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PRCI Project No. PR-185-084501
EWI Project No. 51219CSP

PRCI Cost Share for EWI DOT PHMSA Program Entitled "Advanced Technologies and Methodology for Automated Ultrasonic Testing Systems Quantification" Project Status Update

June 10, 2009

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Presentation Outline

- DOT Objectives
- DOT Schedule
- Funding Sources
- DOT Deliverables
- DOT Work Plan & PRCI Work Plan
- Cost Share Contribution Details
- PRCI Deliverables/Milestones/Invoicing
- Next Steps
- Examples of Technical Data

DOT Program Objectives

- Quantify the Performance of Multiple AUT Systems
- Develop a Methodology for Quantification of AUT Systems
- Establish a Guidance Document
- Advance and Quantify AUT Systems Image-Capture Capabilities
- Implement the Quantification Methodology in Field Tests and Guidance Document in Reliability Based Design and Assessment (RBDA) Standards

DOT Program Schedule

Q10 = Dec09

Task	Description	Quarter									
		1	2	3	4	5	6	7	8	9	10
1	Develop a Methodology for Quantification of AUT Systems	X	X								
2	Advance and Quantify AUT Systems Image Capture Capabilities	X	X	X							
3	Quantify the Performance of AUT Systems		X	X							
4	Field Tests Implementation of the Quantification Methodology		X	X	X	X					
5	Develop Reference Library				X	X					
6	Develop Guidance Document					X	X	X	X		
7	Standards Implementation					X	X	X	X		
8	Progress Meetings, Pipeline Conference, Annual Panel Peer Review, and Reporting	X	X	X	X	X	X	X	X		

X - Original Schedule

- Actual Schedule

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Funding Sources - $2,108K

- **$613K** - DOT Funding (50454GTH)
- **$225K** - PRCI Funding (51219CSP / PR-185-084501)
  - $74,500 for 2008 - Received
  - $65,300 for 2009 - Received
  - $84,700 for 2010 - *Requested*
- **$200K** - ConocoPhillips (50600CSP)
- **$ 80K** - UT Technology/Quality (50416CSP)
- **$160K** - EWI Capital and CRP Funding
- **$100K** - In-kind Contributions from TCPL
- **$530K** - In-kind Contributions from Chevron, BP, UT Technology/Quality, GE Inspection Technologies, Mechanical Integrity, ExxonMobil
- **$200K** - Petrobras*

** - Received in April 09; Requires 12-month Project Extension*

DOT Program Deliverables

- POD and Sizing Accuracy Curves of Representative Multiple Systems
- Methodology to Quantify AUT Systems
- Guidance for AUT Capabilities and ECA/Strain-Based Design Approach Applicability
- Technical Justification for Modifications Of The Current Requirements for AUT Qualification Trials Demanded By The Global Practices Of Major Companies and Codes

DOT Work Plan

Task 1 – Develop a Draft Methodology for Quantification of AUT Systems/Tests (Funding Source: DOT and Industry In-kind)

- ✓ Methodology for an initial assessment of AUT systems and procedures
- ✓ Methodology for design, fabrication and fingerprinting of quantification welds
- ✓ Methodology for blind tests and destructive validation
- ✓ Methodology for statistical analysis
- ☞ Harmonize with future revisions of the U.S. and international standards

☞ = *On-going* ✓ = *Complete*

DOT Work Plan

Task 2 – Advance and Quantify AUT Systems Image Capture Capabilities (Funding Source: DOT and Industry In-kind)

- ✓ Investigate AUT systems detection and imaging capabilities and focused on systems with a second layer imaging capabilities
- ✓ Enhance via software modification and quantify AUT systems image capture capabilities using open and blind trial specimens

DOT Work Plan

Task 3 – Quantify the Performance of AUT systems (Funding Source: ConocoPhillips (EWI Project No. 50600CSP), UTT/UTQ (EWI Project No. 50416CSP), DOT (50454GTH), PRCI (51219CSP) and Industry In-kind

- ✓ Selected material (including high strength steel) and typical weld geometry for the first set of welds (30” diam., X80, 15.6mm WT)
- ✓ Fabricated the first set quantification welds with statistically valid population of flaws. The type, sizes, location and number of the implanted and natural flaws were determined based on the technical and economical approaches developed in the previous task. Sonaspection fabricated welds with implanted flaws; EWI fabricated welds with natural flaws
- ✓ PRCI project for an additional set of welds & flaws to study the interaction rules

DOT Work Plan

Task 3 – Quantify the Performance of AUT systems (Funding Source: ConocoPhillips (EWI Project No. 50600CSP), UTT/UTQ (EWI Project No. 50416CSP), DOT (50454GTH), PRCI (51219CSP) and Industry In-kind

- Fingerprint the quantification welds using several independent NDE techniques including computed digital radiography.
- Quantify the performance of multiple representative state-of-the-art AUT systems.
  - Destructively validate and compare the results. The principals established in Task 1 will be applied for selection of the flaws for destructive validation.
  - Statistically analyze and present POD and sizing results in tabulated and graphical format for AUT systems and independent techniques
- All new funding from PRCI used for additional materials, welds, flaws, fingerprinting, and destructive and statistical analysis.

PR-185-084501 Work Plan
(in Support of DOT Task 3)

- ✓ Samples with Implanted Flaws
  - *Selected Materials and Typical Weld Geometries*
  - *Identified Statistically Valid Population of Flaws*
  - *Designed Weld Samples*
  - *Pipe Material Provided by TransCanada*
  - *Samples Fabricated*
- ✓ Samples with Natural Flaws
  - *Provided by TransCanada from Keystone Project*
- ✓ Assess Capabilities of Selected AUT Procedures to Inspect Above Samples using Modeling and Simulation Tools
- ☞ Fingerprinting, Destructive and Statistical Analysis

DOT Work Plan

Task 4 – Field Tests Implementation of the Quantification Methodology (Funding Source: DOT and Industry In-kind)

- ✓ Keystone Project Selected for Field Tests
  - *June 8 - 19, 2009 in Hardisty, Alberta*
- ✓ During the Welder Qualification Trials, Selected Welds with Natural Flaws for Blind Trials
- ☞ Field Comparison of two AUT Systems
  - Zonal – UT Quality; Non zonal – EWI
- Validate and Compare the Results
  - *Salami Sectioning of All Cut Outs*

DOT Work Plan

Task 5 – Develop Reference Library (Funding Source: DOT and Industry In-kind)

- ✓ Selected Typical Defects and AUT Images
- Developing a Reference Library with Comparison AUT and Destructive Digital Images for Selected Defects
- Present Reference Library to Sponsors and Industry during Project Meetings, Workshops and Conferences
- Develop Training Class for Representative AUT Systems and Implement the Reference Library for Training of AUT Operators/Company Auditors

DOT Work Plan

Task 6 – Develop Guidance Document (Funding Source: DOT and Industry In-kind)

- Develop a Guidance Document for AUT Capabilities and ECA/Strain-based Design Approach Applicability
  - *Planning October Meeting to Discuss Guidance Document*
- Develop Operator Procedures for Weld Inspection Applications
- Present Documents to Sponsors and Industry

DOT Work Plan

Task 7 – Standards Implementation (Funding Source: DOT and Industry In-kind)

- Apply POD and Sizing Information in ECA/Strain-based Design Applications of the Sponsors
- Present POD and Sizing Information and Guidance Document for Future Implementation in API 1104, Appendix A Reliability Based Design and Assessment Standard and ASTM 1961 Recommended Practice

DOT Program Objectives

- Quantify the Performance of Multiple AUT Systems
- Develop a Methodology for Quantification of AUT Systems
- Establish a Guidance Document
- Advance and Quantify AUT Systems Image-Capture Capabilities
- Implement the Quantification Methodology in Field Tests and Guidance Document in Reliability Based Design and Assessment (RBDA) Standards

DOT Cost Share Summary

Funding	Company	Funded Activities
$613K	DOT	All Activities
$225K	PRCI	Sample Fabrication, Assess Capabilities of AUT Procedures (via Modeling & Simulation), Fingerprinting, Destructive & Statistical Analysis
$200K	ConocoPhillips	Sample Fabrication, Destructively Validate AUT Detection and Sizing Capabilities, Engineering Support
$80K	UTT/UTQ	Sample Fabrication, Destructively Validate AUT Detection and Sizing Capabilities, Engineering Support
$160K	EWI	Purchased PA System, Assess Capabilities of AUT Procedures (via Modeling & Simulation)
$100K	TCPL	Host Field Trials and Engineering Support
$530K	Chevron, BP, UTT/UTQ, GE Inspection Technologies, Mechanical Integrity, ExxonMobil	Engineering Support, Equipment Loans/Scanning, Field Trial Support
$200K	Petrobras	Sample Fabrication, Assess Capabilities of AUT Procedures (via Modeling & Simulation), Fingerprinting, Destructive & Statistical Analysis, Guidance Document

PR-185-084501
Milestones/Payment Status

Payable Milestone	Year	Milestone/Deliverable Description	Status	Amount	Invoice
1	2008	Design PRCI Weld Samples	Complete	$20,000	Paid
2	2008	Deliver Matrix of Flaw Design for Weld Samples	Complete	$30,000	Paid
3	2008	Fabricate PRCI Weld Samples	Complete	$24,500	Paid
4	2009	Begin Fingerprinting & Quantifying Performance	Complete	$16,352	Paid
5	2009	Continue Fingerprinting & Quantifying Performance	In-Process	$16,352	
6	2009	Continue Fingerprinting & Quantifying Performance		$16,352	
7	2009	Continue Fingerprinting & Quantifying Performance		$16,352	
8	2010	Continue Fingerprinting & Quantifying Performance		$21,300	
9	2010	Complete Fingerprinting; Continue Quantifying Performance		$21,300	
10	2010	Complete Performance Quantification; Begin Destructive Validation and Comparing Results		$21,300	
11	2010	Complete Destructive Validation and Comparing Results; Complete Statistical Analysis; Complete POD and Sizing Results		$21,300	
12	2011	Deliver Final Report		$0	n/a

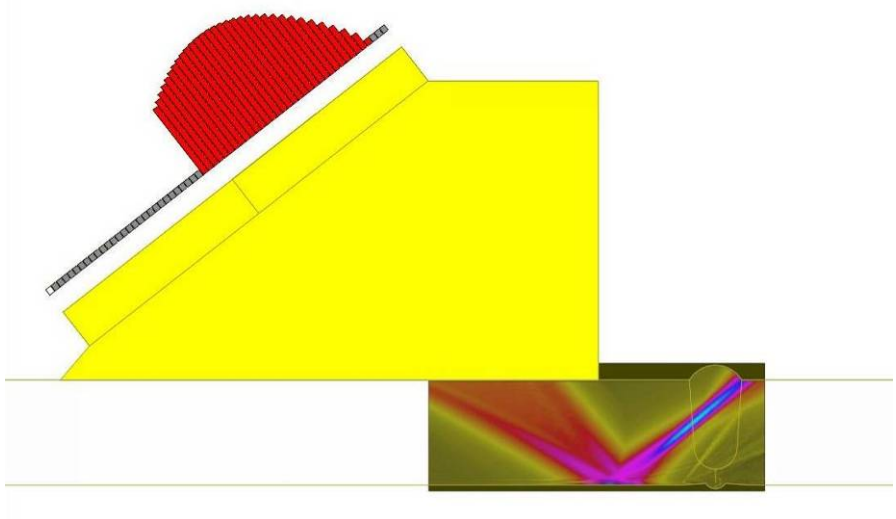
- Project Initiated in April 08
- Current End Date December 2009

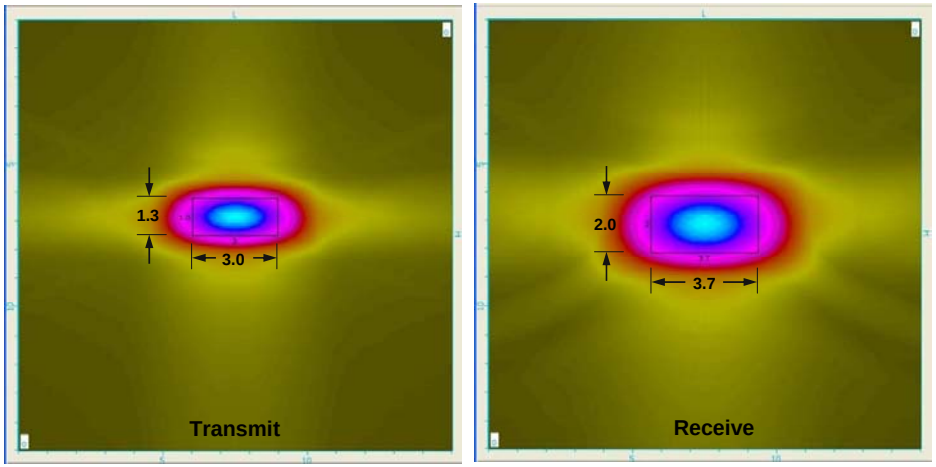
Next Steps

- Complete Field Trials
- Destructively Evaluate Samples
- Calculate POD and Sizing Accuracies
- Complete Guidance Document
- Provide Periodic Project Updates
- Present Guidance Document to Standards Committees
- Conduct Workshop
- Deliver Final Report

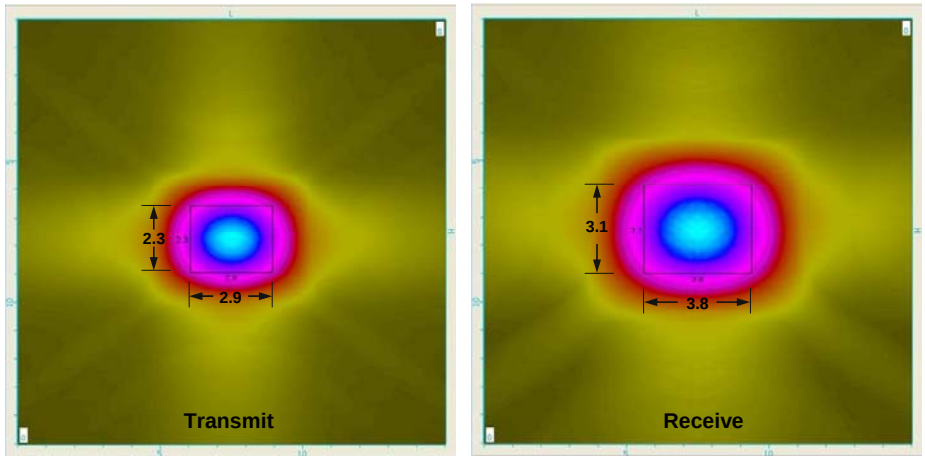
Examples of Technical Data

Technique Evaluations; Fill 2 – Beam Profiles



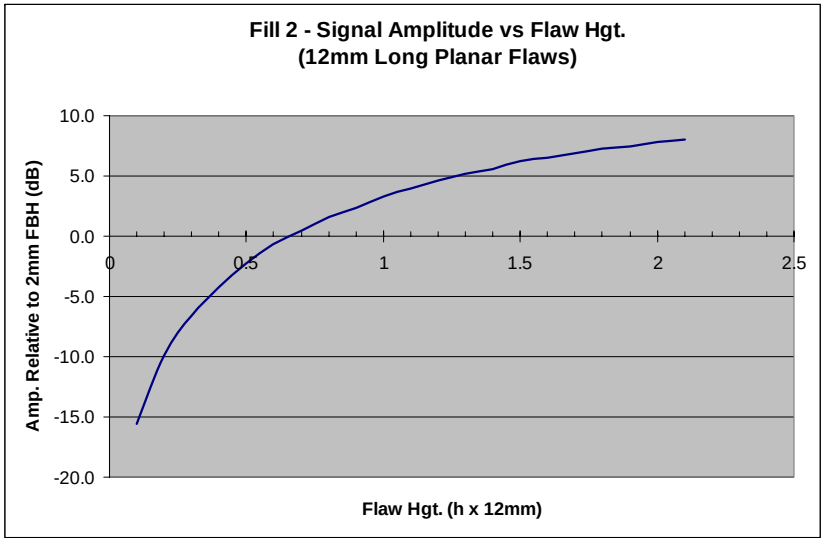


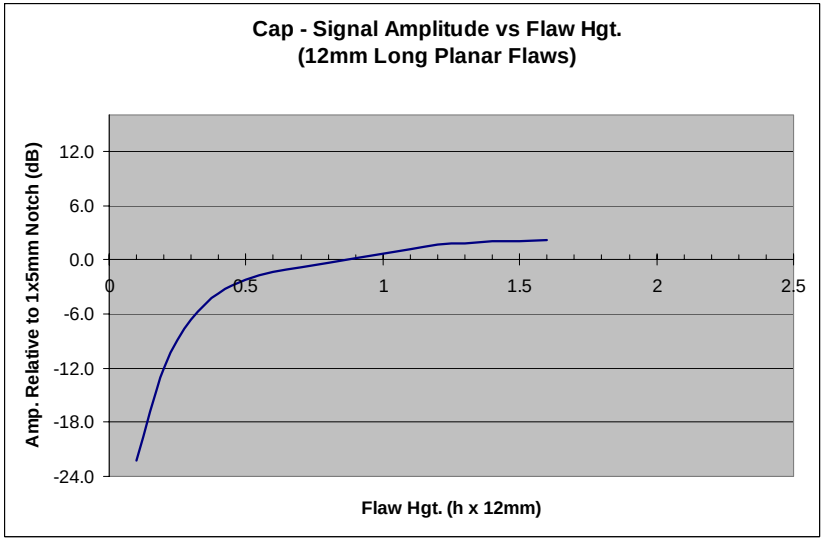
Original Technique

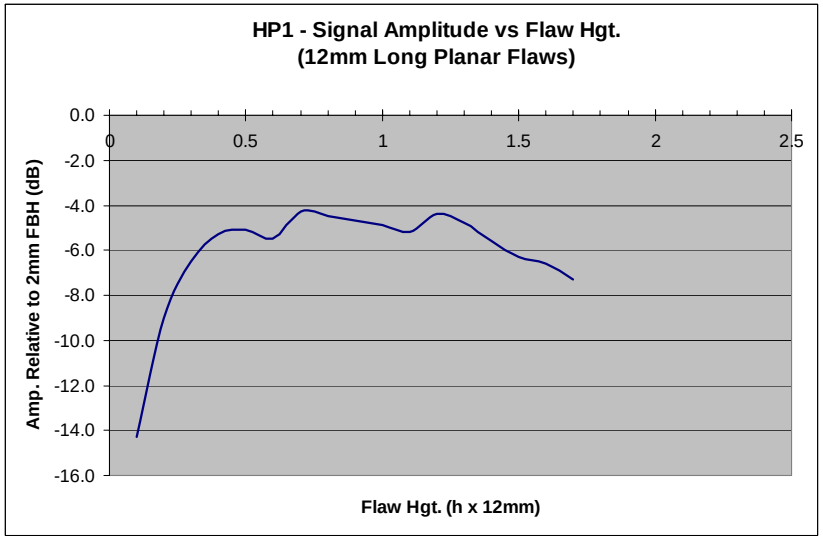


Modified Technique

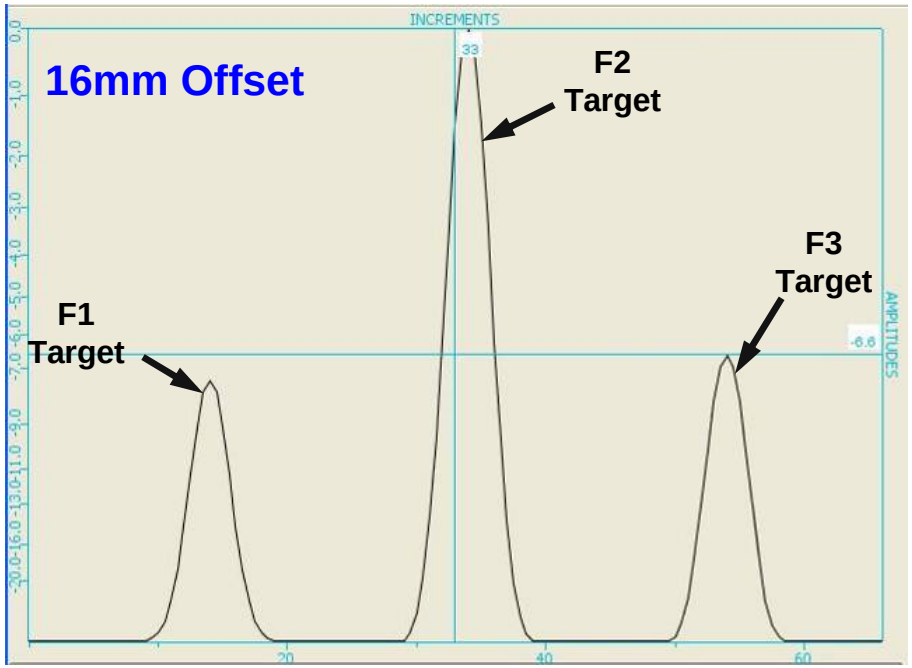
Technique Evaluations; Zonal Signal Amplitudes vs Flaw Height

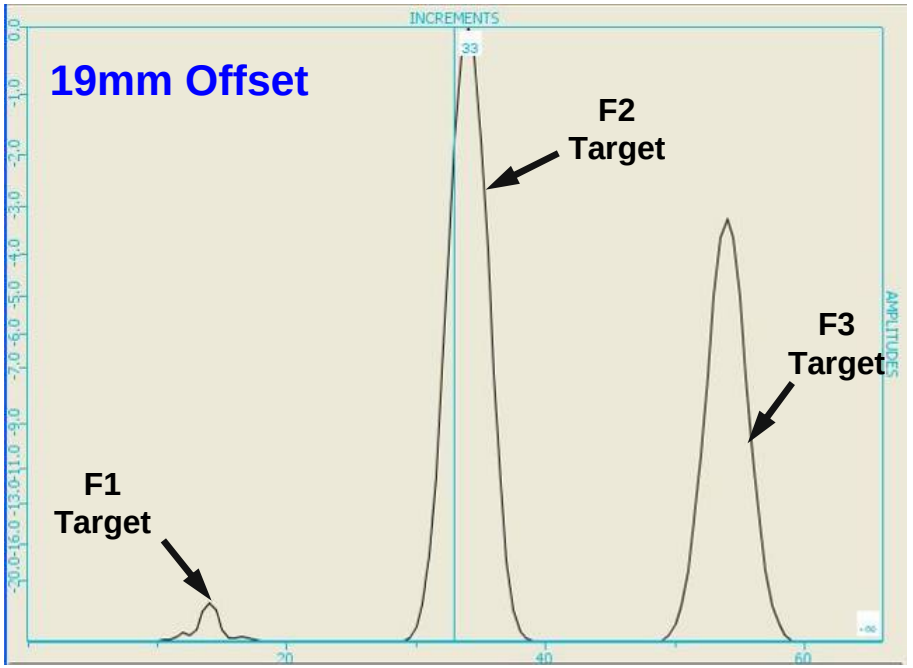




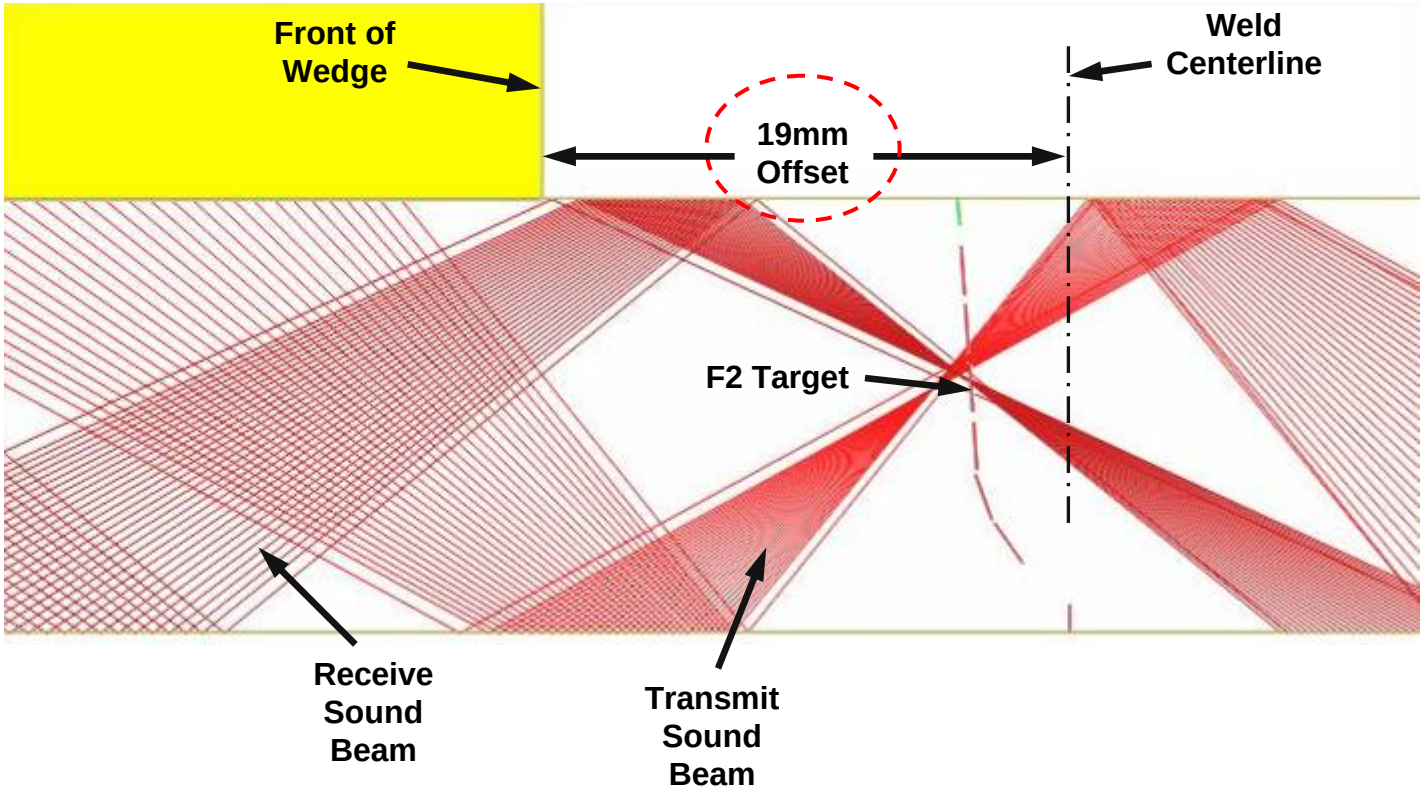


Technique Evaluations; F2 Zone Overtrace – Original Technique

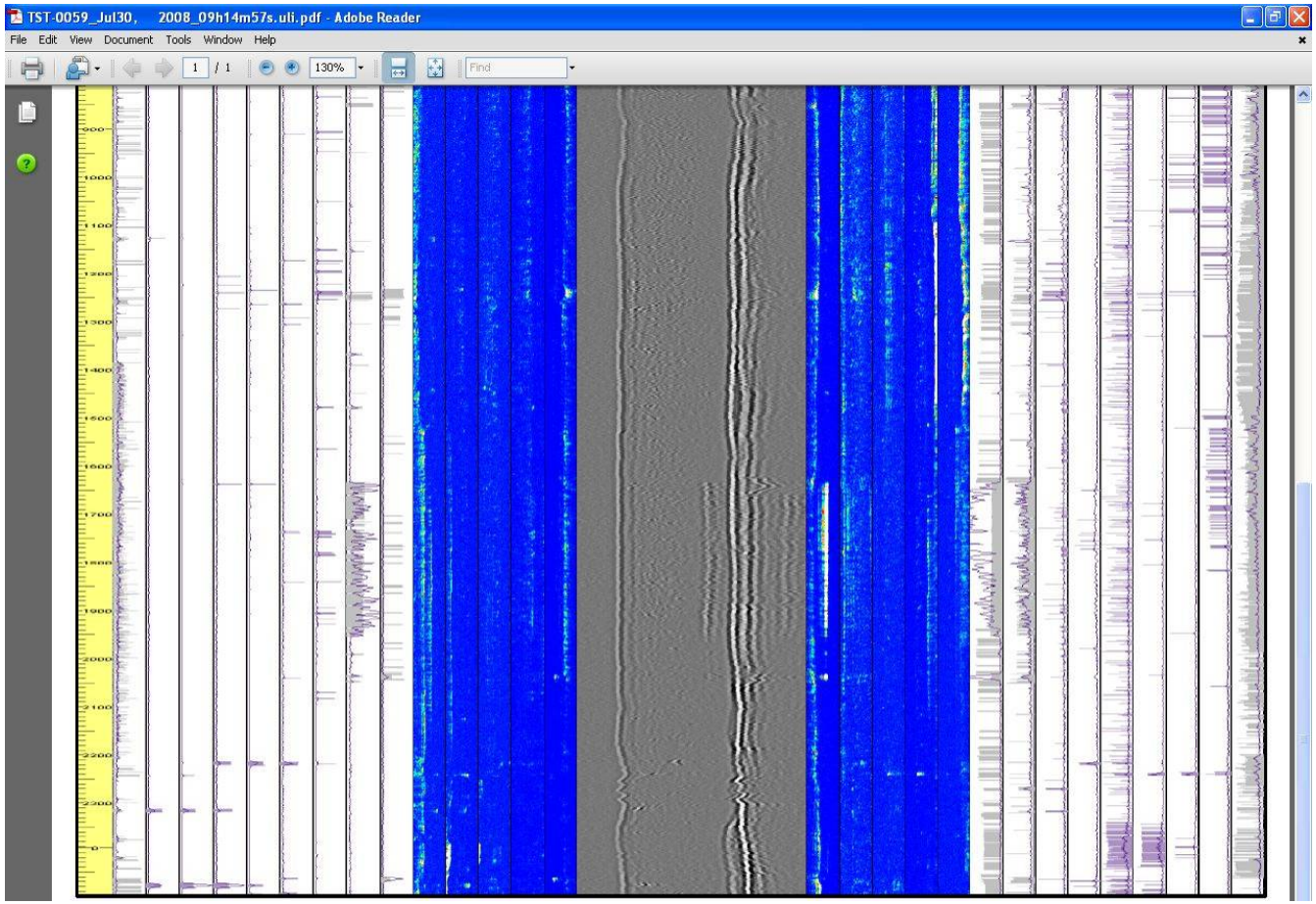




Technique Evaluations; F2 Channel – Original Technique with Modified Offset



Sample UT Data from Welder Trial Sample (TCPL)

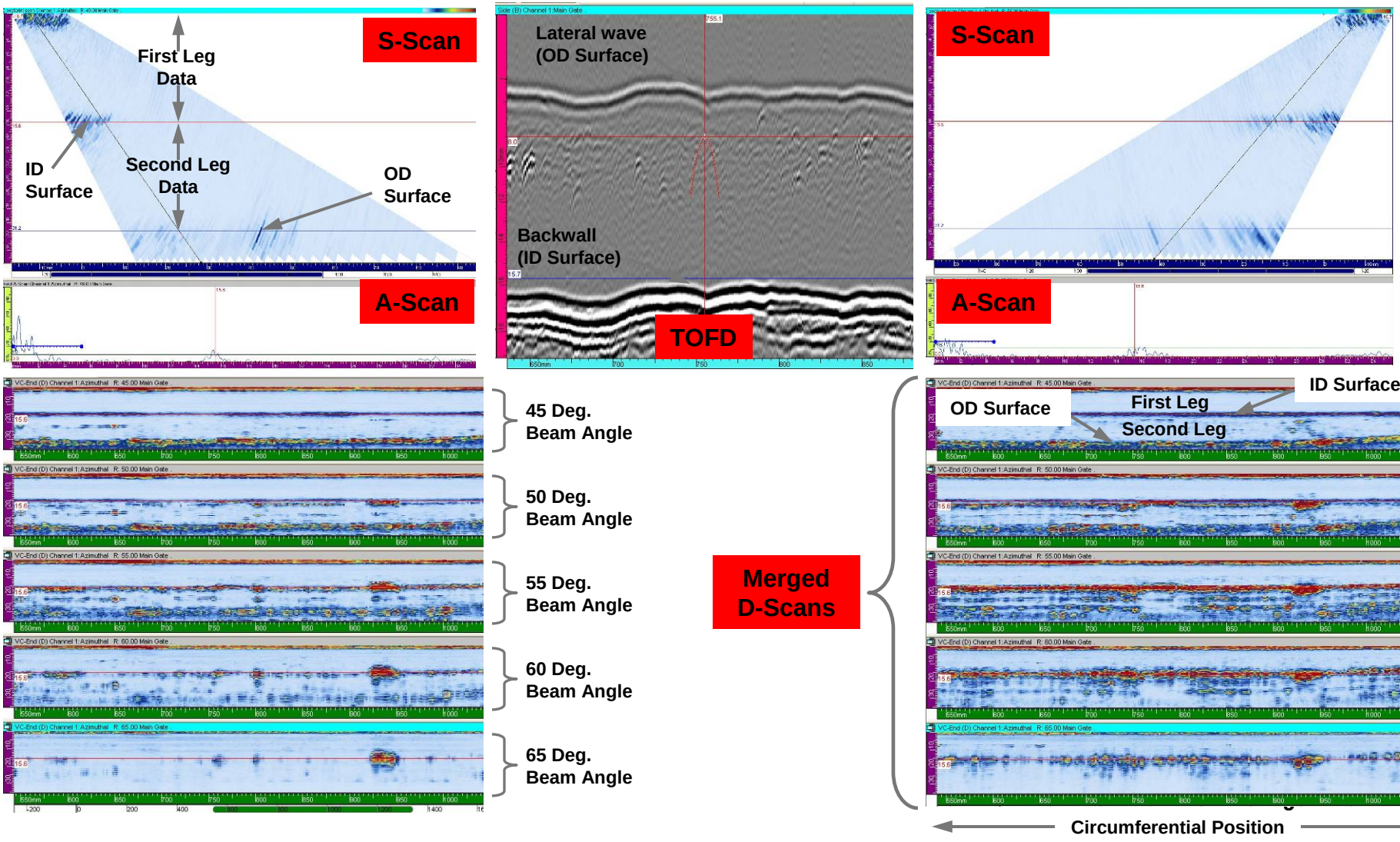


UT Data Collection

Example for Reference Library

Non-zonal PA Techniques

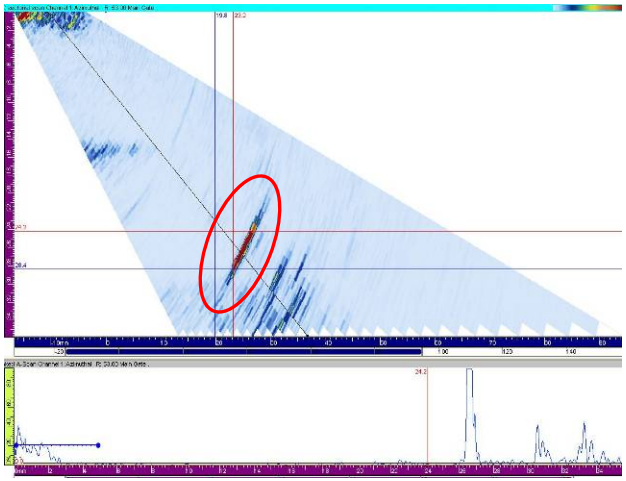
Upstream **Downstream**

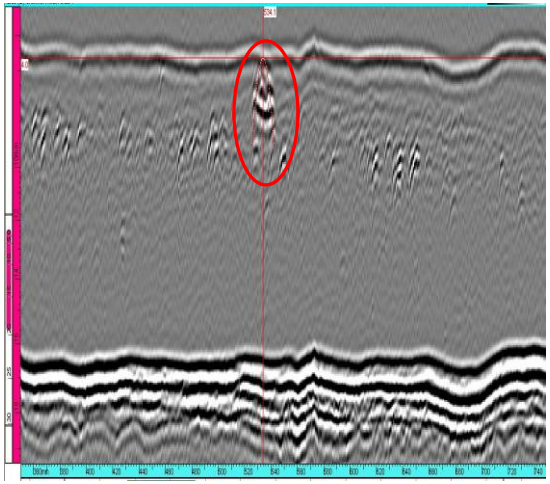


Weld 1-I-0 30 in.; Loc. 532 (Reference Library)

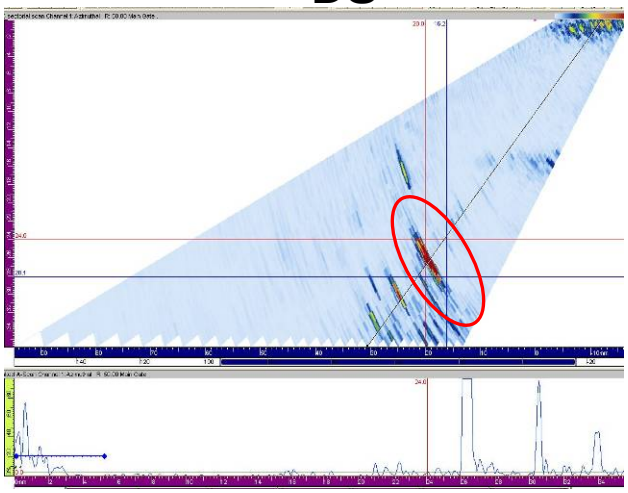
Non-zonal PA Techniques

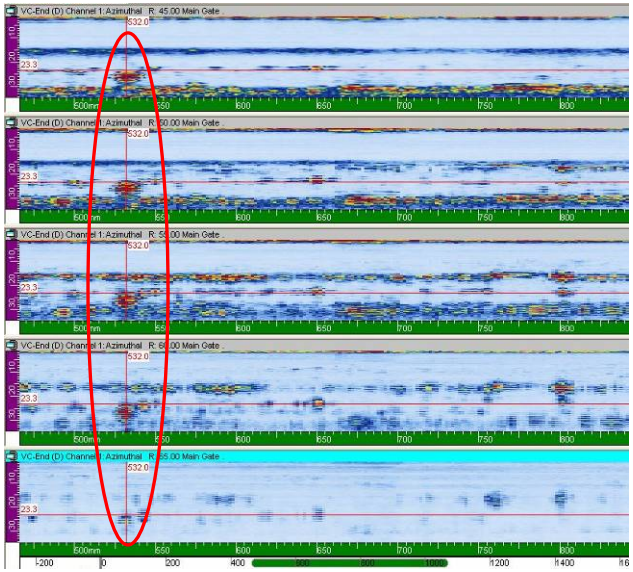
US



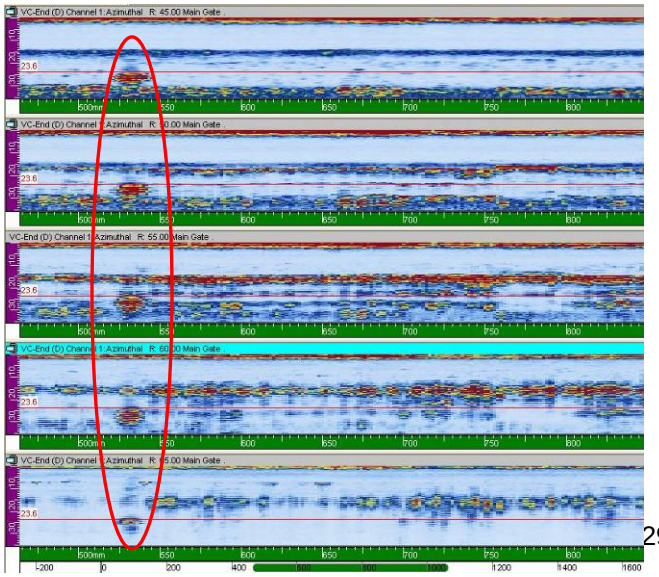


DS





Insert
Macro Image Here
After Cross Sectioning



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Questions

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