of the IRPA Regulations. The package contained the Canadian Immigration's *Use of Representative* Form 5476 and the requisite background information including resumes, DOT contracts, an EWI letter describing the project work, and an invitation to the field trials from TCPL. The letters from Mr. Allen, EWI, and TCPL are located in Appendix C.

Saturday June 6, 2009

Prior to Mr. White and Mr. Eff arriving in Canada, EWI shipped the scanning equipment to the UT Quality (UTQ) facilities in Edmonton. UTQ assisted EWI with customs associated with shipping the EWI scanning equipment to and from Canada. When the equipment arrived at UTQ, it was unpacked and loaded on a truck provided by UTQ (Figure 1). Figure 2 is a photo of the inside of the UTQ truck loaded with the EWI phased-array (PA) equipment. Additionally, UTQ provided a driver to transport the equipment and EWI staff to and from the field trial site every day of the field trial period.

Figure 1. UTQ Truck for Field Trials

Figure 2. Interior of UTQ Truck with EWI Equipment Installed

Sunday June 7, 2009

At the UTQ facility in Edmonton, the linear phased array (LPA) set up was verified with the new EWI calibration block using a manual non-encoded technique. After set up was complete, the equipment was broken down and secured for transport to the remote field location in Hardisty. Figure 3 shows the EWI LPA scanning equipment mounted on a pipe section.

Figure 3. Mike Eff with LPA Scanner

Monday June 8, 2009

EWI personnel were required to take the general contractor's job specific safety training. This 3-hr training took place at the Ledcor construction yard in Hardisty (Figure 4).

Figure 4. Ledcor Construction Yard in Hardisty, Alberta, Canada

After safety training was complete, two welder qualification welds WT-003 and WT-004 were available for scanning. Both samples consisted of 9.8-mm wall pipe welded with a semi-automated gas metal arc welding (GMAW) process. Both WT-003 and WT-004 were known to be acceptable welds with no rejectable defects; they were scanned for informational purposes only. Figure 5 is a screen capture from the scan of WT-003 using EWI's prototype LPA scanner with the non zonal technique. Figure 6 is a screen capture from the scan of WT-004 using EWI's prototype LPA scanner with the non-zonal technique.

Figure 5. Weld WT-003 - EWI Scan Screen Capture

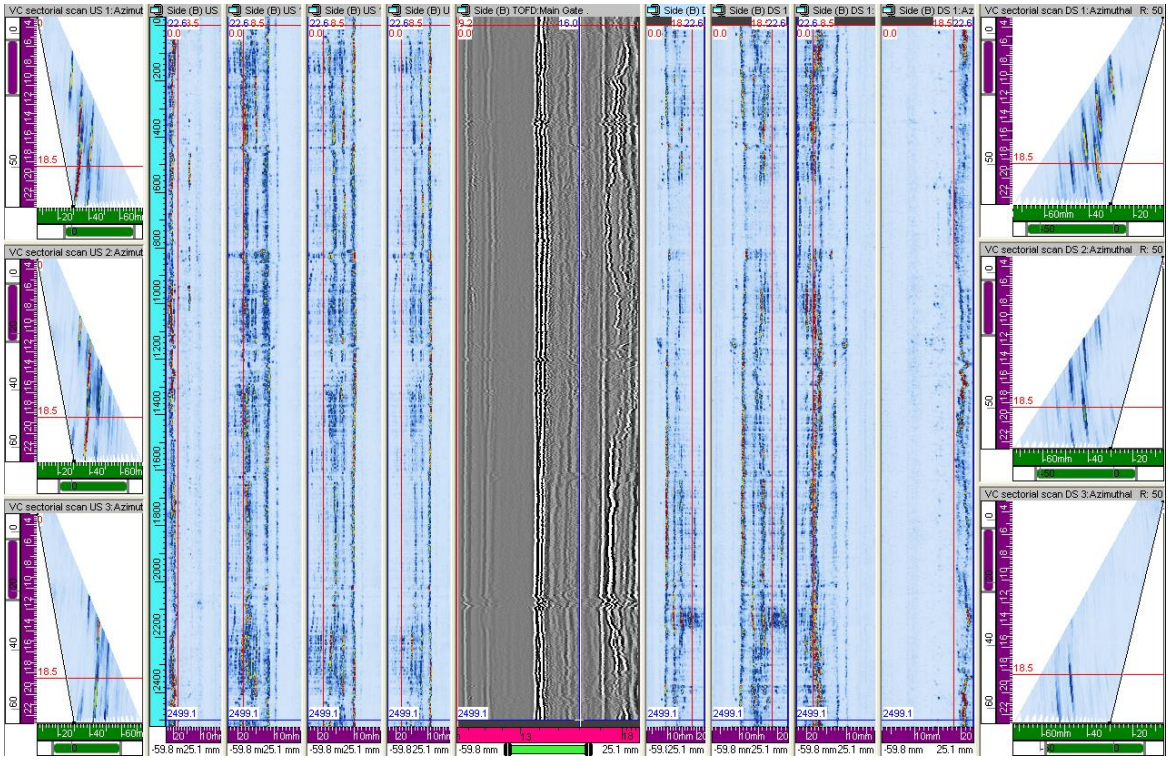


Figure 6. Weld WT-004 - EWI Scan Screen Capture

EWI personnel were joined by Evan Vokes of TCPL. Mr. Vokes facilitated the field trails, provided vital input for immigration paperwork, coordinated onsite safety training, and was present during the entire field trial period. Figure 7 shows Mr. White and Mr. Vokes in the UTQ truck observing the collection of scan data.

Figure 7. Perry White (EWI) and Evan Vokes (TCPL)

Tuesday June 9, 2009

Using the EWI LPA non-zonal technique, WT-004 was found to have a small geometry indication on the upstream (US) side (Figure 8). WT-004 was also scanned with matrix phased array (MPA). Figure 9 contains the screen capture of the MPA US scan that shows a 780- to 880-mm geometry indication. Figure 10 contains the screen capture of the MPA downstream (DS) scan that shows 780- to 880-mm geometric indication. All MPA scans are in the Field Trial report for DOT project *Enhanced Defect Detection and Sizing Accuracy Using Matrix Phased Array Ultrasonics Tools Program* (DTPH56-08-T-000002).

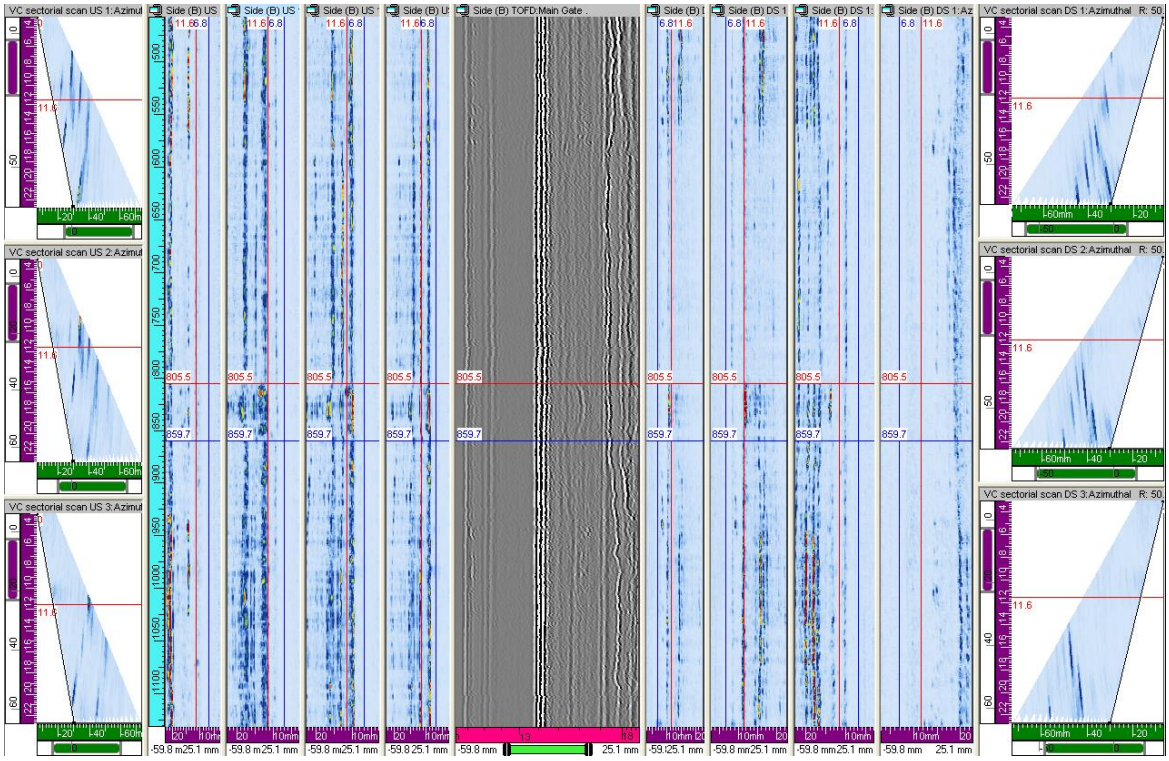


Figure 8. Weld WT-004 - EWI LPA Scan Screen Capture

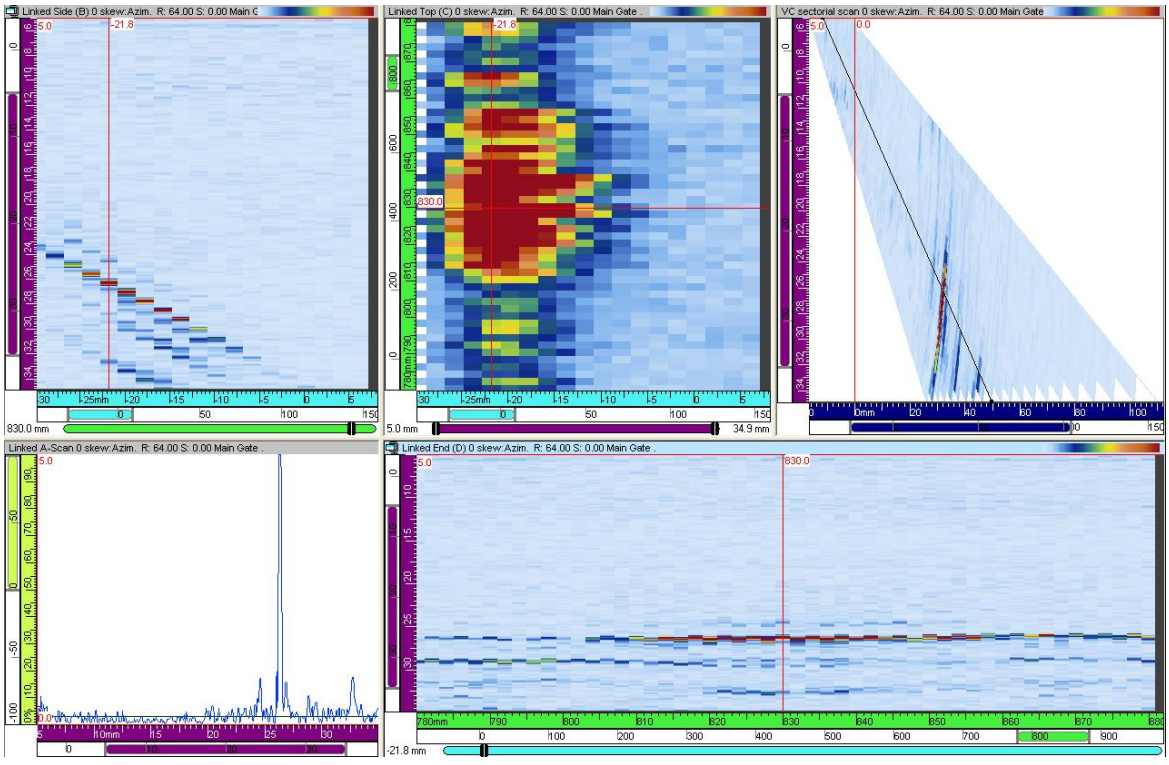


Figure 9. WT-004 - EWI MPA Scan Screen Capture (US)

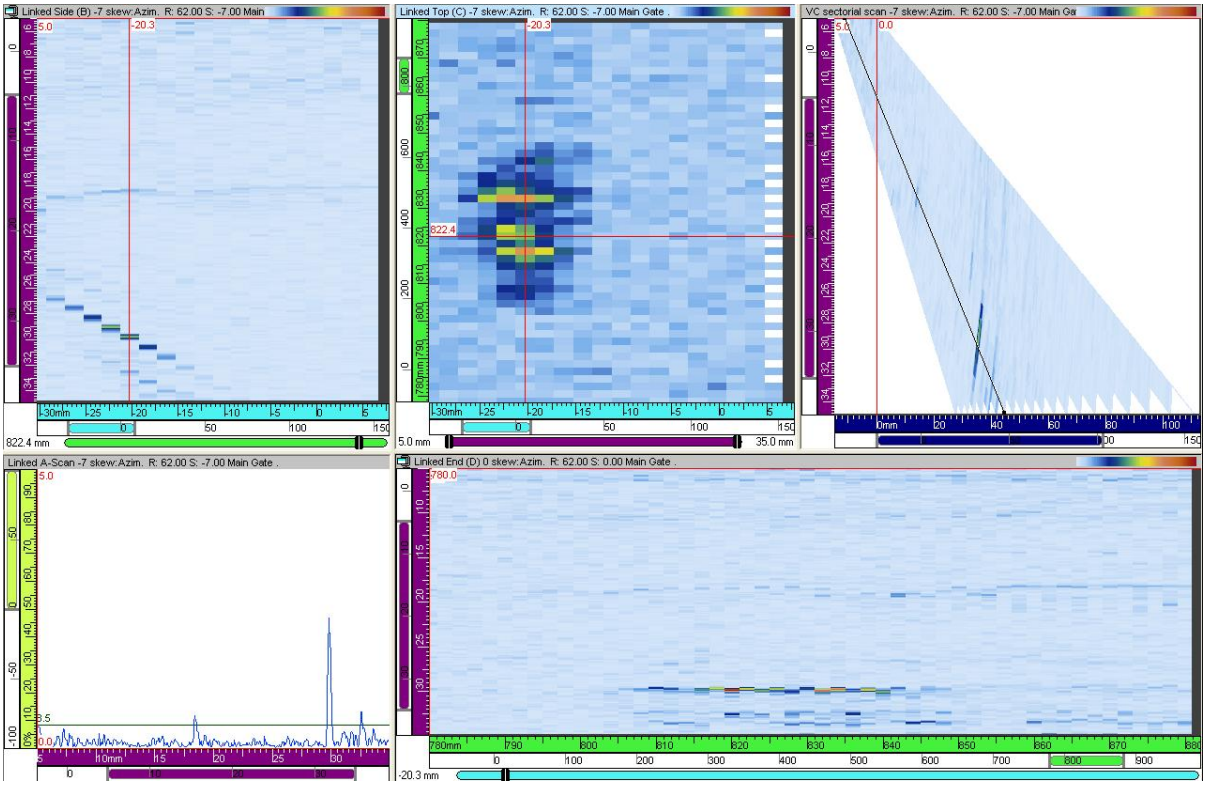


Figure 10. WT-004 - EWI MPA Scan Screen Capture (DS)

Another welder qualification weld was available; however, it had a 15.6-mm wall thickness. The remainder of the day was spent working on the set up file for the 15.6-mm wall using the offset required for scanning.

Wednesday June 10, 2009

An attempt was made to scan a qualification weld on a 15.6-mm wall pipe. When the band scanner was turned on, there was a problem with the encoder and the drive motor. It appeared that the two were not receiving the correct signals for proper positioning required for scanning. After trouble shooting, it was determined that there may be a power issue at the encoder switch box. UT Technology (UTT) was contacted for assistance and the equipment was driven to their facility in Edmonton (Figure 11). After UTT personnel re-wired the encoder switch box, they determined that there may be an encoder issue. Since the encoder and scanner were purchased from JIREH Industries (also located in Edmonton), EWI staff spent the night in Edmonton in order to be at JIREH at the start of business Thursday morning.

Figure 11. UTT Facility in Edmonton

Thursday June 11, 2009

Equipment was set up and ready for JIREH when they opened for business. JIREH personnel checked the encoder and the drive motor for proper operation using their motor control system. After checks were complete, it was determined that a polarity issue between the drive motor and the encoder was the problem. Possibly during the re-wiring of the encoder switch box, a wire was re-connected causing the polarities to reverse. The polarities were reversed in the software and the band scanner then operated correctly.

After arriving back in Hardisty, EWI and TCPL personnel went directly to the right of way where the Keystone Pipeline was located. UTQ is the inspection company hired by TCPL to inspect all production welds on the site where the field trials took place. The approach for the field trial was simple. When UT Quality discovered a significant weld defect, EWI was to step in and do a LPA scan (for DTPH56-07-T-000002). When that scan was complete, EWI was to change the scanner equipment to do a MPA scan (for DTPH56-08-T-000002). This was anticipated to be the best approach to gather data in the most efficient manner with minimal interruption to the TCPL production schedule. Figure 12 shows the EWI truck (provided by UTQ) following the UTQ truck with the crew that was performing the AUT inspections for TCPL.

Figure 12. EWI Truck Following UTQ Truck Performing AUT Scans for TCPL

Scanning activities resumed on weld MLA 4530, which was rejected by UTQ using the zonal discrimination method for an indication exceeding allowable dimensions per the governing acceptance criteria. The zonal discrimination UTQ scan is shown in Figure 13. EWI's LPA non-zonal scan is shown in Figure 14. Figure 15 shows the EWI scan on the DS side with S-Scans and volume corrected side view (B-Scans). There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

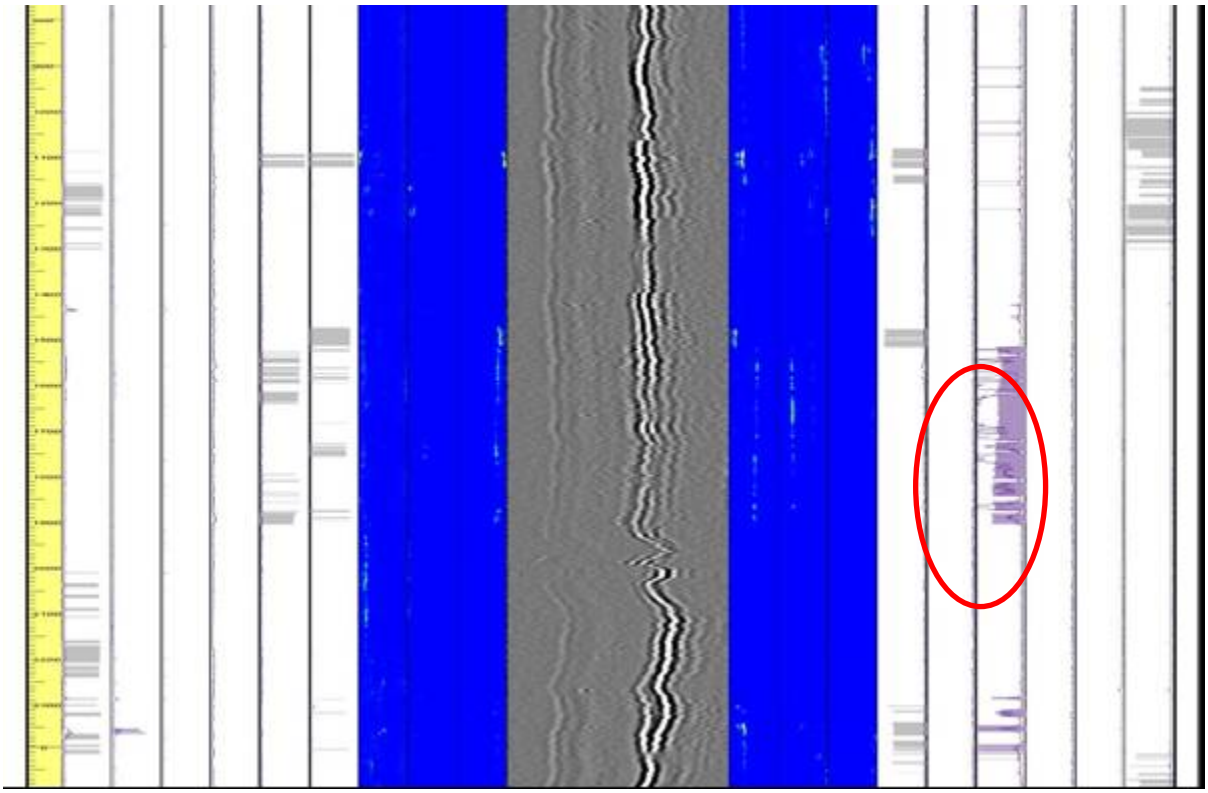


Figure 13. Weld MLA 4530 - UTQ Scan Screen Capture

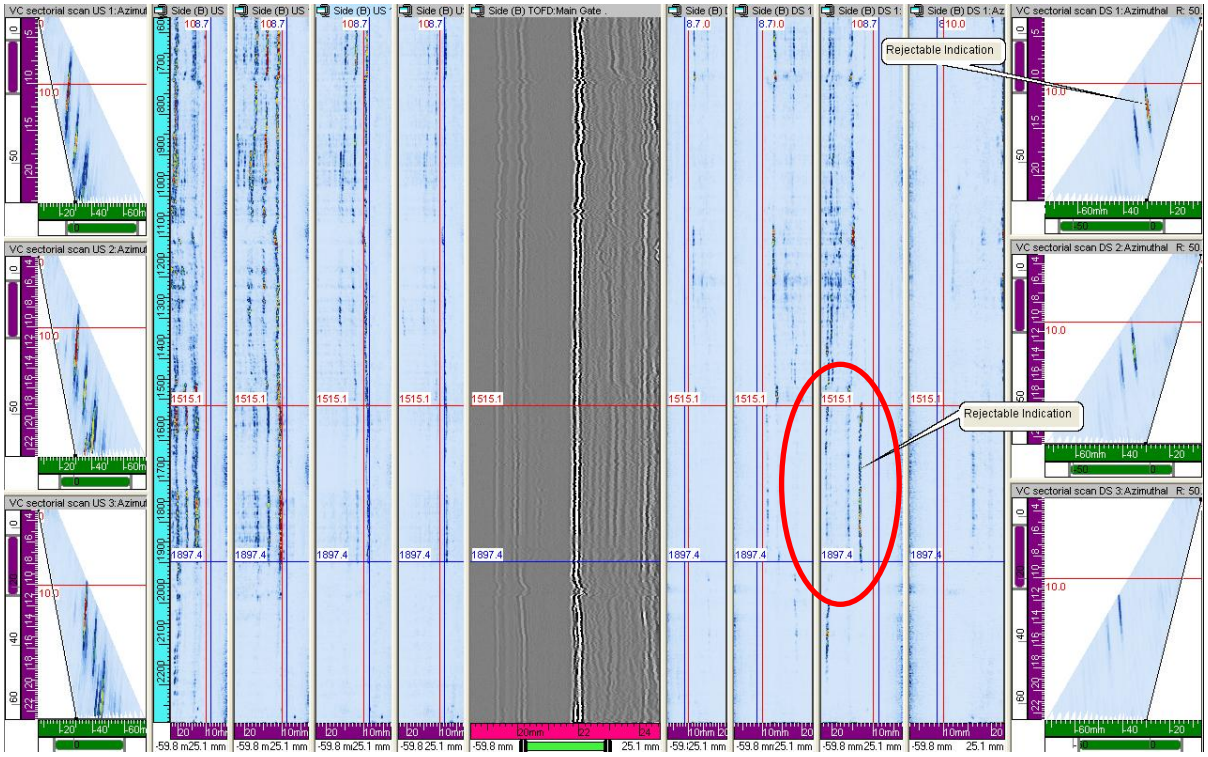


Figure 14. Weld MLA 4530 - EWI Scan Screen Capture

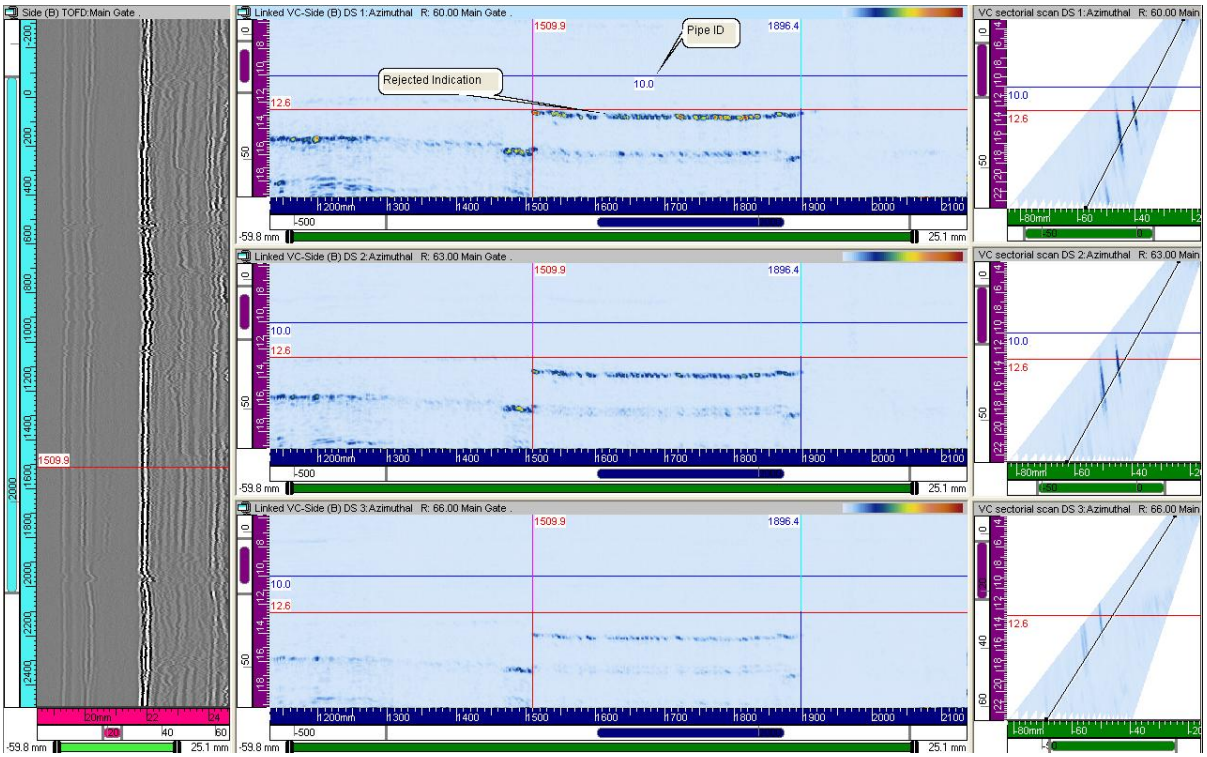


Figure 15. Weld MLA 4530 - EWI Scan Screen Capture - DS View

Friday June 12, 2009

Due to exceptional weld quality on the Keystone project, there were no welds containing rejectable indications on Friday June 12, 2009. Consequently, the team decided to scan good main line welds. Acceptable weld MLA 4568 was scanned to compare techniques. For MLA 4568: the zonal discrimination UTQ scan is shown in Figure 16 and the EWI LPA non-zonal scan is shown in Figure 17. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

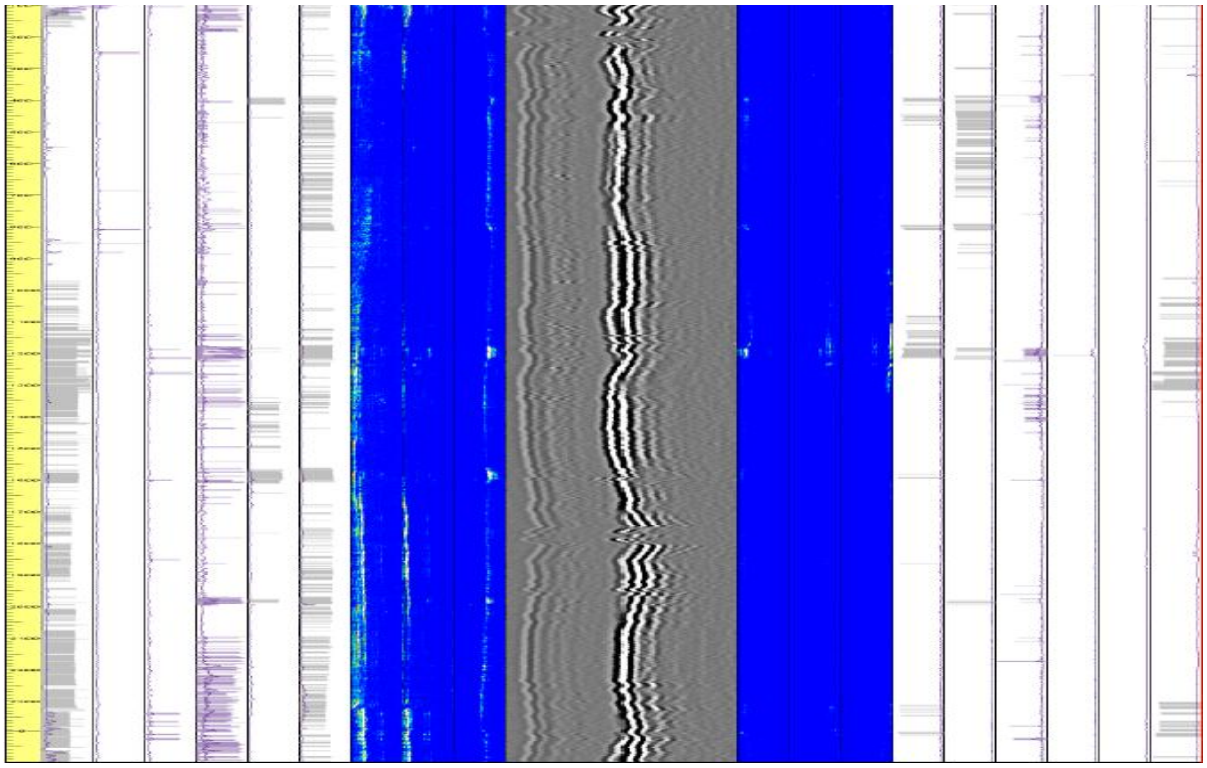


Figure 16. Weld MLA 4568 - UTQ Screen Capture

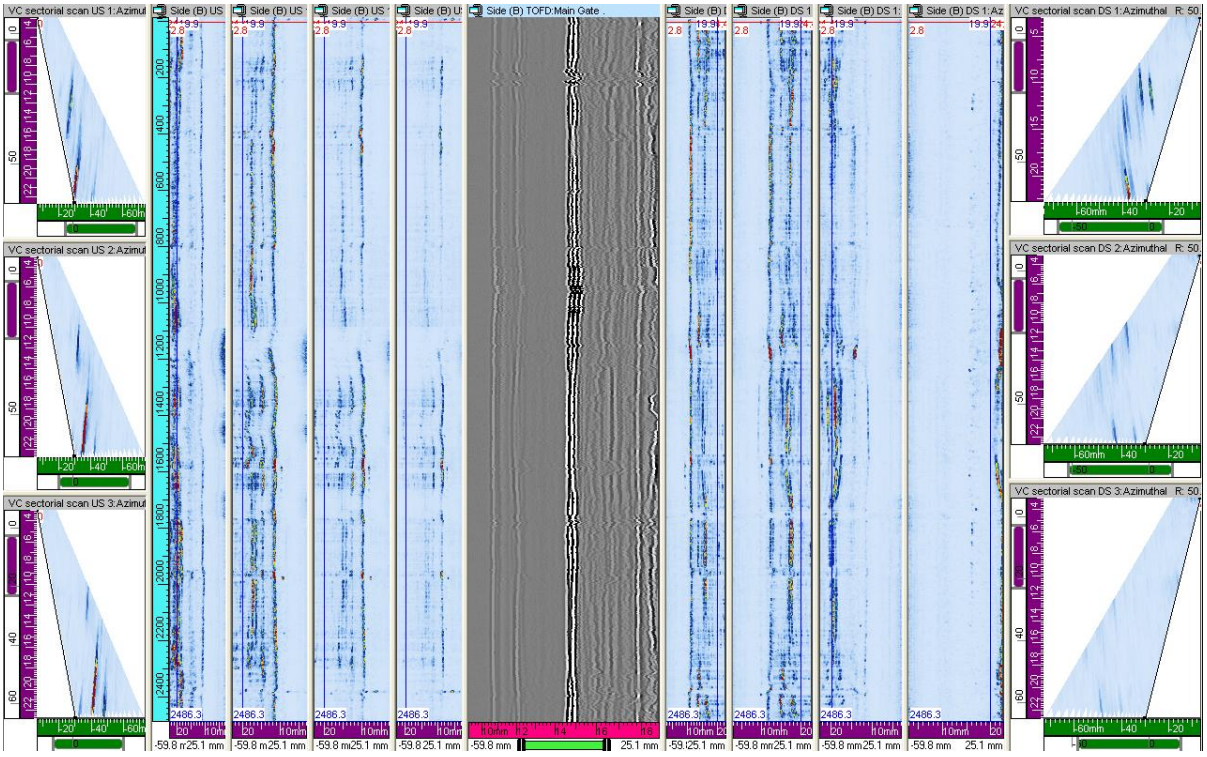


Figure 17. Weld MLA 4568 - EWI LPA Screen Capture

Weld MLA 4584 was scanned, as it was found to contain one indication that could be used for technique comparison. For MLA 4584: the zonal discrimination UTQ scan is shown in Figure 18; the EWI LPA non-zonal scans are shown in Figures 19 and 20 (DS). There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

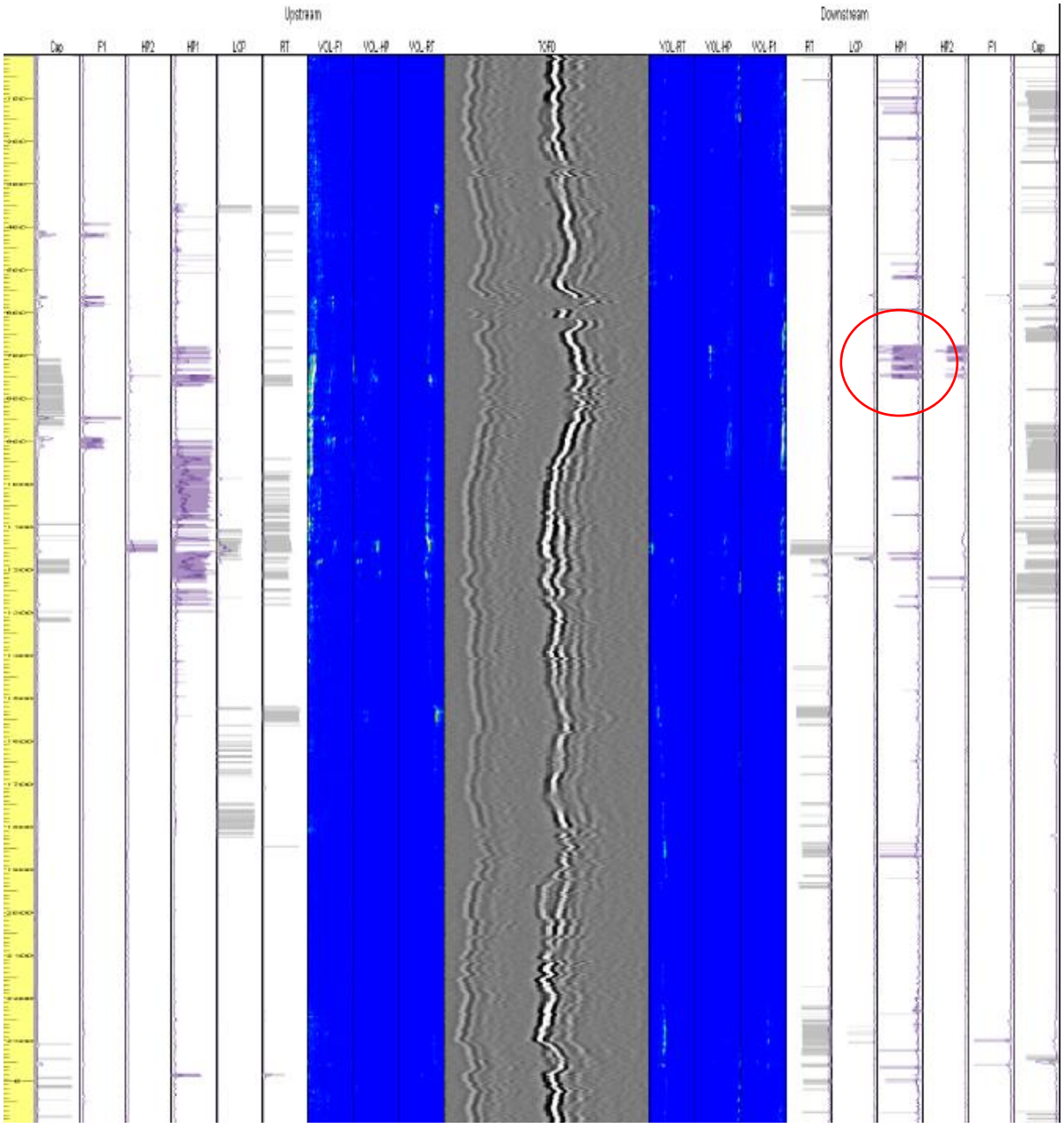


Figure 18. Weld MLA 4584- UTQ Scan Screen Capture

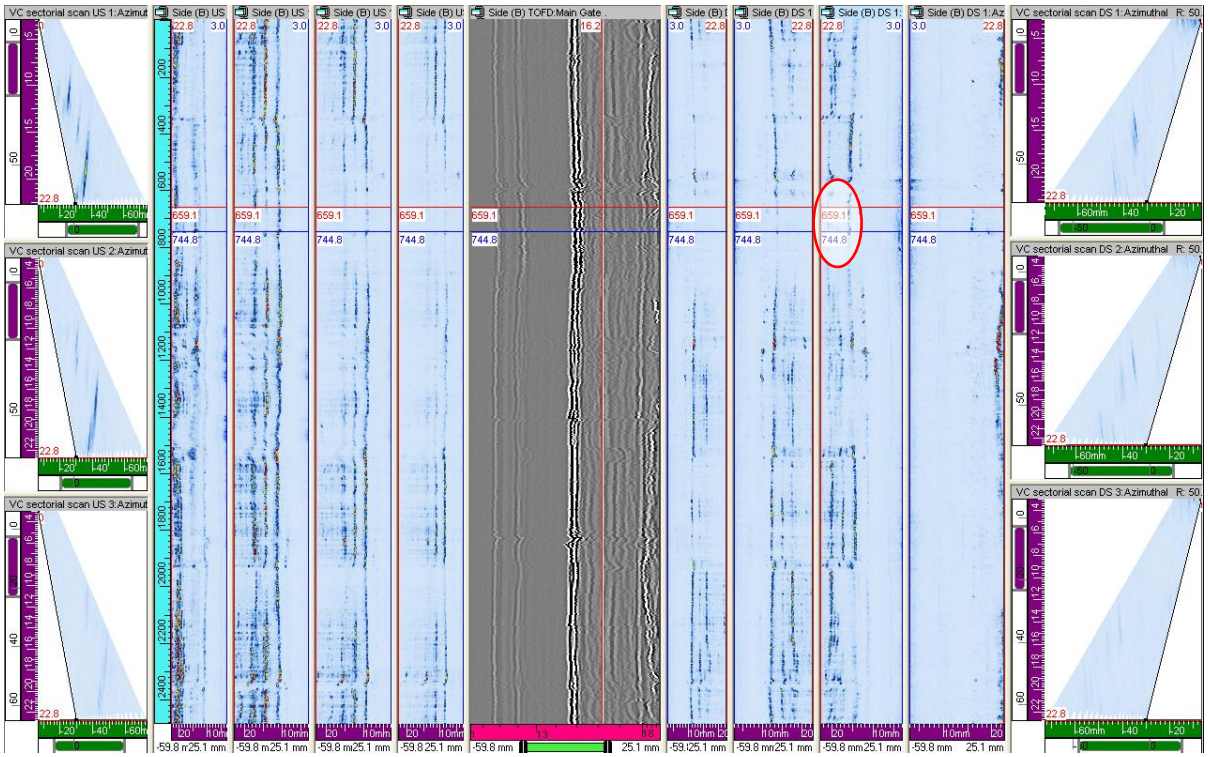


Figure 19. Weld MLA 4584 - EWI LPA Scan Screen Capture 1

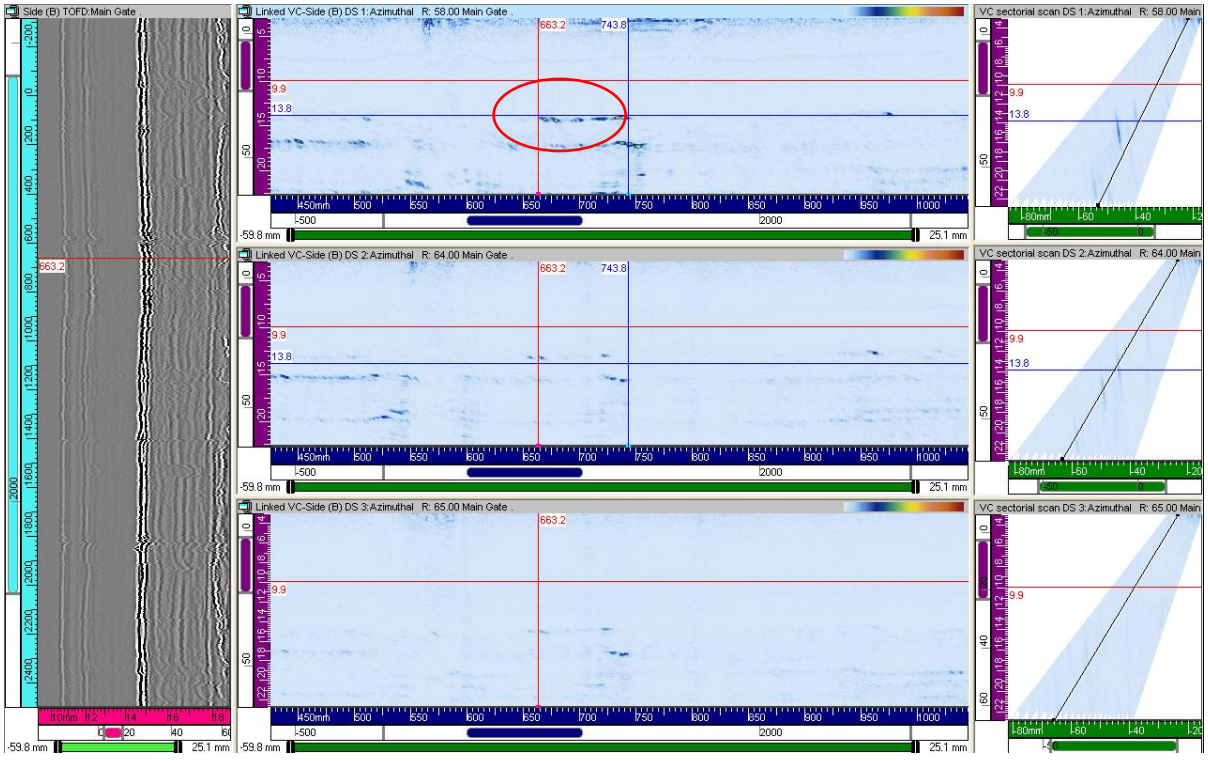


Figure 20. Weld MLA 4584 - EWI LPA Scan Screen Capture 2 (DS)

Saturday June 13, 2009

Weld MLA 4685 was scanned, as it was found to contain one rejectable indication that could be used for technique comparison. For MLA 4685 the zonal discrimination UTQ scan is shown in Figure 21. The EWI LPA non-zonal scan is shown in Figure 22. The EWI scan on the US side with S-scans and volume corrected side view (B-scans) is shown in Figure 23. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

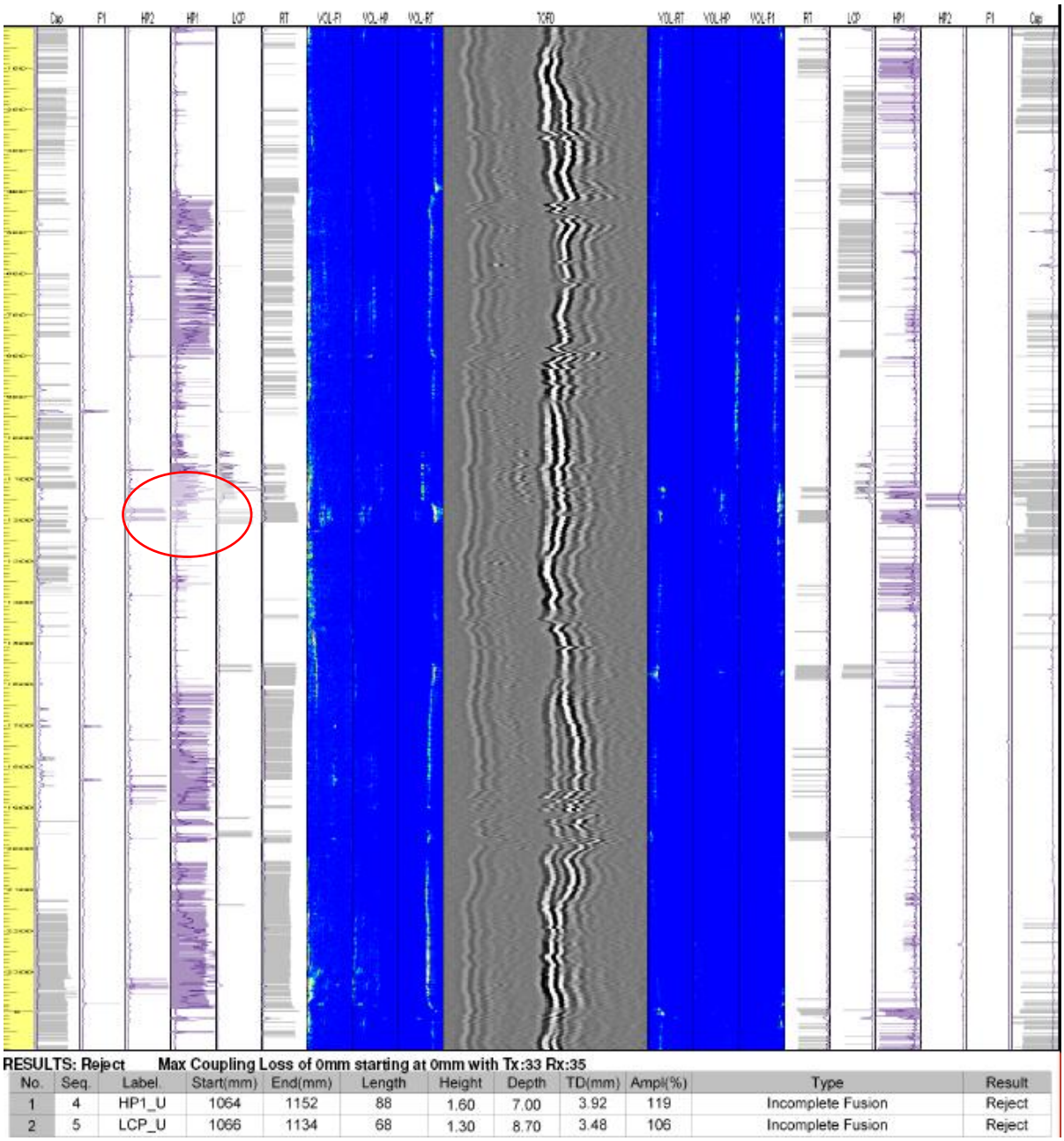


Figure 21. Weld MLA 4685 - UTQ Scan Screen Capture

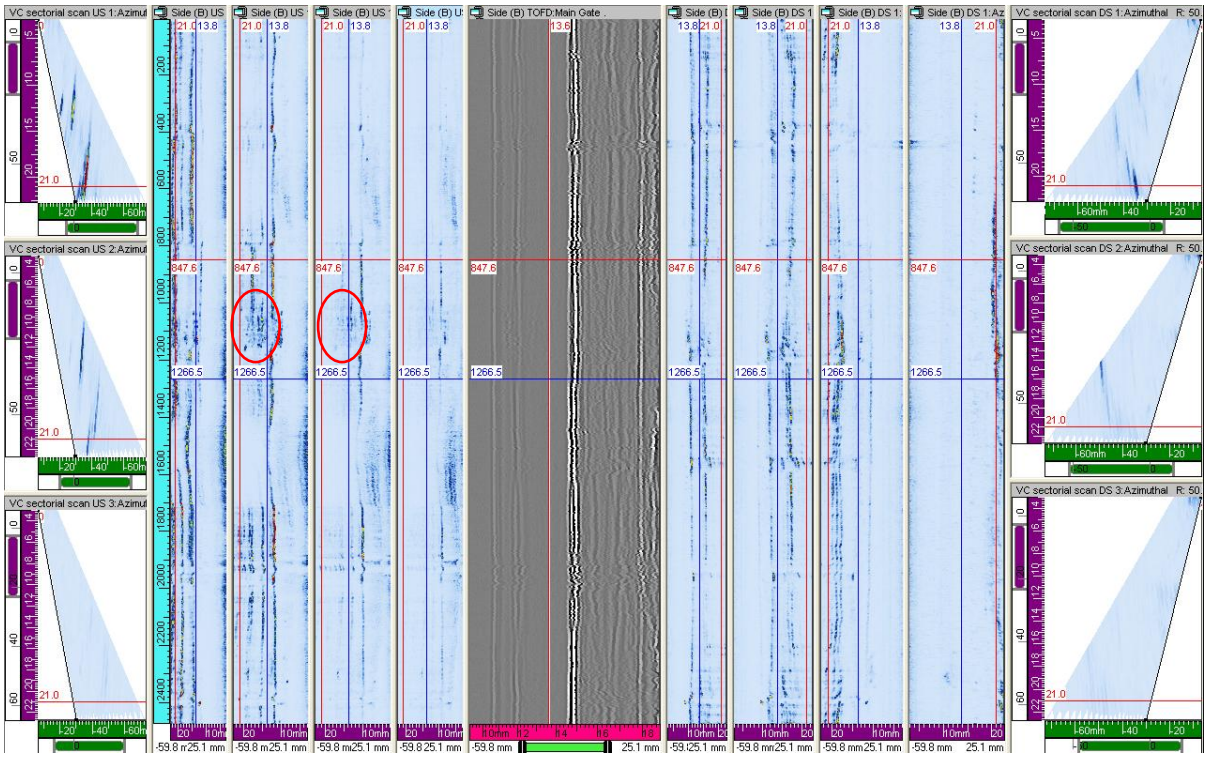


Figure 22. Weld MLA 4685 - EWI LPA Scan Screen Capture1

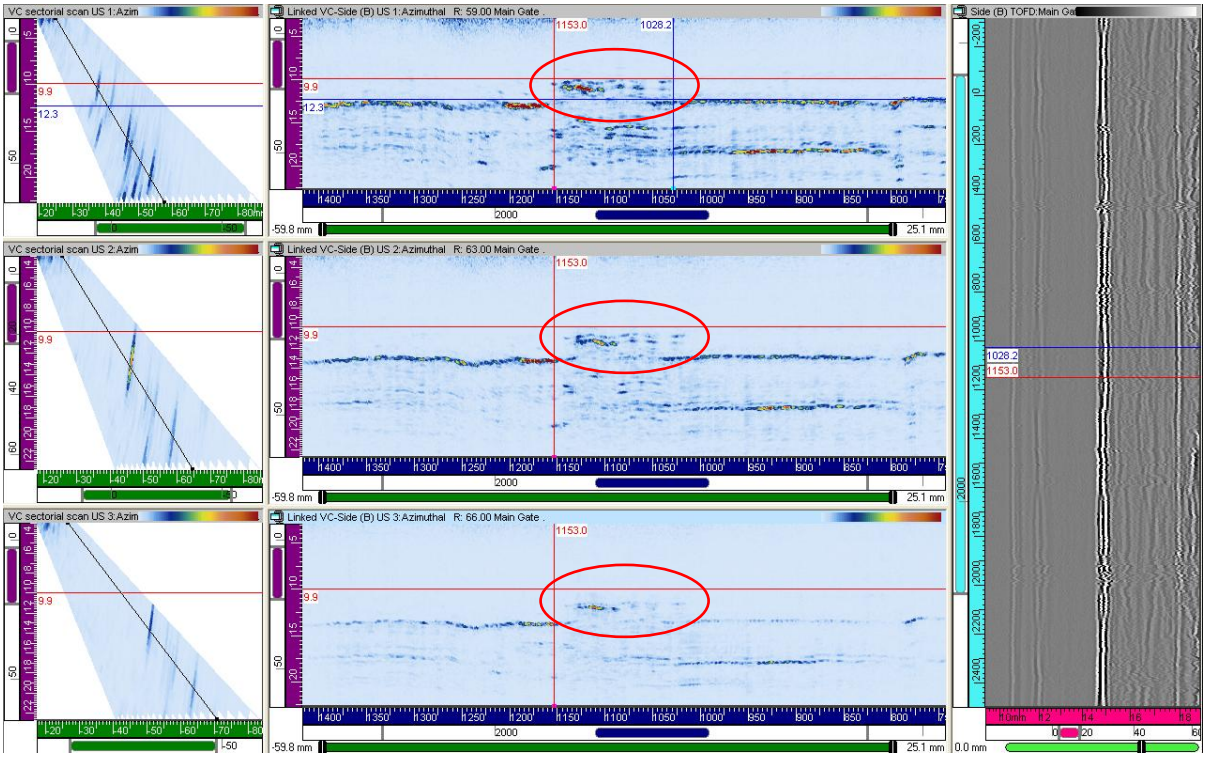


Figure 23. Weld MLA 4685 - EWI LPA Scan Screen Capture2 (US)

Due to exceptional weld quality on the Keystone project, there was only one weld containing rejectable indications on Saturday June 13, 2009. Consequently, the team decided to scan good main line welds. For MLA 4698: the zonal discrimination UTQ scan is shown in Figure 24 and the EWI LPA non-zonal scan is shown in Figure 25. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

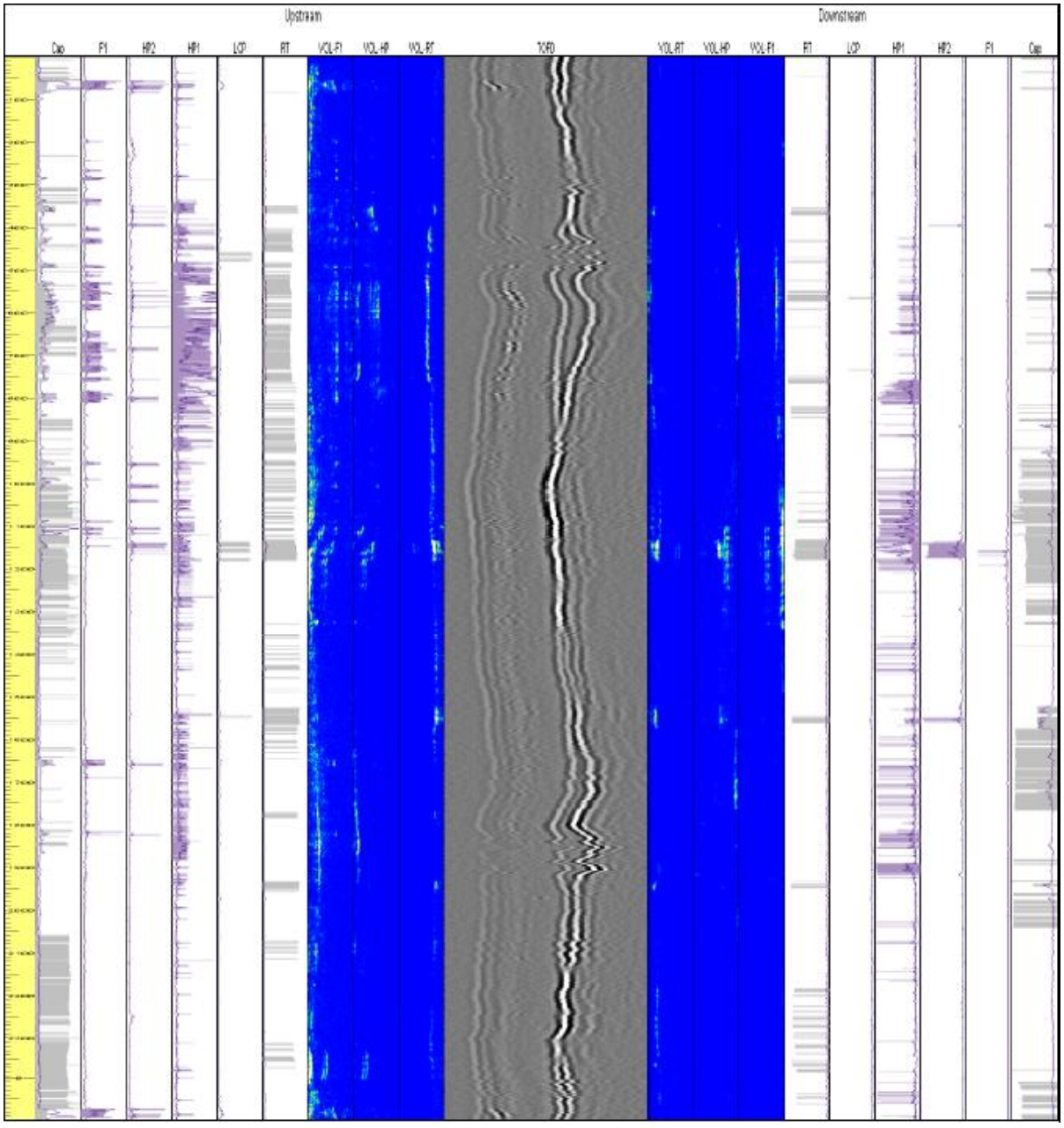


Figure 24. Weld MLA 4698 - UTQ Scan Screen Capture

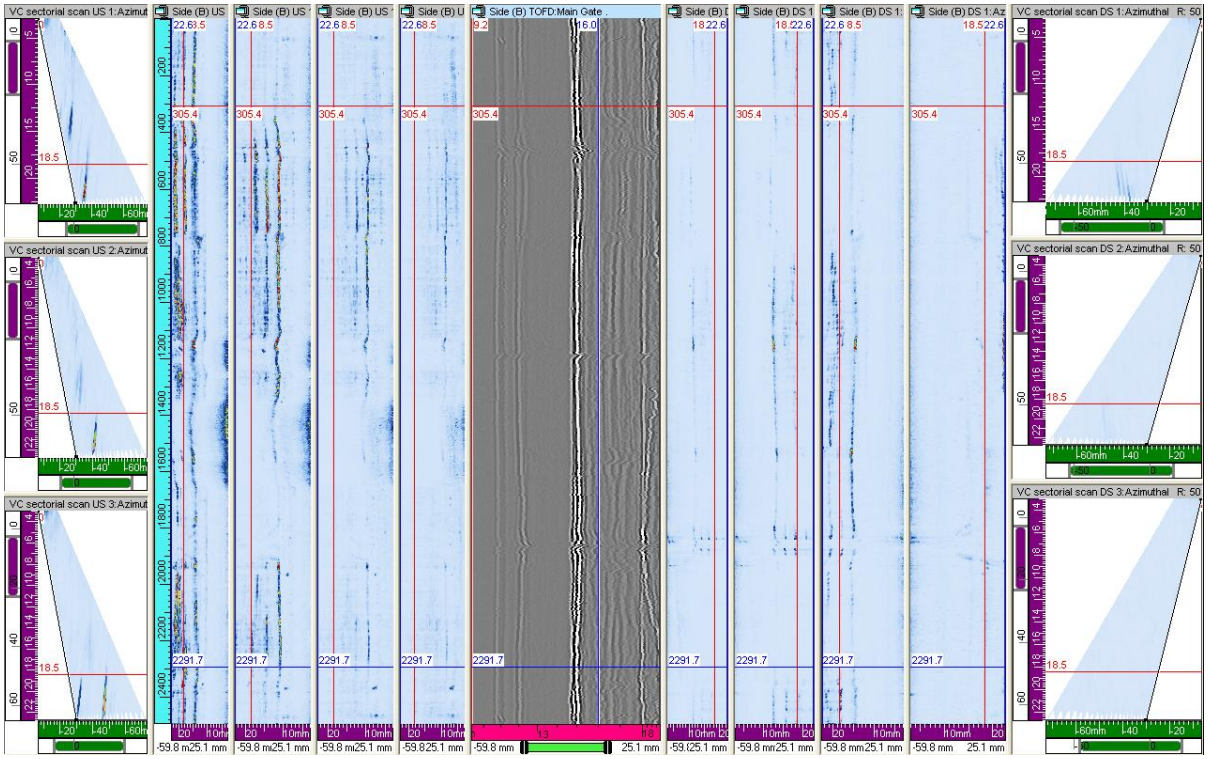


Figure 25. Weld MLA 4698 - EWI LPA Scan Screen Capture

For MLA 4591: the zonal discrimination UTQ scan is shown in Figure 26 and the EWI LPA non-zonal scan is shown in Figure 27. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

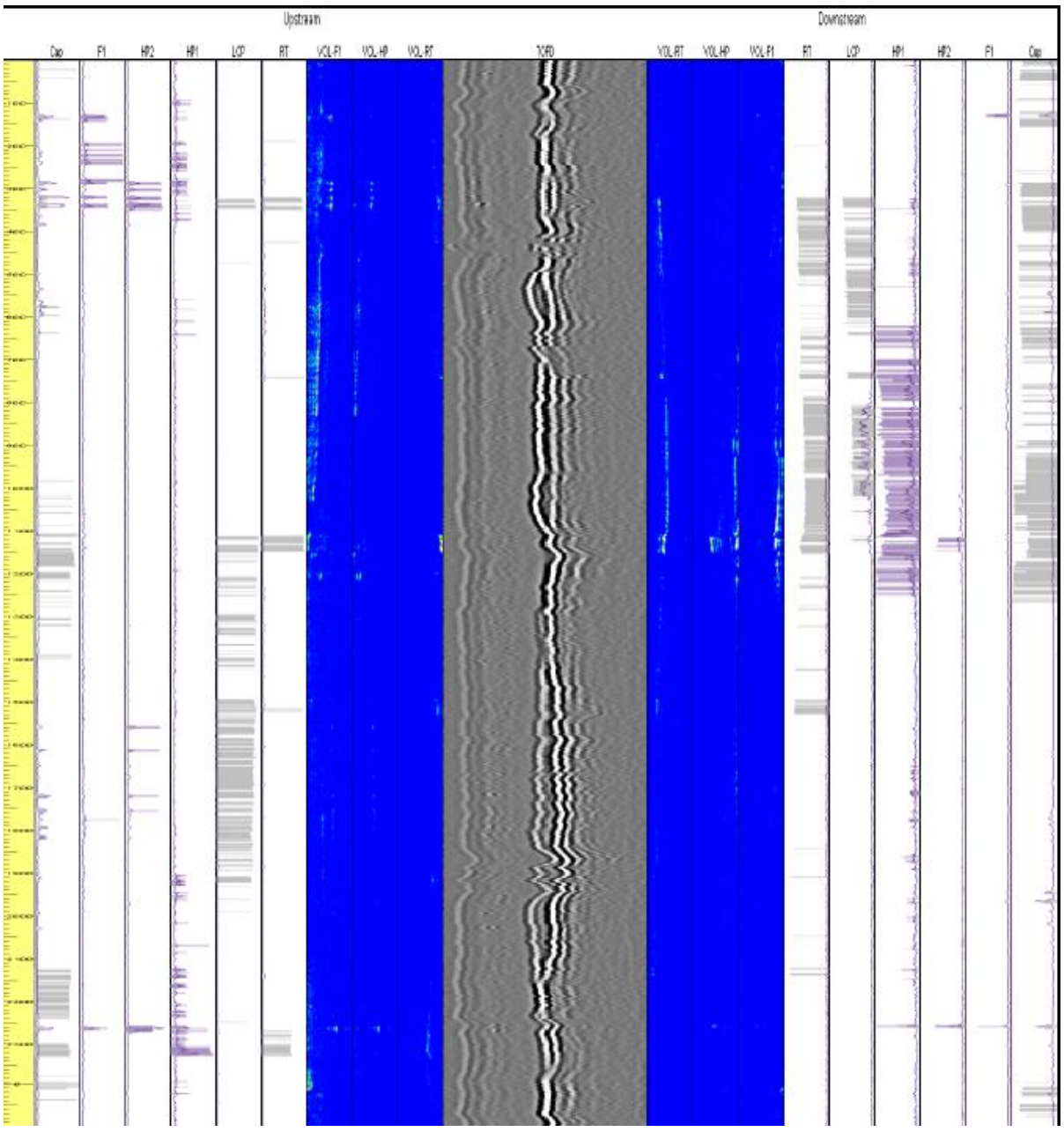


Figure 26. Weld MLA 4591 - UTQ Scan Screen Capture

Figure 27. Weld MLA 4591 - EWI LPA Scan Screen Capture

Sunday June 14, 2009

No project-related activities were conduced on Sunday June 14, 2009.

Monday June 15, 2009

U.S. DOT Project Technical Manager, Frank Licari, was on site all day to witness field trial activities for LPA scanning (for DTPH56-07-T-000002) and for MPA scanning (for DTPH56-08-T-000002).

At select locations, weld scans were requested by TCPL project representative Evan Vokes.

Acceptable weld MLA 4681 was scanned to compare techniques. For MLA 4681: the zonal discrimination UTQ scan is shown in Figure 28 and the EWI LPA non-zonal scan is shown in Figure 29. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

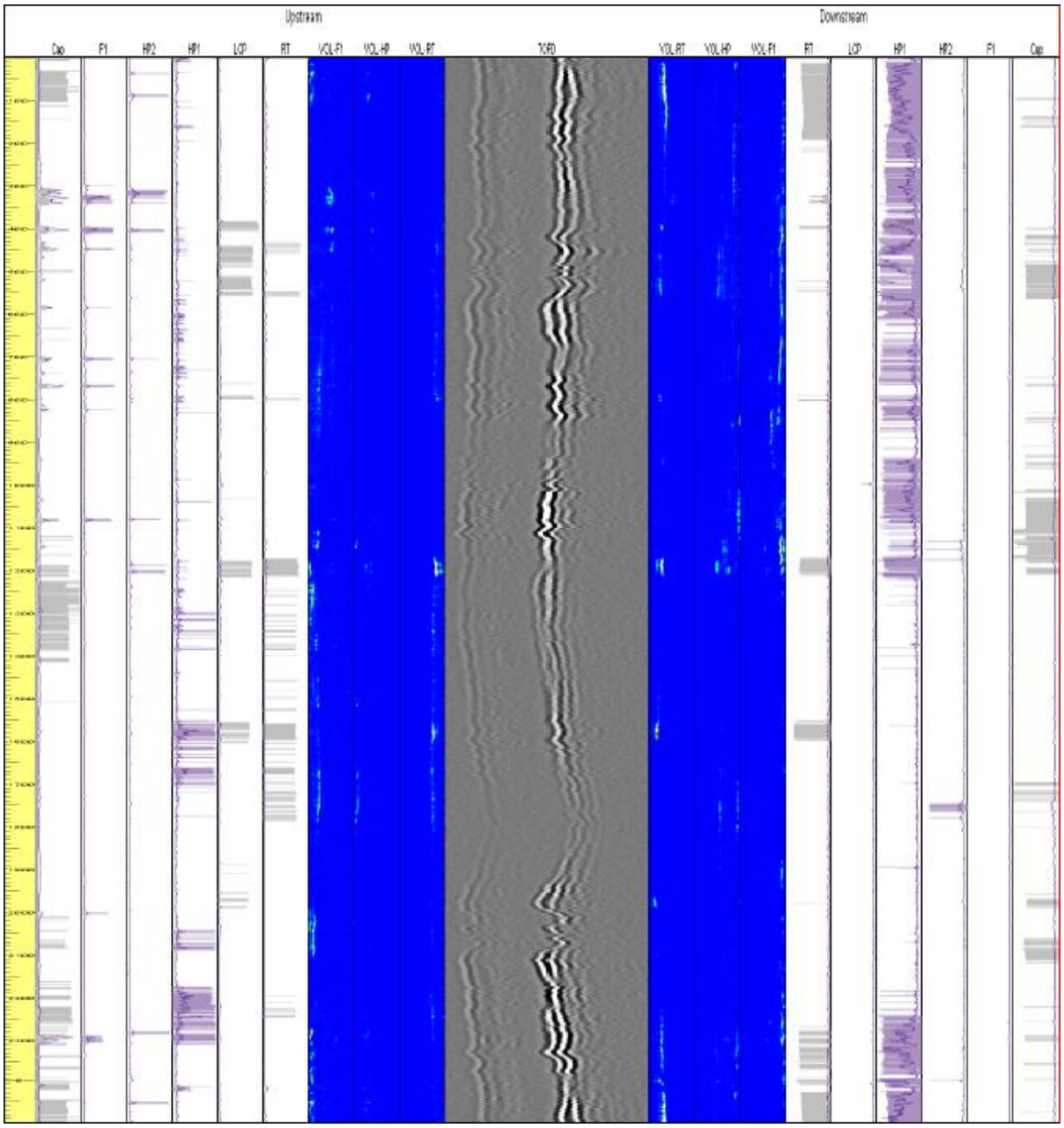


Figure 28. Weld MLA 4681 - UTQ Scan Screen Capture

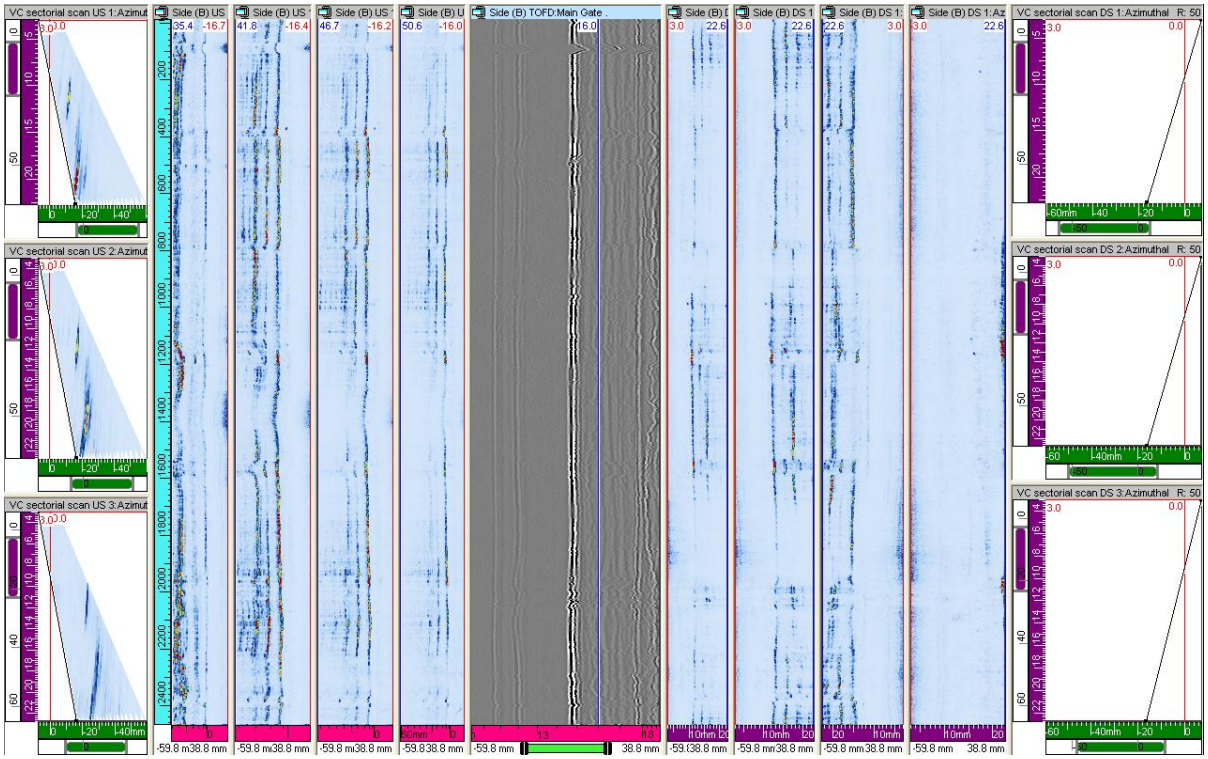


Figure 29. Weld MLA 4681 - EWI LPA Scan Screen Capture

Acceptable weld MLA 4695 was scanned to compare techniques. For MLA 4695: the zonal discrimination UTQ scan is shown in Figure 30 and the EWI LPA non-zonal scan is shown in Figure 31. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non zonal method.

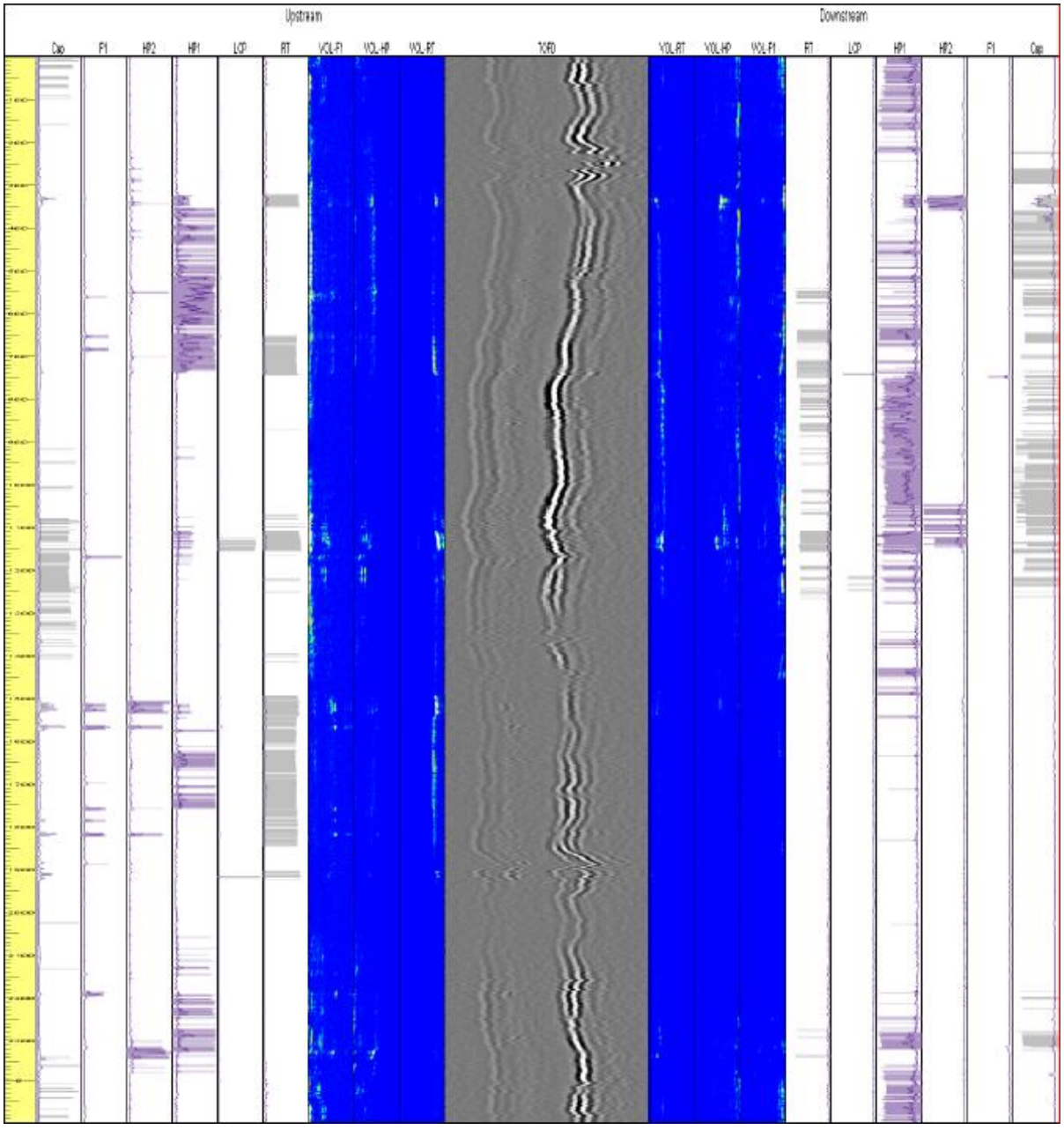


Figure 30. Weld MLA 4695 - UTQ Scan Screen Capture

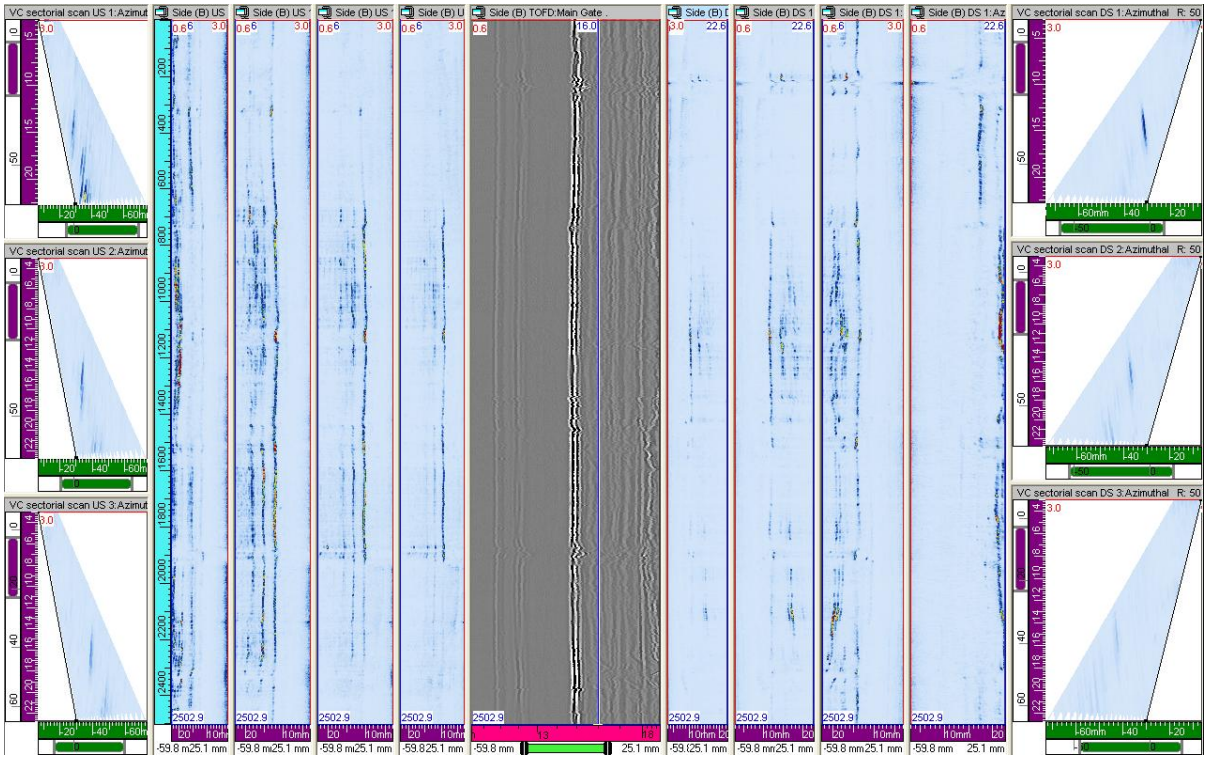


Figure 31. Weld MLA 4695 - EWI LPA Scan Screen Capture

Acceptable weld MLA 4809 was scanned to compare techniques. For MLA 4809: the zonal discrimination UTQ scan is shown in Figure 32 and the EWI LPA non-zonal scan is shown in Figure 33. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

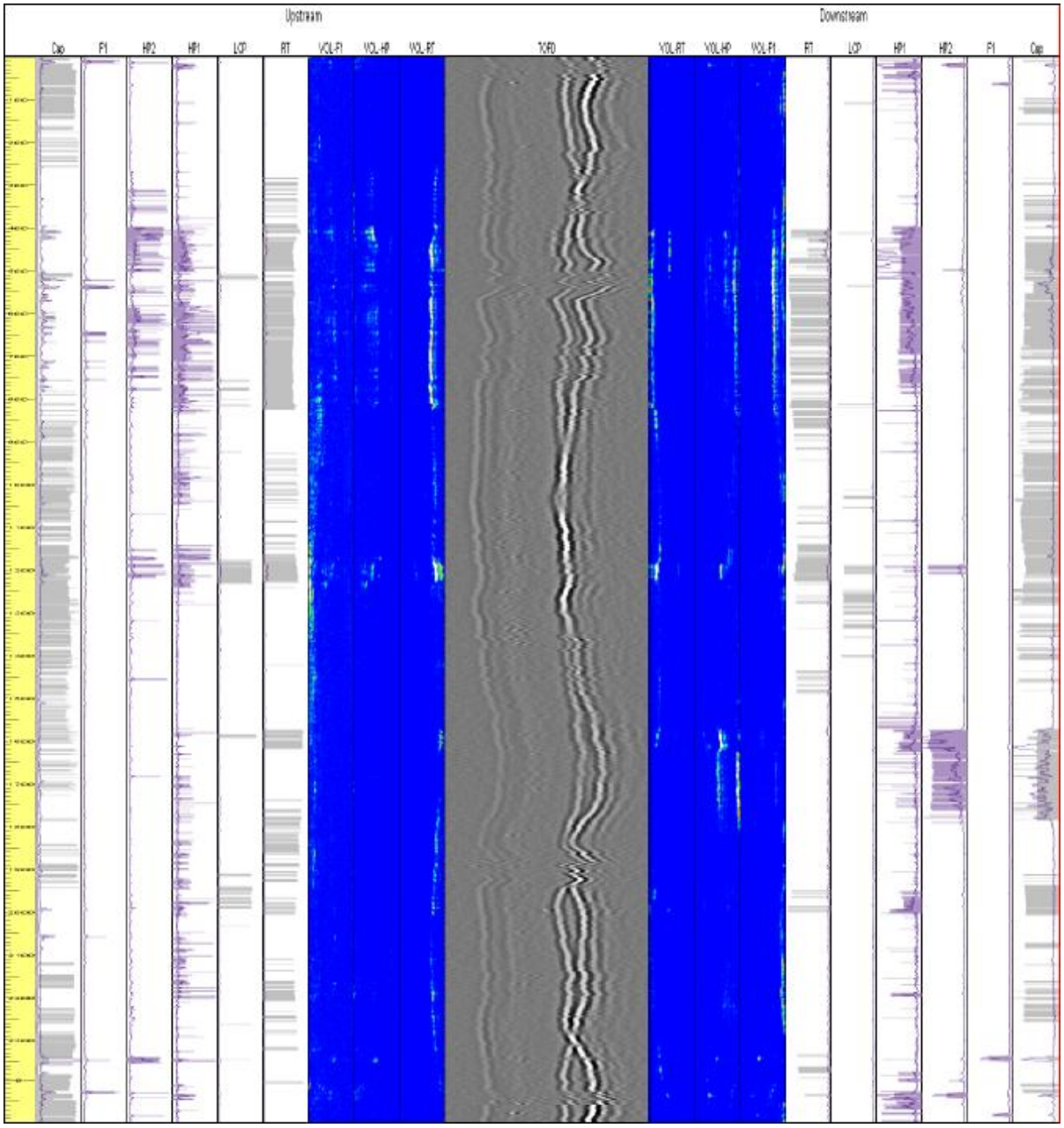


Figure 32. Weld MLA 4809 - UTQ Scan Screen Capture

Figure 33. Weld MLA 4809 - EWI LPA Scan Screen Capture

Tuesday June 16, 2009

U.S. DOT Project Technical Manager, Frank Licari, was on site all day to witness field trial activities for LPA scanning (for DTPH56-07-T-000002) and for MPA scanning (for DTPH56-08-T-000002).

TCPL project representative Evan Vokes requested a scan of acceptable weld MLA 4811 to compare techniques. For MLA 4811: the zonal discrimination UTQ scan is shown in Figure 34 and the EWI LPA non-zonal scan is shown in Figure 35. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

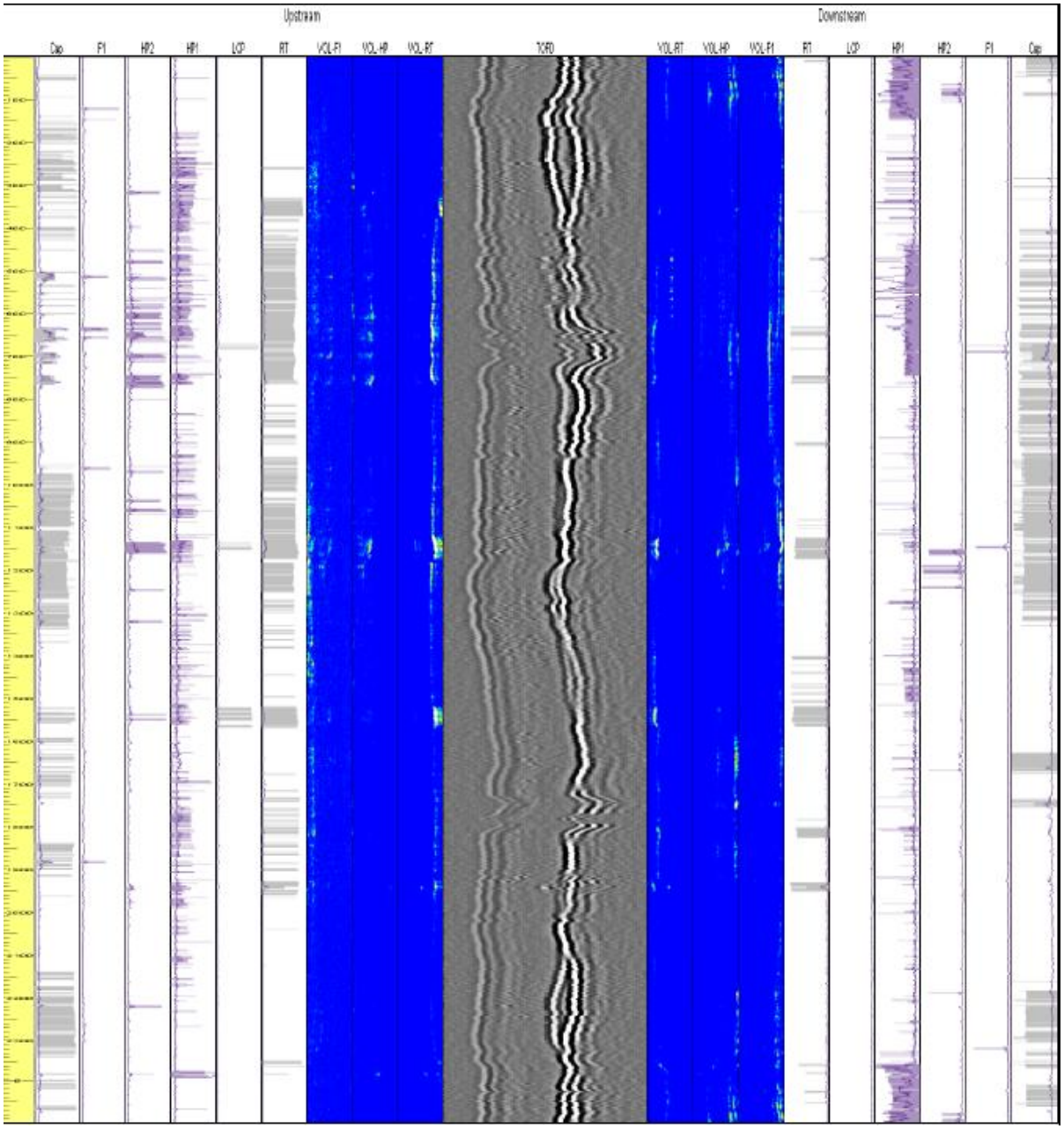


Figure 34. Weld MLA 4811 - UTQ Scan Screen Capture

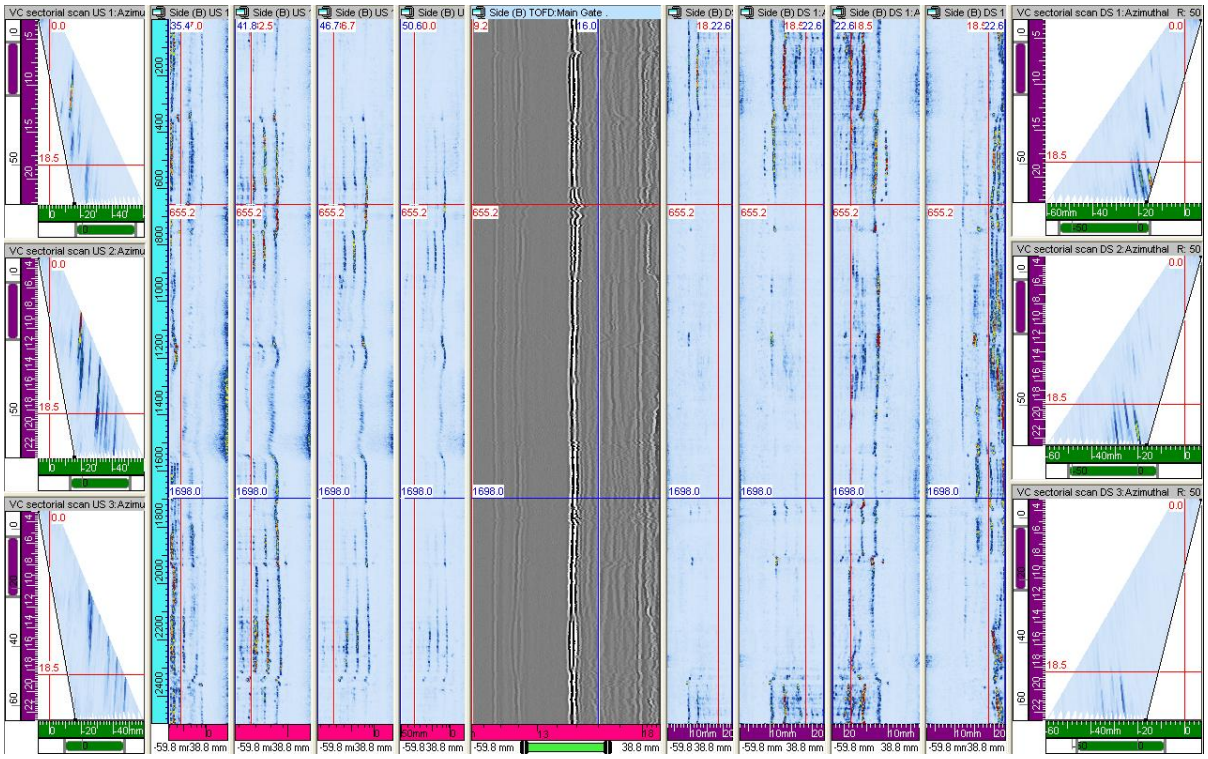


Figure 35. Weld MLA 4811 - EWI LPA Scan Screen Capture

Weld MLA 4887 was scanned, as it was found to contain one rejectable indication that could be used for technique comparison. For MLA 4887 the zonal discrimination UTQ scan is shown in Figure 36. The EWI LPA non-zonal scan is shown in Figure 37. The EWI scan on the DS side with S-scans and volume corrected side view (B-scans) is shown in Figure 38. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

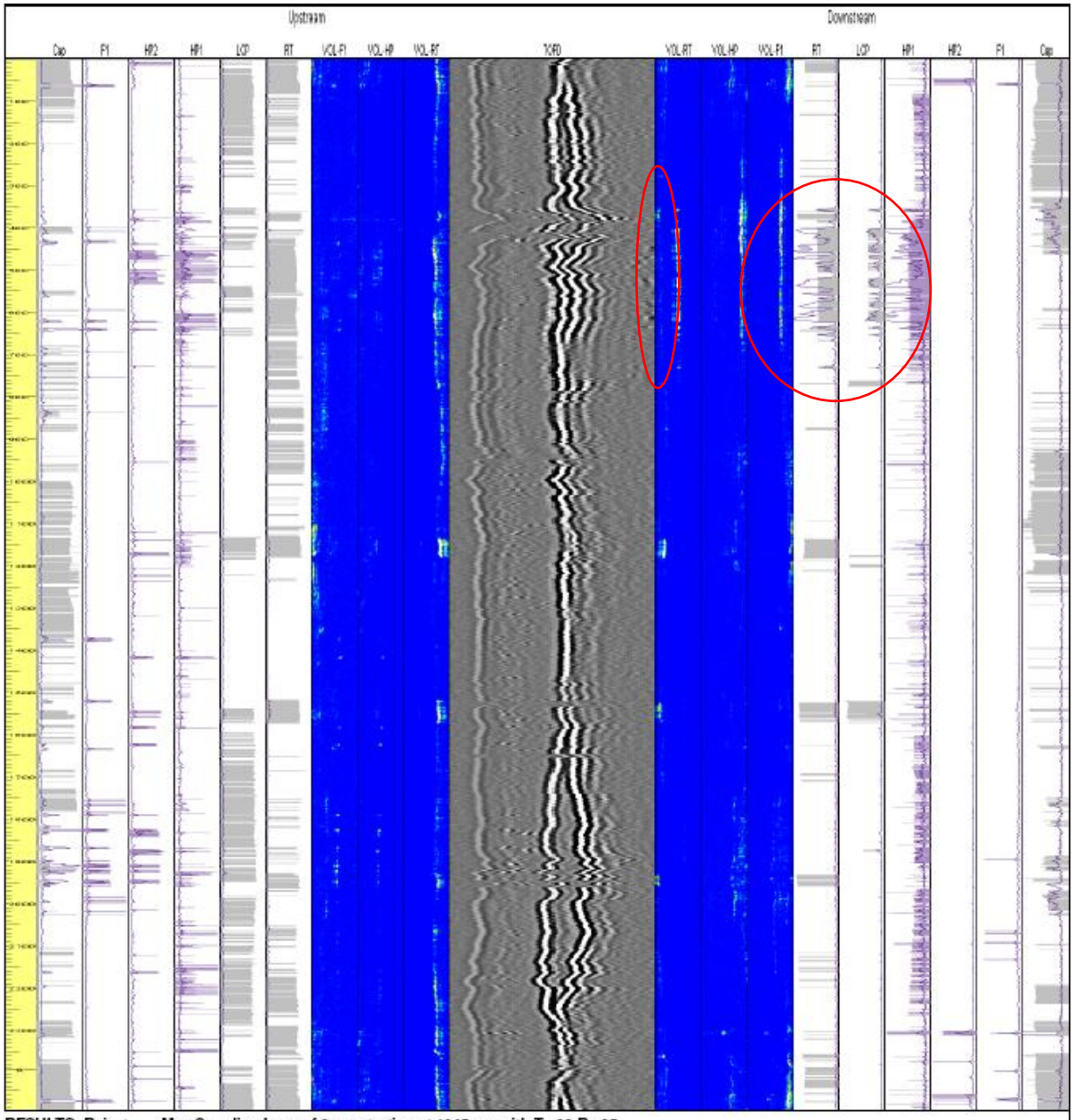


Figure 36. Weld MLA 4887 - UTQ Scan Screen Capture

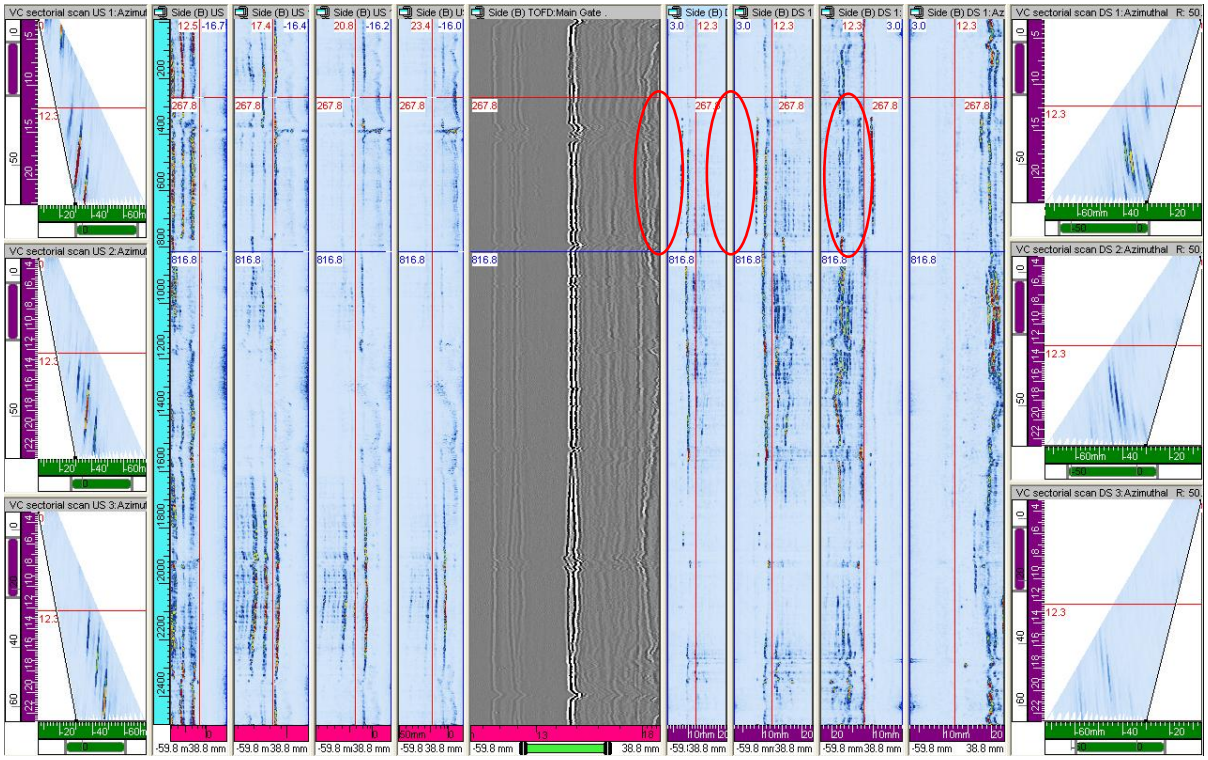


Figure 37. Weld MLA 4887 - EWI LPA Scan Screen Capture 1

Figure 38. Weld MLA 4887 - EWI LPA Scan Screen Capture 2 (DS)

Weld MLA 4890 was scanned, as it was found to contain one rejectable indication that could be used for technique comparison. For MLA 4890 the zonal discrimination UTQ scan is shown in Figure 39. The EWI LPA non-zonal scan is shown in Figure 40. The EWI scan on the DS side with S-scans and volume corrected side view (B-scans) is shown in Figure 41. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

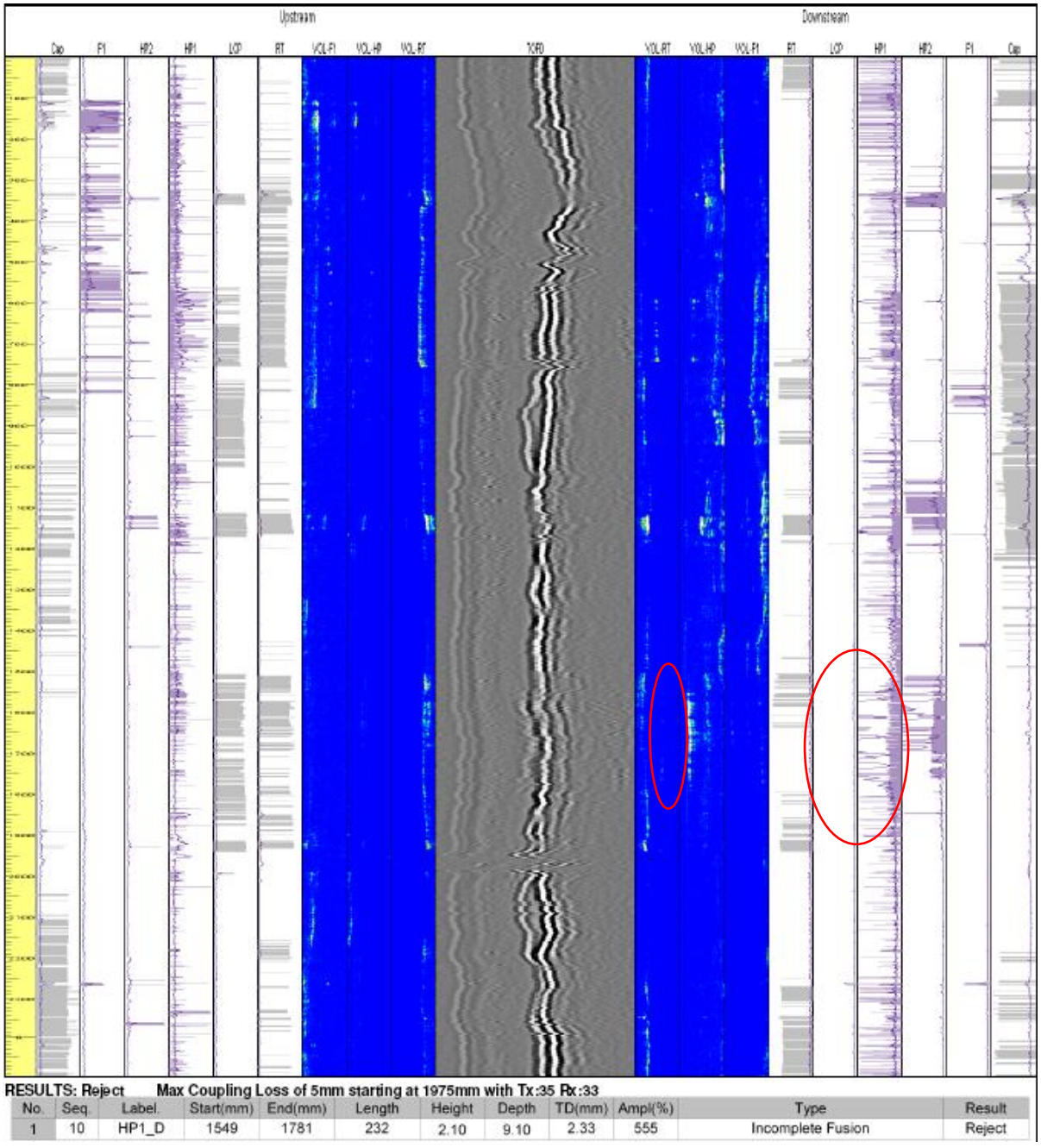


Figure 39. Weld MLA 4890 - UTQ Scan Screen Capture

Figure 40. Weld MLA 4890 - EWI LPA Scan Screen Capture 1

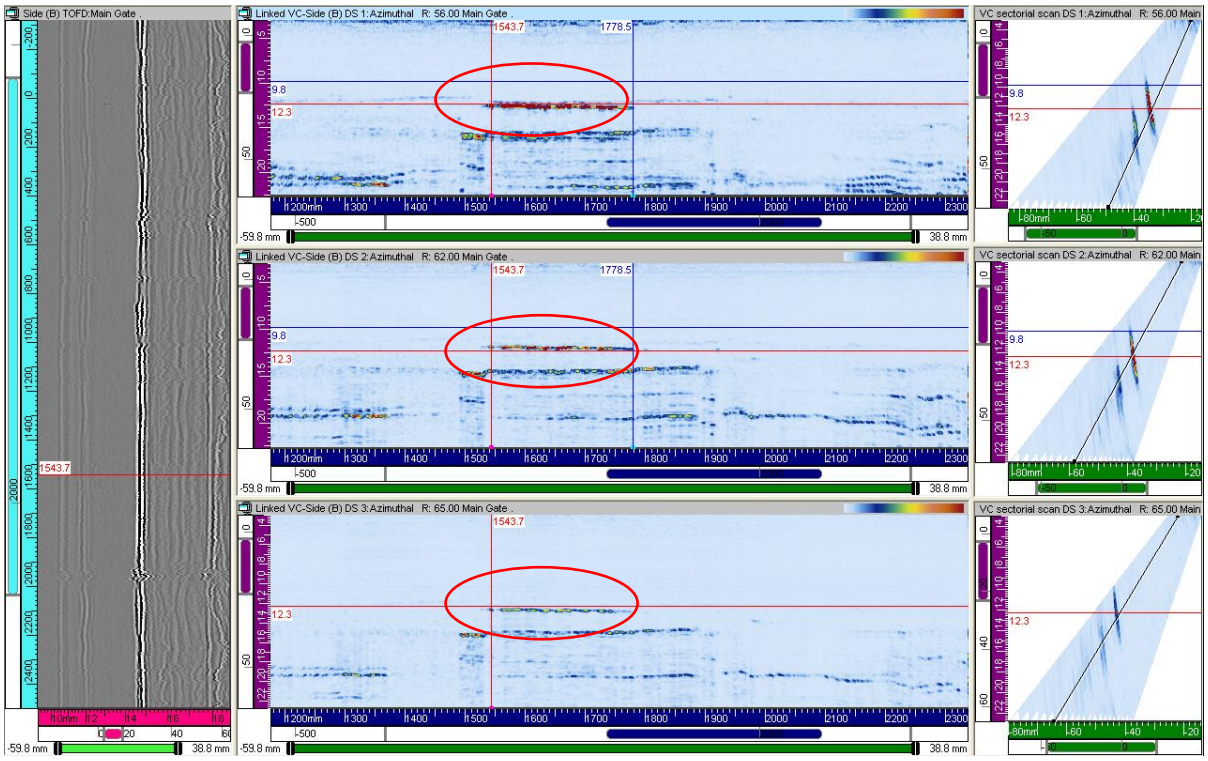


Figure 41. Weld MLA 4890 - EWI LPA Scan Screen Capture 2 (DS)

Wednesday June 17, 2009

U.S. DOT Project Technical Manager, Frank Licari, was on site for one half day to witness field trial activities for LPA scanning (for DTPH56-07-T-000002) and for MPA scanning (for DTPH56-08-T-000002).

Weld MLA 4895 was scanned, as it was found to contain one rejectable indication that could be used for technique comparison. For MLA 4895 the zonal discrimination UTQ scan is shown in Figure 42. The EWI LPA non-zonal scan is shown in Figure 43. The EWI scan on the DS side with S-scans and volume corrected side view (B-scans) is shown in Figure 44. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

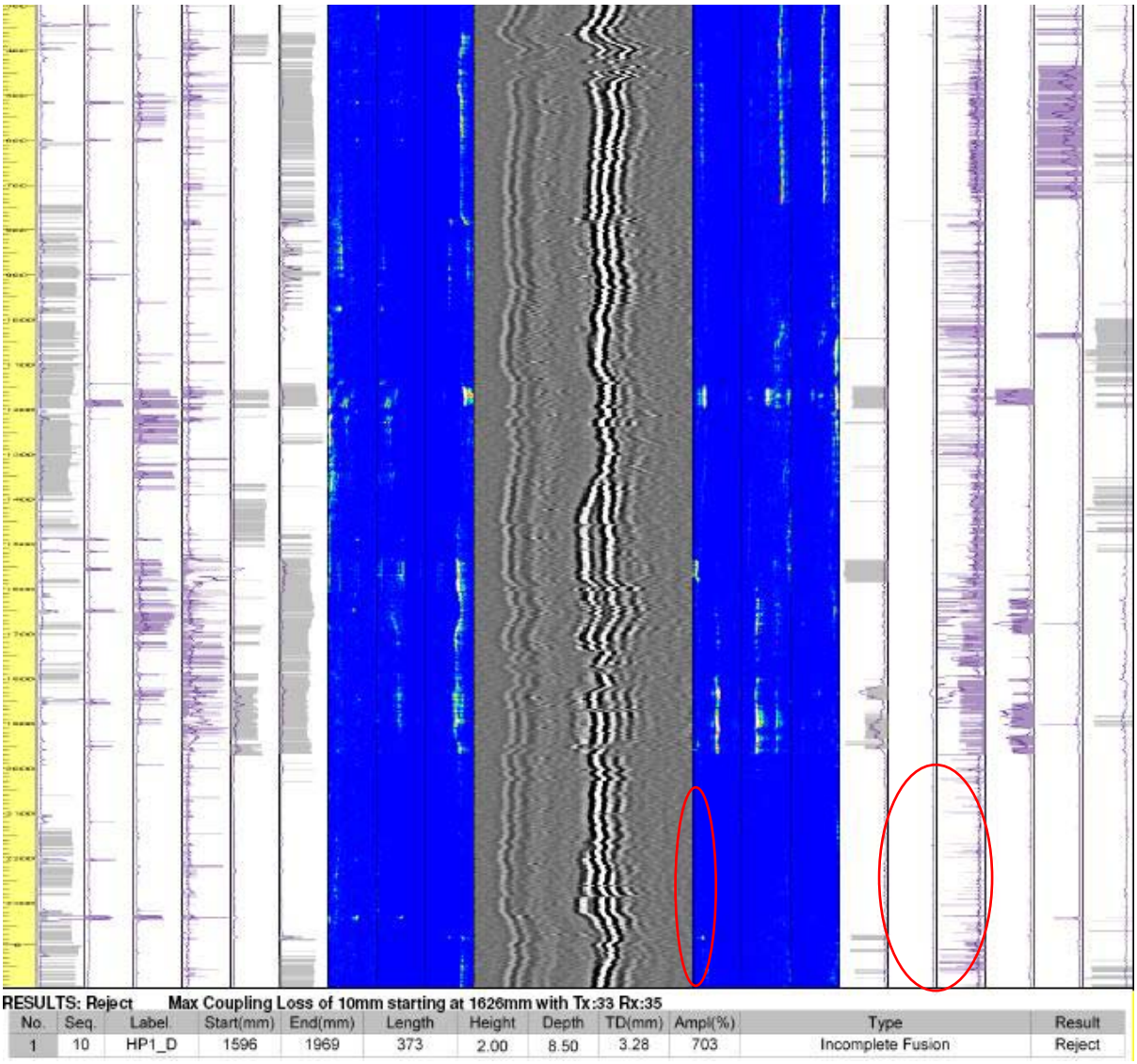


Figure 42. Weld MLA 4895 - UTQ Scan Screen Capture

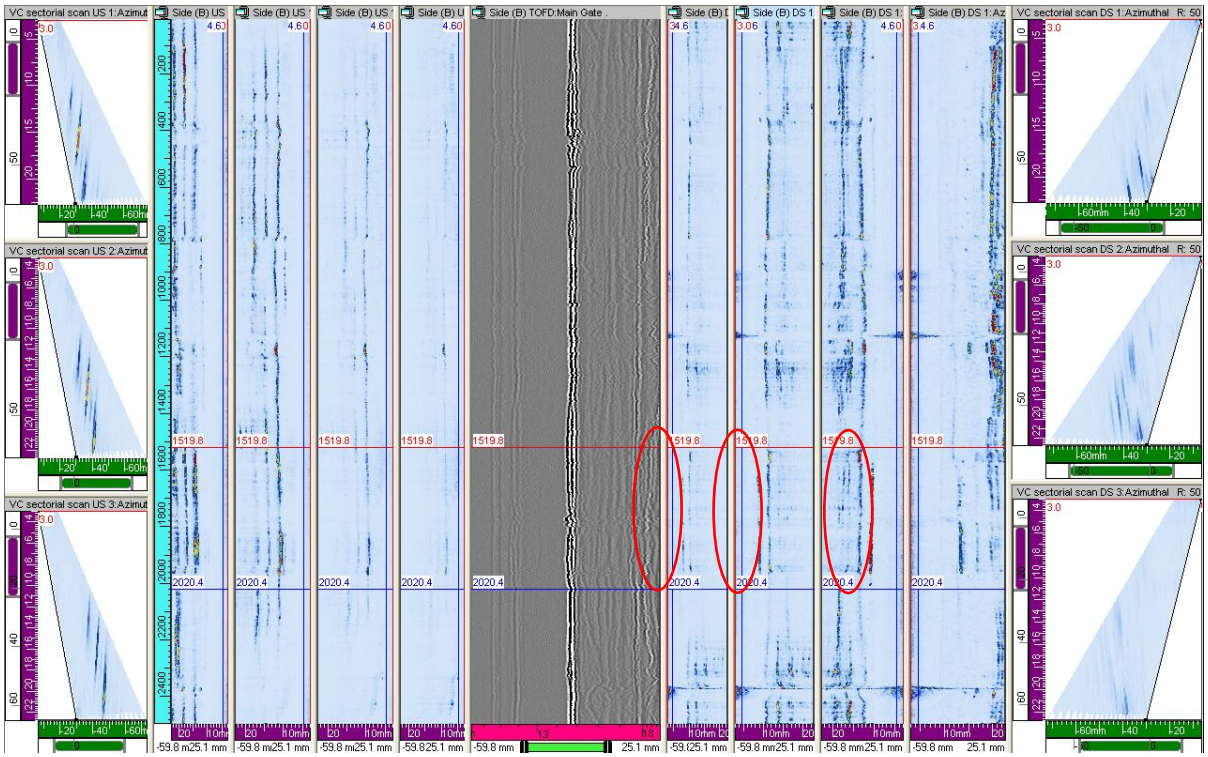


Figure 43. Weld MLA 4895 - EWI LPA Scan Screen Capture 1

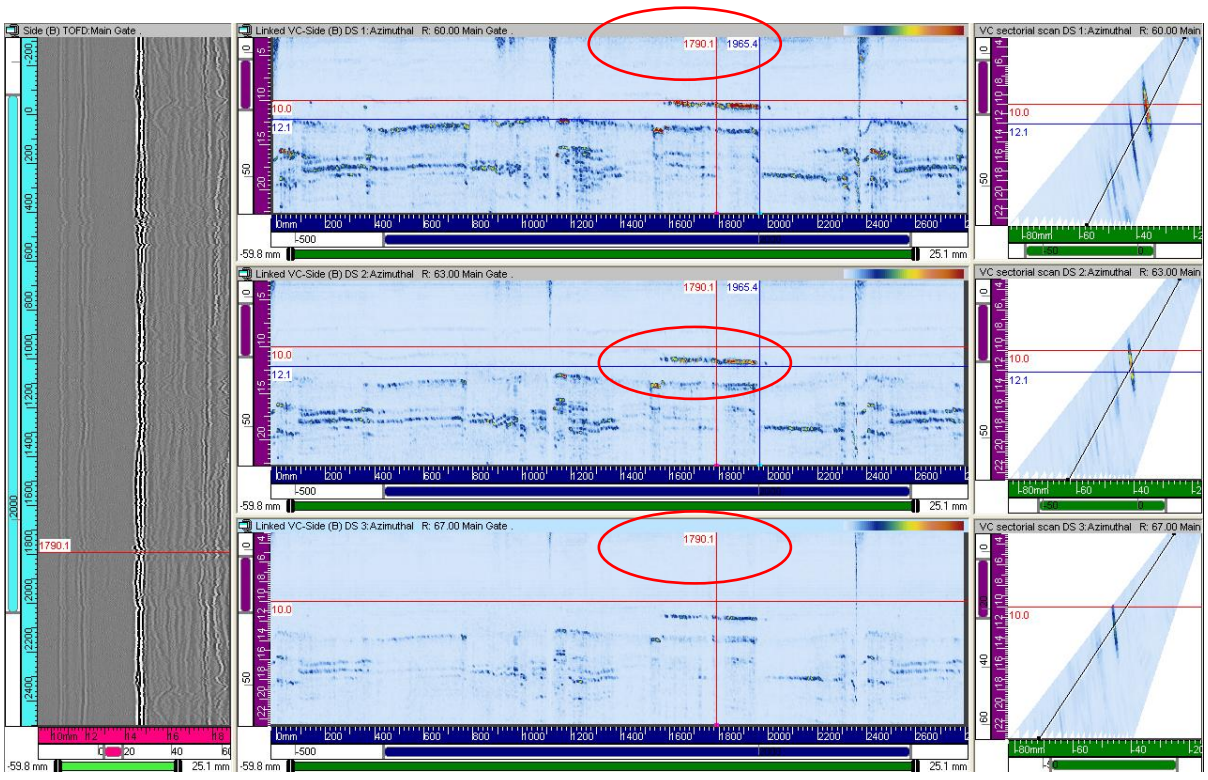


Figure 44. Weld MLA 4895 - EWI LPA Scan Screen Capture 2 (DS)

Weld MLA 4909 was scanned, as it was found to contain one rejectable indication that could be used for technique comparison. For MLA 4909 the zonal discrimination UTQ scan is shown in Figure 45. The EWI LPA non-zonal scan is shown in Figure 46. The EWI scan on the DS side with S-scans and volume corrected side view (B-scans) is shown in Figure 47. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.

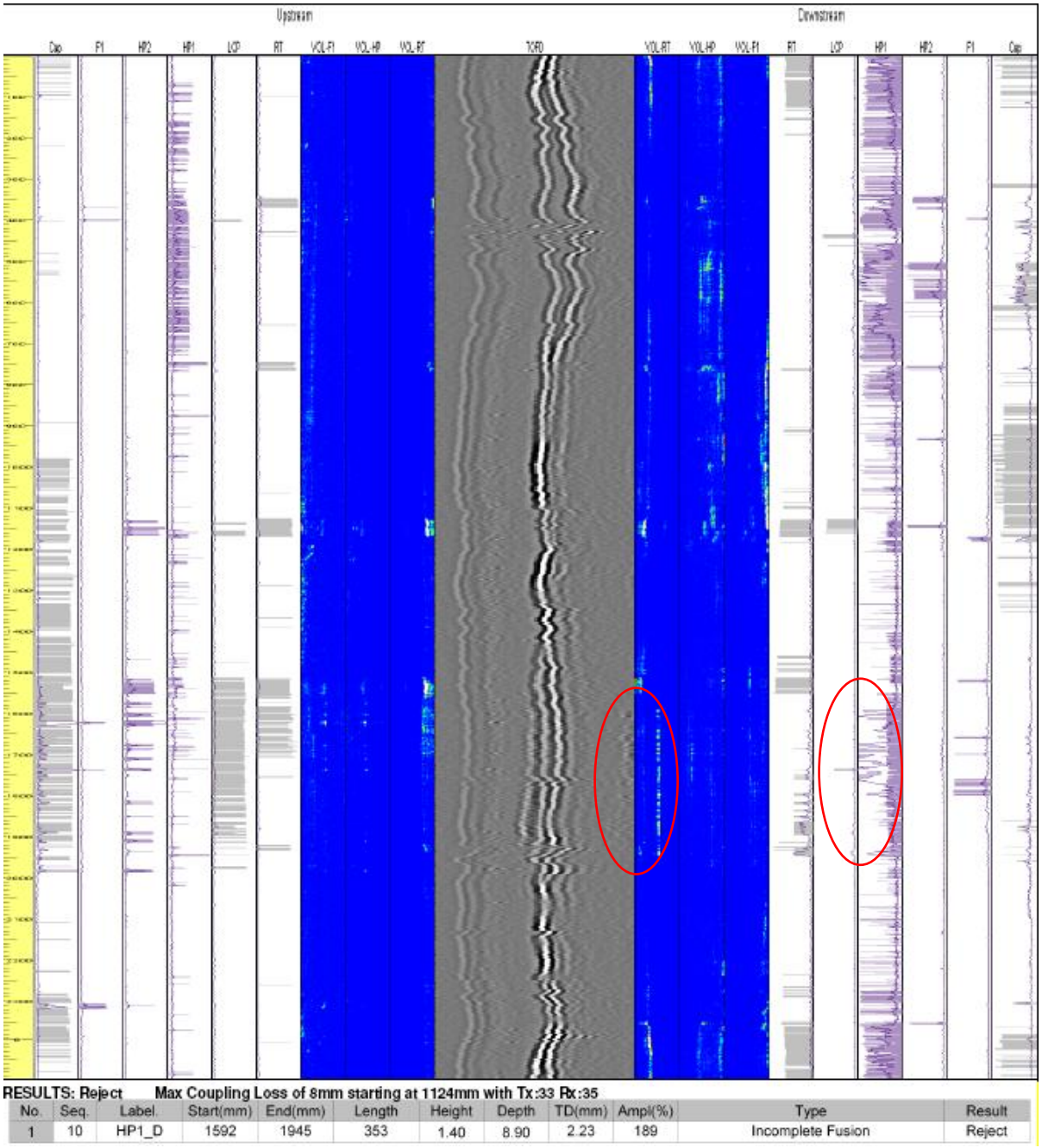


Figure 45. Weld MLA 4909 - UTQ Scan Screen Capture

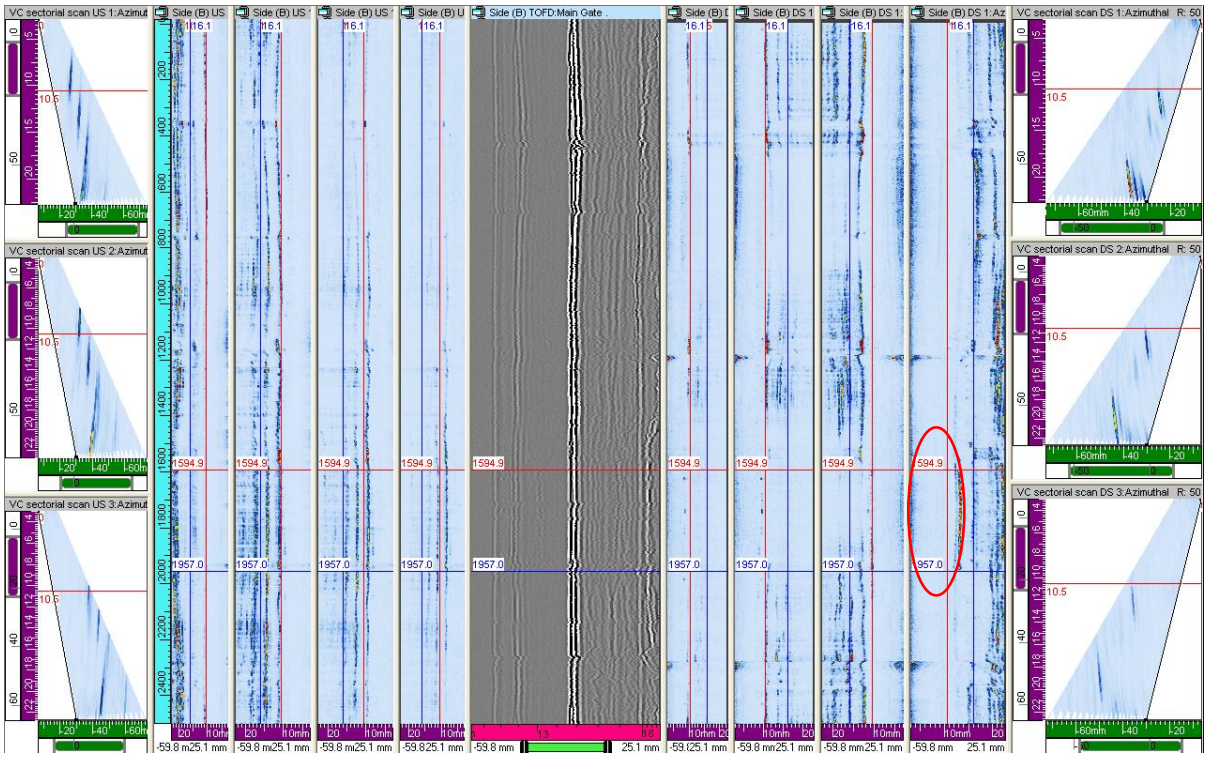


Figure 46. Weld MLA 4909 - EWI LPA Scan Screen Capture 1

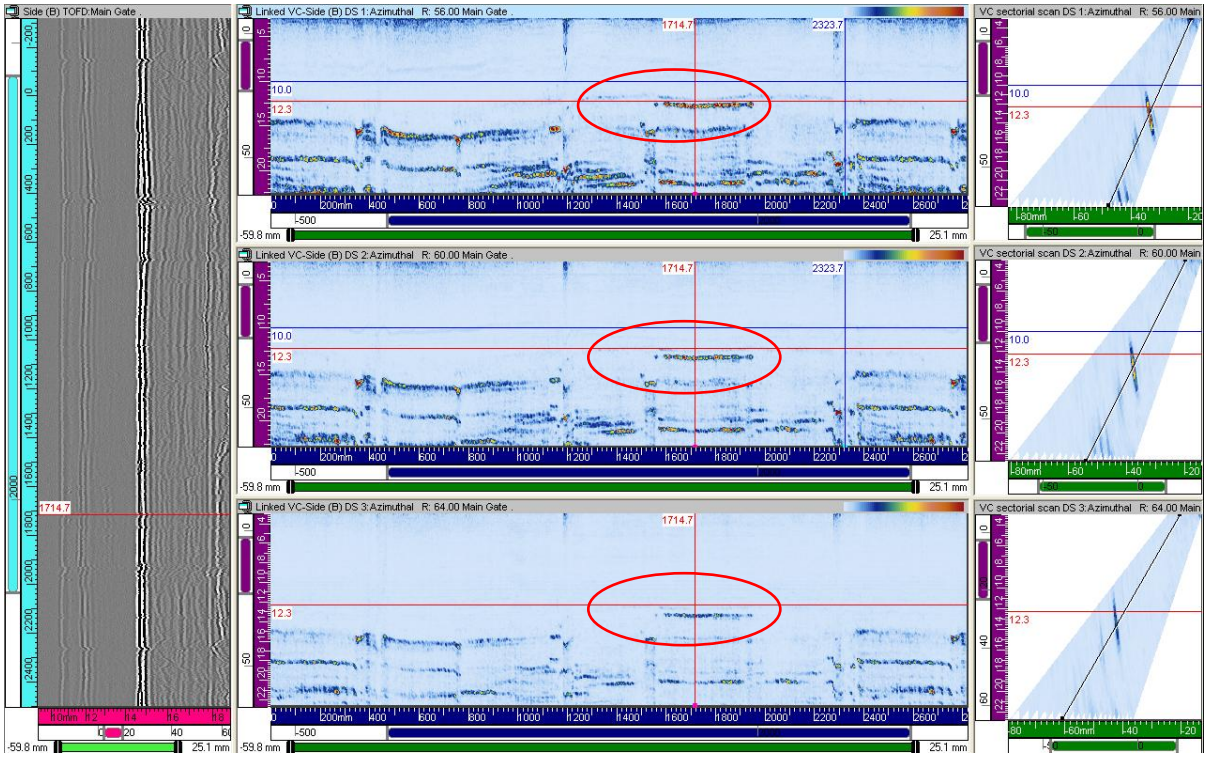


Figure 47. Weld MLA 4909 - EWI LPA Scan Screen Capture 2 (DS)

Acceptable weld MLA 4925 was scanned to compare techniques. For MLA 4925: the zonal discrimination UTQ scan is shown in Figure 48 and the EWI LPA non-zonal scan is shown in Figure 49. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non zonal method.

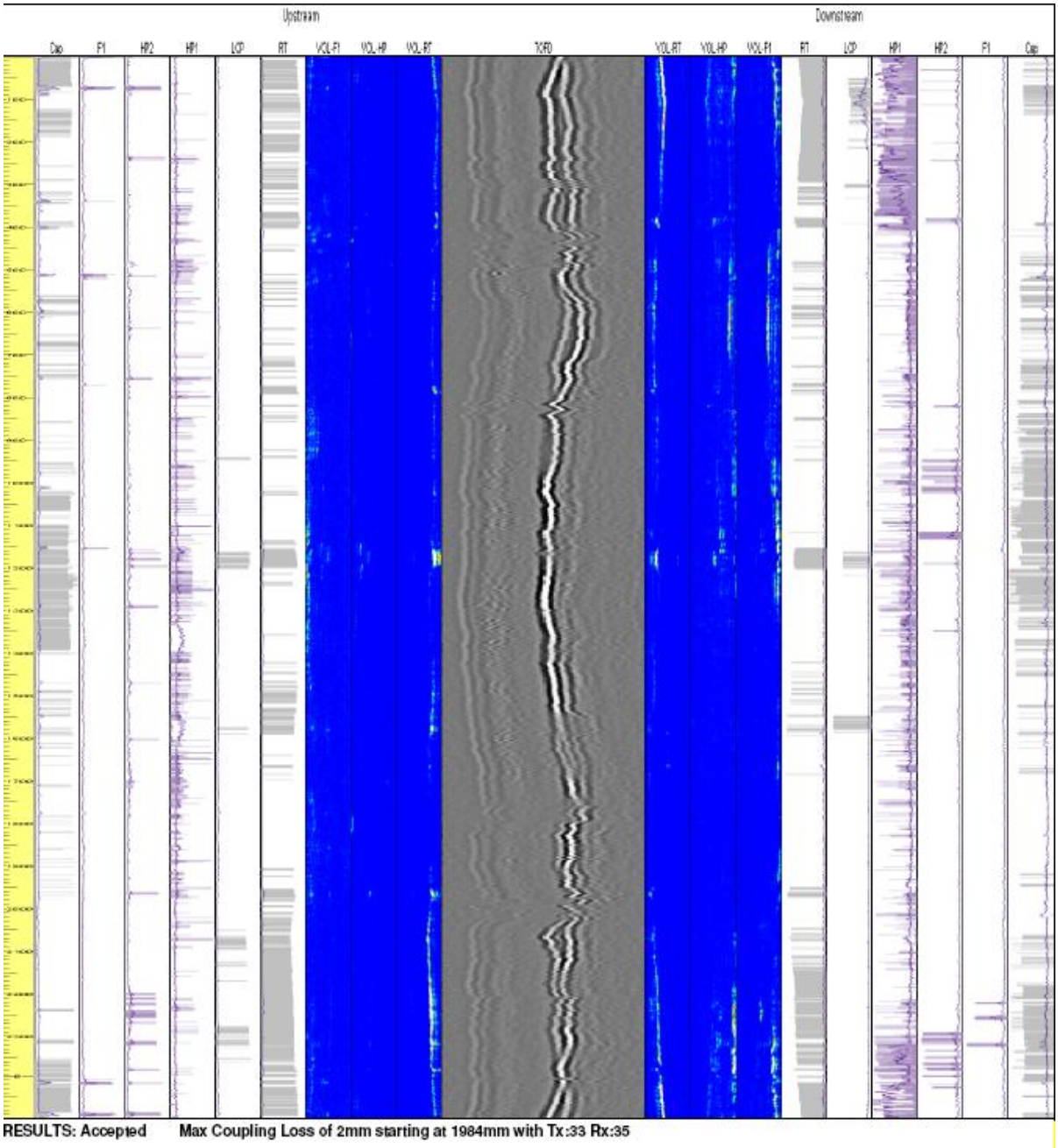


Figure 48. Weld MLA 4925 - UTQ Scan Screen Capture

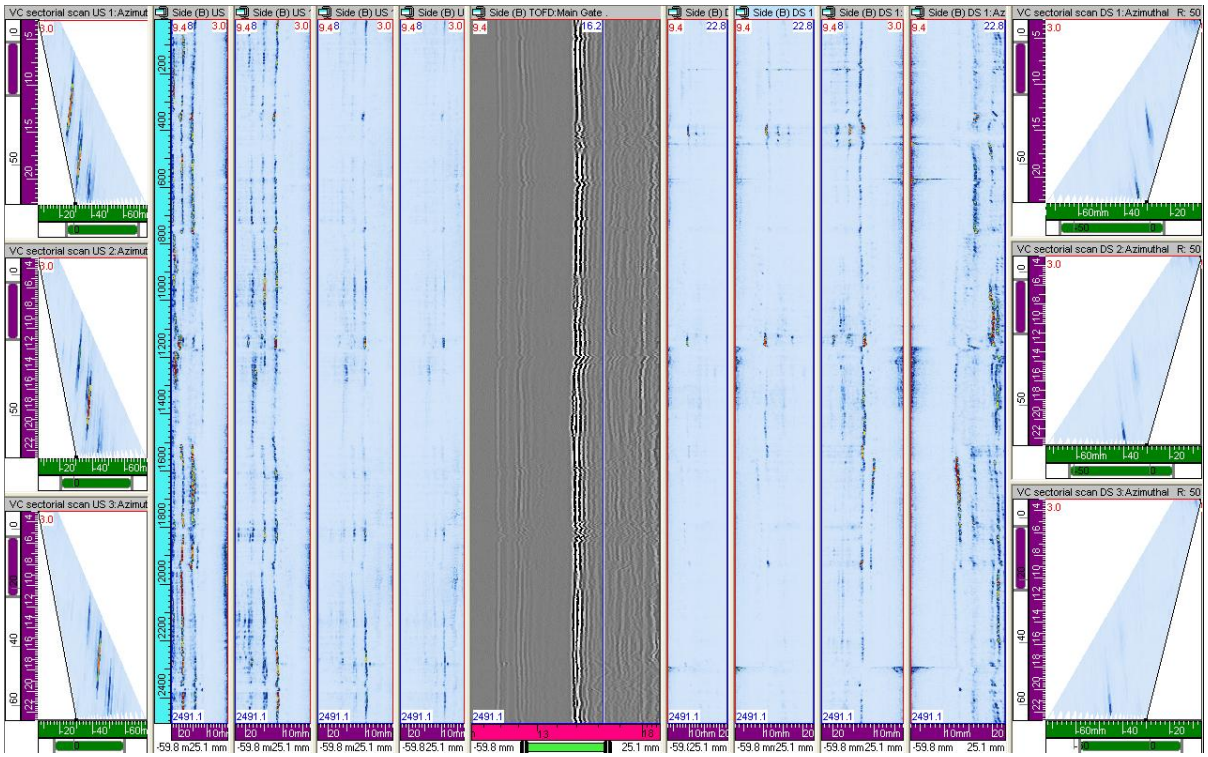
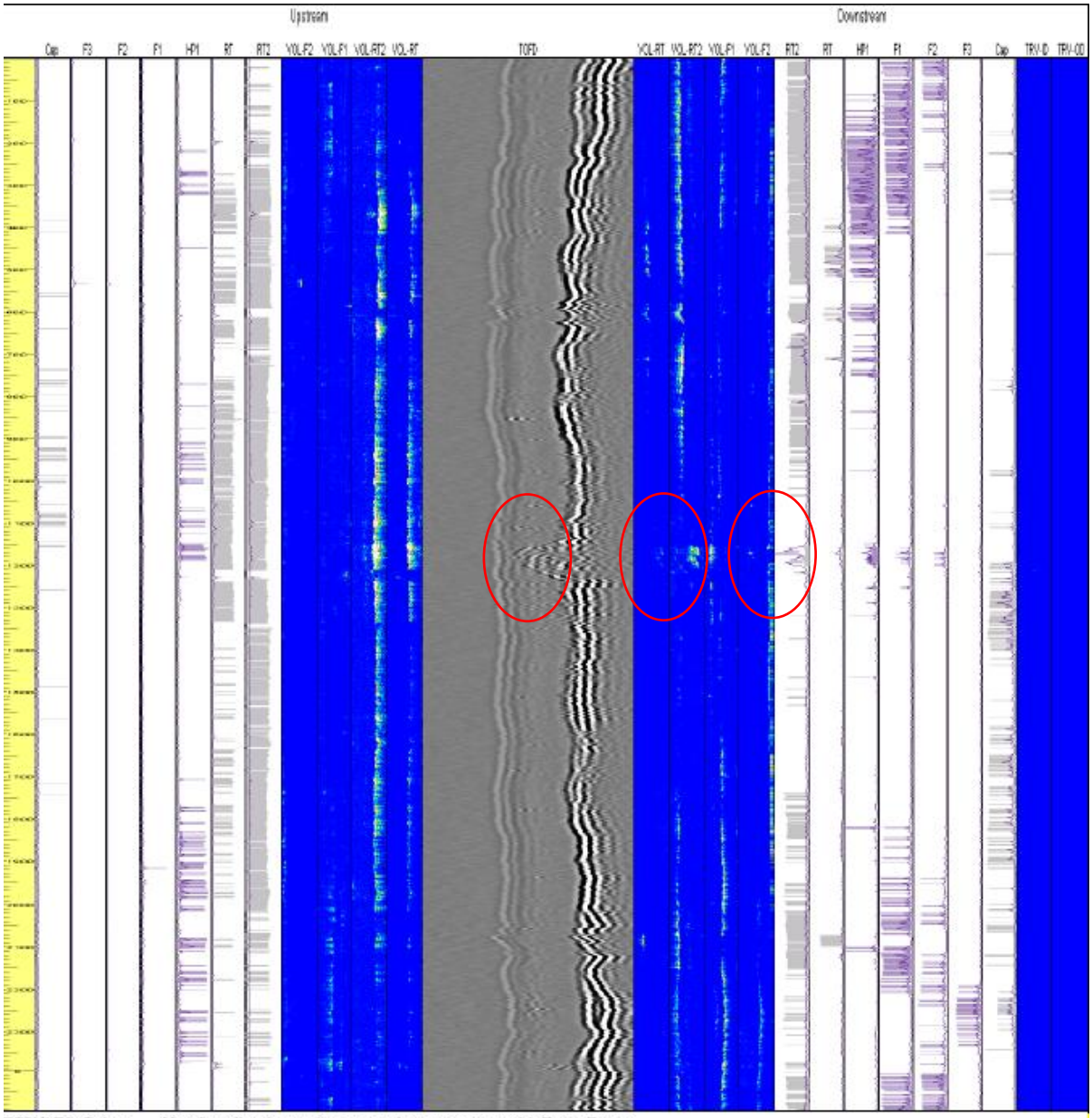


Figure 49. Weld MLA 4925 - EWI LPA Scan Screen Capture

Weld PB 0996 was scanned, as it was found to contain one rejectable indication that could be used for technique comparison. For PB 0996 the zonal discrimination UTQ scan is shown in Figure 50. The EWI LPA non-zonal scan is shown in Figure 51. The EWI scan on the DS side with S-scans and volume corrected side view (B-scans) is shown in Figure 52. There was good agreement between the UTQ zonal discrimination method and the EWI LPA non-zonal method.



No.	Seq.	Label.	Start(mm)	End(mm)	Length	Height	Depth	TD(mm)	Ampl(%)	Type	Result
1	14	RT2_D	1158	1199	41	2.60	9.80	2.50	99	Incomplete Fusion	Reject
2	25	TOFD	1134	1237	103	2.00	9.80	2.22	102	Incomplete Fusion	Reject

Figure 50. Weld PB 0996 - UTQ Scan Screen Capture

Figure 51. Weld PB 0996 - EWI LPA Scan Screen Capture 1

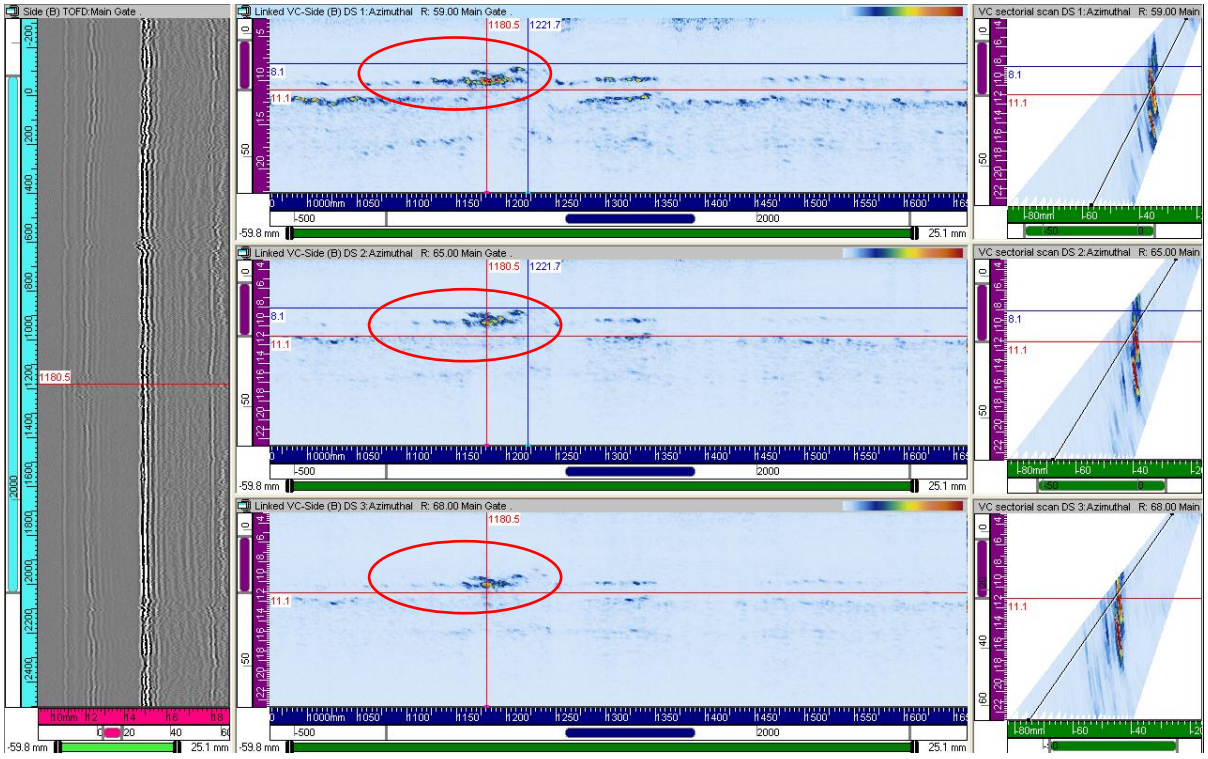


Figure 52. Weld PB 0996 - EWI LPA Scan Screen Capture 2 (DS)

Thursday June 18, 2009

TCPL representative Evan Vokes asked EWI to scan a poor boy weld (PB 1005), which joins welspun (i.e., spiral welded) carbon steel pipe to seam welded carbon steel pipe. It is difficult to inspect this joint as there is a difference in velocity of approximately 300 m/s. This weld was accepted by UTQ as shown in Figures 53 and 54. Figure 53 shows the standard calibration for the seam welded pipe; Figure 55 uses a calibration done on the welspun or spiral welded pipe. The scan screen capture of the EWI LPA non-zonal technique is shown in Figure 56. The non-zonal technique was done using the calibration standard for seam welded pipe (Figure 57); therefore, results are for informational purposes only. Field trial scanning activities concluded at this point and EWI personnel traveled back to Edmonton to the UTQ facilities to unload the truck, pack up equipment, and ship it back to EWI.

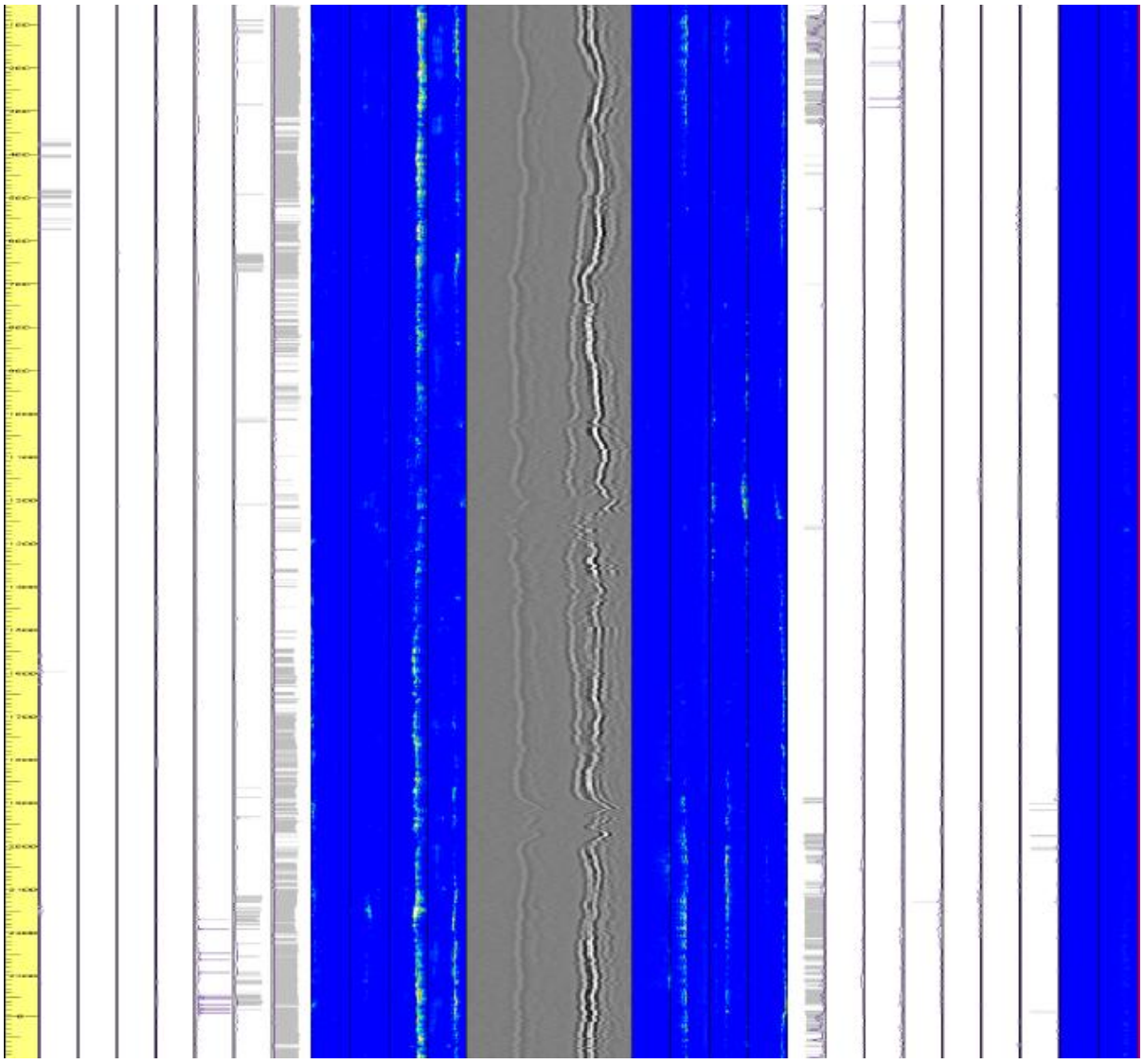


Figure 54. Weld PB 1005 - UTQ Scan Screen Capture 1

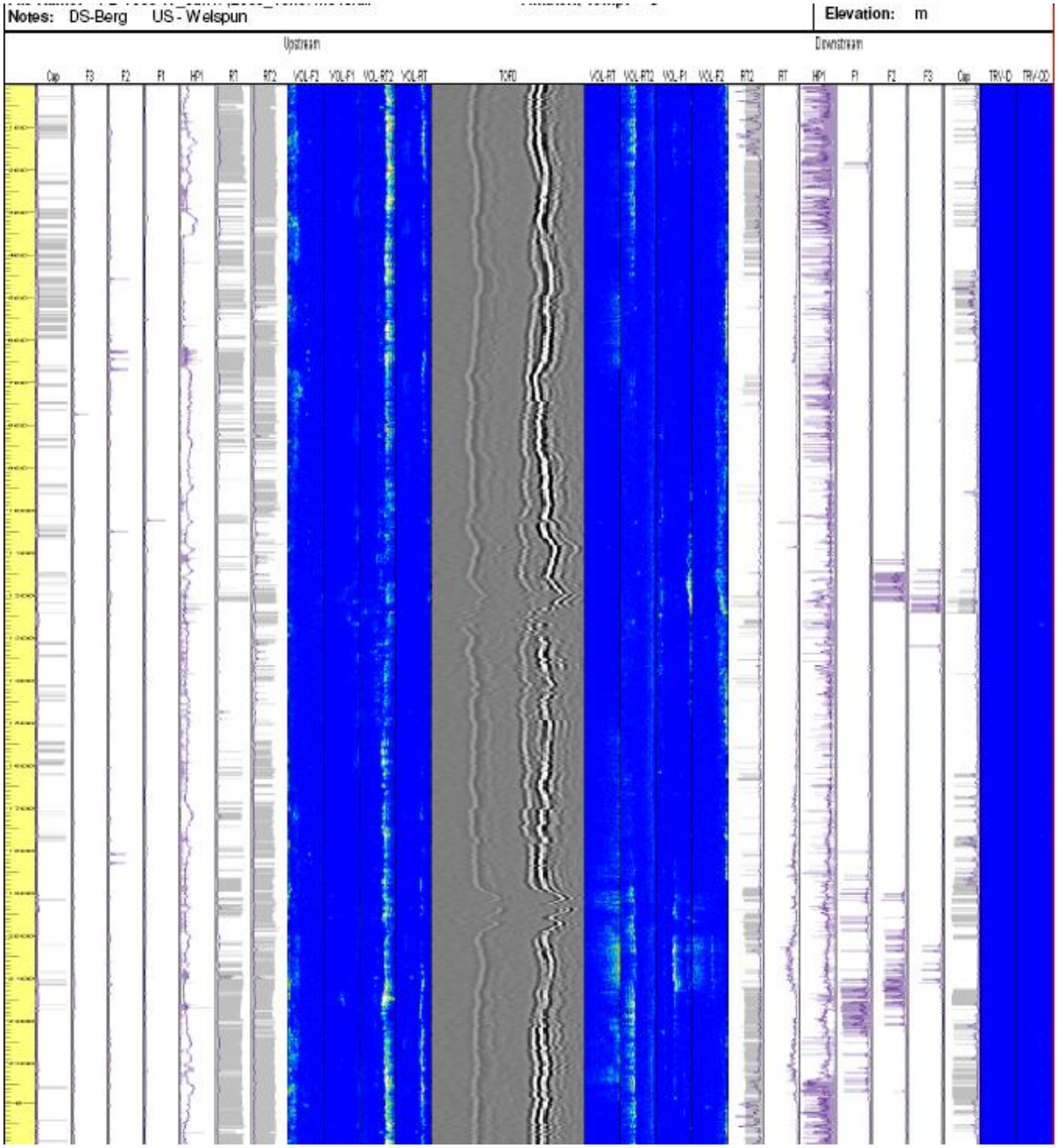


Figure 55. Weld PB 1005 - UTQ Scan Screen Capture 2

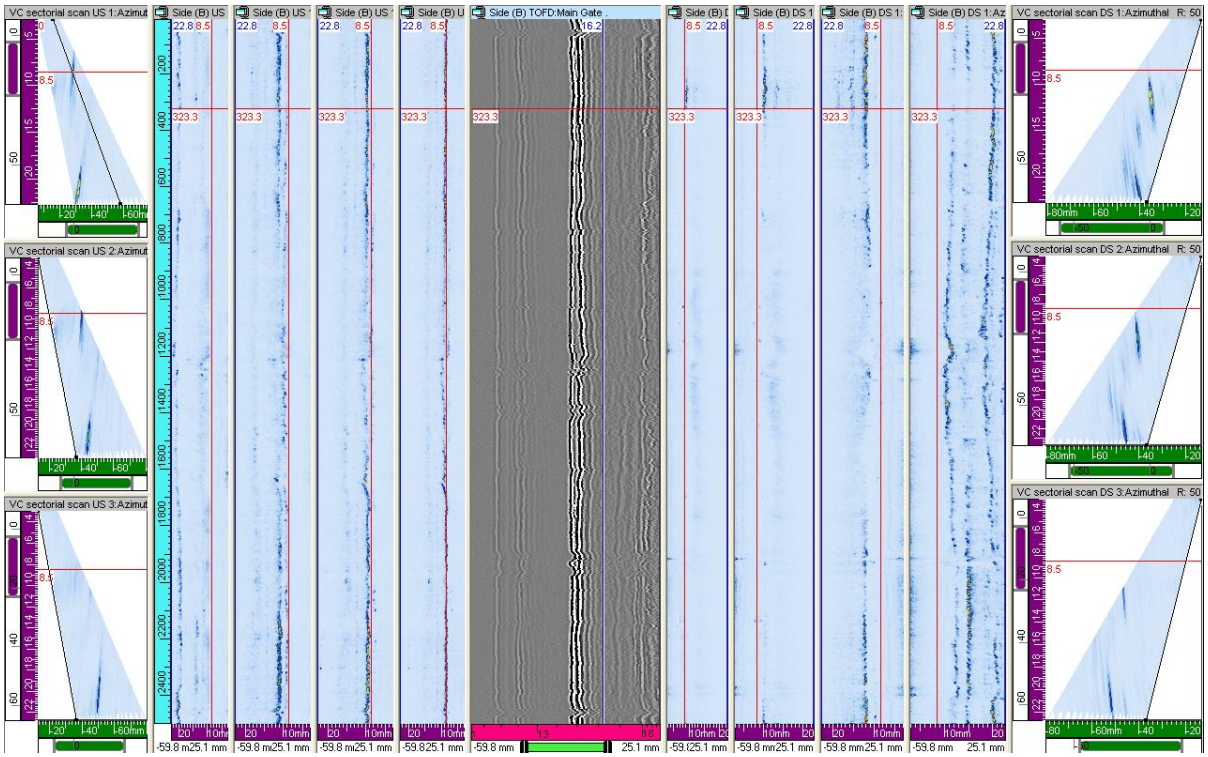


Figure 56. Weld PB 1005 - EWI LPA Scan Screen Capture

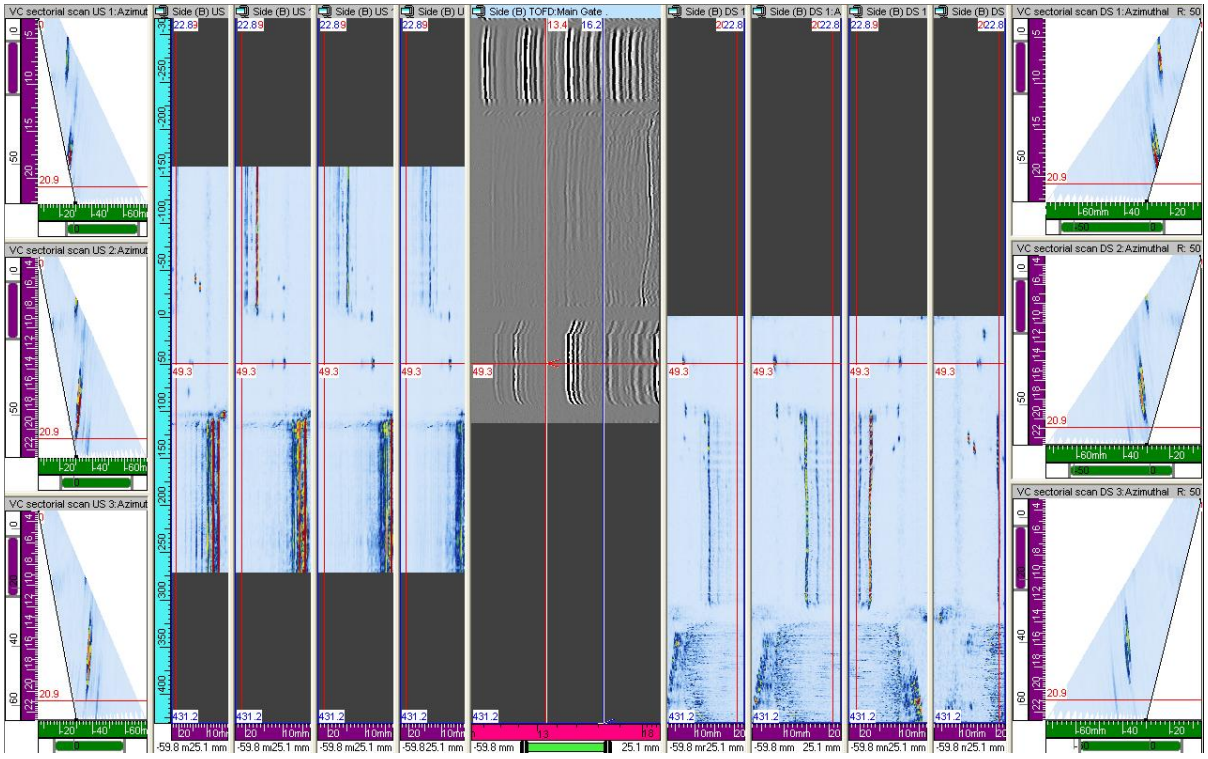


Figure 57. Weld PB 1005 - EWI LPA Calibration Scan Screen Capture