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NRC / Industry meeting on NDE

Kevin Hacker
Dominion; Chairman, EPRI NDE Integration Committee

Washington

January 8-9, 2014

Agenda - Wednesday

Time	Topic	Subtopic	Min	Lead
We0800	Welcome, introductions, attendance, opening remarks		20	NRC Ind
We0820	Update of industry actions to address operating experience	NIFG update Status and open items Team scanning North Anna mockup and probe study UT technology selection Ongoing improvement – technology, training	120	Ind
		Break	15	
		Diablo Canyon	20	Ind
		Shearon Harris	20	Ind
We1115	NRC perspective on the state of NDE and program response to issues		45	NRC
We1230	Public comment		5	
We1235	Lunch		55	
We1300	PDI Program	Program status and action items	30	Ind
		Adoption of latest revisions of generic procedures	10	Ind
		Bolting program	60	Ind
		Examiner population	20	Ind
		Break	15	
		Pass rates and POD	60	NRC
		Transfer function relating qualification performance to field performance	30	Ind
		Adding probes to Table 1	20	Ind
We1650		Public comment		
We1700	Adjourn			

Agenda - Thursday

Time	Topic	Subtopic	Min	Lead
Th0830	NRC discussion items	Coverage calculations	30	NRC
		Performance demonstration for ET on the surfaces of J-welds and butt welds	30	NRC
Th0930	Issues related to currently progressing Code Cases and Appendices		60	Ind
Th1030	Break		15	
Th1045	Discussion		60	All
Th1155	Public comment		5	
Th1200	Adjourn			

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Update of Industry Actions to Address Recent NDE OE

NDE Improvement Focus Group (NIFG)

Kevin Hacker, Dominion
NDE Integration Committee, Chairman

January 8, 2014

Contents

- Focus of NDE Improvement Focus Group (NIFG)
- NIFG Products for Improved DM Weld Examination
  - Extent of Condition
  - DM Weld Examination Guideline
  - PDI Guidance for Improved Reliability in Ultrasonic Examinations
- Summary of Impact with Implementation of NIFG products
- Remaining NIFG Actions
  - Assessment of North Anna Site Specific Mockups and Tandem UT Search Units
  - Team Scanning Effectiveness Assessment

Focus of NDE Improvement for DM Welds

- Appendix VIII
  - Team Scanning Guidance
  - Site Specific Mockup Process
- NDE Implementation
  - UT Examination Technology Selection (encoded or non-encoded)
  - Pre-Job Briefing
- Oversight
  - DM Weld Oversight Guidance
- Examiner Proficiency
  - Hands-on Practice
- Extent of Condition

NIFG Products

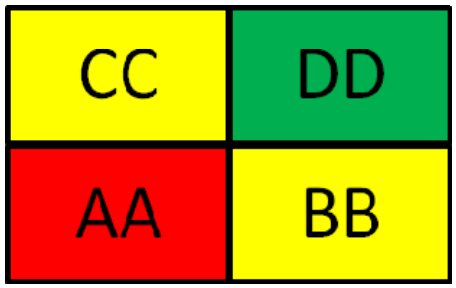
- NIFG Products Issued in 2013:
  - Nondestructive Evaluation Improvement Focus Group Extent of Condition Actions in Response to North Anna Dissimilar Metal Weld Operating Experience: Revision 1 - 3002000041
  - Nondestructive Evaluation: Guideline for Conducting Ultrasonic Examinations of Dissimilar Metal Welds, Revision 1 - 3002000091
  - Performance Demonstration Initiative (PDI) Guidance for Improved Reliability in Ultrasonic Examinations: Guideline for Hands-on Practice PDI-GL-001 Revision B, Site Specific Mockup requirements for Dissimilar Metal Welds Revision C - 3002000204
  - 2013 Team Scanning Assessment Conducted on Behalf of the NDE Integration Committee's NDE Improvement Focus Group - 3002002048

Extent of Condition Actions in Response to North Anna Dissimilar Metal Weld Operating Experience

Extent of Condition

- Objective
  - Provide instructions and necessary follow-up actions required for licensees to complete an evaluation of extent of condition (EOC) for dissimilar metal (DM) welds nondestructively examined in accordance with the *ASME Boiler and Pressure Vessel Code,* Section XI, Appendix VIII, Supplement 10
- Requirements for addressing EOC of DM welds at each facility issued under NEI as “needed”
- The “needed” requirements are the following:
  - Complete the prerequisites and screening actions
  - Perform the corrective actions

Process



- Surveyed Industry for DM Weld Examination & Materials Data
- Analyzed Survey Responses
- Binned Welds by Relative NDE Risk
  - Non-encoded (i.e., manual) examination using Site-Specific Mockup: highest risk - red AA box
  - Non-encoded examination not using a Site-Specific Mockup: medium risk – yellow BB box
  - Encoded (i.e., automated) examination using Site-Specific Mockup: medium risk – yellow CC box
  - Encoded examination not using a Site-Specific Mockup: lowest risk – green DD box

Extent Of Condition

Targeted Welds

CC	DD
AA	BB

Utility representative: JBS
Contact for additional information (Name & Phone): Ernest Rufus 601-437-6582

Utility: Entergy Operations Inc.
Plant Name: Grand Gulf Nuclear Station

Weld ID and Description[1]	Base Materials (e.g., CS to SS, CS to Inconel, SS to Inconel)	Filler Materials, including Buttering (e.g., 316, 316L, 82, 182)	If BWR, GL 88-01 Category (A, B, C, D or E)	Plant system in which the weld is located (Noun Name)	Year of the last exam [2]	Exam Method: Auto, Manual Encoded, or Manual (enter A, ME or M) [3]	Exam Surface (enter ID or OD)	ASME Section XI, Appendix VIII, Supplement 10 (Y or N)	Site specific demo required (Y or N)	If a site-specific demo was required, was a transducer used that did not appear on Table 1 in ePriq? (Y, N or N/A)	If the exam was performed manually was team scanning used during the examination? [4] (Y, N or N/A)	Was the weld mitigated before the last exam (enter No or if Yes enter code) [5]	Was the weld mitigated after the last exam (enter No or if Yes enter code) [5]	Year of next scheduled exam (enter N/A if not Scheduled)
N01A-KB Safe-End to Nozzle	SS to CS	82,182	C	Recirculation	2007	M	OD	Y	N	N/A	N	IHSI	No	2016
N01B-KB Safe-End to Nozzle	SS to CS	82,182	C	Recirculation	2012	A	OD	Y	N	N/A	N/A	IHSI	No	N/A
N02A-KB Nozzle to Safe-End	CS to SS	82,182	C	Recirculation	2008	M	OD	Y	N	N/A	N	IHSI	No	2016

- The targeted welds for the extent of condition corrective actions were the welds with the same NDE conditions as North Anna
  - i.e., those that involved the use of site-specific mockups and non-encoded examinations

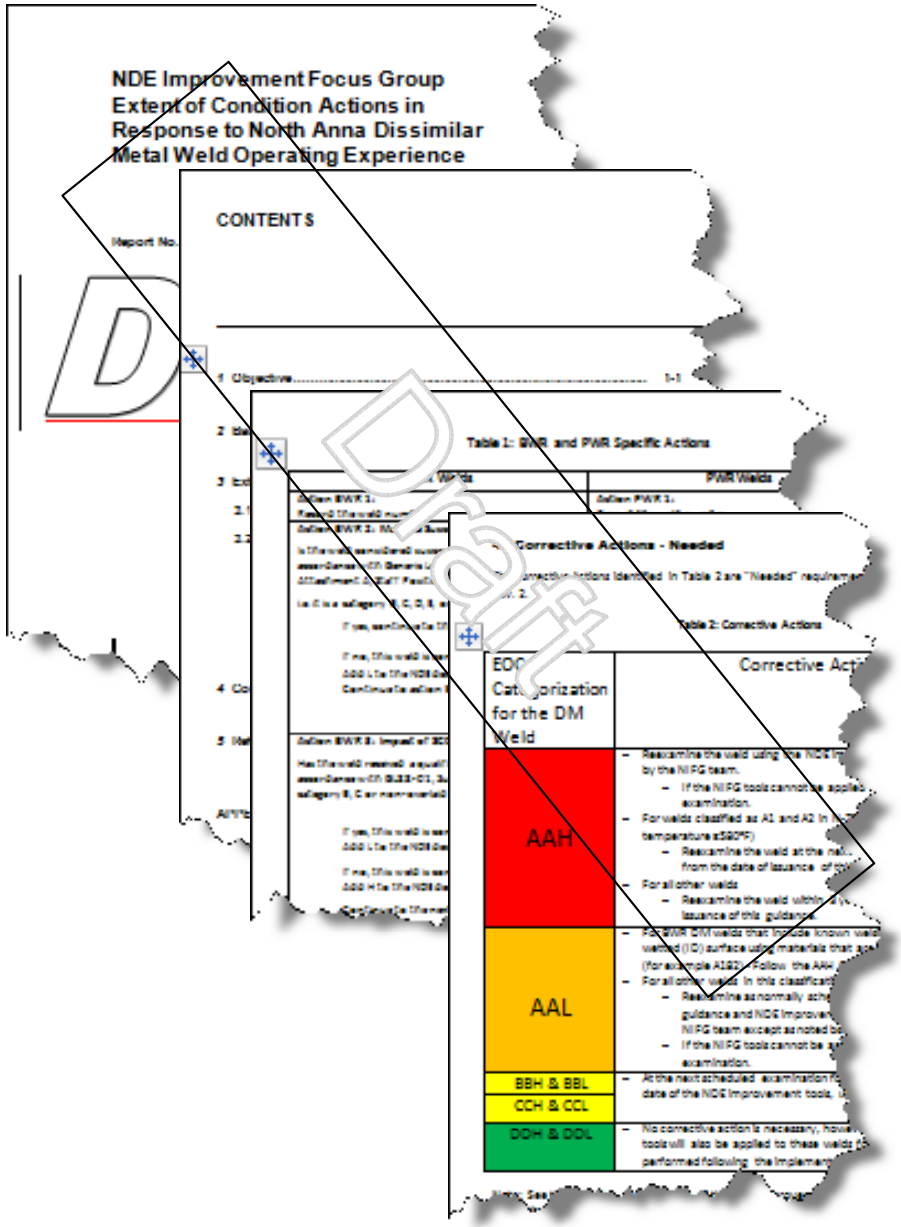
Material Considerations

- Material considerations were then factored into the data analysis
- This resulted in the following two tracks of relative safety risk
  - a “Higher Risk” track for the welds that contain SCC susceptible materials, and
  - a “Lower Risk” track for welds that do not contain SCC susceptible materials or that have SCC susceptible materials but have been mitigated
- Welds in the Lower Risk track with non-encoded examinations using Site-specific Mockups were now identified as “orange box” welds

EOC – Data Analysis and Tool

EOC Team developed a tool

- Completed 2 stages of testing
  - Stage 1 testing – Used by BWR and PWR utilities
  - Stage 2 testing – Used by NIFG to analyze data
  - Reliable results were obtained



Extent Of Condition

NIFG Data Analysis

Higher Risk
OD Exams of welds that are susceptible and not mitigated

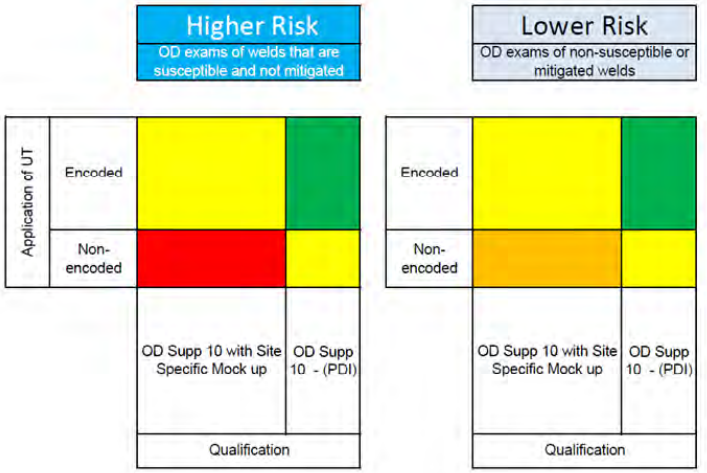
Application of UT		OD supp. 10 with Site-specific mockup	OD supp. 10 Generic-PDI
	Encoded	5	71
	Non-encoded	25	360
		Qualification	

Lower Risk
OD Exams of non-susceptible or mitigated weld

	OD supp. 10 with Site-specific mockup	OD supp. 10 Generic-PDI
Encoded	22	287
Non-encoded	111	412
	Qualification	

Extent Of Condition

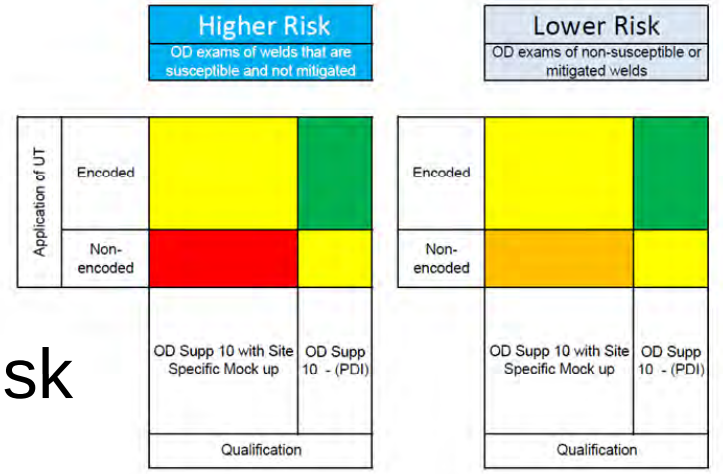
Corrective Actions



- For welds identified as high relative risk (red box welds)
  - Re-examine within 3 years using the DM weld guidance and NDE improvement tools developed by the NIFG team
  - If weld is a Hot Leg weld, re-examine at next refueling outage beyond 6 months of issuance of this guidance

Extent Of Condition

Corrective Actions



- For welds identified as medium relative risk (orange box welds)
  - BWRs perform a review of the weld repair history
    - If repairs history indicates ID materials could have been compromised, then the weld is to be treated the same as a red box weld and red box corrective actions apply
    - If there were no repairs or the repairs were not through-wall or ID repairs, re-examine as normally scheduled using the DM weld guidance and NDE improvement tools developed by the NIFG team

Implementation

- A procedure, or extent of condition “tool”, was provided to the plants with specific instructions for screening and categorizing their welds.
- Applying the tool to the current survey results, the number of welds currently categorized as being “red box” welds is now only 25; 12 BWR welds and 13 PWR welds, with none of the PWR red box welds being Hot Leg welds.

Implementation Schedule

- Tool final review and approval January 2013 (EC votes)
- Transmittal to the utilities – February 2013
- Owners will have 60 days to screen and categorize their welds and report the results to the NDE APC.
- Clock for accelerated re-inspection of the red box welds starts at the end of the 60 days.

Nondestructive Evaluation Guideline for Conducting Ultrasonic Examinations of Dissimilar Metal Welds, Revision 1

DMW Examination Guideline

- Contains 3 Needed and 1 Good Practice
- The “Needed” requirements of Revision 1 of this report shall be implemented to support the next refueling outage scheduled after January 1, 2014, during which DMWs are scheduled for examination

NEI 03-08 Guidance from Revision 1	
The utility shall perform an evaluation of each DMW scheduled for examination in accordance with Appendix A to determine the examination technology (encoded or non-encoded) to be applied for the DMW examination.	Needed
The utility shall have a process delineating that when team scanning is utilized; the guidance of Appendix B, "Guidance for the Application of Team Scanning for Ultrasonic Examination of DM Welds," shall be followed.	Needed
The utility should develop and implement a DMW examination oversight process.	Good Practice
The utility shall have a process defined to conduct a pre-job brief to ensure that examination personnel understand the importance, technical, and administrative details of the DMW examination activity.	Needed

DMW Examination Guideline

- UT Examination Technology
  - Encoded or Non-encoded examinations
- Purpose
  - Provide a decision process for the selection of the appropriate UT examination technology to be used for each DM weld scheduled to be examined
- New guidance for the selection of examination technology based on graded approach:
  - Susceptible or Non-Susceptible Materials
  - Mitigated Welds
  - Use of Site Specific Mockups for Pre-Mitigation Examinations
  - Equipment Available
- Limited to scheduled examinations utilizing Appendix VIII, Supplement 10

DMW Examination Guideline

- Team Scanning is applicable to non-encoded UT examinations and is defined as:
  - When one technician scans or physically manipulates the ultrasonic transducer during an examination while a separate qualified examiner performs real time interpretation of the displayed ultrasonic information
- Purpose
  - Enhance an approved process by providing guidance for the consistent and proper application of team scanning for the non-encoded ultrasonic examination of DM welds
  - Includes the steps necessary to ensure that the team scanning process is effectively implemented

DMW Examination Guideline

- Oversight Process
  - The North Anna RCE identified a lack of utility oversight in the examination preparation and performance of the examination as a contributor to the issue
- Purpose
  - Provide guidance for increased utility engagement with key aspects of the entire DM weld examination process to enhance NDE reliability
  - Intended to supplement existing site oversight process

DMW Examination Guideline

- Pre-Job Brief
  - The North Anna RCE identified a lack of an effective pre-job briefing as a contributor to the issue. The pre-job brief provided did not address the critical UT examination attributes.

- Purpose
  - Provide guidance to utilities for the performance of focused DM weld examination pre-job briefs to assure that examination personnel understand the importance, technical and administrative details of the DM weld examination activity
  - Intended to supplement existing pre-job briefing process

Nondestructive Evaluation Performance Demonstration Initiative (PDI) Guidance for Improved Reliability in Ultrasonic Examinations

PDI Guidance for Improved Reliability in Ultrasonic Examinations

- 1 Needed and 1 Good Practice
- Needed:
  - The “Needed” requirement is for the utility to have a process to ensure compliance with the Performance Demonstration Initiative (PDI) Site Specific Configuration Mockup Requirements for Dissimilar Metal Welds, Revision C, included in this report as Appendix A.
  - The “Needed” requirements for site specific configuration mockups do not apply to those plants that have no dissimilar metal welds that require site specific mockups.
  - The “Needed” requirement shall be implemented to support the next refueling outage scheduled after January 1, 2014, during which DMWs are scheduled for examination.
- Good Practice:
  - The “Good Practice” recommendation is for the utility to have a process to verify that examination personnel have received hands-on practice in accordance with *The Performance Demonstration Initiative, (PDI) Guideline for Hands-on Practice PDI-GL-001, Revision B*, included in this report as Appendix B.

PDI Guidance for Improved Reliability in Ultrasonic Examinations

- Site Specific Mockup Process
  - Used to optimize Appendix VIII demonstrated techniques to provide the best examination process when field configurations differ from those within the PDI demonstration mockup inventory
  - Must still be within the minimum and maximum thickness and diameters demonstrated
- Purpose
  - Strengthened the Site Specific Mockup process due to recent industry issues and NRC concerns

PDI Guidance for Improved Reliability in Ultrasonic Examinations

- Hands-on Practice
  - The PDI Hands-on Practice Policy is intended to provide a consistent process for the administration of hands-on practice for Appendix VIII qualified ultrasonic (UT) examiners to satisfy the 8 hours of hands-on training as specified in 10CFR50.55a (b)(2)(xiv) and ASME Appendix VII-4240
- Purpose
  - Provide a more robust process to maintain and improve qualified Appendix VIII UT examiner proficiency

Summary of Impact with Implementation of NIFG Products

- Extent of Condition
  - Some examinations may be pulled up and performed earlier than originally planned to satisfy EOC
- UT Examination Technology Selection (encoded or non-encoded)
  - May require more encoded examinations, possible impact examination schedule, dose, and budget
  - Evaluation must be performed well in advance of the outage to allow for proper planning
  - May require development of encoded equipment for critical welds
- Team Scanning Guidance
  - More utility involvement in the pre-job planning process
- Pre-Job Briefing
  - Will require better planning and more involvement in the pre-job activities

Summary of Impact with Implementation of NIFG Products

- DM Weld Oversight Guidance
  - May require additional recourses to provide oversight
  - May result in higher dose for additional oversight personnel in the field
- Site Specific Mockup Process
  - Assessment of the previous technical justification should be performed to the current standards
  - May take longer to perform demonstration due to the more detailed process
- Hands-on Practice
  - Will require more effort to perform hands-on practice to the new standards
  - Oversight of NDE vendors hands-on practice to ensure compliance
  - May require additional mockups or practice samples for examiners with qualifications where samples don't exist

Questions?

Remaining NIFG Actions

- Assessment of North Anna Site Specific Mockups and Tandem UT Search Units

- Team Scanning Effectiveness Assessment
  - Perform Appendix VIII demonstrations using the NIFG team scanning guidance

Assessment of North Anna Site Specific Mockups and Tandem UT Search Units

Assessment Purpose

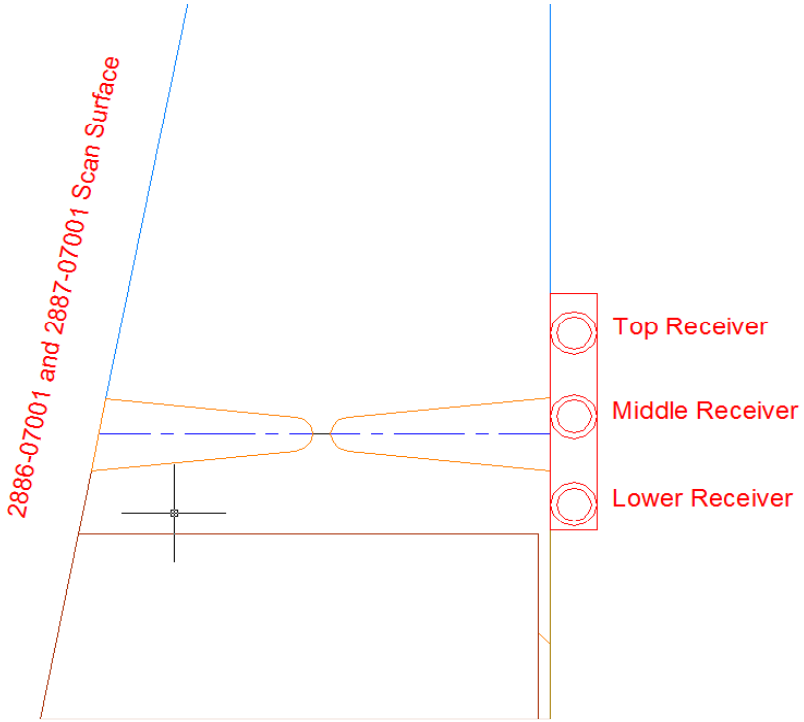
- An assessment of the North Anna site specific mockup quality and the performance of the North Anna tandem UT search units was performed to address concerns raised by PNNL-21546
  - Report questioned the quality of the mockups
    - Representing typical metallurgical or other fabrication features of dissimilar metal welds
    - Spurious indications that interfere with detection and classification of simulated flaws
  - Report indicates that the tandem probes have insufficient acoustic energy that would be available near the inner surface of the weld to ensure detection of ID surface connected axially oriented flaws

Evaluation of Tandem Search Units

- The EPRI Modeling and Simulation group used information provided by the manufacturer to model the theoretical performance of the tandem search units
- Tests were performed to investigate the performance of the conventional tandem search units
  - Through transmission utilizing the site specific mockups
  - Probe measurements utilizing the EPRI Ultrasonic Probe Verification System
  - Search unit performance on site specific mockup flaws

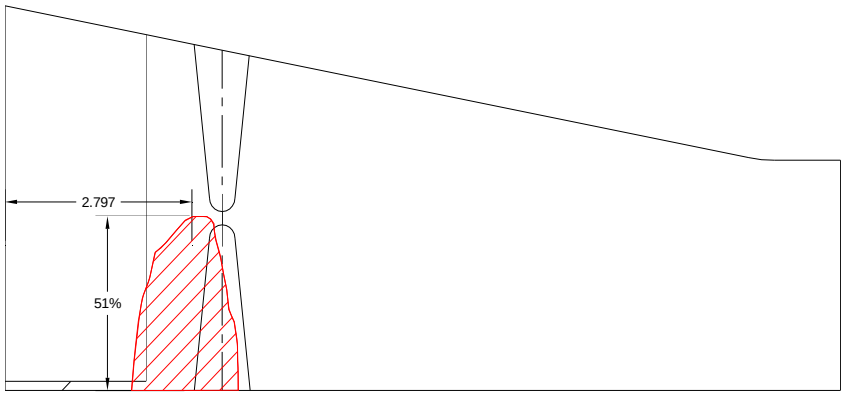
Through-Transmission Utilizing the Site Specific Mockups

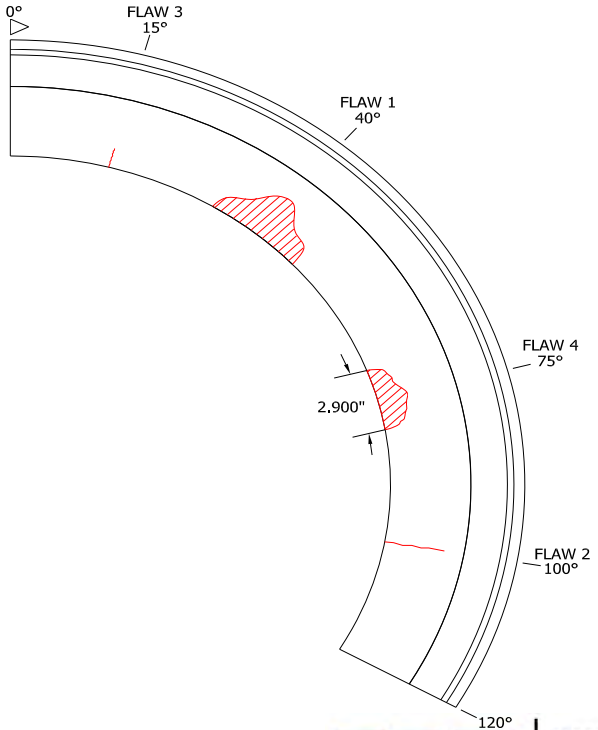
- Through-transmission testing was used as a means to verify the refracted and skew angles
- Testing was performed in an area without any intentional defects
- Three fixed receivers
  - Butter material (lower)
  - Weld (middle)
  - Stainless base material (upper)



Search Unit Performance on Site Specific Mockup Flaws

- The North Anna circumferential scan search units were used on the flaws contained within the site specific mockups
- Encoded technique using equipment settings that simulated the non-encoded field examination





Summary of Evaluation of the Tandem Search Units

- The search units proved to be capable of detecting all of the axial flaws contained within the site specific mockups
- The search units provide refracted angle and skew consistent with the manufacturer's design
- The actual focal point is shallower than the intended focal point
  - The physical size of the search units were limited due to scan access
  - Element size is thought to be the major contributing factor that caused the shallow focal point
  - The designed geometric crossing point was approximately two times the distance of the effective focal point
- The search units were shown to perform sufficiently to detect axial flaws

Summary of Evaluation of the Mockups

- The mockups contained unintentional fabrication defects
  - None were observed to affect the usefulness of the mockups
  - All of the intentional flaws were detectable in accordance with the UT procedure
  - Similar types of flaws were observed in the field components
- The mockups contained flaws with a variety of depths (some greater than 20%), supporting evaluation of detection effectiveness over a range of depths
- Proximity of the flaws in relation to the edge of the mockup and EDH is not ideal

Questions Related to North Anna Search Units or Mockups Evaluations?

Team Scanning Effectiveness Assessment

Team Scanning Effectiveness Assessment

- **Objectives**
  - The primary objective of this project was to assess team scanning in blind Appendix VIII Supplements 10 and 12 test conditions to determine its effectiveness for the detection of flaws
  - A secondary objective was to determine whether additional requirements or recommendations should be added to the current industry guidelines for team scanning

Team Scanning Effectiveness Assessment

- Assessment performed in July 2013
- NDE vendors provided UT examination teams to support this effort
  - GE, Areva, LMT and WesDyne
- Teams consisted of a Level II or III qualified to the appropriate Supplement, and a UT Level I or Trainee
  - The backgrounds and experience levels for each team varied greatly
  - Level I/Trainees had never attempted an Appendix VIII qualification, nor were any of them eligible for such testing
  - The Level II/III examiners had many years of UT experience
    - Two had not performed non-encoded UT field examinations for many years and were considered primarily encoded UT examiners

Team Scanning Effectiveness Assessment

- Performed standard Appendix VIII personnel demonstration tests that a single examiner would perform for flaw detection
  - 2 teams performed Supplement 10 (DM weld) demonstrations
  - 2 teams performed Supplement 12 (austenitic and ferritic piping) demonstrations
  - Test sets met the requirements for an Appendix VIII qualification, representing the full ranges of thicknesses, diameters, and weld joint configurations and the full range of flaw sizes, locations, and orientations normally provided for a standard qualification for that supplement
  - Other possible scope – IGSCC, weld overlay, sizing – was excluded

- With the exception of allowing team scanning, each test was administered in accordance with the same EPRI PD Program process used during normal Appendix VIII testing

Team Scanning Effectiveness Assessment

- The industry guidance for team scanning was used:
  - The person performing the scanning shall be trained and qualified in accordance with IWA-2300, as a minimum to an ultrasonic trainee level.
  - During the pre-job brief, the qualified examiner, as well as the responsible utility representative, shall review the expectations for the examination with the person performing the scanning. The review shall include the procedure scanning requirements such as; scan speed, indexing, monitoring proper coupling, dimensioning of indication, etc.

Team Scanning Effectiveness Assessment

- The industry guidance for team scanning was used:
  - The team shall demonstrate the scanning process on a mockup containing reflectors. The qualified examiner shall ensure correct scan speed, indexing, and adequate coupling, and the process for dimensioning of indications are demonstrated. The process for team communication to be used in the field shall also be practiced during the demonstration.
  - The scanner and the qualified examiner shall be in direct communication. The qualified examiner shall maintain the ability to monitor the scanner's technique.
  - The scanner shall have the ability to monitor the instrument display that the qualified examiner is viewing to assist in performing a proper scan.

Team Scanning Effectiveness Assessment

- Demonstration conditions
  - The teams calibrated their equipment, practiced their scanning and communication techniques, and demonstrated their proficiency implementing the scanning requirements
  - The scanner and qualified examiner were placed at opposing tables maintaining approximately 5 to 8 feet of separation
  - Scanner was provided with a monitor to view the A-scan presentation
  - Examiner was able to visually monitor the scanning technique being used and to verbally communicate with the scanner
  - The teams were allowed to step away from the test to work on practice samples any time they needed to work on their communication or other aspects of the examination process
  - The examiner was never allowed to manipulate the search unit
  - Teams tested under normal testing conditions, similar to that of any individual currently tested for Appendix VIII qualification at EPRI

Summary of Results

- Results
  - Both Supplement 10 teams passed DM weld flaw detection
  - Both Supplement 12 teams passed austenitic weld flaw detection
    - One of the Supplement 12 teams passed ferritic weld flaw detection
- Supplement 12 (austenitic and ferritic piping) test sets contained 28 samples
  - 32 flawed grading units and 79 unflawed grading units
  - 29 flaws detected with 2 false calls
- Supplement 10 (DM) test sets contained 22 samples
  - 32 flawed grading units and 58 unflawed grading units
  - 29 flaws detected with 5 false calls
- This assessment contained 201 observations (grading units), 64 were flawed and 137 unflawed

Summary of Conclusions

- Conclusions
  - Team scanning, applied properly, is effective
  - The team scanning guidance provided in Appendix B of the Guideline for Dissimilar Metal Weld Examination, Revision 1, contains sufficient direction to ensure effective weld examination
  - Team scanning provides an excellent training opportunity for the Level I and Trainee personnel supporting the examination
    - Based on observation and on feedback from the participants

(Discussion)

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Update of Industry Actions to Address Recent NDE OE

Diablo Canyon Unit 2 Pressurizer Weld Overlays Missed Fabrication Flaws

Gary Lofthus, Southern Nuclear
NDE Integration Committee, Vice-Chair

January 8, 2014

Diablo Canyon NDE OE

- **Background**
  - DCPP Unit 2 pressurizer has full pre-emptive structural weld overlays (SWOL) applied to all 6 nozzle to safe end and adjacent SS welds
  - Overlays installed in 2R14, February 2008 via Relief Request
    - Acceptance/PSI examinations were manual conventional UT using PDI generic procedure PDI-UT-8
    - First ISI of all 6 SWOLs in the following outage 2R15, October 2009 using same procedure as PSI
  - Safety “B” nozzle SWOL selected for ISI during the spring 2013 refueling outage, 2R17

Diablo Canyon 2R17 ISI

- Manual Phased Array (PA) examination of Safety Nozzle “B” identified 3 indications characterized as lack of bond/inter-bead non-fusion (LOB/IBNF)indications
  - EPRI and vendor NDE experts reviewed PG&E characterization of indications
  - Located at edge of “ISI Volume” over the low alloy nozzle forging at or near the overlay to base material interface
  - Aggregate OD length ~5.5 inches when indications combined per proximity rules of IWA-3360-1
  - Length exceeds original relief request acceptance criteria “no linear dimension of the laminar flaw exceeds 3 inches or 10 percent of the nominal pipe circumference”
  - Acceptance/PSI and subsequent ISI of the “B” nozzle reported no recordable indications (NRI)

Diablo Canyon 2R17 ISI (continued)

- PA Examination scope expanded to Safety “A” nozzle
  - Identified ~ 18.75 inch long continuous indication also characterized as LOB/IBNF
    - Easily seen with angles from 0 through 45+ degrees
  - Similar location to the “B” nozzle but outside ISI volume and near the edge of acceptance volume at the nozzle forging
  - Acceptance/PSI reported two indications of ~ 1 inch length recorded with both 0 degree and 45 degree search units within the 18.75 inch length

Diablo Canyon 2R17 ISI (continued)

- Scope expanded to include all 6 pressurizer SWOLs
  - Similar findings in the Spray Nozzle SWOL, 360 intermittent LOB/IBNF near the edge of the acceptance volume
    - PSI and subsequent ISI reported as NRI
  - Safety “C” nozzle has smaller LOB/IBNF with lengths meeting the RR acceptance criteria
    - One indication is over SS weld at mid overlay depth
    - PSI and subsequent ISI reported as NRI
  - Power operated relief valve and Surge Nozzle SWOLs - NRI

NDE IP FG Status for Diablo Canyon

- Diablo Canyon RCE Report identified several areas for enhancement of the PDI generic non-encoded weld overlay UT examination procedure
  - Areas were related to scan speed, length sizing, sensitivity for 0 degree, and instructions related to detection of low angle flaws
- Industry's qualification process for weld overlays was evaluated by an NDE Integration Committee Focus Group

NDE IP FG Status for Diablo Canyon

- Industry's qualification process for weld overlays was evaluated by an NDE Integration Committee Focus Group
  - Determined that the **generic UT procedure was technically acceptable** as qualified
    - The non-phased array examinations were repeated and the flaws were verified to be detectable
    - Nevertheless, the FG revised the procedure (next slide) to provide more guidance in the areas identified
  - Determined that the PDI specimen set includes an appropriate representation of geometry and flaw conditions, and that PDI continues to expand its specimen inventory
- This OE is still being evaluated by the FG to determine any cross cutting issues that may be relevant to other NDE applications

Procedure Enhancements

- Included additional guidance for the examiner to consider when determining the proper scan speed
- Included additional guidance to assist the examiner in maintaining the proper scan gain for the 0 degree scans
- Included additional guidance for the detection of fabrication defects (lack of bond and/or inter-bead lack of fusion) with the angle beam examinations for non-parallel WOL surfaces
- Updated the procedure to latest PDI format

- The above enhancements are included in PDI-UT-8 Revision G, September 13, 2013

(Discussion)

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Update of Industry Actions to Address Recent NDE OE

Harris Nuclear Plant Missed Flaw in the Reactor Vessel Closure Head (RVCH) Penetration Nozzle

Dan Nowakowski, NextEra Energy
NDE Integration Committee

January 8, 2014

Harris Nuclear Plant OE

- Background
  - On May 15, 2013, the Harris Nuclear Plant (HNP) shut down to repair a flaw in Reactor Vessel Closure Head (RVCH) Penetration Nozzle 49
  - This flaw should have been identified during refueling outage 17 (RO-17), when several other similar flaws were identified and repaired
  - The previously unidentified RVCH Penetration Nozzle 49 flaw was discovered during an independent third party review of the RO-17 UT data in preparation for refueling outage 18 (RO-18)
  - The root cause team reviewed significant amounts of information from RO-17, interviewed multiple personnel involved in the event and worked with several industry experts to identify the potential causes for this event

Industry Status for Harris Nuclear Plant OE

- The NDE Integration Committee formed a focus group (FG) to evaluate the Harris OE and determine the appropriate industry actions
  - The NDE IP FG is working with the MRP Inspection TAC to address this issue
- The Root, Primary Contributing Cause and Corrective Actions were addressed in a 2013 MRP report (MRP-360) that provides guidance for preparing and performing RVCH examinations
  - MRP is considering NEI 03-08 implementation guidance

Industry Guidance *(1 of 2)*

- Industry recommendations include:
  - Review upper head drawings to determine the as-built penetration configurations, and understand the examination procedure qualifications and limitations as they relate to the site's head penetrations
  - Determine whether supplemental examination methods or techniques are required to meet the minimum coverage requirements
  - Perform an analysis of NDE data by at least two NDE personnel working independently
  - Analyze the NDE data in an environment with minimal distraction
  - Determine whether additional qualifications are required for the existing head penetration configurations to obtain effective coverage

Industry Guidance *(2 of 2)*

- Industry recommendations include (continued):
  - Perform a comprehensive review of previous examination data
  - Perform comprehensive pre-job briefings
  - Prepare to perform additional supplemental examinations for suspect indications to include visual or surface examinations as appropriate
  - Implement a utility oversight process for these examinations to assure adequate control over the entire examination process
  - Promptly perform a thorough review and disposition of examination results and adherence to guidance for documentation of examinations
  - Perform a detailed examination coverage assessment to determine compliance with the examination coverage requirements
  - Review of personnel and procedure qualifications

- This OE is still being evaluated by the FG to determine any cross cutting issues that may be relevant to other NDE applications

(Discussion)

NRC:
NRC perspective on the state of NDE and program response to issues

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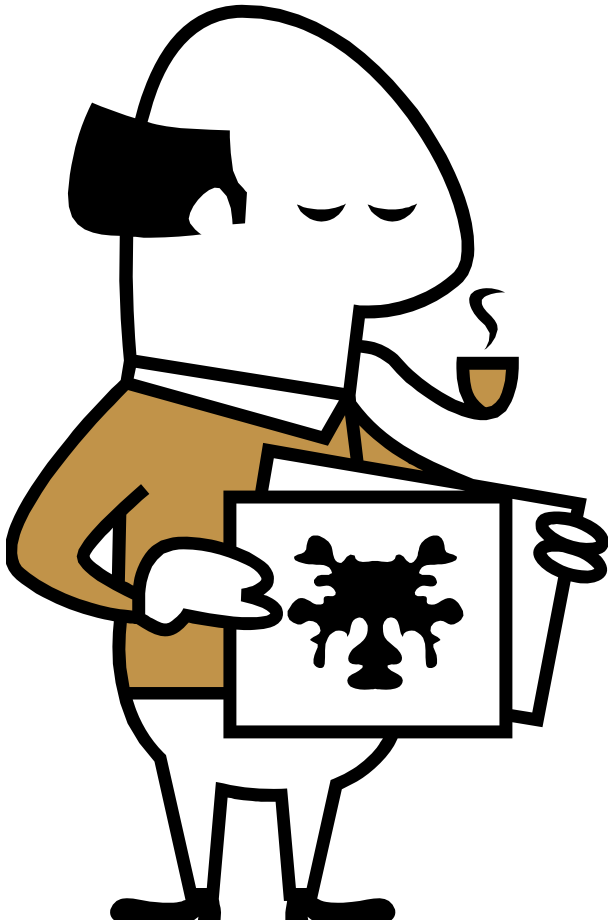
Performance Demonstration Initiative Program Update

David Anthony, Exelon
Chairman, PDI

January 8, 2014

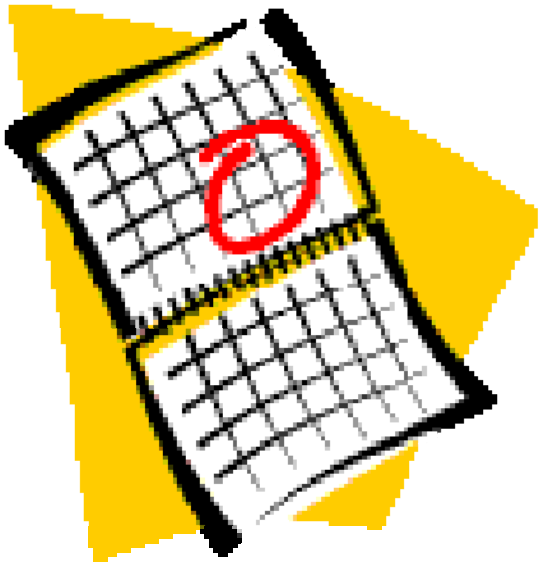
2013 PDI Program
Piping Personnel Qualification Activities

- **76** Non-Encoded
  - Initial Supplement 2 or 12 detection **(16)**
  - IGSCC detection requalification **(29)**
  - Depth sizing **(13)**
    - 4 initial qualification and 9 requalification
  - Weld overlay **(18)**
  - Dissimilar metal **(0)**
- **34** Encoded
  - Initial Supplement 2 or 12 detection **(6)**
  - IGSCC Requalification **(11)**
  - Depth sizing (initial and requalification) **(10)**
  - WOR (initial and requalification) **(1)**
  - DM **(6)**
- % of piping personnel qualifications that used phased array
  - Non-Encoded qualifications = **25% (19/76)**
  - Encoded qualifications = **44% (15/34)**



2014 PDI Program
Planned Piping Personnel Qualification Activities

- 1st quarter 2014
  - Southern Nuclear Company
  - Sonic Systems International (supplier of personnel to GE and W)
  - WesDyne
  - IHI Southwest Technologies
  - Curtiss-Wright (LMT)
  - Qualitech (Switzerland)
  - SVTI (Switzerland)
  - Dominion Energy



- Remainder of 2014
  - Some vendors have indicated plans, but nothing is booked yet

2013 PDI Program
Piping Procedure Qualifications

- Encoded Procedure Qualifications
  - One new OD phased array DM Weld procedure was qualified
  - Supplement 14/Supplement 3 ID qualification started in late Fall; in process
  - Zetec TOPAZ instrument added to the PA-03 family of procedures (versions of PA-03 exist for several different instruments)
  - Several added probe / wedge combinations to existing OD phased array procedures
- Non-Encoded Procedure Qualifications
  - Manual Phased Array on austenitic stainless steel including IGSCC, and ferritic steel

2014 Piping Program
Planned Procedure Qualification Activities

- Supplement 14 (Main Loop and Safety Injection) and Supplement 3 (Main Loop) ID encoded procedures
  - One ongoing demo will continue into 2014
  - One new demo to begin at end of Spring outage season
- First of a kind ID demonstration; includes both Appendix VIII, Supp.10 scope, and Section V, Article 14 demo for CASS
  - Blind/non-blind CASS-to-wrought configuration demonstration for new plants
- Demonstrations (encoded phased array procedures) are also anticipated as older equipment becomes obsolete and newer equipment is adopted
- Table 1 additions are performed as unique configurations are discovered

2013 RPV Program
Personnel qualifications

- GEH – 1 Candidate, encoded Supplement 4 & 6
- WesDyne - 4 Candidates, encoded Supplement 4, 6 & 7
- GE - 2 Candidates, encoded Supplement 4 & 6
- SIA – 3 Candidates, non-encoded PA Supplement 4, 5, & 6
- AREVA – 3 Candidates – non-encoded Supplement 4, 5, & 6

2013 Bolting Program
Personnel qualifications

- Duke - 5 Candidates
- Olympus – 1 Candidate
- Southern Nuclear - 1 Candidate
- Taiwan Power Company - 1 Candidate
- LMT - 1 Candidate
- IHI Southwest - 1 Candidate
- NIC - 1 Candidate
- PG&E - 1 Candidate

2013 PDI RPV Program
Procedure qualifications

- GEH – Supp 4 & 6 procedure revision to add equipment
- GEH – Supp 5 procedure revision to add equipment
- WesDyne – Supp 7 nozzle bore procedure expansion

2014 PDI RPV Program
Planned qualifications

- Procedure qualifications
  - AREVA – Supp 4 & 6 ID qualification encoded
  - AREVA – Supp 7 ID qualification encoded
  - IHI Southwest - Supp 4 & 6 ID & OD qualification encoded
- Personnel qualifications
  - WesDyne – Supp 4 & 6 and Supp 8 non-encoded

PDI generic procedures activities

- PDI-UT-7 (Sizing – RPV weld indications) revision F went live July 1, 2013
- PDI-UT-11 (RPV Nozzle-to-Shell and Nozzle IR) was revised and is in final PDI committee review/approval process
  - Primarily brings verbiage and formatting up to date with latest PDI generic procedures
- PDI-UT-10 is next on PDI's list for review and possible revision

- Draft revisions of PDI-UT-5 (straight beam examination of bolts and studs) and PDI-UT-4 (bore probe examination of bolts and studs) were developed in December 2013 by the PDI Focus Group
  - Will be discussed in detail later in the agenda

Section XI, Appendix VIII activities

- PDI and EPRI continue to work in ASME Section XI, Appendix VIII
  - Developing Code Case to revise Supplement 8 (bolts and studs)
  - Development of single sided examination rules in Supplement 2
  - Early development of draft Supplement 9 (cast stainless UT qualification)
  - Revision to CC N-780 (working with PNNL)
  - Inclusion of parameters for NDE-related Section XI Technical Justifications (working with PNNL)
- Near-term planned additions/modifications to Section XI:
  - Use of site specific mockups
  - Updated essential variables (phased array)
  - Revision of Appendix VIII-4000 for equipment substitution
- Additional changes under consideration
  - Codification of NIFG guidance

Action Item Review

- Action 12-2011-2
  - Include in Quality instructions all actions required to add new equipment equivalencies for commercially available manual instruments
- Owner
  - Carl Latiolais/Kull
- Status:
  - Latiolais provided status of this action at 11-2012 meeting
  - Draft completed and will be incorporated into program by 3/2014. Action is coordinated with work to revise VIII-4000 criteria
- Due
  - Next PDI/NRC Meeting

Action Item Review

- Action 12-2011-3
  - Provide finalized quality instruction documenting the PDI processes that will be used to implement CC-780
- Owner
  - PDI
- Due
  - Next PDI/NRC meeting
- Status:
  - Hacker provided status update at 11-2012 PDI/NRC meeting
  - Providing comments via the ASME Code process

Action Item Review

- Action 12-2011-6
  - PDI requests NRC to consider freezing the edition and addenda of Appendix in future rule making if no significant changes will be realized
- Owner
  - NRC/PDI
- Due
  - Next meeting
- Status:
  - Complete

Action Item Review

- Action 12-2011-11
  - Discuss process for dealing with old revisions of qualified procedures (Sunset process)
- Owner
  - PDI (Linden/Lofthus/Anthony)
- Status:
  - Ready to go to IC in January 2013
  - Provide status at next PDI-NRC meeting
- Due
  - Due 1-2013

Action Item Review

- Action 6-2012-1
  - Complete PDI implementation instruction for equipment equivalency, via Code Case N-780, and provide information about the major components back to NRC
    - Owner PDI
    - Review assistance to be provided by Steve Doctor
    - Due Date: October 1, 2012
    - Status:
      - This action is redundant. Closed to Action 12-2011-03

Action Item Review

- Action 6-2012-2
  - Develop Appendix VIII pass rate statistics for presentation at future PDI/NRC meetings
    - Owner: PDI
    - Due Date: Nov 15, 2012
    - Status:
      - Update provided at 11-2012 meeting

Action Item Review

- Standing Action 6-2012-5
  - Discuss Cast Stainless Steel
- Owner
  - PDI/NRC attendees
- Due
  - On-going

Action Item Review

- Action 11-2012-1
  - Review NUREG Report containing Technical Basis information on Appendix VIII to determine if there are any modifications needed to Appendix VIII – Report is due out by March 2013
  - Owner: Dave Anthony / PDI Committee
  - Due Date: June 1, 2013

(Discussion)

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Adoption of the Latest Revisions of Generic Procedures

Dan Nowakowski, NextEra

January 8, 2014

PDI Position on the Use of Generic Procedure Revisions

- While each PDI generic procedure revision has met the requirements to be considered fully qualified to Appendix VIII, the FG revises these procedures from time to time for purposes of clarifying the wording, correcting editorial errors, or adding enhancements in order to make the procedure more effective or user friendly
- Once a new revision is published, previous revisions are not longer considered the best, generically available examination procedure for that particular Appendix VIII Supplement
- The PDI Focus Group (FG) has developed Policy 13-01 recommending:
  - Utilities should implement the latest revision of PDI generic procedures within one year of the effective date
  - If an older revision is used, a technical justification should be prepared

PDI Position on the Use of Generic Procedure Revisions

- Implementation of the Policy
  - Implementation is at the discretion of the utility
- To ensure that the best versions of the generic procedures are being implemented, the PDI FG has requested the NDE IC to consider NEI 03-08 implementation of this policy

(Discussion)

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Status of the PDI Supplement 8 Bolting Program

Kevin Hacker, Dominion
NDE Integration Committee, Chairman

January 8, 2014

Contents

- Examination Requirements
- Background
- Acceptance of Program
- Description of Program
- Deviations between ASME Code and Program
- Actions
- Summary

Examination Requirements

- The requirements for examination and acceptance of safety class 1 and 2 pressure retaining bolting, greater than 2.0 inches in diameter (50 mm) are listed in IWB-2500 and IWC-2500
- IWB-2500 and IWC-2500 require 100% of all bolts and studs to be volumetrically examined each interval
  - Volumetric examinations of these bolts and studs are performed with ultrasonic examination techniques
- The mandatory requirements of Article I-2000 require ultrasonic procedures, equipment and personnel used to detect flaws in bolts and studs to be qualified by performance demonstration in accordance with ASME Section XI, Appendix VIII, Supplement 8

Examination Requirements

Examination Volume 95 Edition 96 Addenda (Safety Class 1)

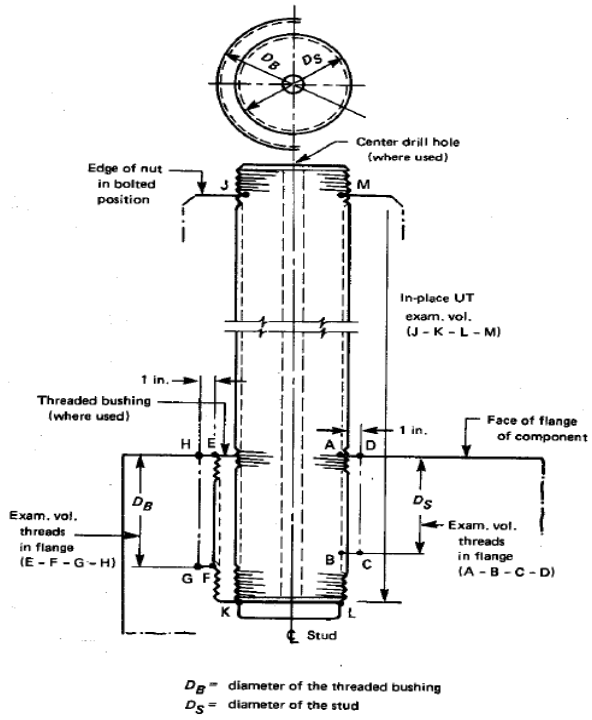


FIG. IWB-2500-12 CLOSURE STUD AND THREADS IN FLANGE STUD HOLE

Examination Volume 2001 and later Editions (Safety Class 1)

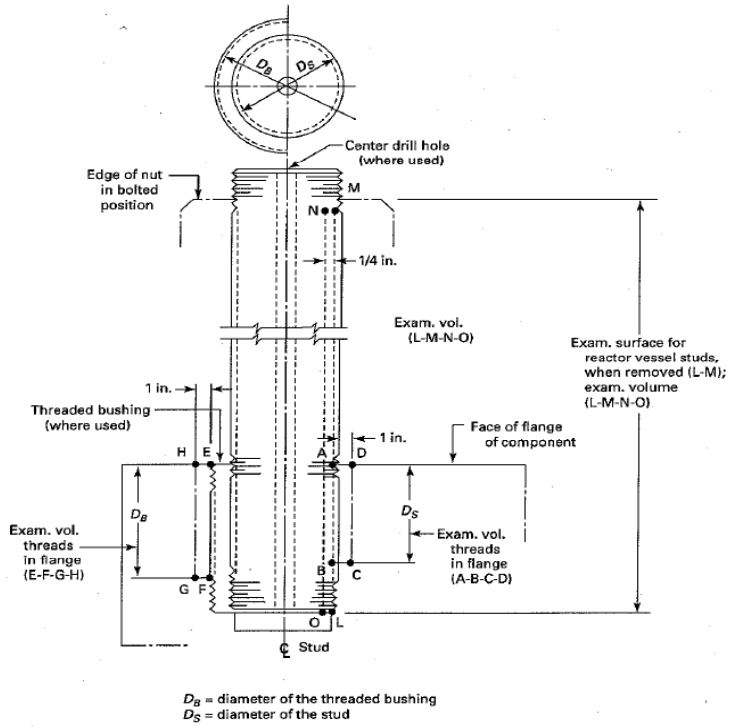


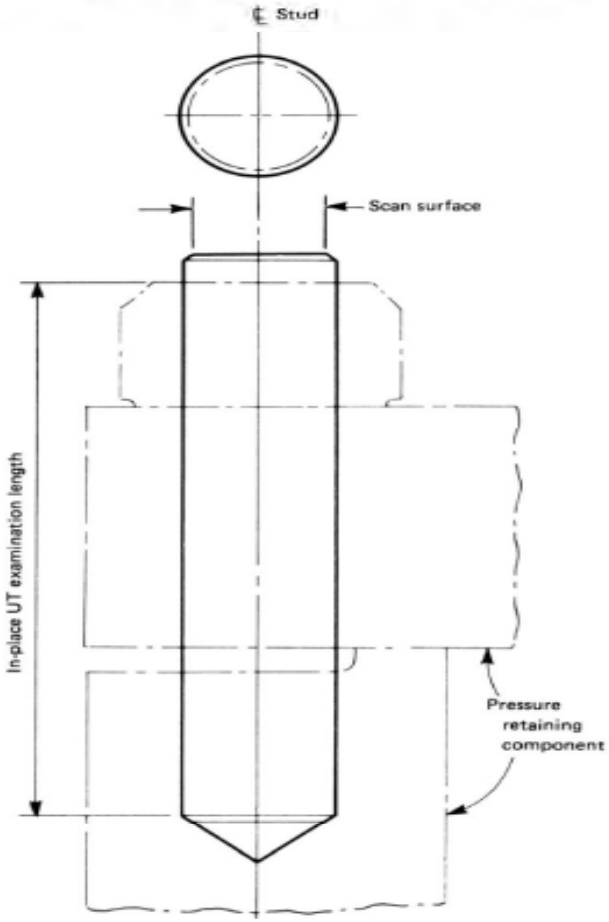
FIG. IWB-2500-12 CLOSURE STUD AND THREADS IN FLANGE STUD HOLE
(1 in. = 25 mm, ¼ in. = 6 mm)

In 2001 the examination volume was reduced from the full cross-section to the outer ¼ inch

Examination Requirements

Examination Volume 2001 and later Editions (Safety Class 2)

FIG. IWC-2500-6 PRESSURE RETAINING BOLTING



Examination Requirements

- ASME Section XI 1989 Addenda through the 1996 Addenda of Appendix VIII, Supplement 8 included bore hole notches in the qualification specimens
- ASME Section XI 2001 Edition of Appendix VIII, Supplement 8 removed the requirement for bore hole notches to be included in qualification
- Program continues to address both
  - Licensees working to earlier Code years are still required to perform examinations of bore

Background

- Prior to Appendix VIII, bolting requirements were described in Appendix VI “Ultrasonic Examination of Bolts and Studs”
  - Blind procedure qualification (monitored by Level III on site)
  - Blind personnel qualification (monitored by Level III on site)
  - Similar requirements to Supplement 8 with regards to notch reflective area and location
    - Required notches in outside threads and inside of bore
    - Required 100% detection of notches at the minimum and maximum metal paths

- ASME Section XI incorporated requirements for qualification of bolting procedures and personnel into the 1989 Edition

Background

- ASME Section XI 1989 Addenda incorporated Appendix VI into the Appendix VIII (Supplement 8), with several changes
  - Demonstration to be performed on a full scale bolt or stud section sufficient to demonstrate minimum and maximum metal paths and scanning technique (Appendix VI allowed segments to be used)
  - Samples shall be of similar chemical, tensile properties, and metallurgical structure as the bolt or stud to be examined
  - Scan surface of the qualification specimen shall have a configuration similar to the bolt or stud to be examined
  - Notches may be located within one diameter of the end opposite the search unit to demonstrate maximum metal path
    - No direction for minimum metal path
    - Did not consider examinations performed from bore

Background

- In 1994 PDI proactively started development of the current program (7 years prior to Rule) using the requirements of the 1989 Edition, 1989 Addenda, and with help from utilities, vendors, PNNL, EPRI, and NRC
- Challenges identified with Supplement 8
  - Unlike other Supplements, Supplement 8 was not designed to address a range of configurations
    - Written to be administered to address a specific bolt or stud at a plant site
  - Every conceivable configuration that existed in the industry was not known
  - The chemical composition, tensile properties and metallurgical structure of each bolt or stud in the industry was not known

Acceptance of Program

- NRC interaction with the program during development
  - The program was evaluated by the NRC in 1995 and found to be acceptable
  - Prior to issuance of final rule NRC, PDI, EPRI and Nuclear Energy Institute (NEI) staff met four times between May 12, 1998 and November 19, 1998 to discuss items such as the current status of the PDI program, and Appendix VIII of Section XI as modified by PDI during the development of the program
  - Subsequent to these meetings and consideration of the public comments, the NRC reviewed the latest version of the PDI program for examination of vessels, piping and bolting
  - The NRC stated in the discussion portion of the final rule (Page 51377):
    - This version would provide reasonable assurance of detecting flaws of concern
    - Adoption of Appendix VIII as modified by PDI during the development of the program means that the present test specimens are acceptable
  - The final rule also recognized that the use of notches in the bolting specimens were acceptable and provided increased latitude for flaw placement

Description of Program

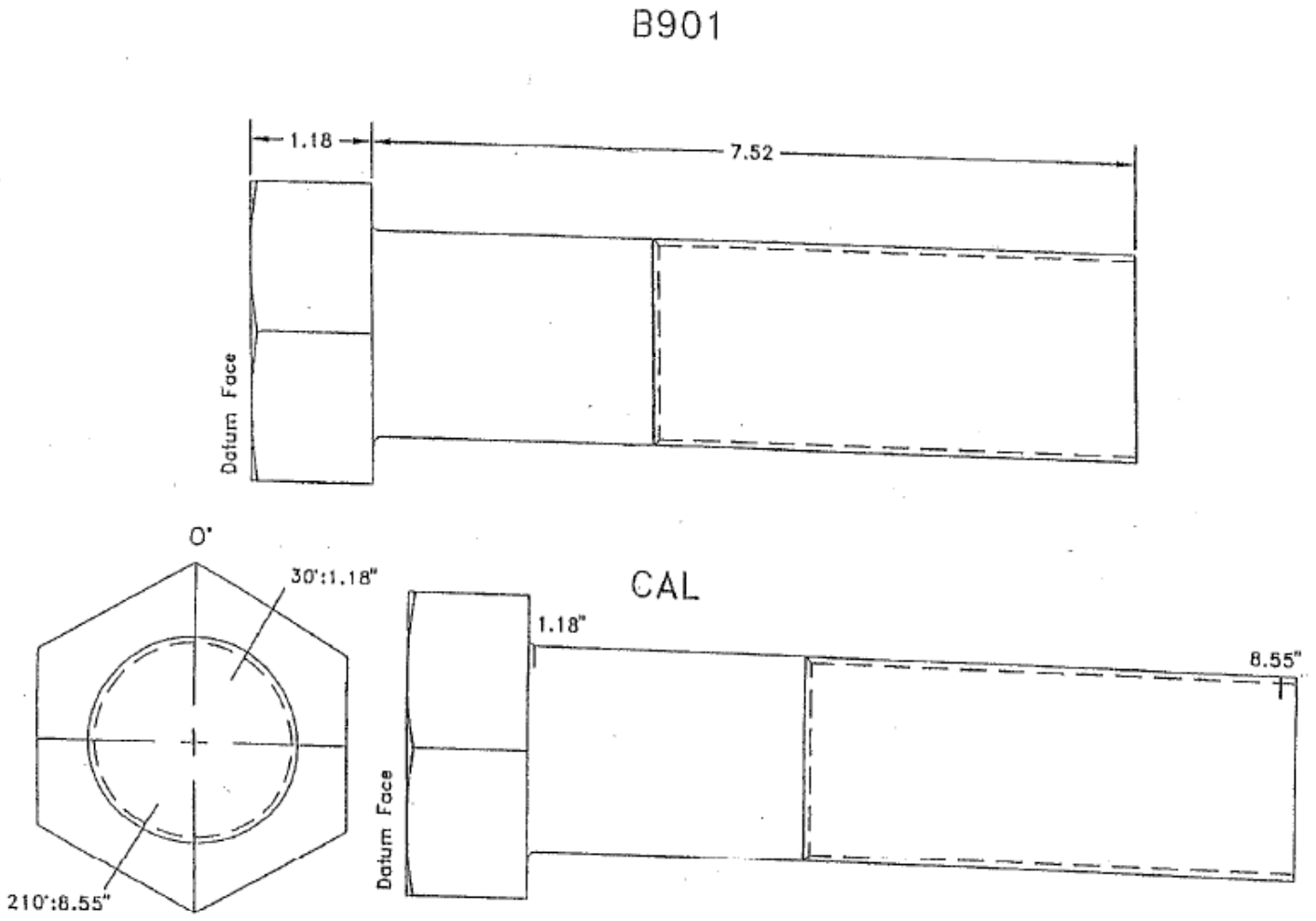
- To comply with Supplement 8 requirements PDI developed an approach that included two parts
  - Part 1
    - Using the available bolts and studs that could be purchased from cancelled plants, PDI designed sample sets that contained a wide range of configurations that satisfied all of the Supplement 8 requirements with the exception of the material and geometry requirements
    - These test sets were to be used to perform blind personnel and procedure qualifications
  - Part 2
    - Licensees would expand successful qualifications (personnel and procedure) using site calibration standards that satisfy the material and geometric requirements of Supplement 8

Description of Program

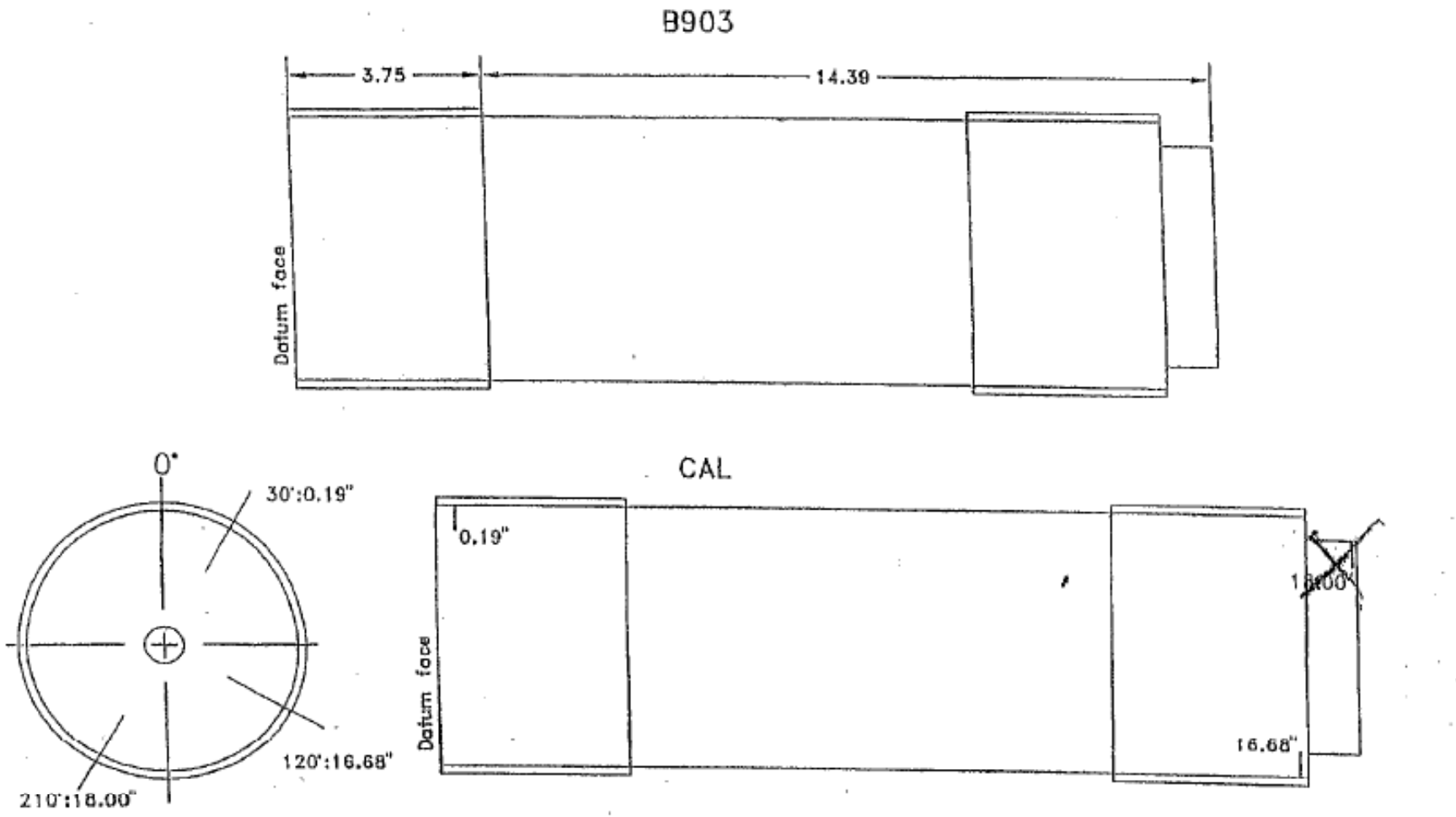
Part 1

- PDI qualification sets include:
  - Ferritic forged material (obtained from canceled plants)
  - Range of bolts and stud configurations (minimum of 3)
  - Various configurations
  - Scanning surfaces appropriate to the procedure (end of bolt or stud, or from bore)
  - Typical geometric conditions that normally require discrimination from flaws (e.g., shank to thread transitions, head to shank transitions, bore hole geometry and threads)
  - Typical scanning surface conditions (e.g., bore holes, grooves, transitions)
  - Notches
    - Meet requirements for reflective area and depth
    - Are located on the outside surface of the bolt or stud and the bore surface (the latter to support Code years prior to 2001)

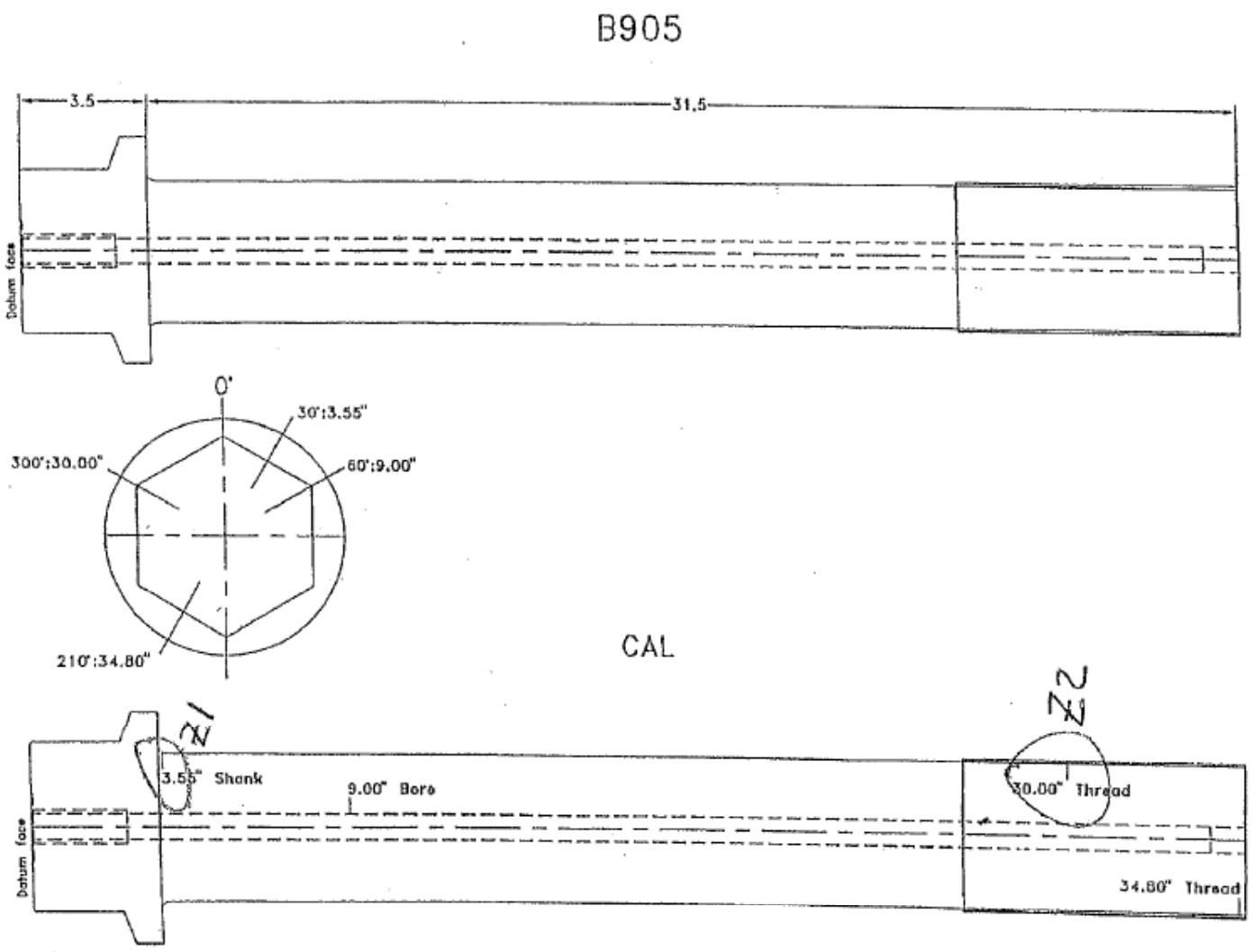
Description of Program



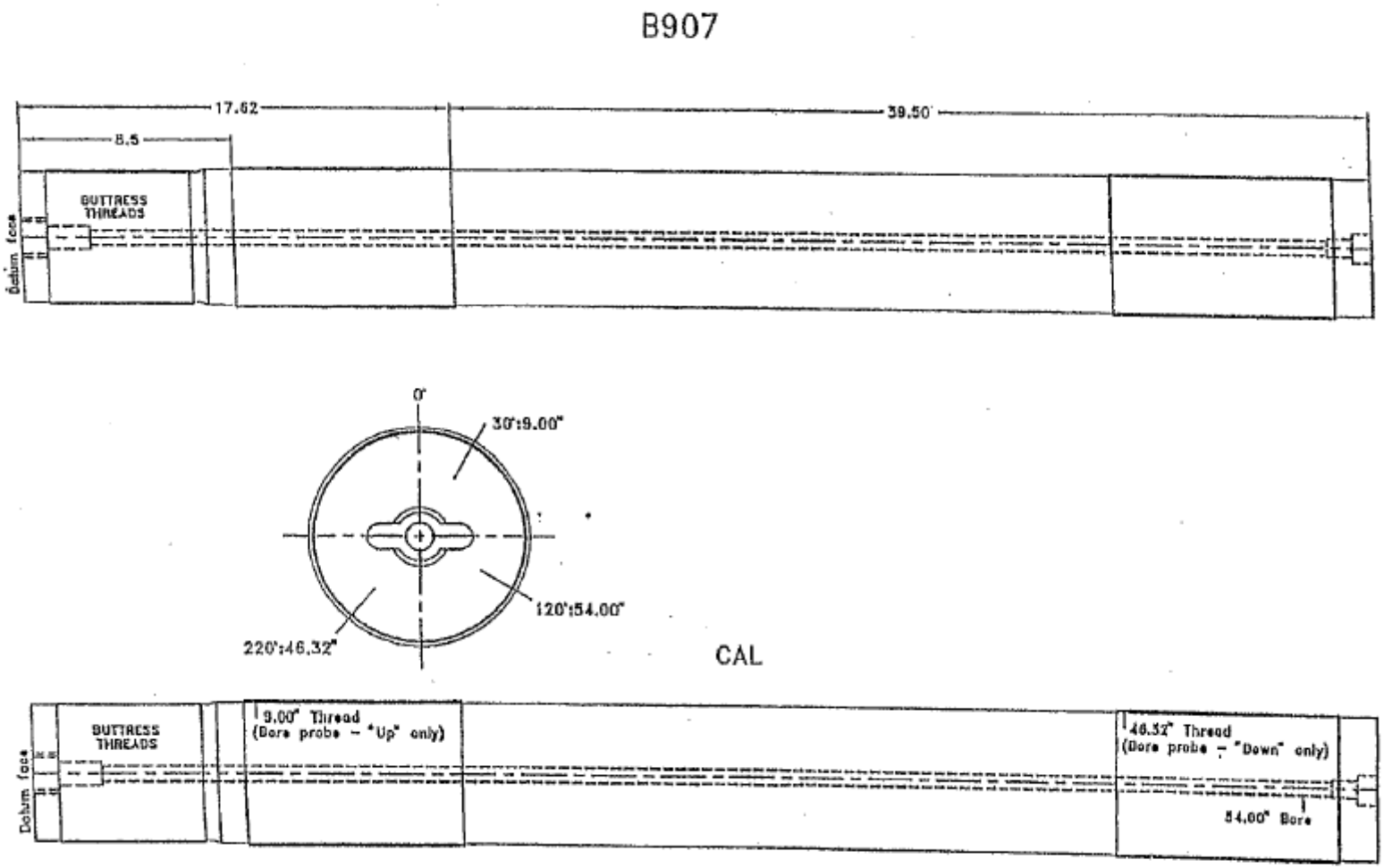
Description of Program



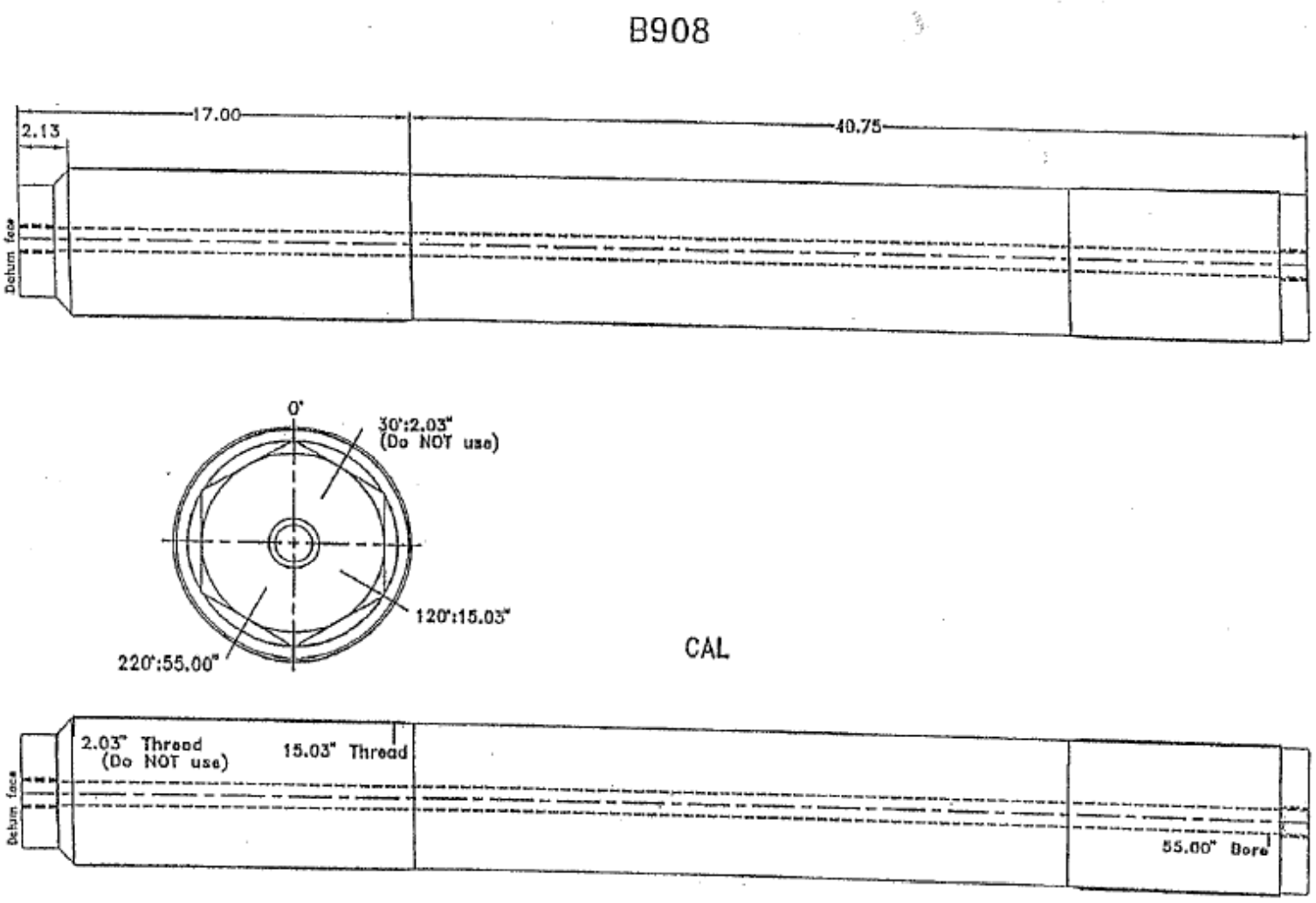
Description of Program



Description of Program



Description of Program



Description of Program

Part 1

- Specimen set (Continued)
  - The notch locations are within the required examination volume and coincident with geometric features that would exercise the techniques discrimination capabilities (e.g. threaded surface, thread to shank transitions, head to shank transitions, or other geometric features)
  - Notches satisfy the maximum depth and reflective area requirements of Supplement 8
  - For examinations performed from the end of a bolt or stud, the specimen sets contain notches at the minimum and maximum required metal paths representative of the examination volume
  - Notches located within one diameter of the end(s) of the bolts or studs were used for demonstrating the metal path distances for examinations performed from the end of the bolt or stud
  - For bore hole examinations the specimen set contained a range of bore hole sizes and stud diameters sufficient to demonstrate the minimum and maximum metal paths

Description of Program

Part 1

- Administration
  - Blind testing
    - In order to maintain a blind test, PDI test sets were designed to contain notches in various locations, not just minimum and maximum metal paths
    - The minimum number of notches included in the sample set is 5 which exceeded the minimum requirements of Supplement 8

Description of Program

Part 1

- Acceptance Criteria
  - Since the number configurations and flaws had been significantly increased, acceptance criteria similar to other Supplements were applied
    - 80 percent detection
    - No more than 20% false calls (in all cases based on sample size the maximum number allowed was 1)
      - False calls not addressed in Supplement 8

Description of Program

Part 1

- Acceptance Criteria (Continued)
  - To receive credit for detection, the following criteria must be satisfied
    - (a) The notch response shall have a minimum peak signal to peak noise ratio of 2:1
    - (b) The notch responses shall equal or exceed the reporting criteria specified in the procedure
    - (c) The reported notch axial location correlation shall be ±½" (±13 mm) or ±5% of the bolt/stud length, whichever is greater
    - (d) False calls are any call made by the candidate where a flaw is not present or the flaw is positioned outside the limits specified in (c) above

Description of Program

Part 2

- Qualified PDI procedures require the use of calibration standards that:
  - Satisfy the material and geometry requirements of Supplement 8
  - Contain notches that satisfy the following Supplement 8 requirements:
    - Depth and reflective area requirements
    - Location requirements

Description of Program

Part 2

- Implementation
  - Prior to the start of examination or series of examinations the qualified examiner must calibrate on the calibration standard to establish the required sensitivity for the examination
  - This calibration satisfies the requirements not addressed in the qualification (Part 1)

Description of Program

Part 2

- The site implementation process includes:
  - Demonstrate the actual minimum and maximum metal paths required for the specific examination
  - Examiner familiarization with the geometric responses
  - Demonstrate the scanning technique required for examination
    - From one end or a combination of two (dictated by surface geometry and capability to resolve required notches)
  - Demonstrate any changes in equipment required to address the specific bolt or stud
    - Bore hole size (adaptation of search units to fit specific bore holes)
    - Address attenuation differences (potentially a reduction in frequency may be required)

Reconciliation with ASME Code

- During an internal review of the PDI Program, differences between the PDI bolting program and ASME Section XI, Appendix VIII, Supplement 8 were identified

- These differences have been present since the original development, review and subsequent acceptance of the program

Differences between ASME Code and Program

- Qualification: PDI acceptance criteria
  - Allows missed detections (not addressed in Code)
  - Allows false calls (not addressed in Code)
- Implementation on site
  - Open demonstrations
  - Change of equipment
  - Changes to procedures to address specific configurations and material
- Notch placement
  - Code does not address bolts with threads only on one end or with integral heads

Actions

- EPRI has entered this into its corrective action program
- Industry has been informed via NDE Alert (NDE 2013-09)
  - Description of PDI Program differences for bolting, and a technical evaluation of PDI process
  - Actions to align the Performance Demonstration Initiative Program and ASME Section XI, Appendix VIII, Supplement 8
  - Recommended actions to consider during evaluations

Actions

- Develop Code actions to align PDI Program and Code
  - Draft Code case and technical basis (13-2273) has been developed and sent to task group Appendix VIII for review and comment
    - Will be presented to Code during February 2014 meeting
  - Update the Figures for examination of bolting
- Develop guideline in accordance with NEI-03-08 requirements that will ensure consistent implementation of the program on site
- Update examination procedures
- Extent of condition
  - Determine if there other differences in Code and PDI Program not identified
- Develop preventive actions to preclude recurrence

Summary

- The PDI Appendix VIII, Supplement 8 program has functioned since 1995 and has proven to be a robust and technically valid demonstration process
- The two-part process (central qualification and site calibration) provides the licensee reasonable assurance that the procedures and personnel are capable of detecting flaws of interest in safety related bolting
- Changes to the ASME Code are required
- The industry has developed a detailed plan to move forward
- The industry requests NRC support to resolve this issue

(Discussion)

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Examiner population and PDI pass rates

David Anthony, Exelon
Chairman, PDI

January 8, 2014

Contents

- Piping pass rates
  - Includes specific information regarding examiners holding both Supplement 10 and IGSCC
- RPV pass rates
- Bolting pass rates
- Summary

The following slides include best estimates of the pass rates for specific time periods.

The data were tabulated manually and have not been independently verified.

Piping Pass Rates 2011 to Present

Initial qualification – non-encoded

PDI STATUS REPORT

INITIAL QUALIFICATIONS

January 2011- December 2013

NON-ENCODED	# Candid. 1st attm.	# Passed 1st attm.	# Candid. 2nd attm.	# Passed 2nd attm.	# Candid. 3rd attm.	# Passed 3rd attm.	%Pass rate 1st attm.	%Pass rate 2nd attm.	%Pass rate 3rd attm.	Yield %
AUST. DETECTION (NO) IGSCC	56	23	23	17	3	3	41.1	73.9	100.0	77%
LENGTH SIZING (NO) IGSCC	56	23	23	17	3	3	41.1	73.9	100.0	77%
AUST. DETECTION / W IGSCC	57	38	16	8	3	2	66.7	50.0	66.7	84%
LENGTH SIZING / W IGSCC	51	7	22	14	3	2	13.7	63.6	66.7	45%
SUPPLEMENT 12 FERRITIC DET.	112	55	41	29	8	8	49.1	70.7	100.0	82%
SUPPLEMENT 12 FERRITIC LENG	98	46	40	27	9	9	46.9	67.5	100.0	84%
FERRITIC DETECTION	2	1	1		1		50.0	0.0	0.0	50%
LENGTH SIZING FERRITIC	2	1	1		1		50.0	0.0	0.0	50%
DEPTH SIZING (NO) IGSCC	9	5	4	3			55.6	75.0		89%
DEPTH SIZING / W IGSCC	21	16	5	5			76.2	100.0		100%
WOR - SUPPLEMENT 11	41	35	6	5			85.4	83.3		98%
DISSIMILAR METAL WELDS - DET	13	10	3	3			76.9	100.0		100%
DISSIMILAR METAL WELDS - LEN	13	8	3	3			61.5	100.0		85%
DISSIMILAR METAL WELDS - TWS	10	1	7	5	2		10.0	71.4	0.0	60%

Piping Pass Rates 2011 to Present

Initial qualification – encoded

PDI STATUS REPORT

INITIAL QUALIFICATIONS

January 2011- December 2013

ENCODED	# Candid. 1st attm.	# Passed 1st attm.	# Candid. 2nd attm.	# Passed 2nd attm.	# Candid. 3rd attm.	# Passed 3rd attm.	% Pass rate 1st attm.	%Pass rate 2nd attm.	%Pass rate 3rd attm.	Yield %
AUST. DETECTION (NO) IGSCC										
LENGTH SIZING (NO) IGSCC										
AUST. DETECTION / W IGSCC	17	14	1				82.4	0.0		82%
LENGTH SIZING / W IGSCC	17	13	2	1	1	1	76.5	50.0	100.0	88%
SUPPLEMENT 12 FERRITIC DET.	11	8					72.7			73%
SUPPLEMENT 12 FERRITIC LENGTH	11	7	2	1	1	1	63.6	50.0	100.0	82%
FERRITIC DETECTION										
LENGTH SIZING FERRITIC										
DEPTH SIZING (NO) IGSCC										
DEPTH SIZING / W IGSCC	7	4	3	3			57.1	100.0		100%
WOR - SUPPLEMENT 11	3	3					100.0			100%
DISSIMILAR METAL WELDS - DET	10	6	4	4			60.0	100.0		100%
DISSIMILAR METAL WELDS - LENGTH	10	4	6	5			40.0	83.3		90%
DISSIMILAR METAL WELDS - TWS	9	5	4				55.6	0.0		56%

Piping Pass Rates 2011 to Present

Requalification

PDI STATUS REPORT

CONVENTIONAL - REQUALIFICATIONS

January 2011- December 2013

NON-ENCODED	# Candid. 1st attm.	# Passed 1st attm.	# Candid. 2nd attm.	# Passed 2nd attm.	# Candid. 3rd attm.	# Passed 3rd attm.	%Pass rate 1st attm.	%Pass rate 2nd attm.	%Pass rate 3rd attm.	Yield %
AUST. DETECTION / W IGSCC	76	44	31	13	6	6	57.9	41.9	100.0	83%
LENGTH SIZING / W IGSCC	76	41	30	10	10	10	53.9	33.3	100.0	80%
DEPTH SIZING / W IGSCC	17	11	6	4	1	1	64.7	66.7	100.0	94%
WOR - SUPPLEMENT 11	10	9	1	1			90.0	100.0		100%

ENCODED	# Candid. 1st attm.	# Passed 1st attm.	# Candid. 2nd attm.	# Passed 2nd attm.	# Candid. 3rd attm.	# Passed 3rd attm.	% Pass rate 1st attm.	%Pass rate 2nd attm.	%Pass rate 3rd attm.	Yield %
AUST. DETECTION / W IGSCC	18	11	3	3			61.1	100.0		78%
LENGTH SIZING / W IGSCC	17	8	7	6	1	1	47.1	85.7	100.0	88%
DEPTH SIZING / W IGSCC	7	4	3	2	1	1	57.1	66.7	100.0	100%
WOR - SUPPLEMENT 11										

NRC Question Pertaining to Combined Qualifications

- Current qualified populations:
  - 101 individuals qualified for IGSCC detection (encoded and non-encoded)
  - 153 individuals with non-encoded Supplement 10
  - 143 individuals with encoded Supplement 10
- 47 individuals hold both Supplement 10 and current IGSCC qualifications (includes both encoded and non-encoded)
- For requalification pass rates see previous slides

RPV Pass Rates Since the Start of the Program

PDI STATUS REPORT

RPV INITIAL QUALIFICATIONS

TO PRESENT

NON-ENCODED	# Candid. 1st attm.	# Passed 1st attm.	# Candid. 2nd attm.	# Passed 2nd attm.	# Candid. 3rd attm.	# Passed 3rd attm.	%Pass rate 1st attm.	%Pass rate 2nd attm.	%Pass rate 3rd attm.	Yield %
Shell (inner 15%) OD (Detection)	135	39	80	38	32	18	28.9	47.5	56.3	70%
Shell (inner 15%) OD (Length Sizing	74	68	6	5	1	1	91.9	83.3	100.0	100%
Shell (inner 15%) OD (Depth Sizing	74	48	26	22	3	2	64.9	84.6	66.7	97%
Shell (outher 85%) OD (Detection)	129	74	49	26	19	15	57.4	53.1	78.9	89%
Shell (outher 85%) OD (Length Sizi	74	72	2	1	1	1	97.3	50.0	100.0	100%
Shell (outher 85%) OD (Depth Sizin	74	66	8	6	2	2	89.2	75.0	100.0	100%
Noz-to-shell and IR OD (Detection)	30	21	9	7	0	0	70.0	77.8	#DIV/0!	93%
Noz-to-shell and IR OD (Depth Sizi	14	8	4	2	2	2	57.1	50.0	100.0	86%

RPV Pass Rates Since the Start of the Program

PDI STATUS REPORT

RPV INITIAL QUALIFICATIONS

TO PRESENT

ENCODED	# Candid. 1st attm.	# Passed 1st attm.	# Candid. 2nd attm.	# Passed 2nd attm.	# Candid. 3rd attm.	# Passed 3rd attm.	% Pass rate 1st attm.	%Pass rate 2nd attm.	%Pass rate 3rd attm.	Yield %
Shell (inner 15%) OD (Detection)	111	47	40	23	17	9	42.3	57.5	52.9	71%
Shell (inner 15%) OD (Length Sizing	70	61	9	7	5	4	87.1	77.8	80.0	103%
Shell (inner 15%) OD (Depth Sizing	70	40	30	11	19	14	57.1	36.7	73.7	93%
Shell (outer 85%) OD (Detection)	111	75	23	15	6	5	67.6	65.2	83.3	86%
Shell (outer 85%) OD (Length Sizin	85	69	16	11	5	4	81.2	68.8	80.0	99%
Shell (outer 85%) OD (Depth Sizing	85	41	44	28	16	8	48.2	63.6	50.0	91%
Shell (inner 15%) ID (Detection)	153	108	42	37	5	4	70.6	88.1	80.0	97%
Shell (inner 15%) ID (Length Sizing)	118	109	7	5	2	1	92.4	71.4	50.0	97%
Shell (inner 15%) ID (Depth Sizing)	118	81	37	27	8	5	68.6	73.0	62.5	96%
Shell (outer 85%) ID (Detection)	158	91	62	37	20	13	57.6	59.7	65.0	89%
Shell (outer 85%) ID (Length Sizing	115	84	31	27	2	2	73.0	87.1	100.0	98%
Shell (outer 85%) ID (Depth Sizing)	115	51	64	33	25	4	44.3	51.6	16.0	77%
Noz-to-shell and IR OD (Detection)	24	11	13	6	10	4	45.8	46.2	40.0	88%
Noz-to-shell and IR OD (Depth Sizi	19	8	5	3			42.1	60.0		58%
Noz-to-shell and IR ID (Detection)	48	19	25	15	10	5	39.6	60.0	50.0	81%
Noz-to-shell and IR ID (Length Sizi	7	4	3	3			57.1	100.0		100%
Noz-to-shell and IR ID (Depth Sizing	9	5	4	2	2	1	55.6	50.0	50.0	89%

Bolting Statistics

- Number of Qualified Examiners

Number of qualified examiners	
Staight beam techniques	**303**
Bore hole techniques	**59**

- Pass rates

Examination Type	1st Attempts	Passed 1st Attempts	2nd Attempts	Passed 2nd Attempts	3rd Attempts	Passed 3rd Attempts	%Pass 1st Attempt	%Pass 2nd Attempt	%Pass 3rd Attempt	SUCCESS / ATTEMPTS
STRAIGHT BEAM	318	252	54	47	5	3	79.2	87.0	60.0	80.1
BORE PROB	82	51	17	5	3	2	62.2	29.4	66.7	56.9

Summary

- Overall, the pass rates indicate that the qualification is challenging, and meets its purpose of screening out inappropriate candidates

- As additional data is added a better idea of trends may be identified
  - More automation of process needed for piping
  - Current process is time-consuming and error-prone
  - Project is proposed that may help automate process

(Discussion)

NRC:
Pass rates and POD

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Qualification Performance as it Relates to Field Performance

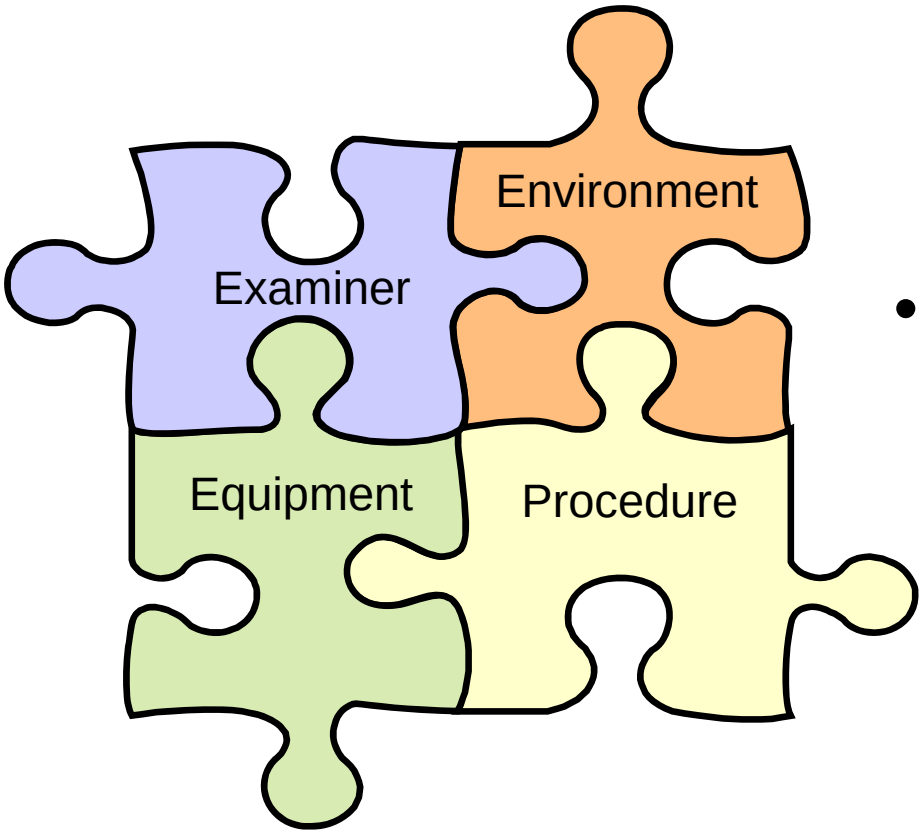
Kevin Hacker

Dominion; Chairman, EPRI NDE Integration Committee

January 8, 2014

The question is…

- What is the current understanding of field performance and how does that compare to qualification performance?



- To answer this question we must:
  - Understand how performance is measured
  - Understand the factors that affect performance

NDE Performance Factor Studies/Research

- Berglund, U. & Lindberg, S., *Human Reliability of Non Destructive Testing. SKI-report* 901207/ub/sI. 1990
- Dickens, J.R. & Bray, D., Human Performance Considerations in Nondestructive Testing. *Materials Evaluation. Vol. 51, No. 9 1033-1041. 1994*
- Firth, D., Demonstrating Effective Inspection. In W. Gardener (Ed.) *Improving the Effectiveness and Reliability of Non-Destructive Testing. 1992*
- Harris, D.H., Effect of Human Information Processing on the Ultrasonic Detection of Intergranular Stress-Corrosion Cracking. *Materials Evaluation. 48 April, pp. 475*-480.1990
- Harris, D.H., *Effect of Decision Making on Ultrasonic Examination Performance* Electric Power Research Institute: Palo Alto, California. EPRI Report TR-100412 1992
- Hoogstraate, H., EN 473/45013 Certificates are not the Ultimate Answer to Questions about Non-Destructive Testing. *Proceedings 7th. ECNDT Copenhagen May 26-29* 1998
- Karimi, S.S., *Human Factors Affecting the Performance of Inspection Personnel in Nuclear Power Plants. Electric Power Research Institute: Palo Alto, California.* EPRI Report NP-6000. 1988
- Kettunen, J., *Beliefs concerning the reliability of nuclear power plant in-service inspections. STUK-YTO-TR 121. 1997*
- Kettunen, J. & Norros, L,. *Human and organizational factors influencing the reliability of non-destructive testing. An international literary survey. STUK-YTO-TR 103,* 1996
- Norros, L. *Human and organizational factors in the reliability of non-destructive testing (NDT). Final report, VTT Symposium No. 190. 1998*
- PISC III,. *Human Reliability in Inspection, Final Report on Action 7 in the PISC III Program, PISC III Report 31. Nuclear Energy Agency 1994*
- Pond, D.J., Donohoo, D.T., & Harris, Jr., R.V., *An Evaluation of Human Factors Research for Ultrasonic Inservice Inspection. NUREG/CR-6605, PNNL-11797.* 1998
- Spanner, J.C., Badalamente, R.V., Rankin, W.L., & Triggs, T.J., *Human Reliability Impact in Inservice Inspection. Vol 1. U.S. Nuclear Regulatory Commission.* Washington, USA 1986
- Taylor, T.T., Spanner, J.C., Heasler, P.G., Doctor, S.R. & Deffenbaugh, J.D., An Evaluation of Human Reliability in Ultrasonic In-Service Inspection for Intergranular Stress-Corrosion Cracks through Round-Robin Testing. *Materials Evaluation, 47,* 338-344. 1989
- Webster, C, Some Individual Psychological Factors Leading to Error in Ultrasonic Testing. *British Journal of Non-destructive testing, 31, 680-682 1989*

What goes into NDE performance?

- Several studies have been performed, mostly outside US
  - Conclude that various factors can have an effect, but there is no identification of which factors, or combinations, are important
  - No quantitative transfer function reported
- A common thread among several studies suggest the keys to quality field examinations are:
  - Performance demonstration ensures that the examiner is capable of accurately assessing the condition of any component within the scope of a qualified procedure
  - Effective training – original, continuing, proficiency exercises
  - Efficient information exchange

(Discussion)

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Adding Search Units to Table 1

The PDI Process

Gary Lofthus, Southern Nuclear

January 8, 2014

The question is…

- Can a probe be added to a procedure without blind demonstration?

- Answer: no.
- The following slides detail the PDI process

Background

- Each PDI qualified procedure has a Table 1 document that lists the equipment combinations that may be used
  - Table 1 for each PDI generic procedure is available to the industry
  - Table 1 for vendor procedures are proprietary and are distributed at the owner's discretion
- Table 1 includes:
  - Ultrasonic instrument
  - Search units (probe and wedge)
  - Cable type and length
  - Intermediate connectors

Background

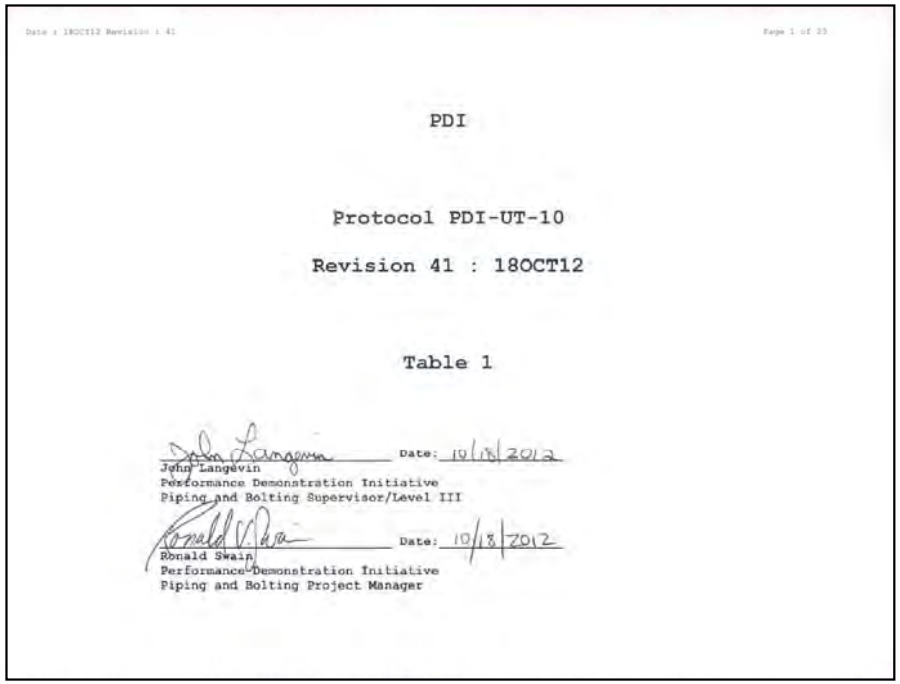
- All equipment combinations that were used and useful during a procedure qualification are included on the original Table 1 (Revision 0)
- Used and Useful
  - To be considered used and useful the search unit must perform the designated task (i.e. detection, length sizing, or depth sizing) specified within the procedure
  - Example: a search unit that accurately detects a flaw but fails to length size it within 0.75” will be added to Table 1 for detection but not length sizing

Background

- Additional equipment combinations may be added to future revisions of Table 1 through:
  - Personnel testing
    - Qualification test set based on the applicable procedure ranges
    - Search units must be used and useful and the candidate must pass the qualification test
  - Table 1 add-ons
    - May be performed by a PDA or vendor/utility personnel
    - Uses blind specimens and same paperwork as for full personnel test
    - Limited samples based on search unit applicability

PDI-UT-10 Table 1 revision example

- Table 1 for the PDI-UT-10 has been revised 41 times (mostly as a result of new qualifications, not add-ons)
- The last revision was in October of 2012:
  - A utility requested 3 search units be added for two different instruments
  - One PDA performed the ultrasonic task blindly; a different PDA performed the independent validation and documentation review



PDI

Protocol PDI-UT-10

Revision 41 : 18OCT12

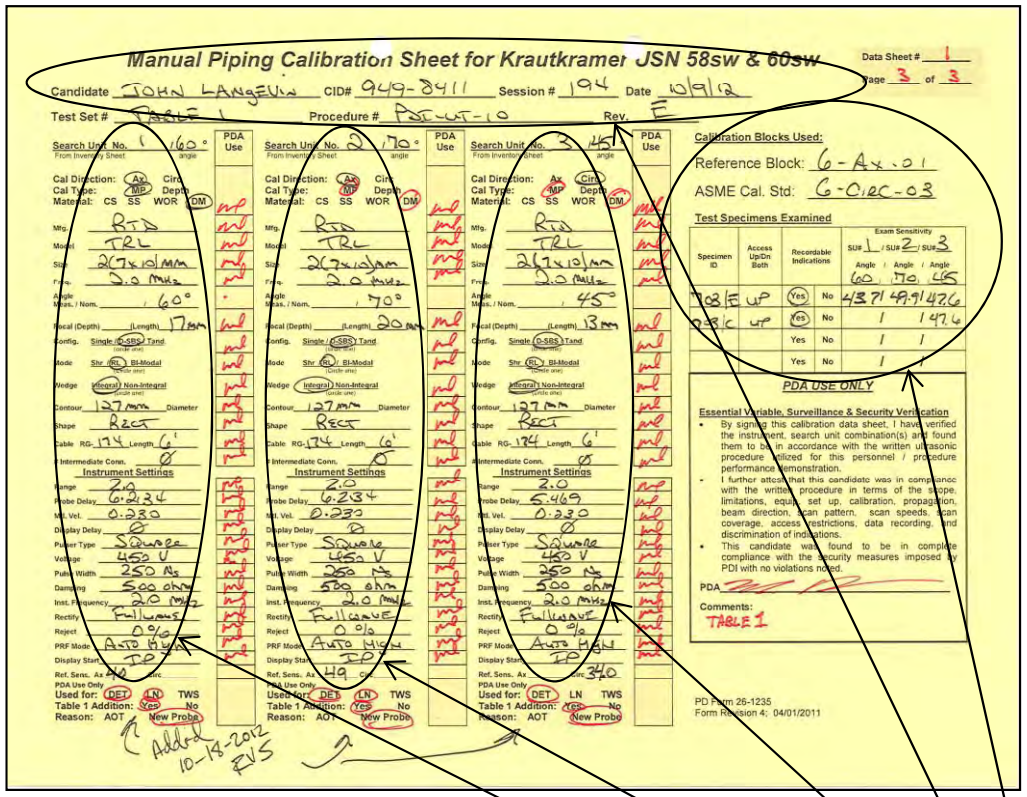
Table 1

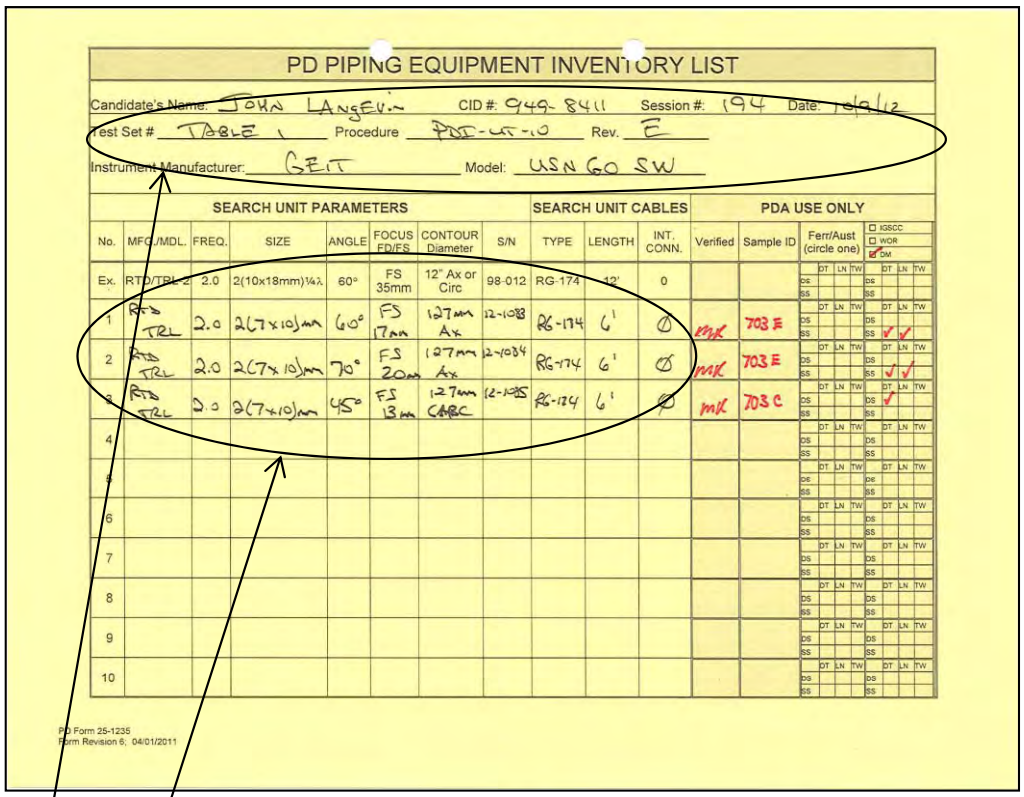
Date: 10/18/2012
John Langevin
Performance Demonstration Initiative
Piping and Bolting Supervisor/Level III

Date: 10/18/2012
Ronald Swain
Performance Demonstration Initiative
Piping and Bolting Project Manager

Table 1 Add-On Process – Step 1

- The candidate must fill out the calibration and inventory sheets for the instruments and search units used

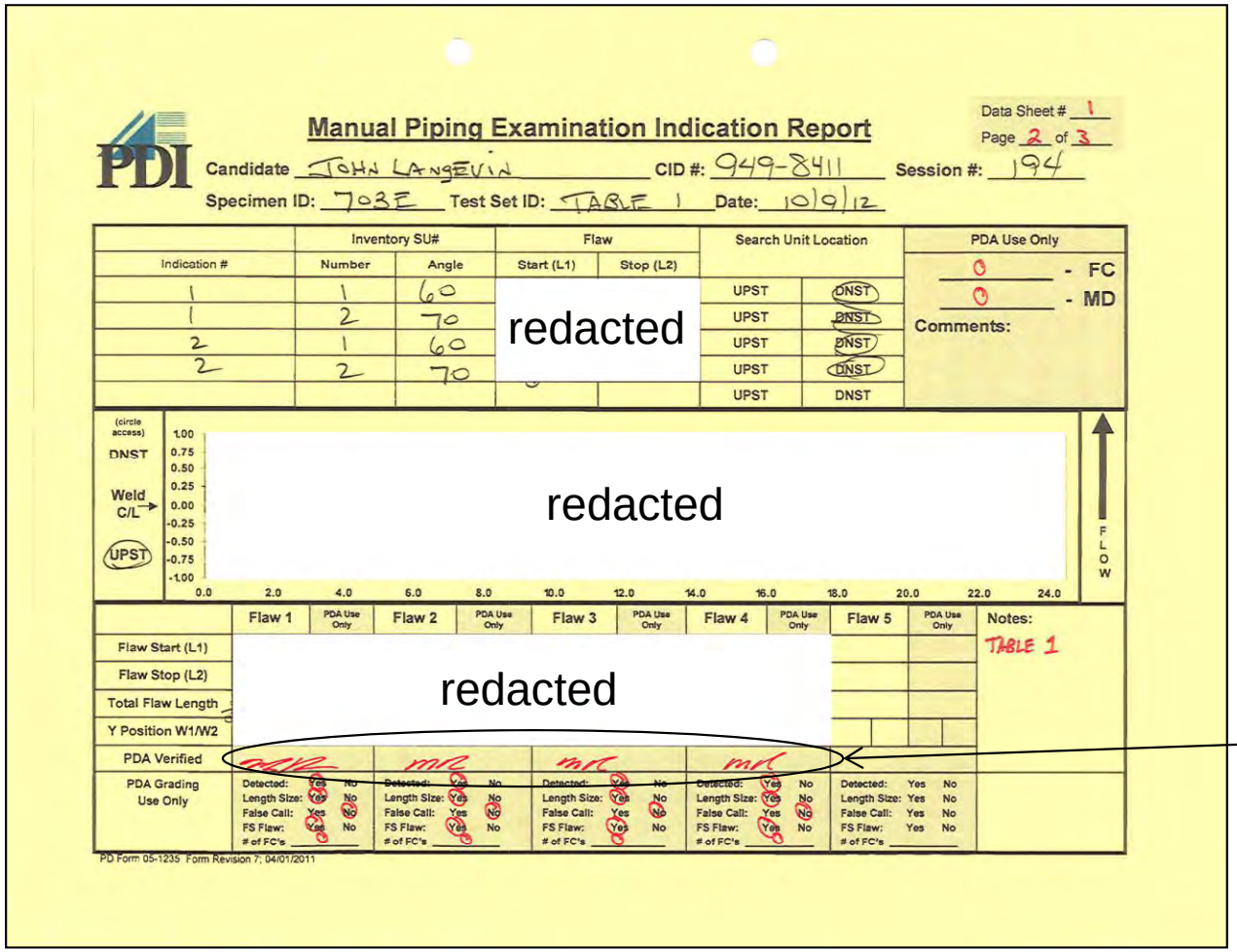




Candidate Fields

Table 1 Add-On Process – Step 2

- The candidate scans (blind) the assigned specimens and fills out the indication report form(s)



Manual Piping Examination Indication Report

Data Sheet # 1
Page 2 of 3

Candidate JOHN LANGEVIN CID #: 949-8411 Session #: 194
Specimen ID: 703E Test Set ID: TABLE 1 Date: 10/9/12

Indication #	Inventory SU# Number	Inventory SU# Angle	Flaw Start (L1)	Flaw Stop (L2)	Search Unit Location		PDA Use Only
1	1	60	redacted		UPST	DNST	0 - FC
1	2	70			UPST	DNST	0 - MD
2	1	60			UPST	DNST	Comments:
2	2	70			UPST	DNST	
					UPST	DNST	

(circle access) DNST Weld C/L UPST

redacted

1.00 0.75 0.50 0.25 0.00 -0.25 -0.50 -0.75 -1.00
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0

FLOW

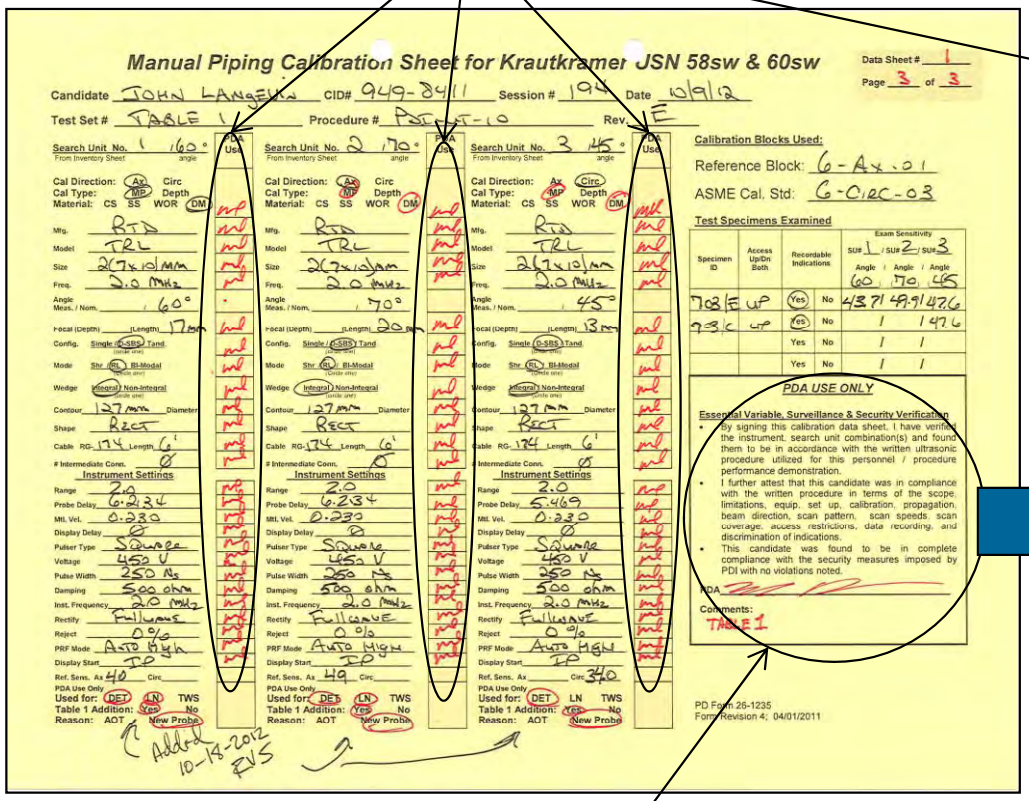
	Flaw 1	PDA Use Only	Flaw 2	PDA Use Only	Flaw 3	PDA Use Only	Flaw 4	PDA Use Only	Flaw 5	PDA Use Only	Notes:
Flaw Start (L1)	redacted										TABLE 1
Flaw Stop (L2)											
Total Flaw Length											
Y Position W1/W2											
PDA Verified	MR		MR		MR		MR				
PDA Grading Use Only	Detected: Yes No Length Size: Yes No False Call: Yes No FS Flaw: Yes No # of FC's		Detected: Yes No Length Size: Yes No False Call: Yes No FS Flaw: Yes No # of FC's		Detected: Yes No Length Size: Yes No False Call: Yes No FS Flaw: Yes No # of FC's		Detected: Yes No Length Size: Yes No False Call: Yes No FS Flaw: Yes No # of FC's		Detected: Yes No Length Size: Yes No False Call: Yes No FS Flaw: Yes No # of FC's		

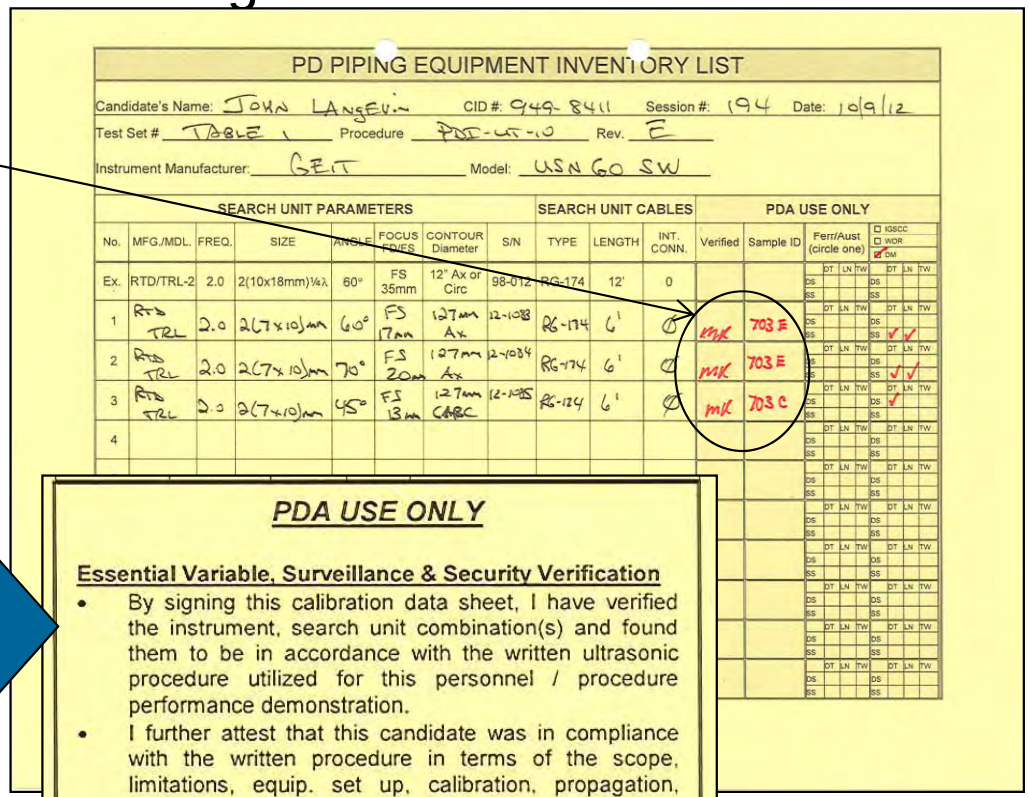
PD Form 05-1235 Form Revision 7; 04/01/2011

- The candidate shows a PDA the signal response(s) from the indication(s)
- The candidate demonstrates length & depth sizing per the applicable procedure
- The PDA initials each reported indication when a candidate demonstrates each reported value

Table 1 Add-On Process – Step 3

- The PDA verifies all of the instrument settings and search unit parameters





- The PDA signs the following statement on every calibration sheet

Table 1 Add-On Process – Step 4

- The PDA grades the exercise
  - Notes false calls and missed detections
  - Lists any important notes
  - Indicates if the candidate's calls meet the detection & sizing criteria

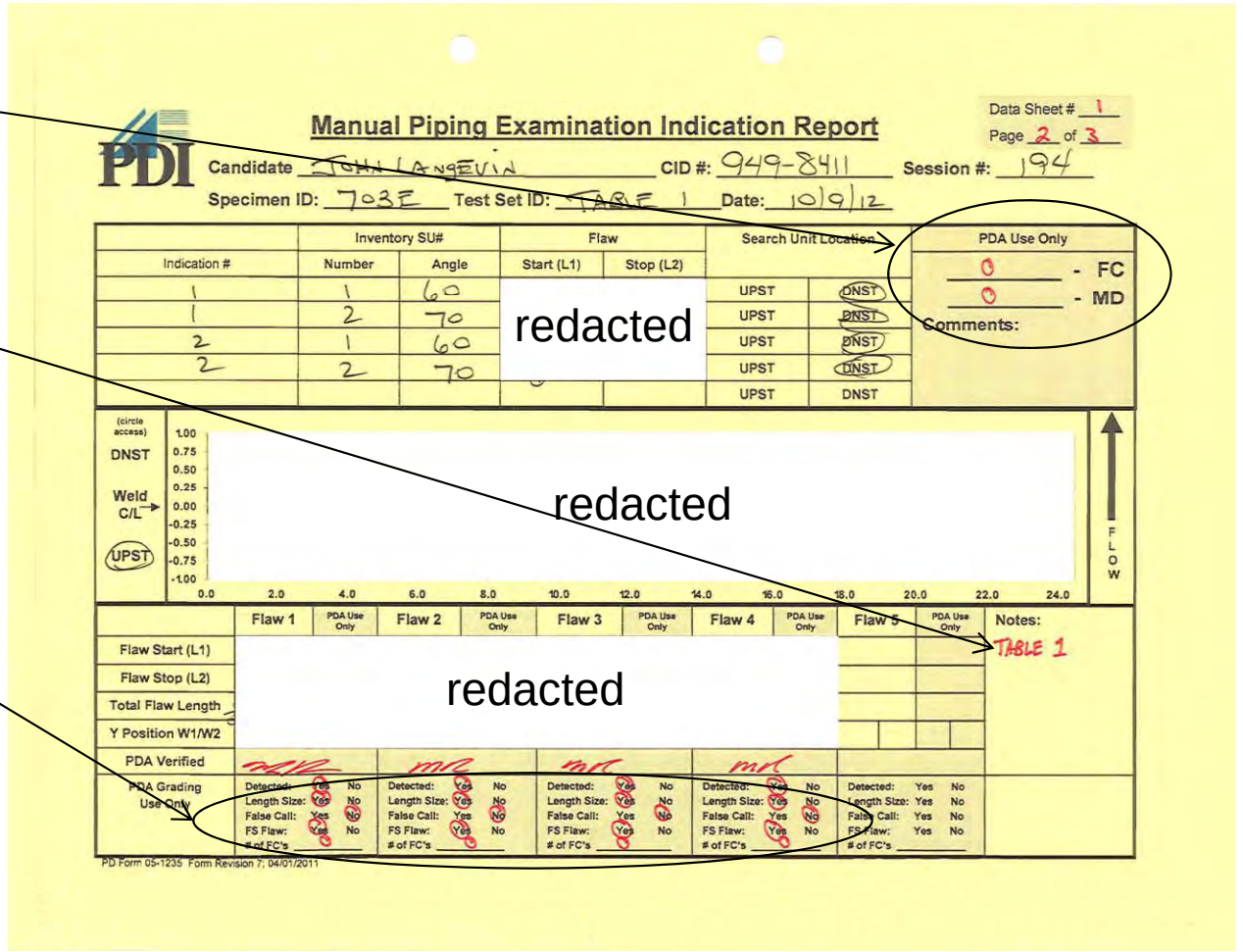


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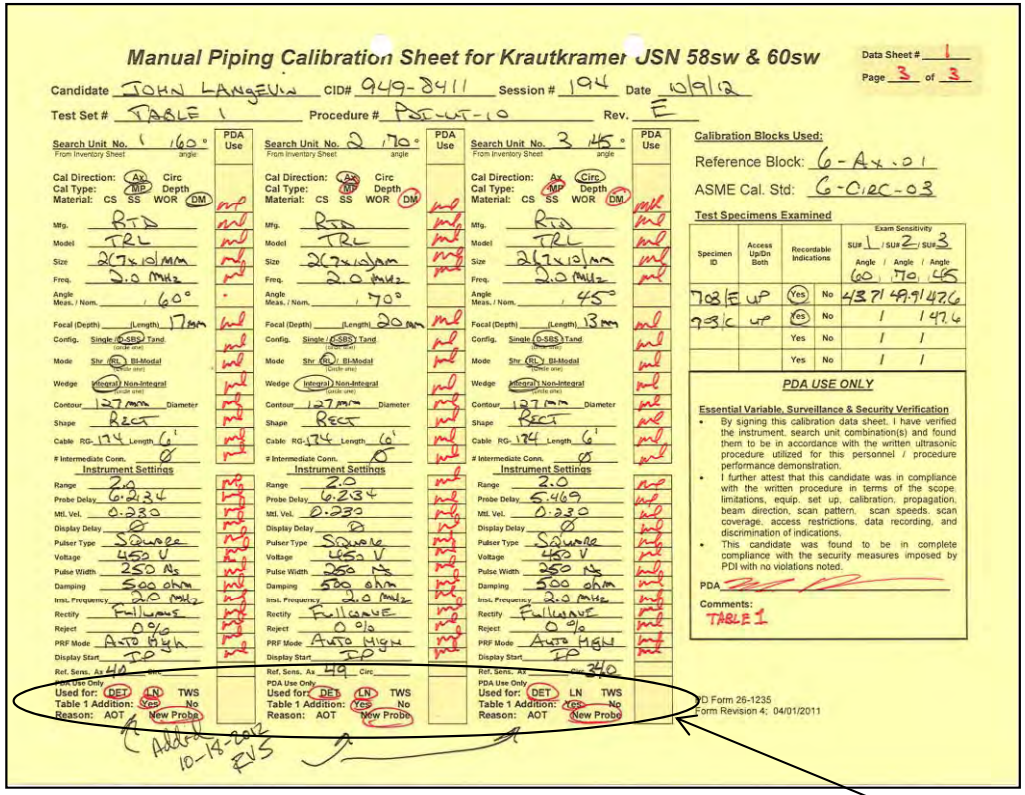
Table 1 Add-On Process – Step 5



Manual Piping Calibration Sheet for Krautkramer USN 58sw & 60sw

Data Sheet # 1 Page 3 of 3

Candidate JOHN LANGEVIN CID# 949-8411 Session # 194 Date 10/9/12

Test Set # TABLE 1 Procedure # PDI-UT-10 Rev. E

Search Unit No. 1 60° | Search Unit No. 2 70° | Search Unit No. 3 45°

Calibration Blocks Used: Reference Block: 6-Ax-01 ASME Cal. Std: 6-CIRC-03

Test Specimens Examined

Specimen ID	Access Up/Dn Both	Recordable Indications	Exam Sensitivity SU# 1 Angle 60	SU# 2 Angle 70	SU# 3 Angle 45
708/E	UP	Yes / No	43	71	49.9 / 47.6
93/C	UP	Yes / No	/	/	47.6
		Yes / No	/	/	
		Yes / No	/	/	

PDA USE ONLY

Essential Variable, Surveillance & Security Verification

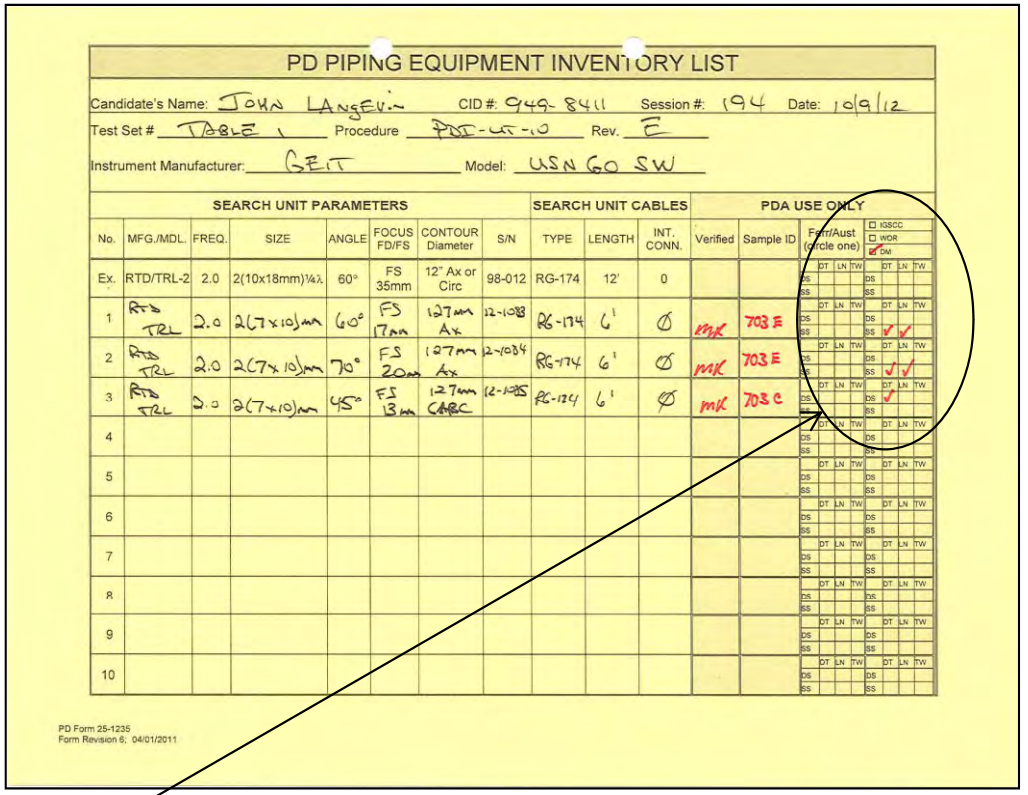
- By signing this calibration data sheet, I have verified the instrument, search unit combination(s) and found them to be in accordance with the written ultrasonic procedure utilized for this personnel / procedure performance demonstration.
- I further attest that this candidate was in compliance with the written procedure in terms of the scope, limitations, equip. set up, calibration, propagation, beam direction, scan pattern, scan speeds, scan coverage, access restrictions, data recording, and discrimination of indications.
- This candidate was found to be in complete compliance with the security measures imposed by PDI with no violations noted.

PDA

Comments: TABLE 1

PD Form 26-1235 Form Revision 4; 04/01/2011

Added 10-18-2012 EVS



PD PIPING EQUIPMENT INVENTORY LIST

Candidate's Name: JOHN LANGEVIN CID #: 949-8411 Session #: 194 Date: 10/9/12

Test Set # TABLE 1 Procedure PDI-UT-10 Rev. E

Instrument Manufacturer: GE IT Model: USN 60 SW

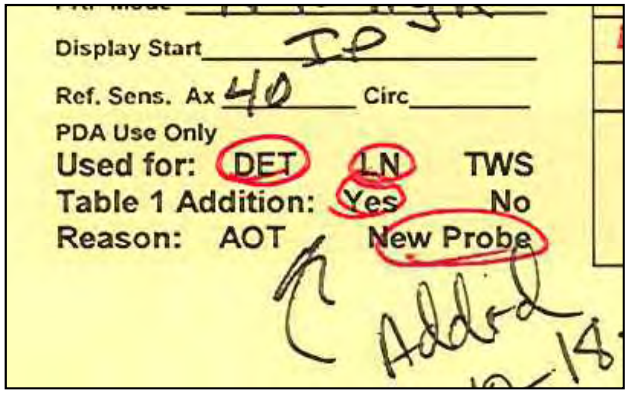
	SEARCH UNIT PARAMETERS							SEARCH UNIT CABLES			PDA USE ONLY		
No.	MFG./MDL.	FREQ.	SIZE	ANGLE	FOCUS FD/FS	CONTOUR Diameter	S/N	TYPE	LENGTH	INT. CONN.	Verified	Sample ID	Ferr/Aust (circle one)
Ex.	RTD/TRL-2	2.0	2(10x18mm)¼λ	60°	FS 35mm	12" Ax or Circ	98-012	RG-174	12'	0			
1	RTD TRL	2.0	2(7x10)mm	60°	FS 17mm	127mm Ax	12-1088	RG-174	6'	Ø	mk	703 E	
2	RTD TRL	2.0	2(7x10)mm	70°	FS 20mm	127mm Ax	12-1034	RG-174	6'	Ø	mk	703 E	
3	RTD TRL	2.0	2(7x10)mm	45°	FS 13mm	127mm CARC	12-1085	RG-174	6'	Ø	mk	703 C	
4													
5													
6													
7													
8													
9													
10													

PD Form 25-1235 Form Revision 6; 04/01/2011

- The PDA indicates what each search unit was used for (detection, length sizing, or depth sizing) and checks if the equipment combination is already represented on the current Table 1

Table 1 Add-On Process – Step 6

- If the equipment combination(s) are not on the current Table 1 they are added to PDI Transducer Database



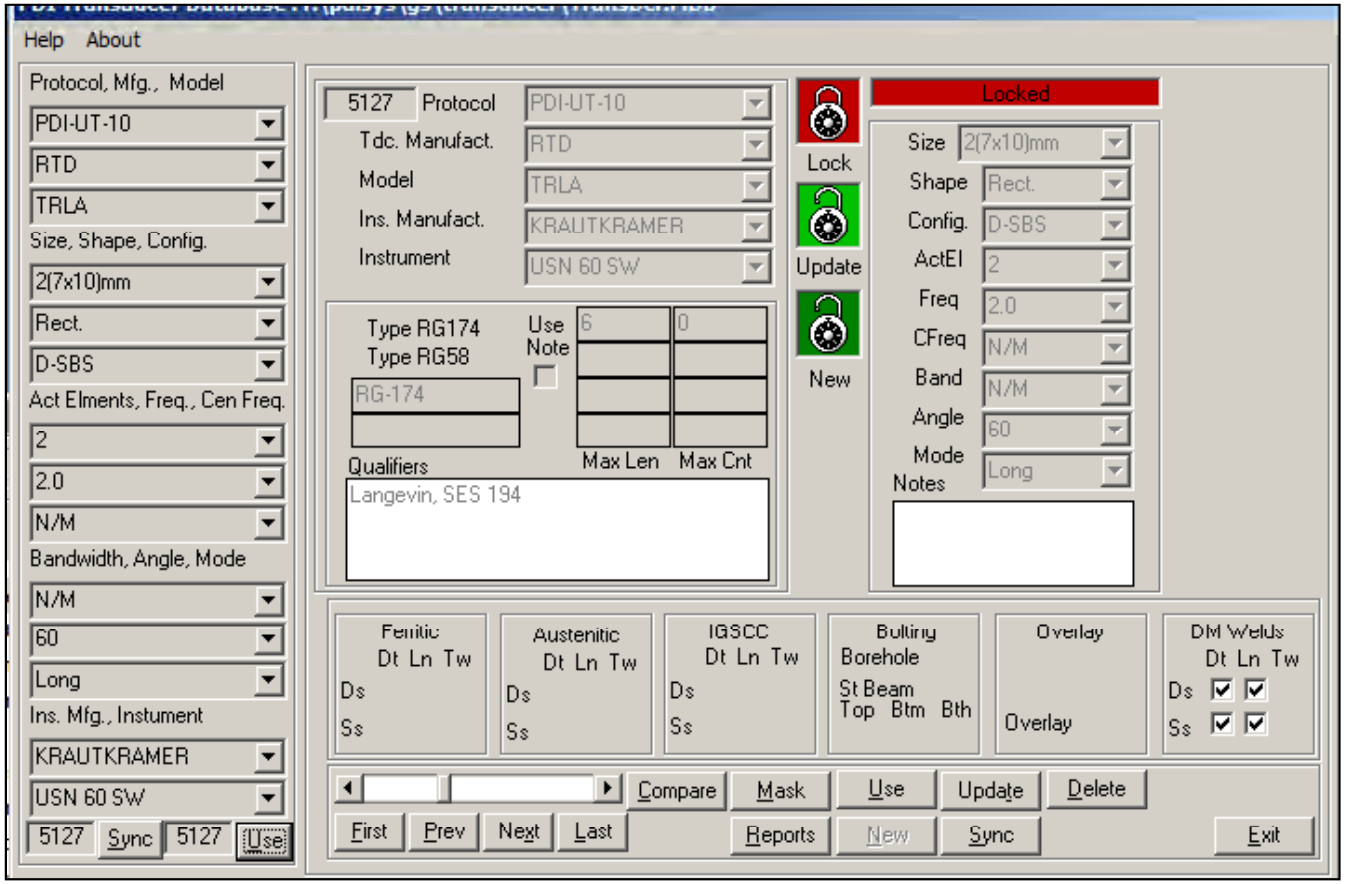


Table 1 Add-On Process – Step 7

- Once a quarter (or sooner) the PDI Transducer Database is checked for Table 1 updates and a report is generated

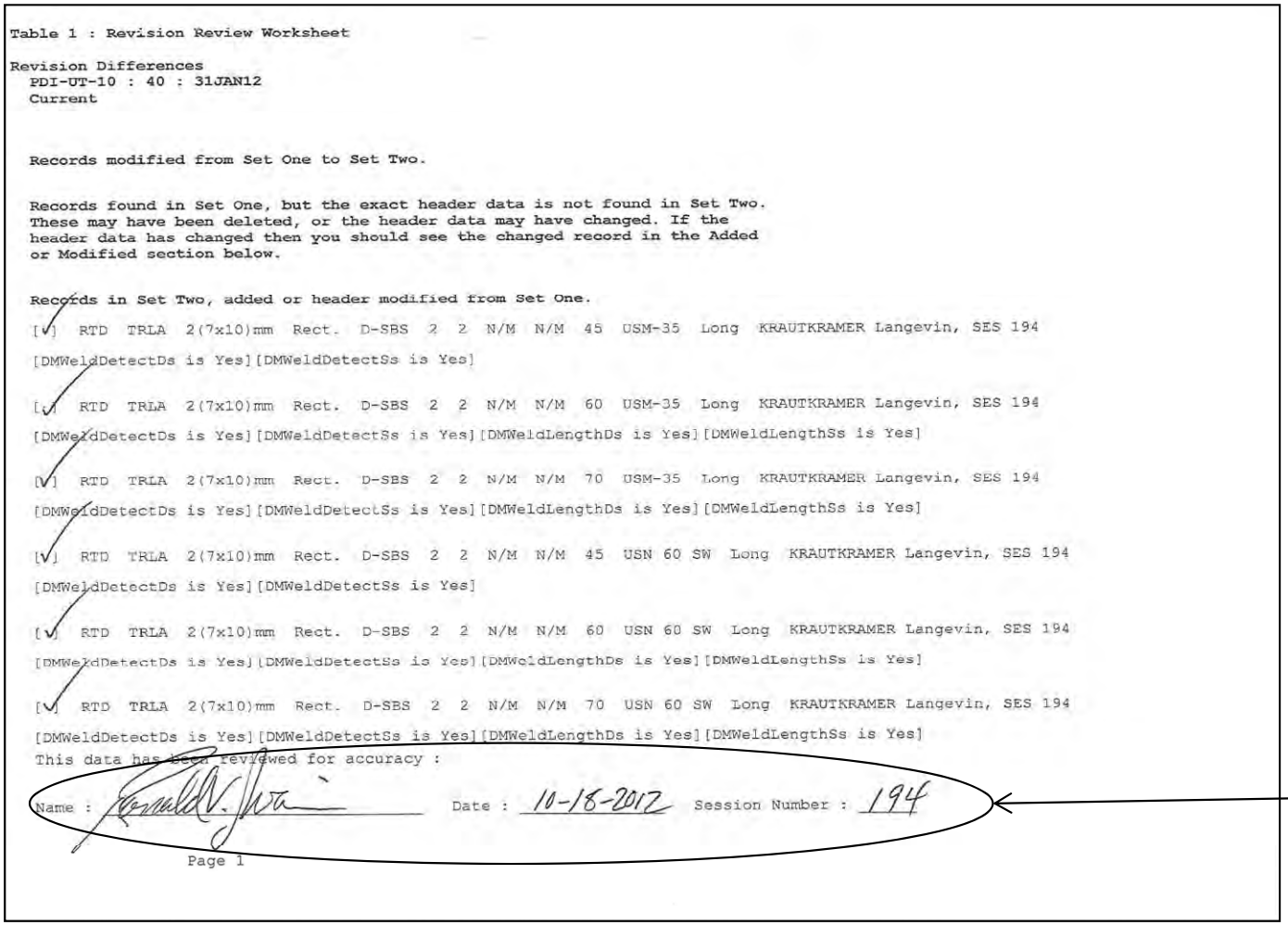


Table 1 : Revision Review Worksheet

Revision Differences
PDI-UT-10 : 40 : 31JAN12
Current

Records modified from Set One to Set Two.

Records found in Set One, but the exact header data is not found in Set Two.
These may have been deleted, or the header data may have changed. If the
header data has changed then you should see the changed record in the Added
or Modified section below.

Records in Set Two, added or header modified from Set One.

[✓] RTD TRLA 2(7x10)mm Rect. D-SBS 2 2 N/M N/M 45 USM-35 Long KRAUTKRAMER Langevin, SES 194
[DMWeldDetectDs is Yes][DMWeldDetectSs is Yes]

[✓] RTD TRLA 2(7x10)mm Rect. D-SBS 2 2 N/M N/M 60 USM-35 Long KRAUTKRAMER Langevin, SES 194
[DMWeldDetectDs is Yes][DMWeldDetectSs is Yes][DMWeldLengthDs is Yes][DMWeldLengthSs is Yes]

[✓] RTD TRLA 2(7x10)mm Rect. D-SBS 2 2 N/M N/M 70 USM-35 Long KRAUTKRAMER Langevin, SES 194
[DMWeldDetectDs is Yes][DMWeldDetectSs is Yes][DMWeldLengthDs is Yes][DMWeldLengthSs is Yes]

[✓] RTD TRLA 2(7x10)mm Rect. D-SBS 2 2 N/M N/M 45 USN 60 SW Long KRAUTKRAMER Langevin, SES 194
[DMWeldDetectDs is Yes][DMWeldDetectSs is Yes]

[✓] RTD TRLA 2(7x10)mm Rect. D-SBS 2 2 N/M N/M 60 USN 60 SW Long KRAUTKRAMER Langevin, SES 194
[DMWeldDetectDs is Yes][DMWeldDetectSs is Yes][DMWeldLengthDs is Yes][DMWeldLengthSs is Yes]

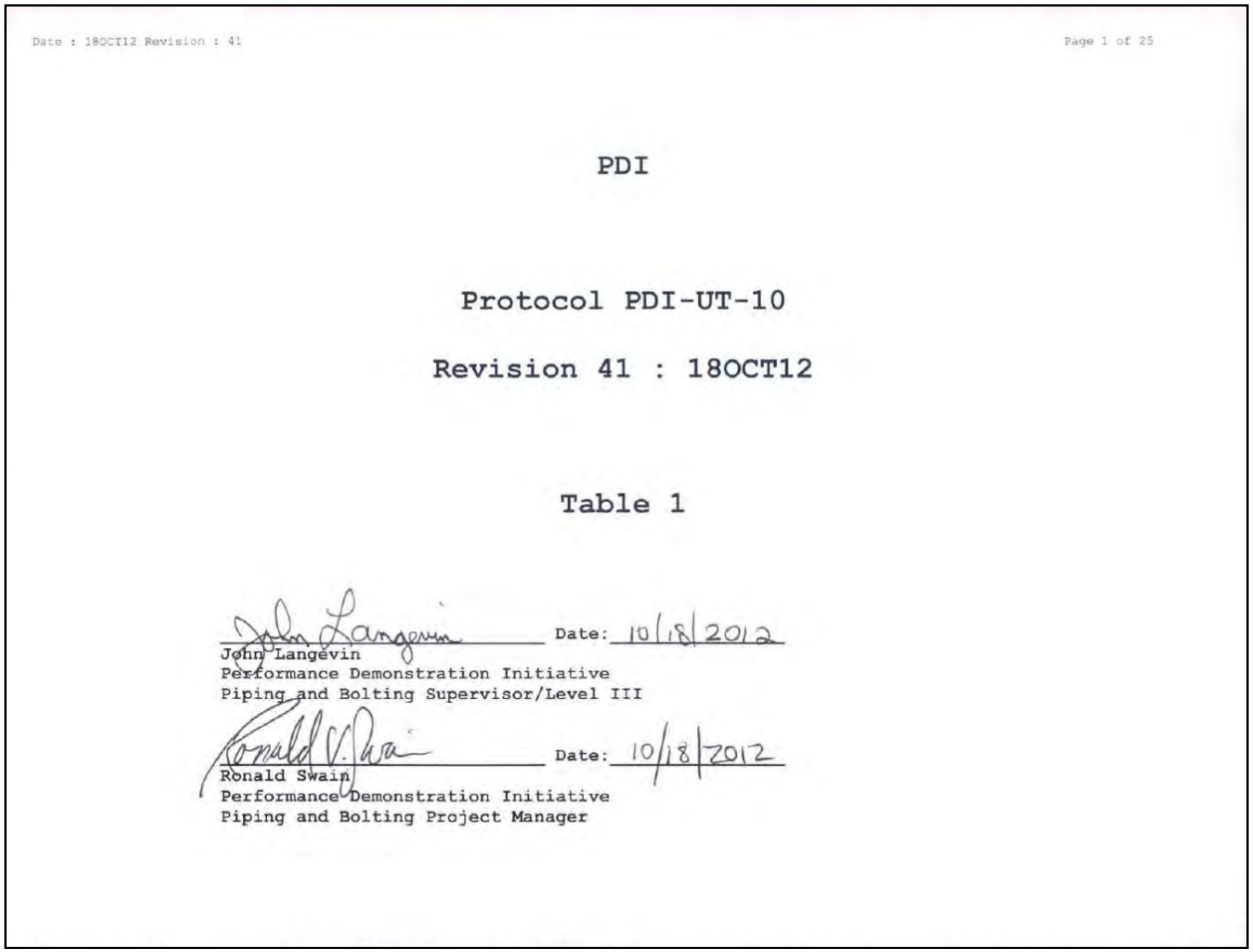
[✓] RTD TRLA 2(7x10)mm Rect. D-SBS 2 2 N/M N/M 70 USN 60 SW Long KRAUTKRAMER Langevin, SES 194
[DMWeldDetectDs is Yes][DMWeldDetectSs is Yes][DMWeldLengthDs is Yes][DMWeldLengthSs is Yes]
This data has been reviewed for accuracy :

Name : Ronald V. Jha Date : 10-18-2012 Session Number : 194

Page 1

Table 1 Add-On Process – Step 8

- The new Table 1 document is then “certified” in the PDI Transducer Database



Date : 18OCT12 Revision : 41 Page 1 of 25

PDI

Protocol PDI-UT-10

Revision 41 : 18OCT12

Table 1

John Langevin Date: 10/18/2012
John Langevin
Performance Demonstration Initiative
Piping and Bolting Supervisor/Level III

Ronald Swain Date: 10/18/2012
Ronald Swain
Performance Demonstration Initiative
Piping and Bolting Project Manager

Summary

- The typical Table 1 addition requires practical, blind qualification with multiple levels of review and verification
- Equipment combinations are only added if they are used and useful
- Equipment combinations from failed test attempts are not included on Table 1
- When a PDA performs a Table 1 add-on a second PDA must perform the validation activities and grading
- All Table 1 additions are reviewed by the PDI Program Supervisor/Level III and Project Manager prior to being signed and published

(Discussion)

NRC:
Coverage calculations

NRC:
Performance demonstration for ET on the surfaces of J-welds and butt welds

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Issues related to currently progressing Code Cases and Appendices

Gary Lofthus, Southern Nuclear
NDE Integration Committee, Vice-Chair

January 9, 2014

Discussion items

- Code Case N-831
- Code Case N-818
- Code Case N-695
- Non-mandatory Appendix D

Code Case N-831: UT in lieu of RT in Ferritic Pipe

- Background
  - RT in nuclear plants can be costly and extend outage durations.
  - The CC provides an alternative when RT is required by the construction code or for repair/replacement activities for carbon steel pipe
  - Includes qualification process requirements to demonstrate effectiveness (personnel, procedure, and specimen description)
    - Need a standard approach with NRC and ANII acceptance, to reduce the regulatory burden

- (Discussion)

Code Case N-818: Use of Analytical Evaluation Approach for Acceptance of Full Penetration Butt Welds in Lieu of Weld Repair

- Background
  - The CC provides a fitness-for-purpose approach for Class 1 and Class 2 vessel and piping full-penetration welds
  - An objective of the CC is to eliminate repairs to structurally benign flaws
    - Reduces cost
    - Repairs may increase susceptibility to degradation during service
  - Includes performance demonstration of the detection and sizing capabilities necessary to verify fitness for purpose

- (Discussion)

Code Case N-695: Qualification requirements for DM welds

- Background
  - Relief is requested for many ID examinations of DM welds because procedures cannot meet .125” RMSE
  - Relief requests could be reduced by changing depth sizing requirements
  - Industry and NRC have developed an alternative approach
    - Remaining action item: industry to prepare a white paper illustrating the results of re-grading prior qualifications using the proposed new criteria

- (Discussion)

Non-mandatory Appendix D: Weld surface conditioning

- Background
  - Improper weld surfaces can cause limited examinations
  - Non-mandatory Appendix D provides guidance for reducing limitations to Code- required volumetric examination
  - Useful in new plants, and for repair/replacement in existing fleet

- (Discussion)

(Discussion)

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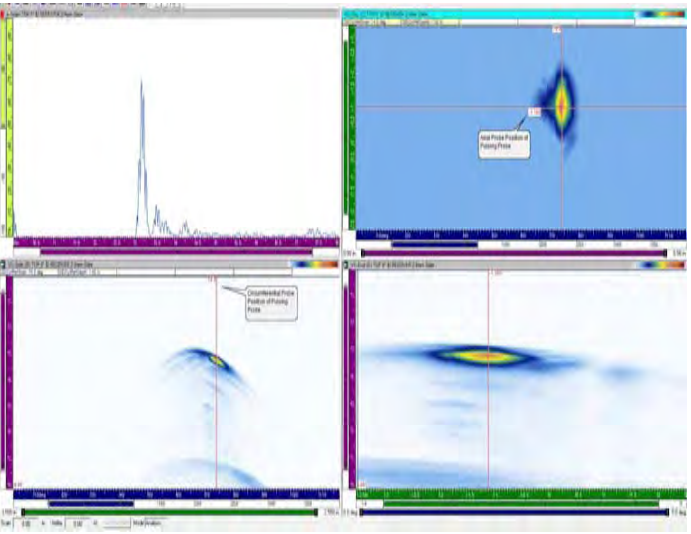
Together…Shaping the Future of Electricity

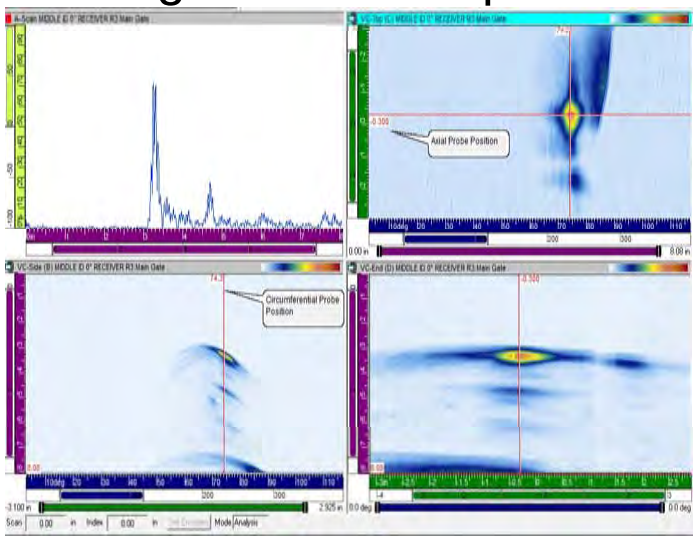
Backup slides

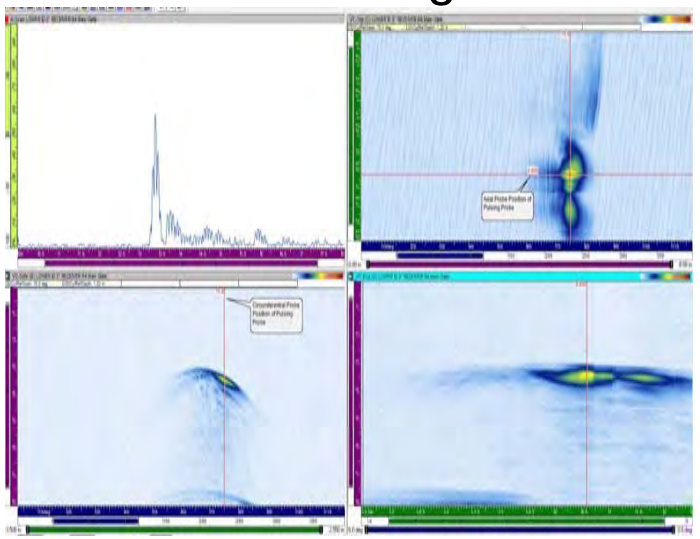
Through-Transmission Utilizing the Site Specific Mockups
The CCW and CW probes perform similarly

Bottom Row - 2886-07001 Looking CW

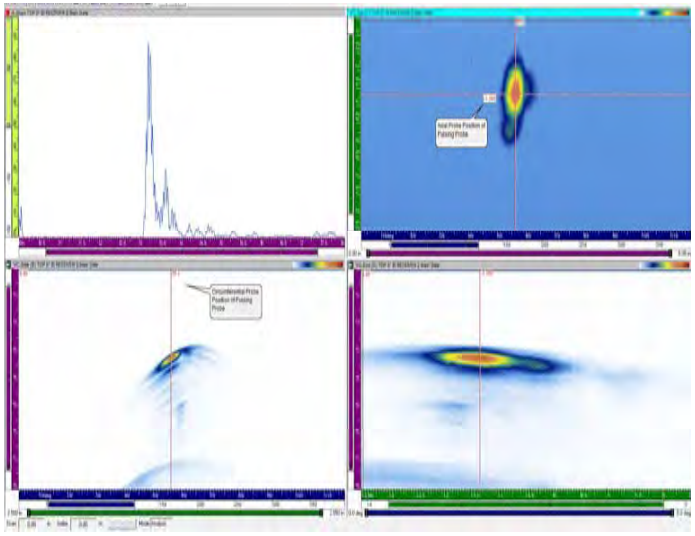
Top Row - 2887-07001 Looking CCW



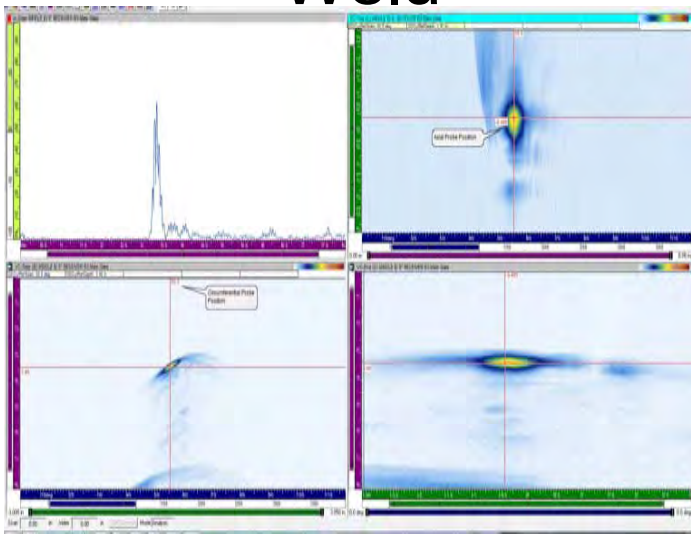




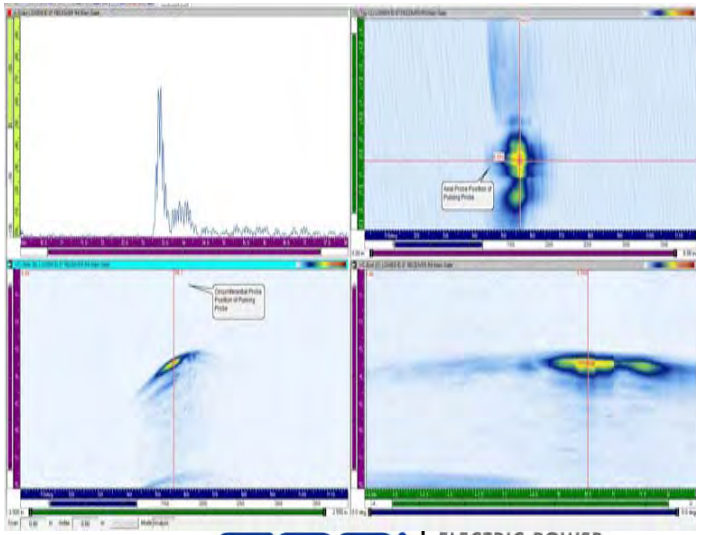
Stainless Steel



Weld



Butter



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Through-Transmission Utilizing the Site Specific Mockups – Front Element Transmitter in Designed Scan Direction

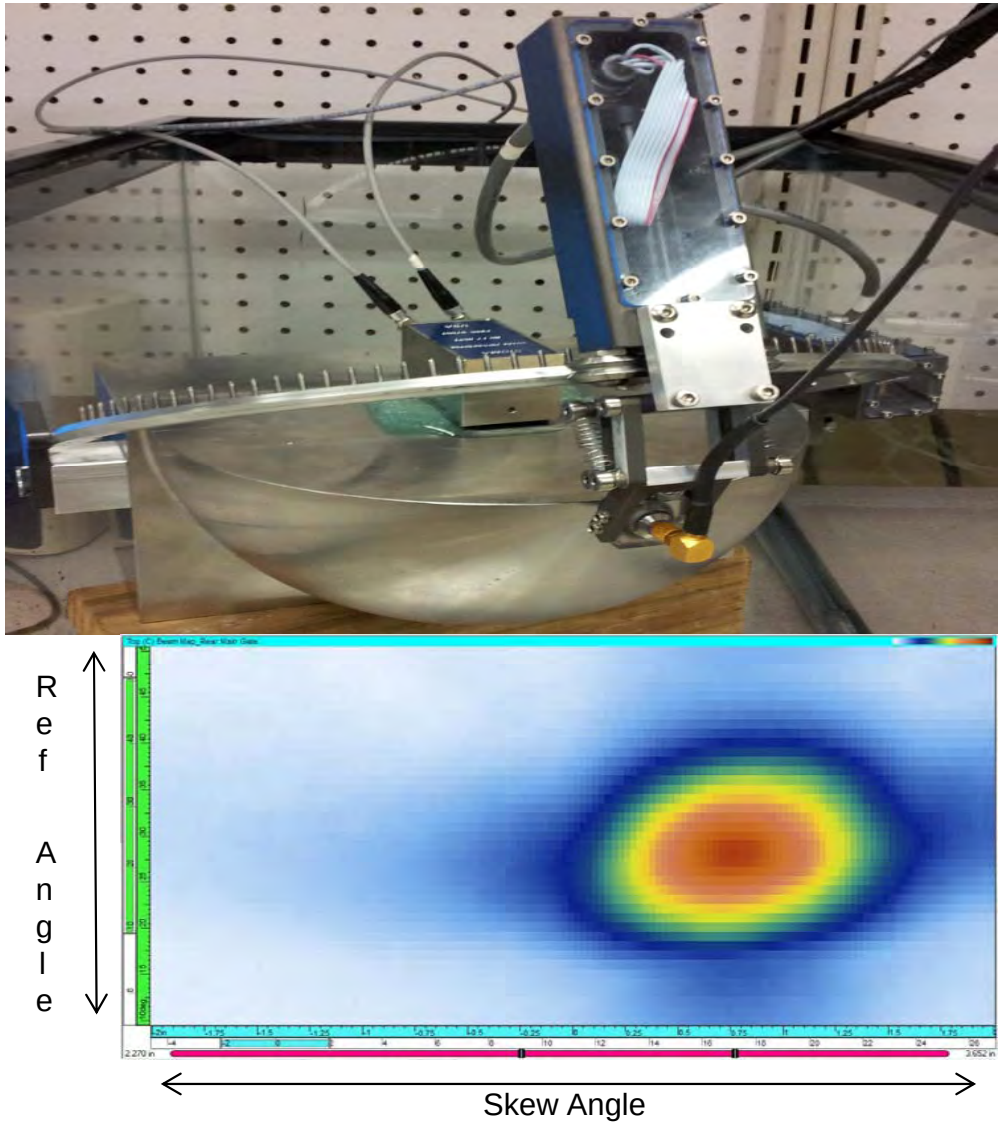
Probe	Firing Element	Position of Receiving Element	Direction (CW / CCW)	Circ Probe Position of Pulsing Probe	Circ Probe Position of 0° Receiver	Axial Probe Position of Pulsing Probe	Axial Probe Position of 0° Receiver	Calculated Refracted Angle	Calculated Skew Angle
2886-07001	Front	Lower	CW	55.6°	64°	0.60	0.80	23°	-9°
2886-07001	Front	Middle	CW	54.8°	64°	-0.70	-0.20	26°	-5°
2886-07001	Front	Top	CW	55.6°	64°	-1.30	-1.15	25°	-9°
2886-07001	Rear	Lower	CW	56.7°	64°	0.50	0.80	20°	-7°
2886-07001	Rear	Middle	CW	57.2°	64°	-0.70	-0.20	20°	-5°
2886-07001	Rear	Top	CW	57.4° **	64°	-1.30 **	-1.15	20° **	-9° **
2887-07001	Front	Lower	CCW	74.0°	64°	0.70	0.80	28°	-10°
2887-07001	Front	Middle	CCW	73.2°	64°	-0.50	-0.20	27°	-7°
2887-07001	Front	Top	CCW	72.2°	64°	-1.05	-1.15	26°	-12°
2887-07001	Rear	Lower	CCW	72.0°	64°	0.65	0.80	23°	-9°
2887-07001	Rear	Middle	CCW	70.4°	64°	-0.65	-0.20	20°	-6°
2887-07001	Rear	Top	CCW	70.4°	64°	-1.10	-1.15	21°	-12°
** - Results may not be reliable due to the signal being saturated									

Results:

- A side-lobe is observed when the UT beam is required to propagate through weld metal
- The taper correct angle (skew) maximum deviation is 5°
- The refracted angle as measured from the center of the search unit (pitch-catch mode) are within ± 3° deviation for each element
- Front element of the 2886-07001 search unit produces a lower amplitude signal at the ID

Probe Measurements Utilizing the EPRI Ultrasonic Probe Verification System

- Search units were coupled to the probe verification system
- The system was setup to scan along the refracted angle axis from 10° to 50° and to index along the skew axis from -35° to 35°
- The ultrasonic transducer was set up to take a measurement every 1° in both directions



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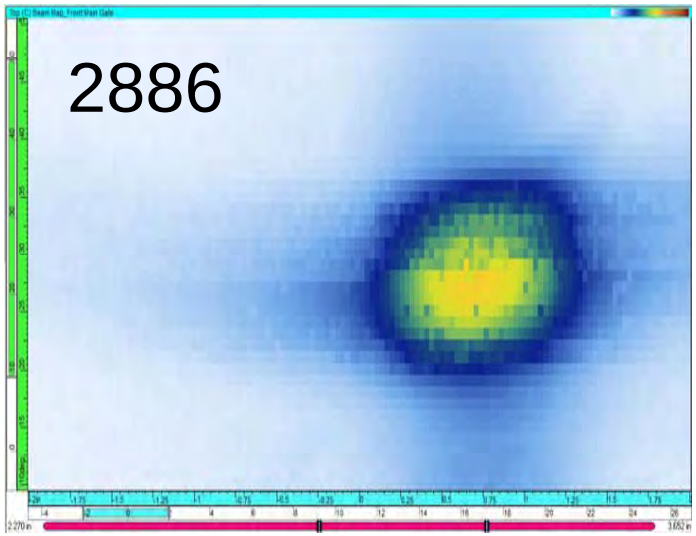
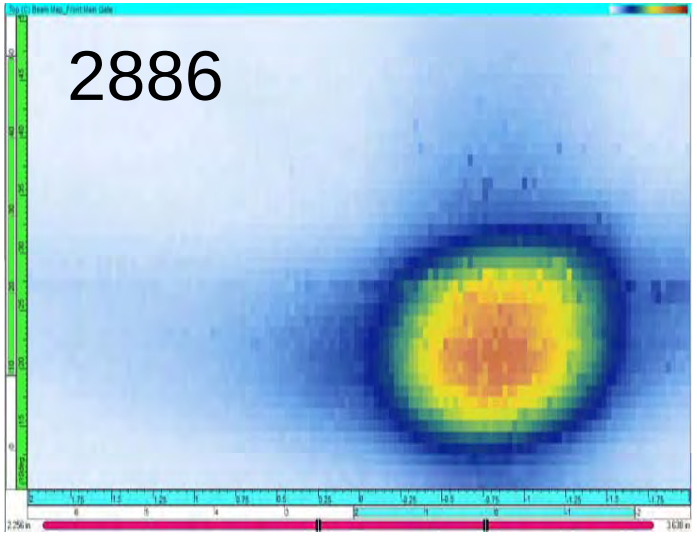
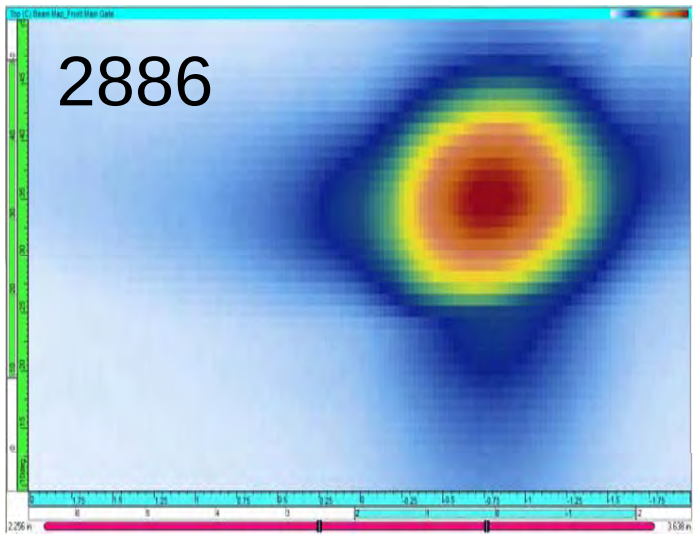
Probe Measurements Utilizing the EPRI Ultrasonic Probe Verification System



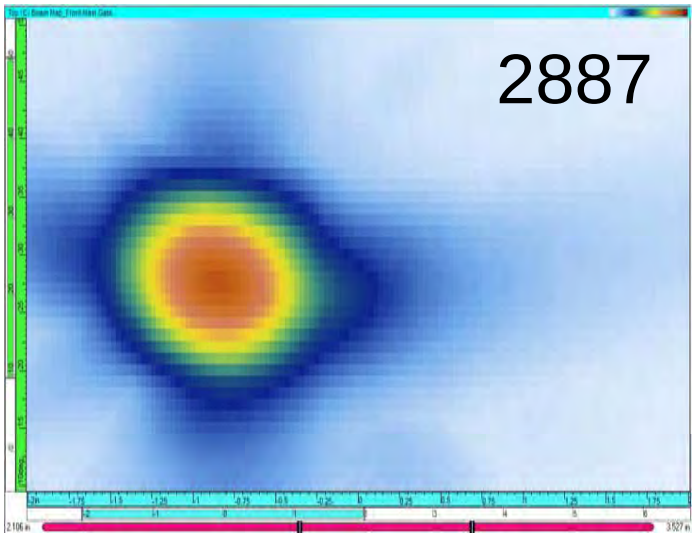
Front Pulse P-C Mode

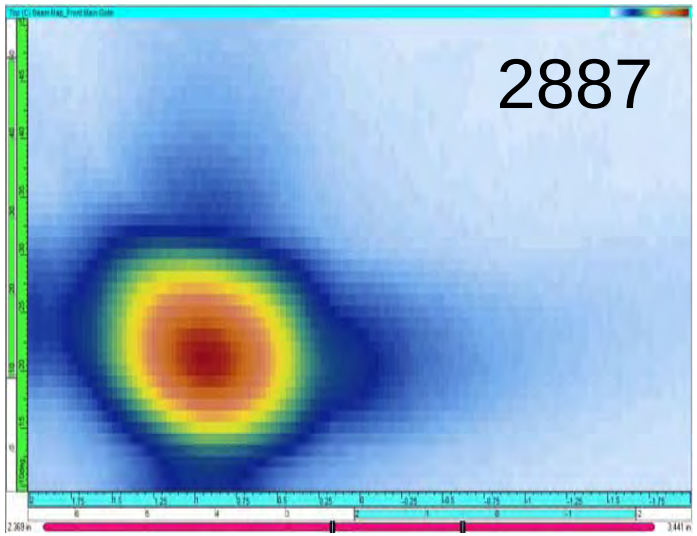


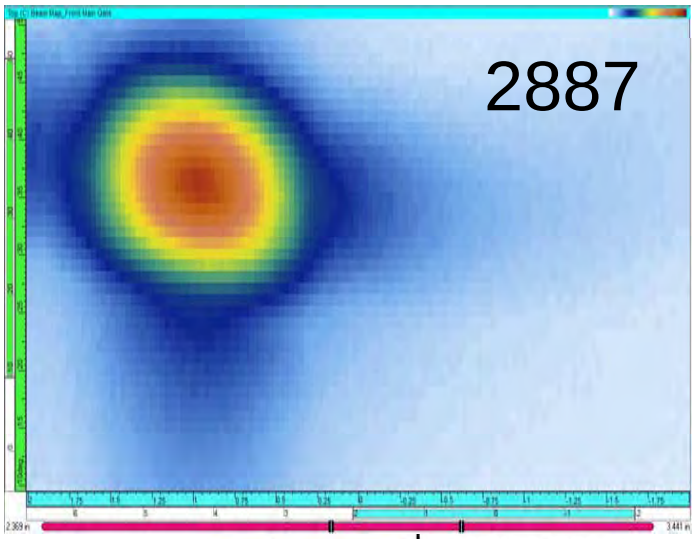
Front Pulse P-E Mode



Rear Pulse P-E Mode







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Probe Measurements Utilizing the EPRI Ultrasonic Probe Verification System

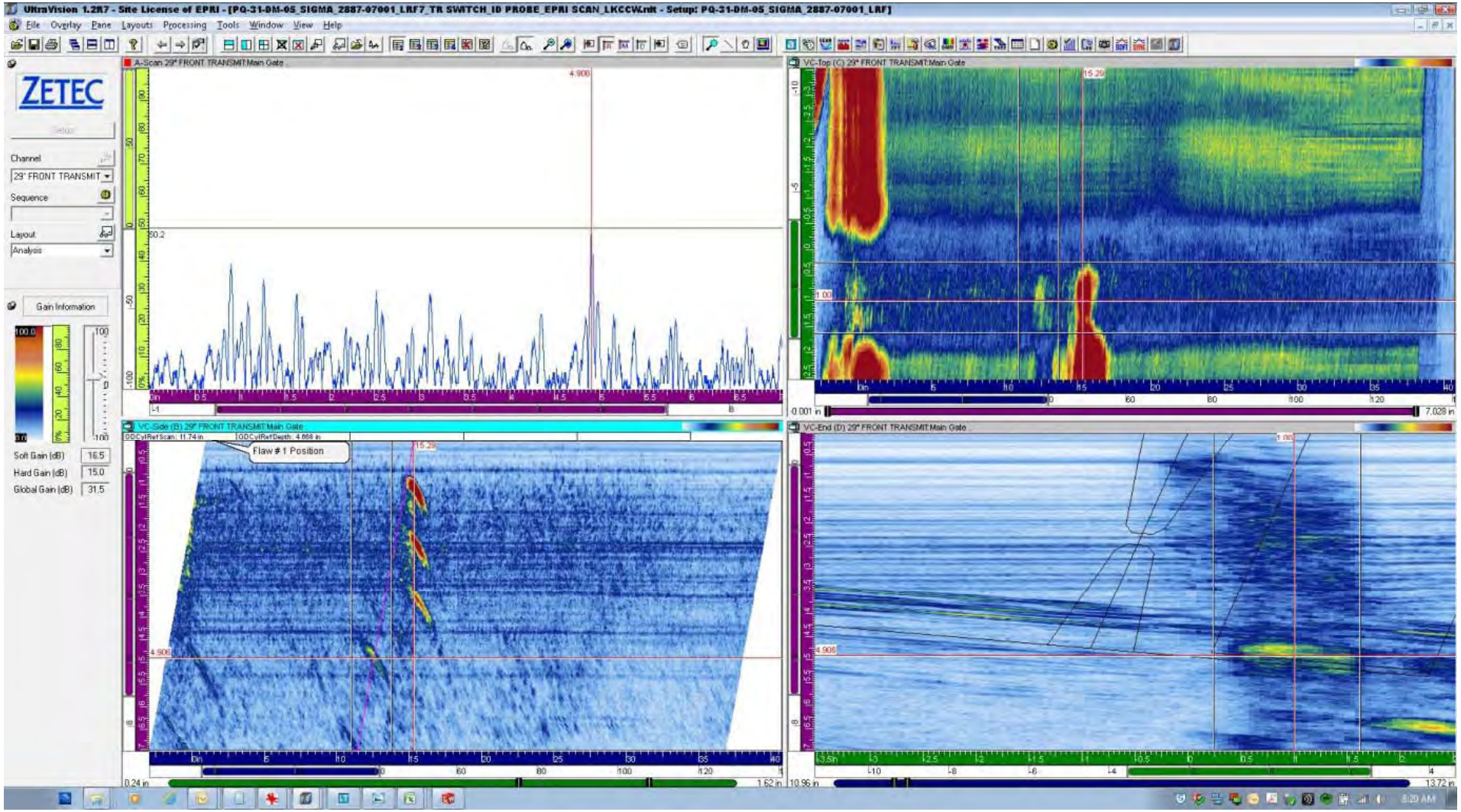
Test #	Probe	Test Type	Measured Refracted Angle	Measured Skew Angle
1	Probe Serial # 2886-07001	Pitch Catch / Front Element Pulse	27°	-10.6°
3	Probe Serial # 2886-07001	Pulse Echo / Front Element	25°	-11.8°
4	Probe Serial # 2886-07001	Pulse Echo / Rear Element	37°	-11.3°
5	Probe Serial # 2887-07001	Pitch Catch / Front Element Pulse	30°	12.2°
7	Probe Serial # 2887-07001	Pulse Echo / Front Element	25°	13.6°
8	Probe Serial # 2887-07001	Pulse Echo / Rear Element	38°	14.0°

Results:

- The taper correction angle (skew) maximum deviation is less than 2°
- The refracted angle as measured from the center of the search unit (pitch-catch mode) closely resemble the modeling results
- Front element of the 2886-07001 search unit produces a lower amplitude signal at the ID
- With exception to the 2886-07001 front element the beam seems to be well formed at 4” in metal path

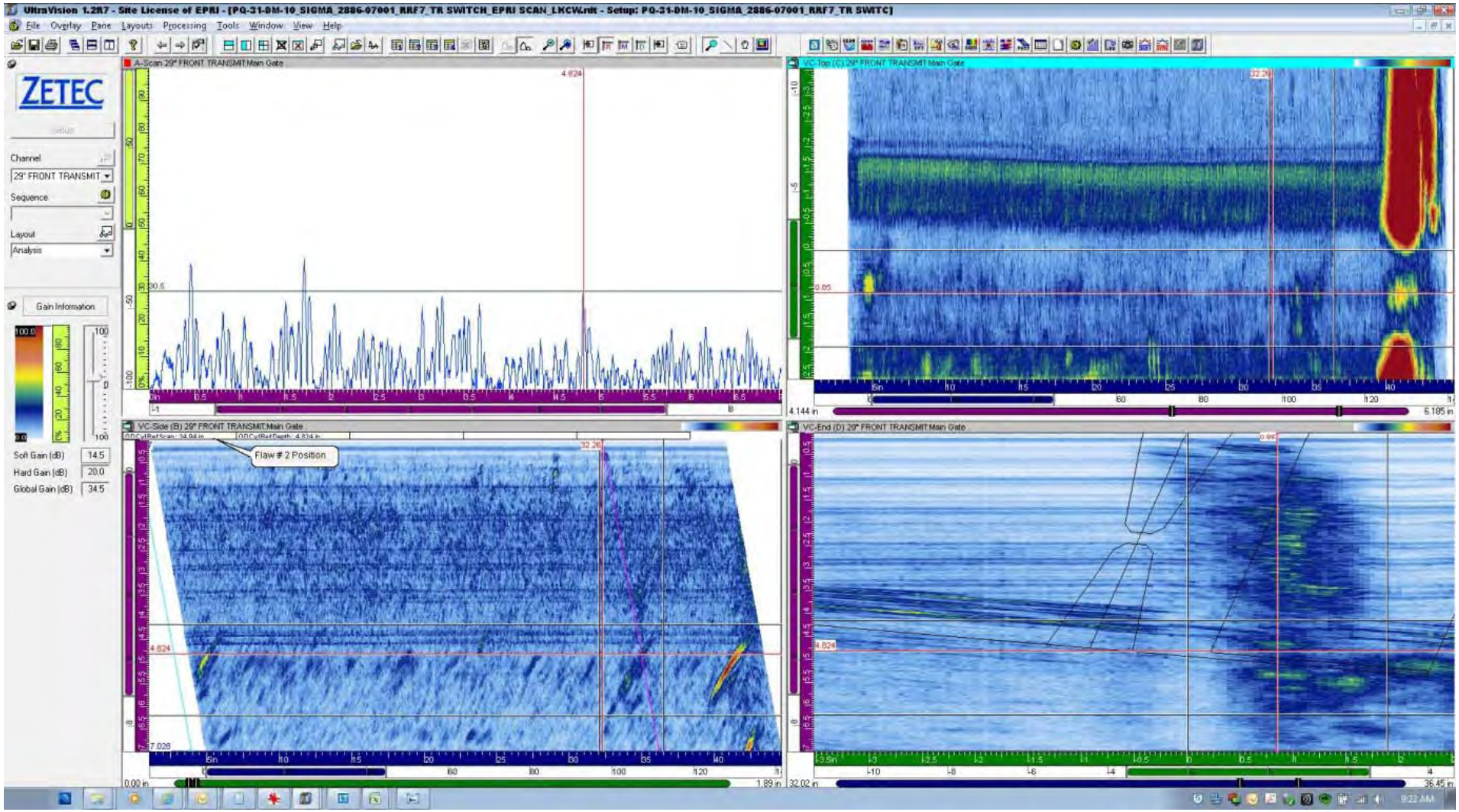
Search Unit Performance on Site Specific Mockup Flaws - PQ31-DM-05 – Flaw # 1

- Probe 2887-07001_LRF7_TR Search Unit_LKCCW



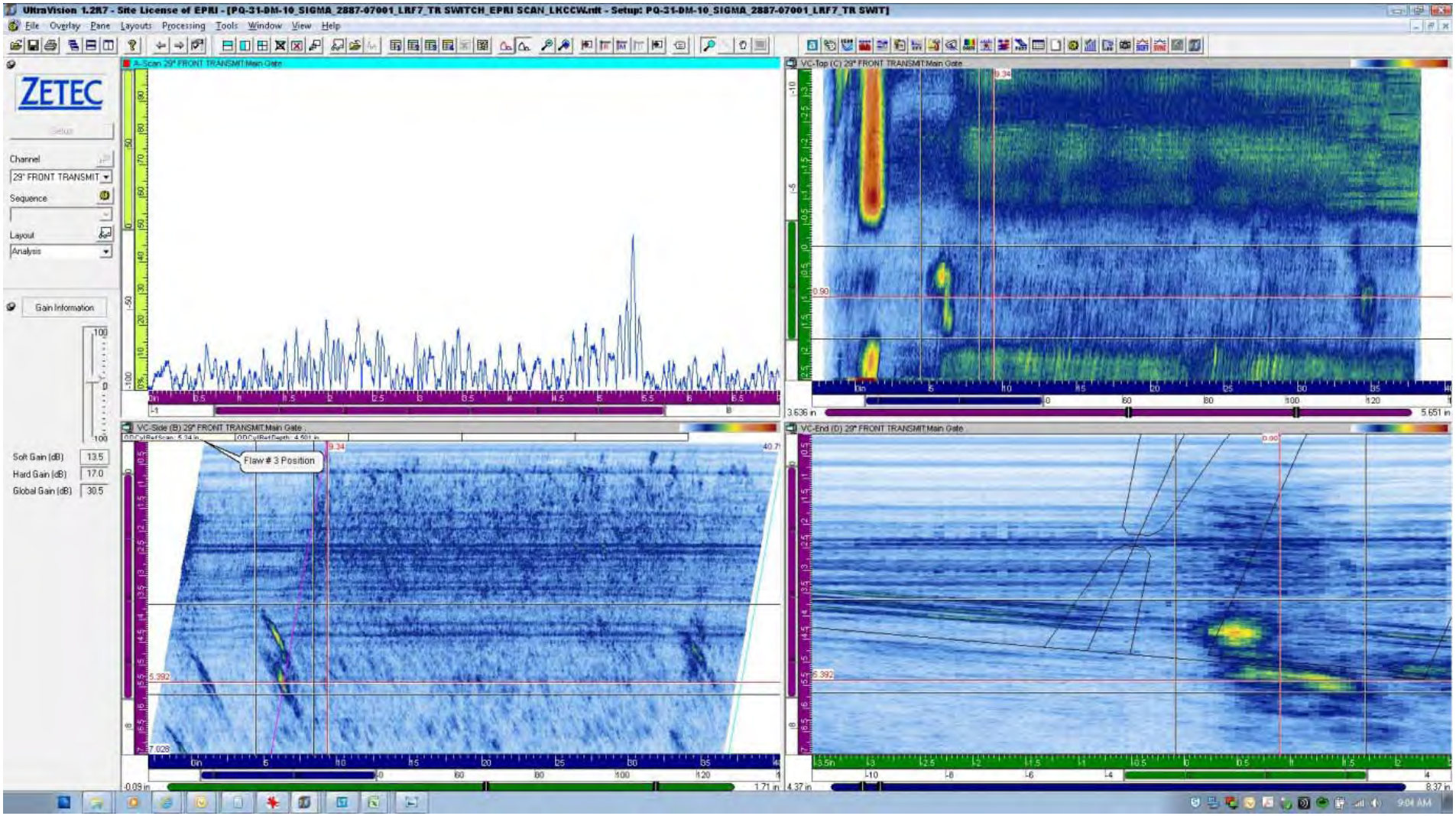
Search Unit Performance on Site Specific Mockup Flaws - PQ31-DM-10 – Flaw # 2

- Probe 2886-07001_RRF7_TR Search Unit_LKCW



Search Unit Performance on Site Specific Mockup Flaws - PQ31-DM-10 – Flaw # 3

- Probe 2887-07001_LRF7_TR Search Unit_LKCCW



Search Unit Performance on Site Specific Mockup Flaws

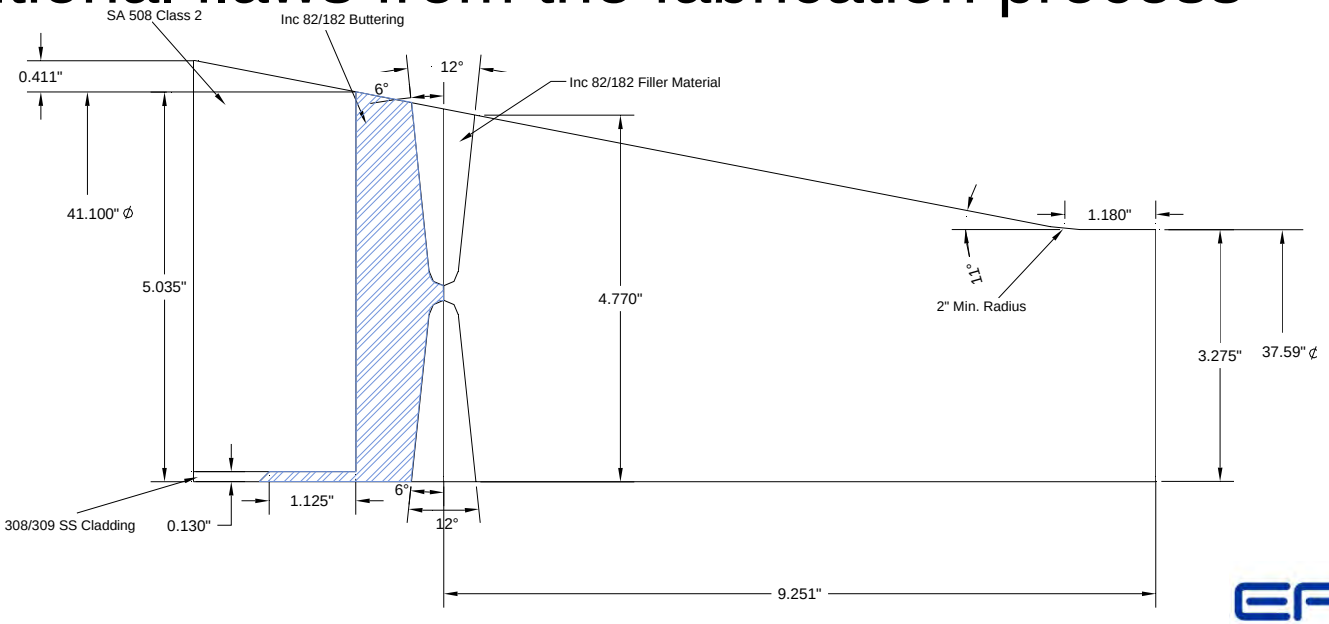
Results:

- **Both search units were shown to be capable of detecting axial flaws in the site specific mockups**
- The evaluation showed that the tandem search units were not capable of accurately depth sizing the axial flaws in the site specific mockups
  - Search Units not designed for depth sizing
  - The non encoded procedure was not qualified for depth sizing
- Minimal echo dynamic travel would make manual examination challenging
- Close flaw proximity to EDH and edges of the mockups are not ideal but they do allow for adequate access from at least one direction

	Mockup	DM-05	DM-10	
Measured Values	Flaw #	1	2	3
	Start(X1)	11.74	34.94	5.34
	Stop(X2)	11.74	34.94	5.34
	Y Start	0.45	0.35	0.05
	Y Stop	1.65	1.25	0.90
	Length	1.20	0.90	0.85
	Depth	0.518	0.356	1.028
As-Built Information:	Start(X1)	12.52	35.70	5.35
	Stop(X2)	12.52	35.70	5.35
	Y Start	0.01	-0.24	-0.06
	Y Stop	1.21	1.36	0.94
	Length	1.200	1.598	1.004
	Depth	1.589	2.510	0.839
	% T.W.	31.98%	50.84%	17.00%
	T @ Flaw	4.968	4.937	4.934
	Initiation	ID Connected	ID Connected	ID Connected
Deviations	**Length**	**0.00**	**-0.698**	**-0.154**
	Depth	**-1.071**	**-2.154**	**0.189**

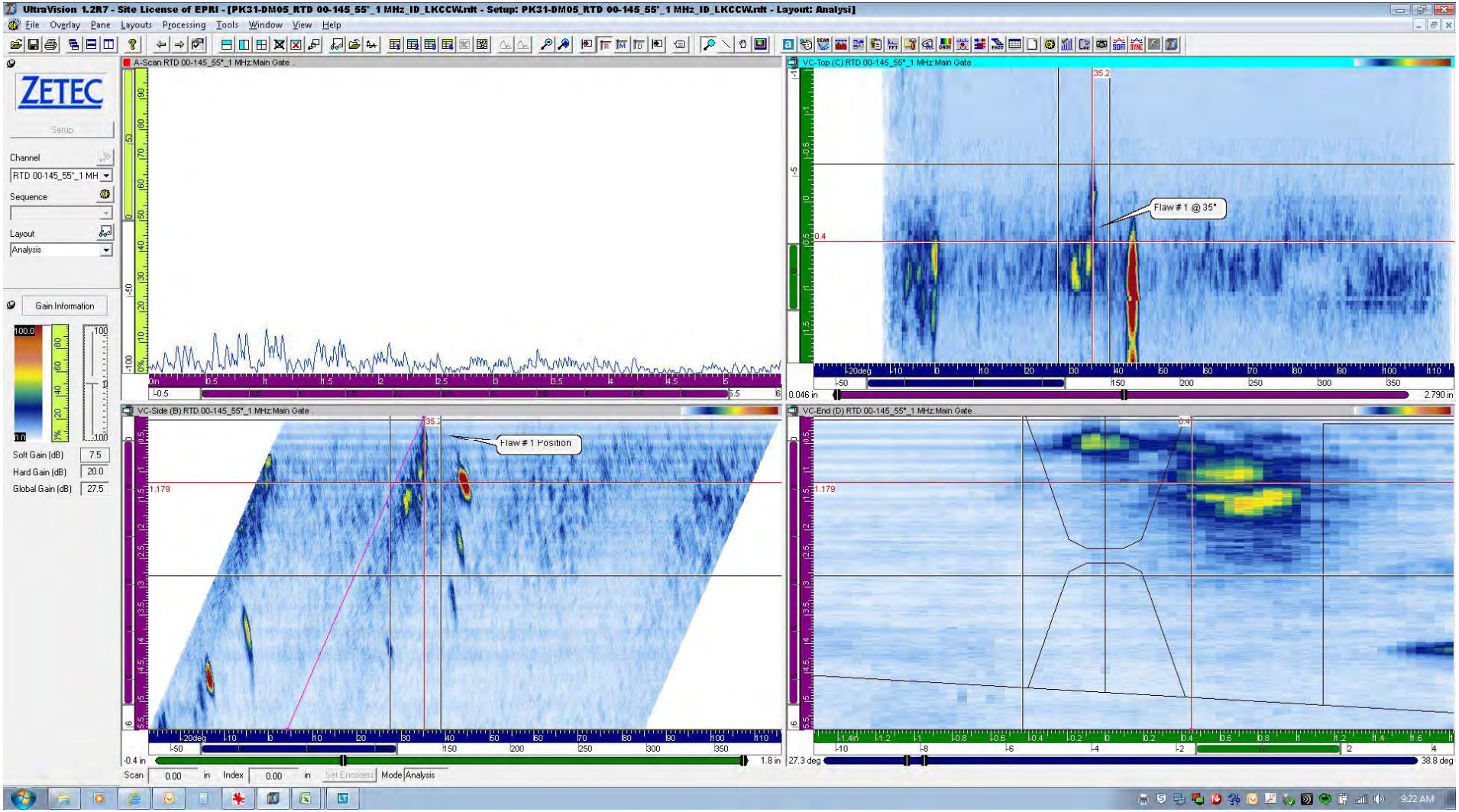
Site Specific Mockup Evaluation

- EPRI staff used ultrasonic techniques to characterize the flaws in the North Anna mockups supplied by Dominion
- The intended focus of this work was to evaluate the axial flaws contained within the mockups but an effort was made to also characterize the circumferential flaws
- Supplemental scans were performed to identify unintentional flaws from the fabrication process



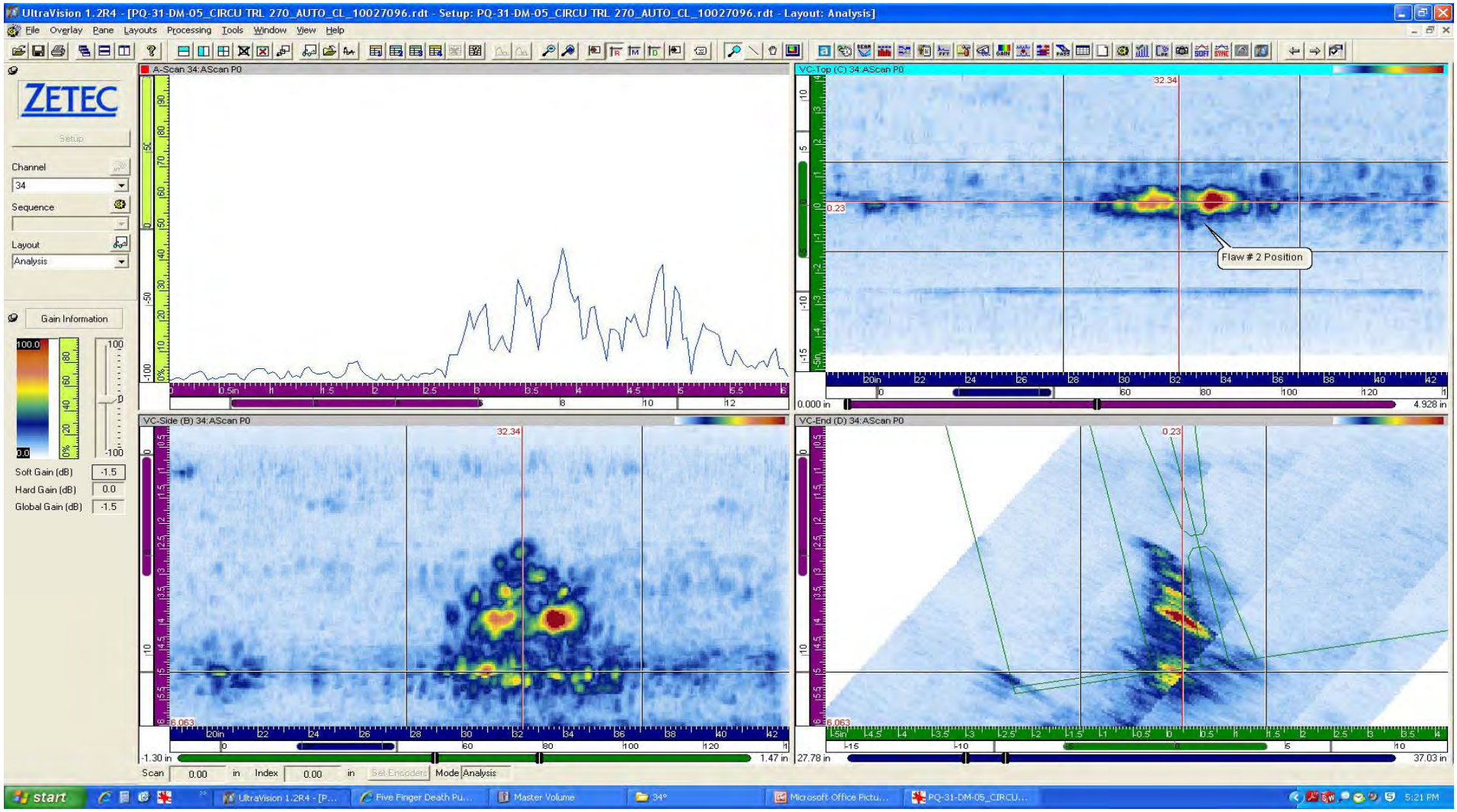
Site Specific Mockup Evaluation
PQ31-DM-05 – Flaw # 1

- 55°_1MHz_ID Surface_LKCCW



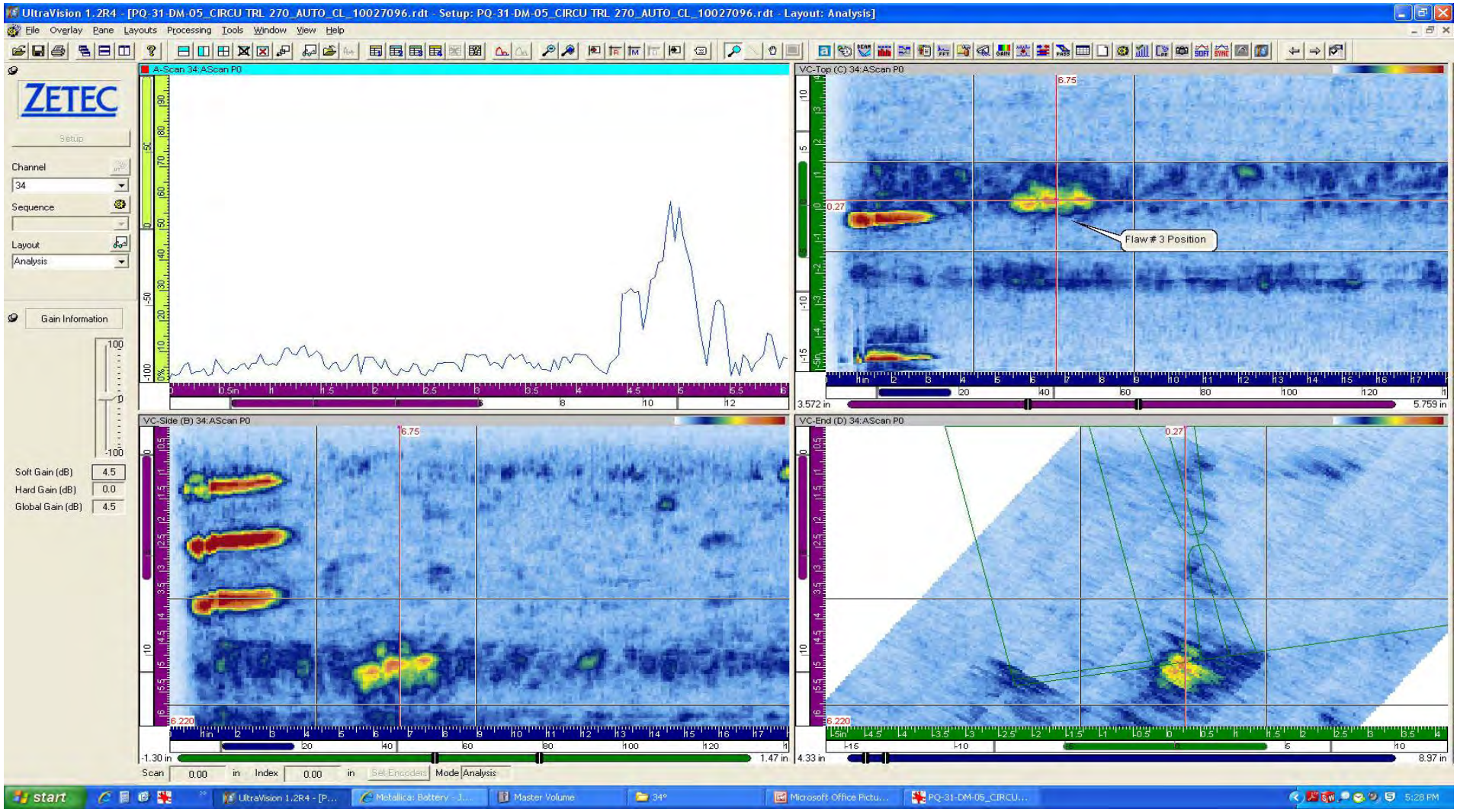
Site Specific Mockup Evaluation
PQ31-DM-05 – Flaw # 2

- 34°_1.5MHz_OD Surface_LKDN



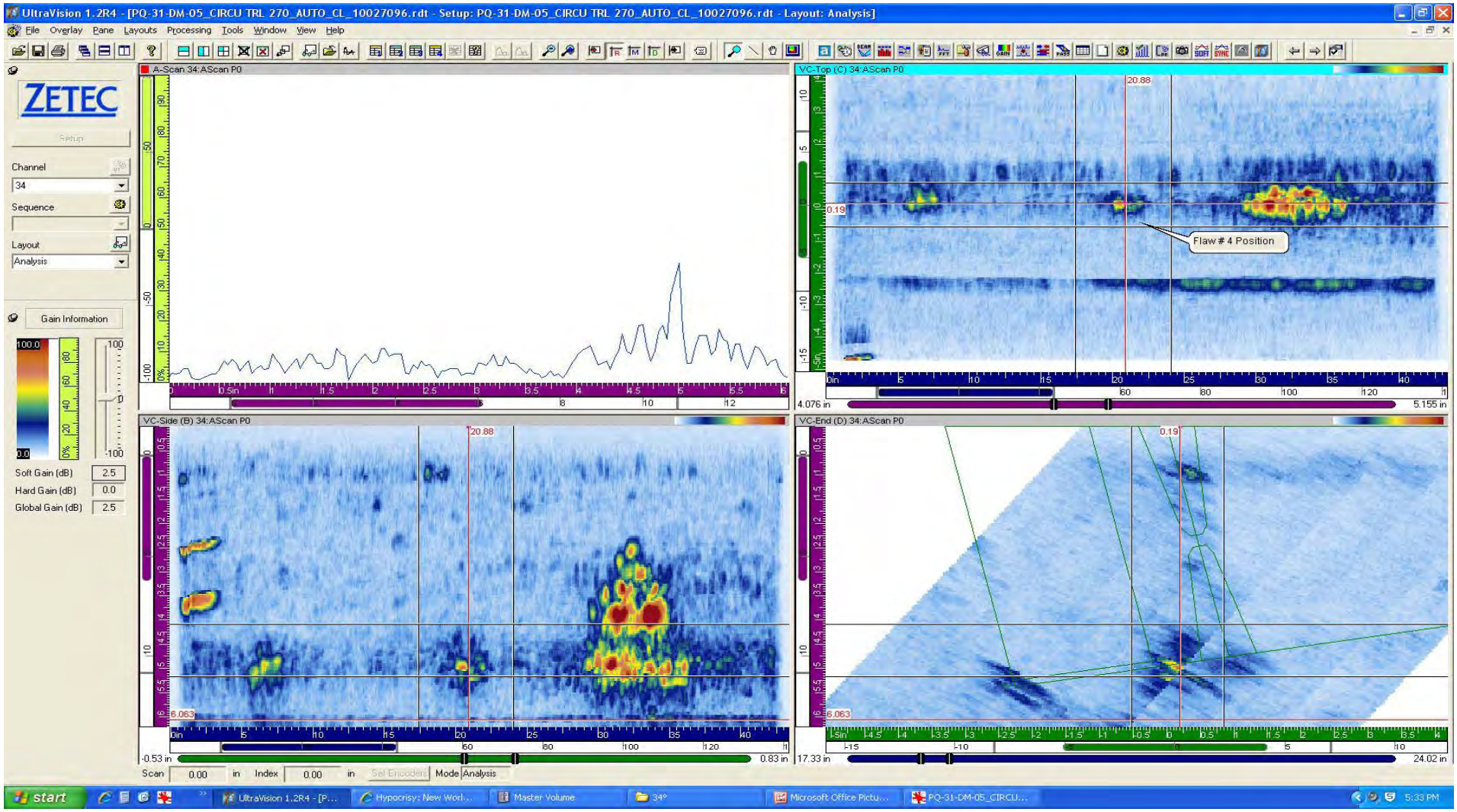
Site Specific Mockup Evaluation
PQ31-DM-05 – Flaw # 3

- 34°_1.5MHz_OD Surface_LKDN



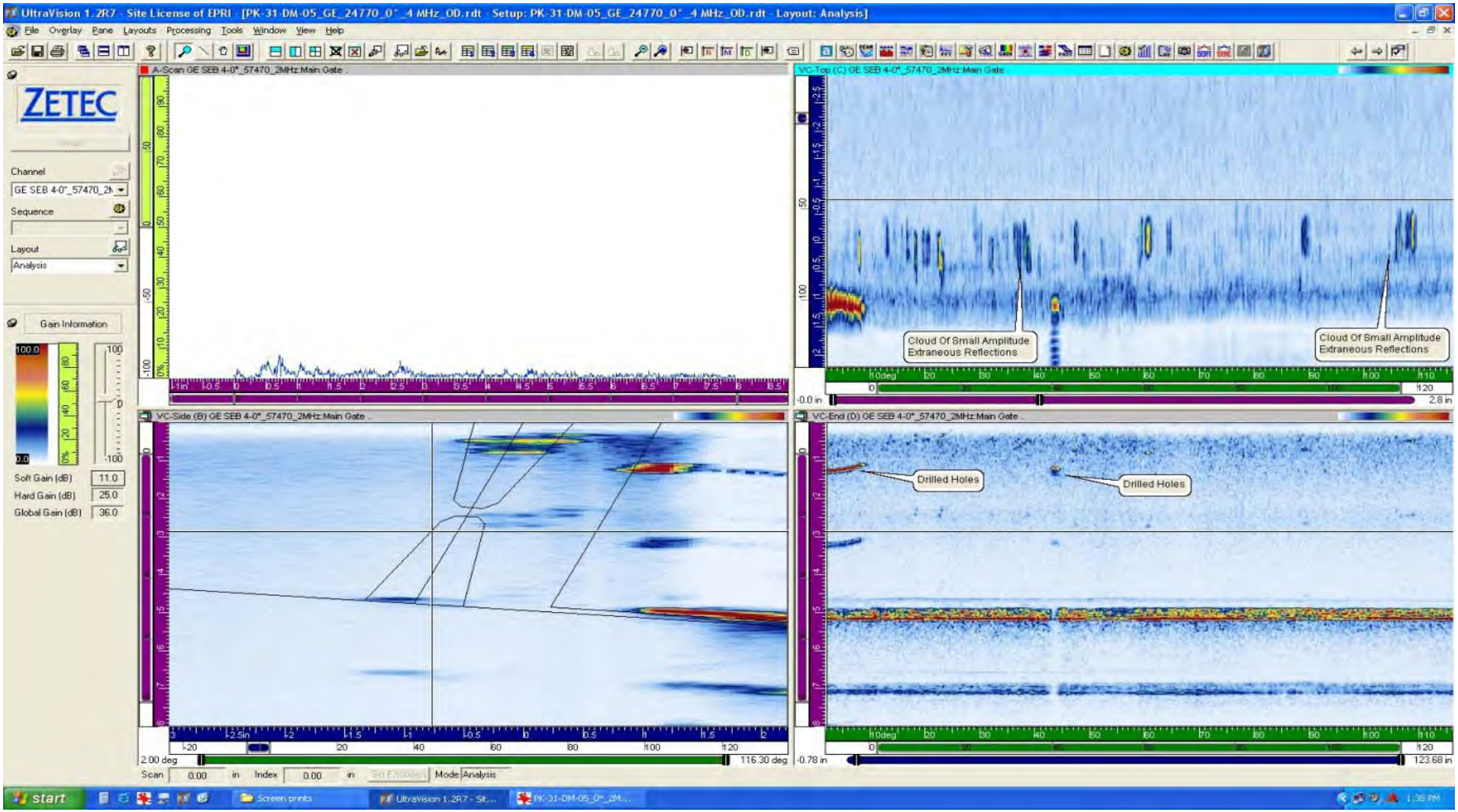
Site Specific Mockup Evaluation
PQ31-DM-05 – Flaw # 4

- 34°_1.5MHz_OD Surface_LKDN



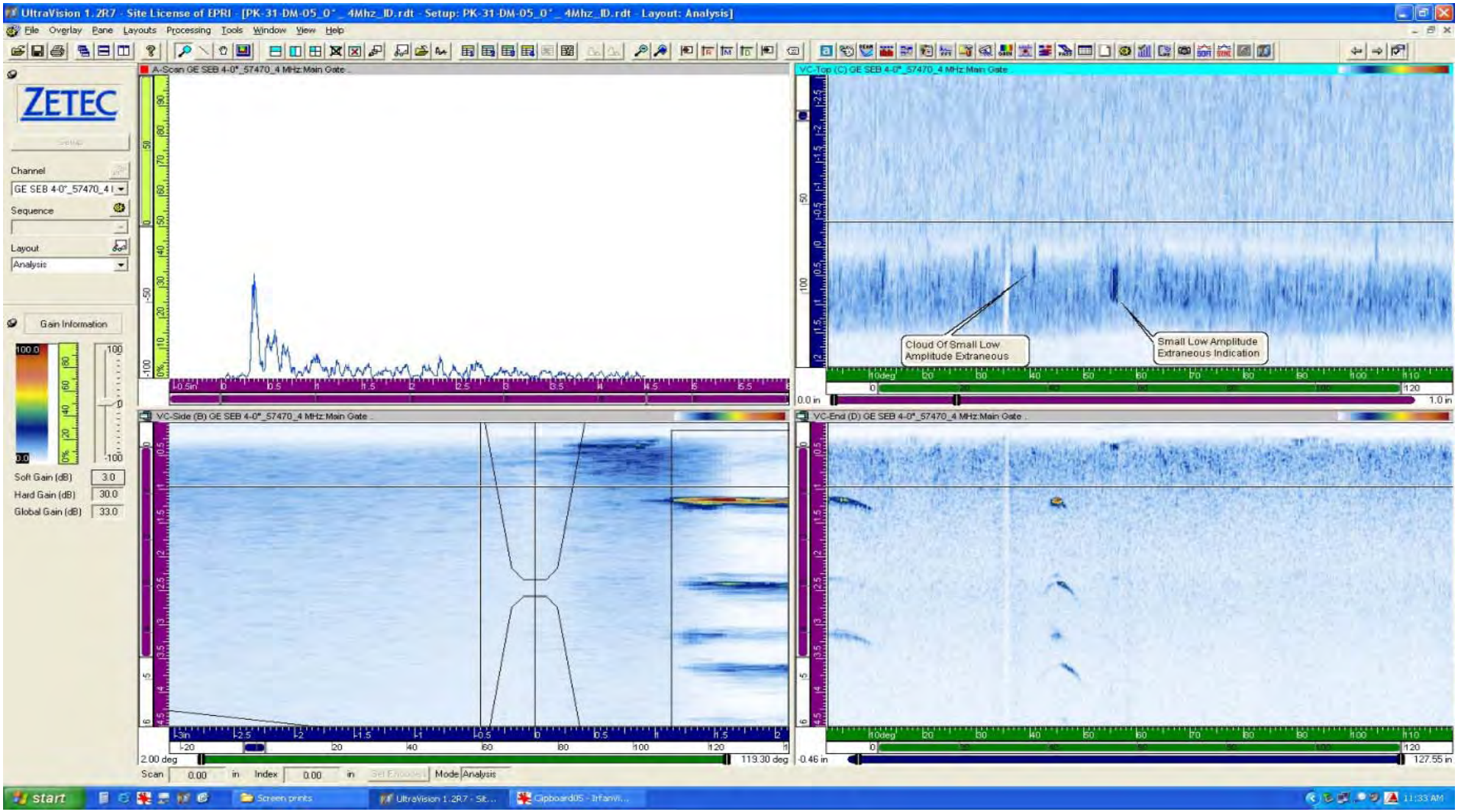
Site Specific Mockup Evaluation
PQ31-DM-05 – Extraneous Reflectors

- 0°_4.0MHz_OD Surface



Site Specific Mockup Evaluation
PQ31-DM-05 – Extraneous Reflectors

- 0°_4.0MHz_ID Surface



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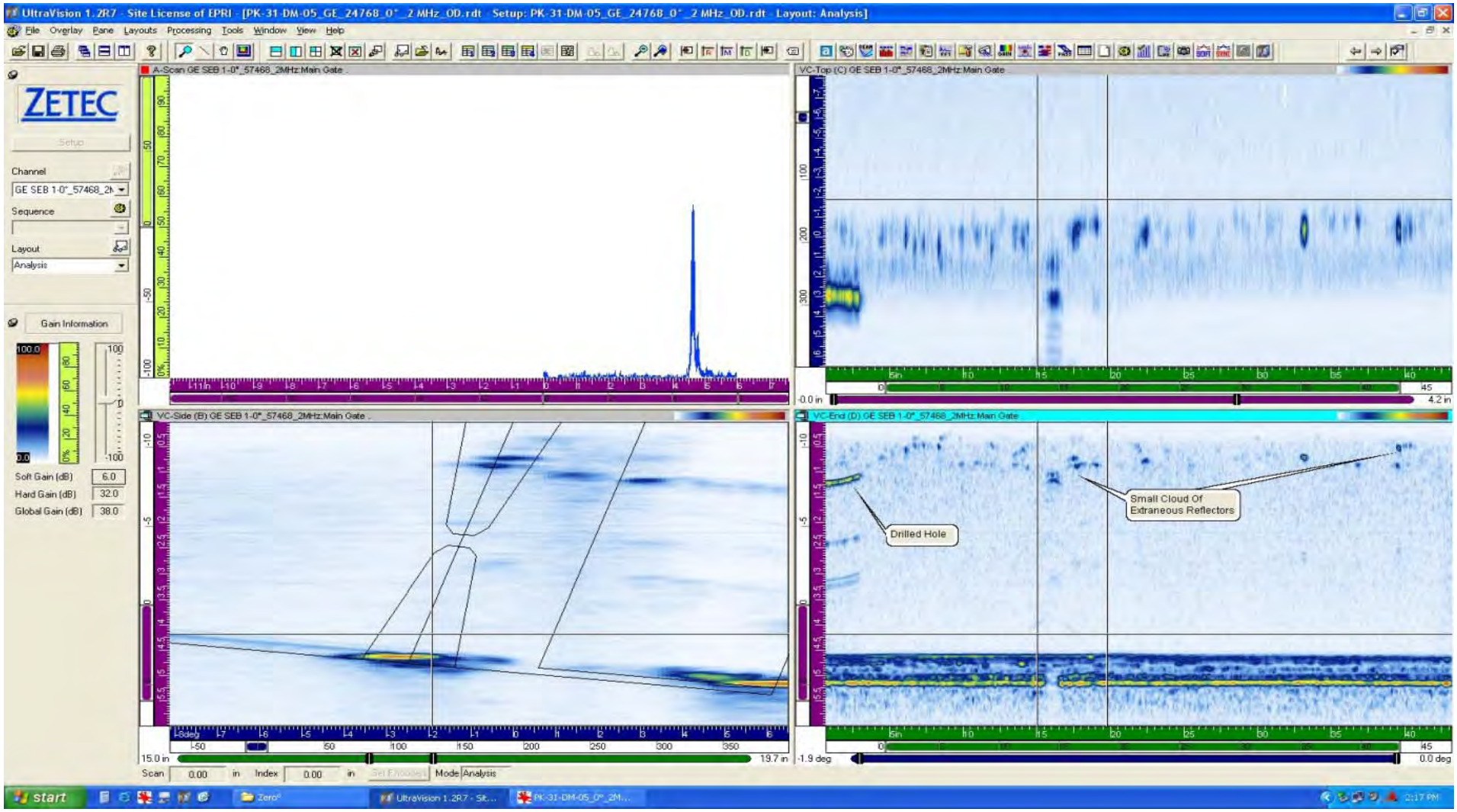
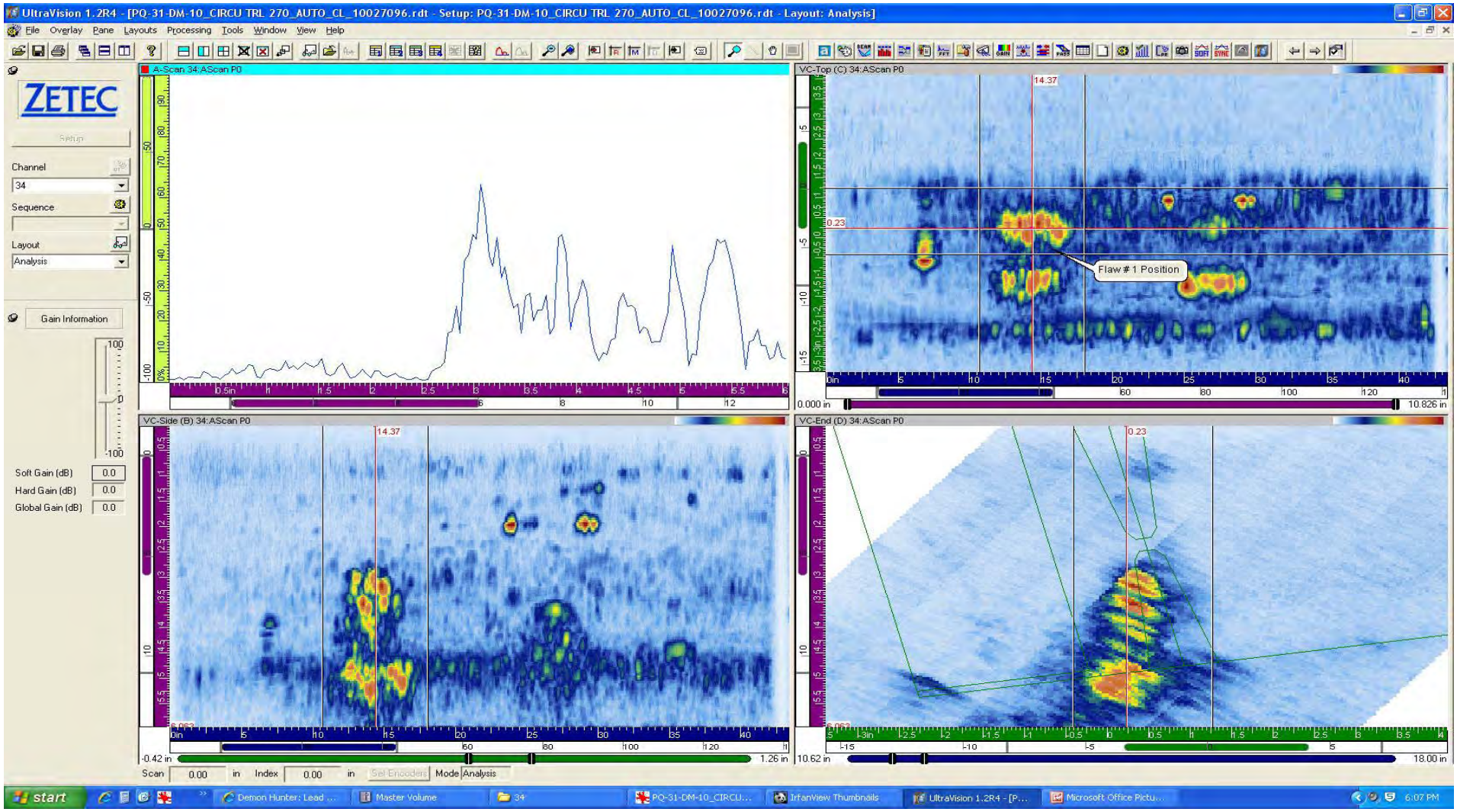
Site Specific Mockup Evaluation
PQ31-DM-05 – Extraneous Reflectors

- 0°_2.0MHz_OD Surface



Site Specific Mockup Evaluation
PQ31-DM-10 – Flaw # 1

- 34°_1.5MHz_OD Surface_LKDN



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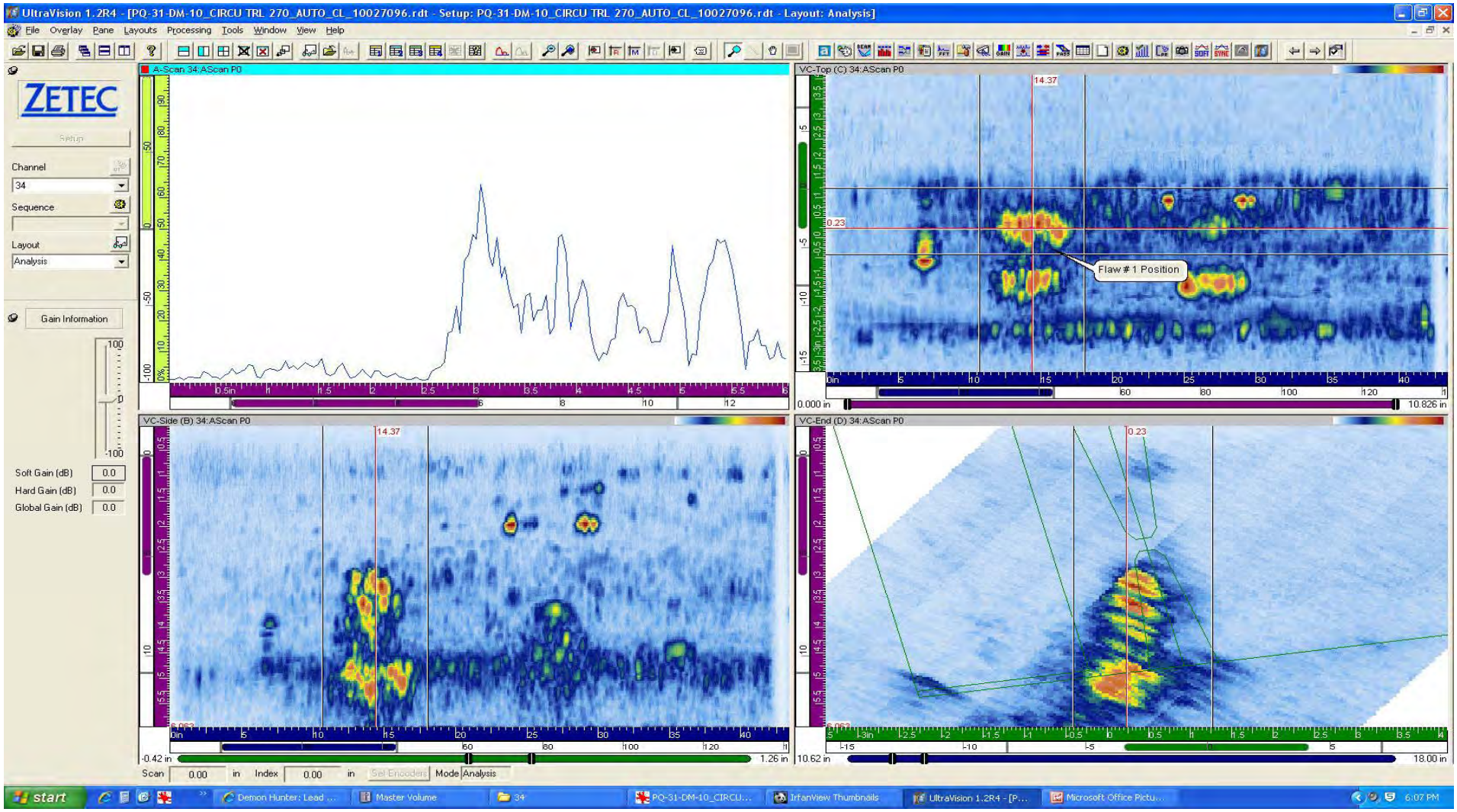
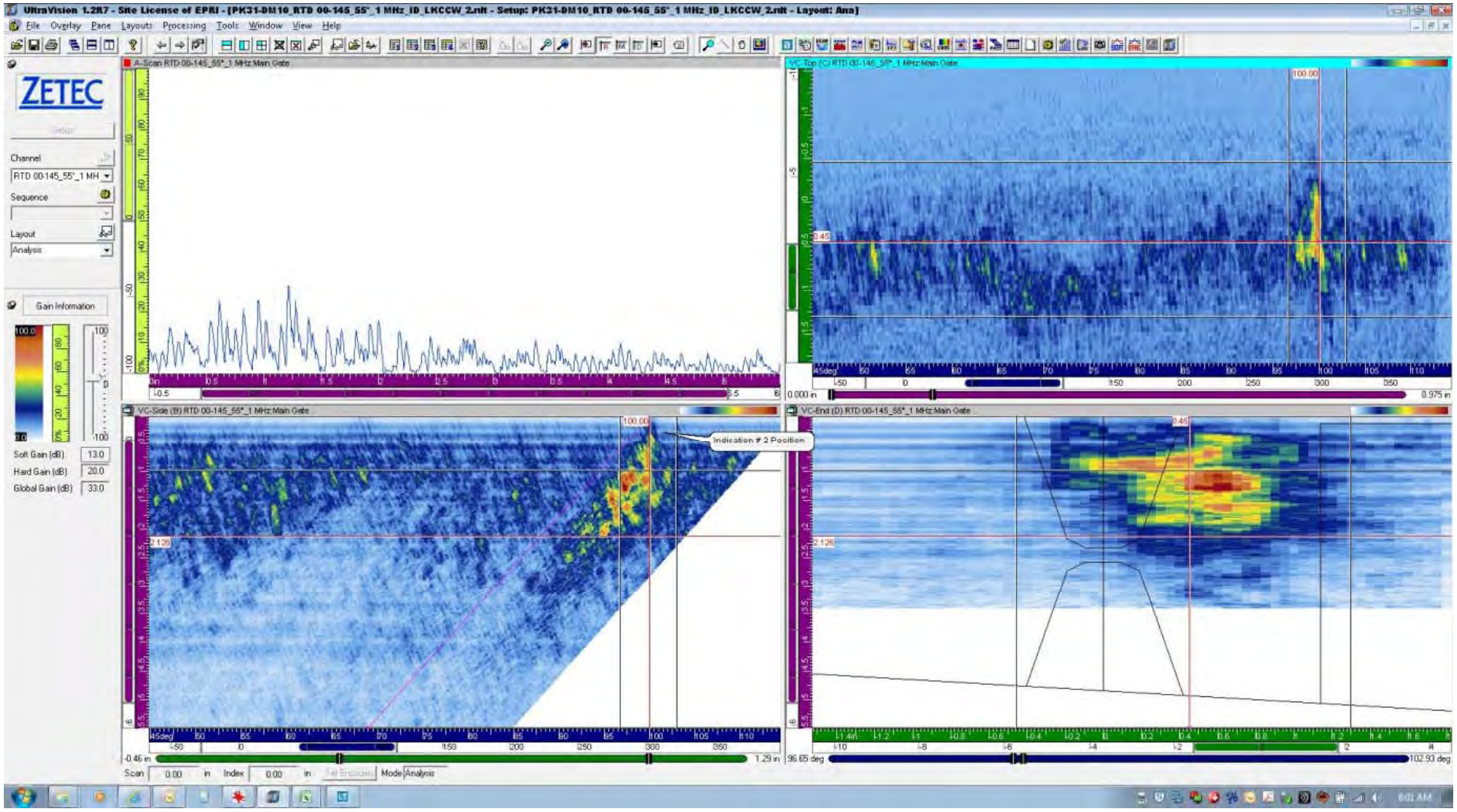
Site Specific Mockup Evaluation
PQ31-DM-10 – Flaw # 1

- 34°_1.5MHz_OD Surface_LKDN



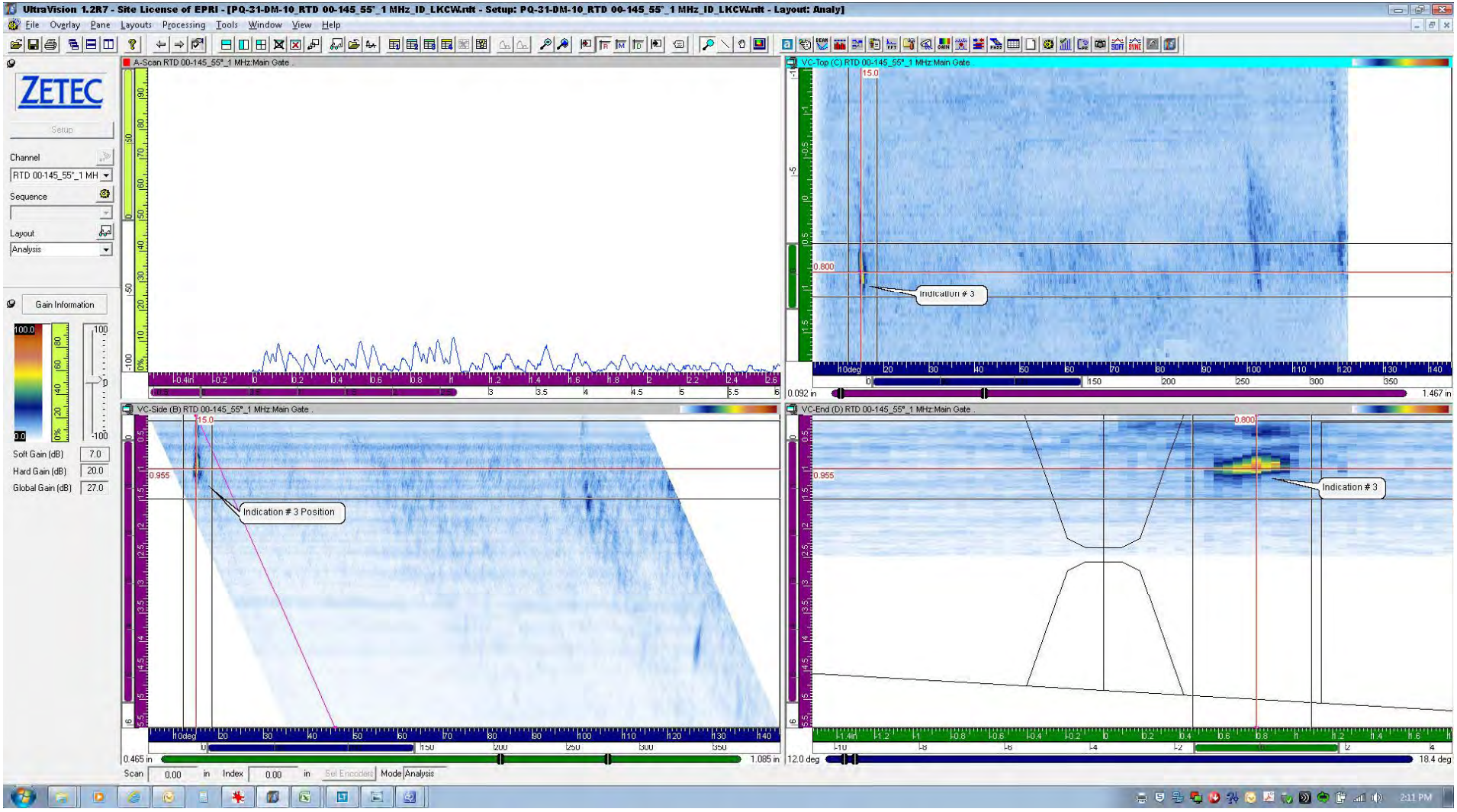
Site Specific Mockup Evaluation
PQ31-DM-10 – Flaw # 2

- 55°_1MHz_ID Surface_LKCCW



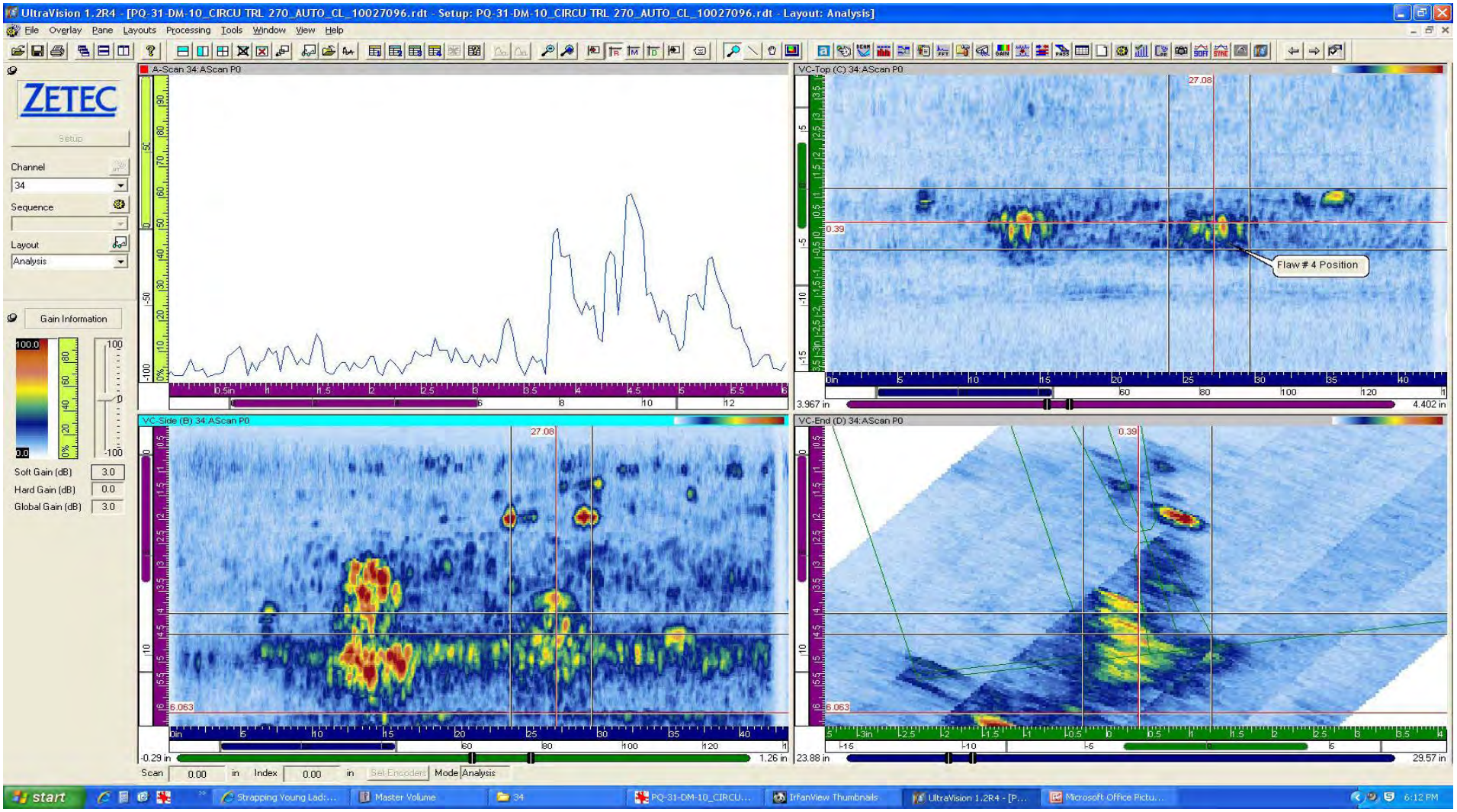
Site Specific Mockup Evaluation
PQ31-DM-10 – Flaw # 3

- 55°_1MHz_ID Surface_LKCW



Site Specific Mockup Evaluation
PQ31-DM-10 – Flaw # 4

- 34°_1.5MHz_OD Surface_LKDN



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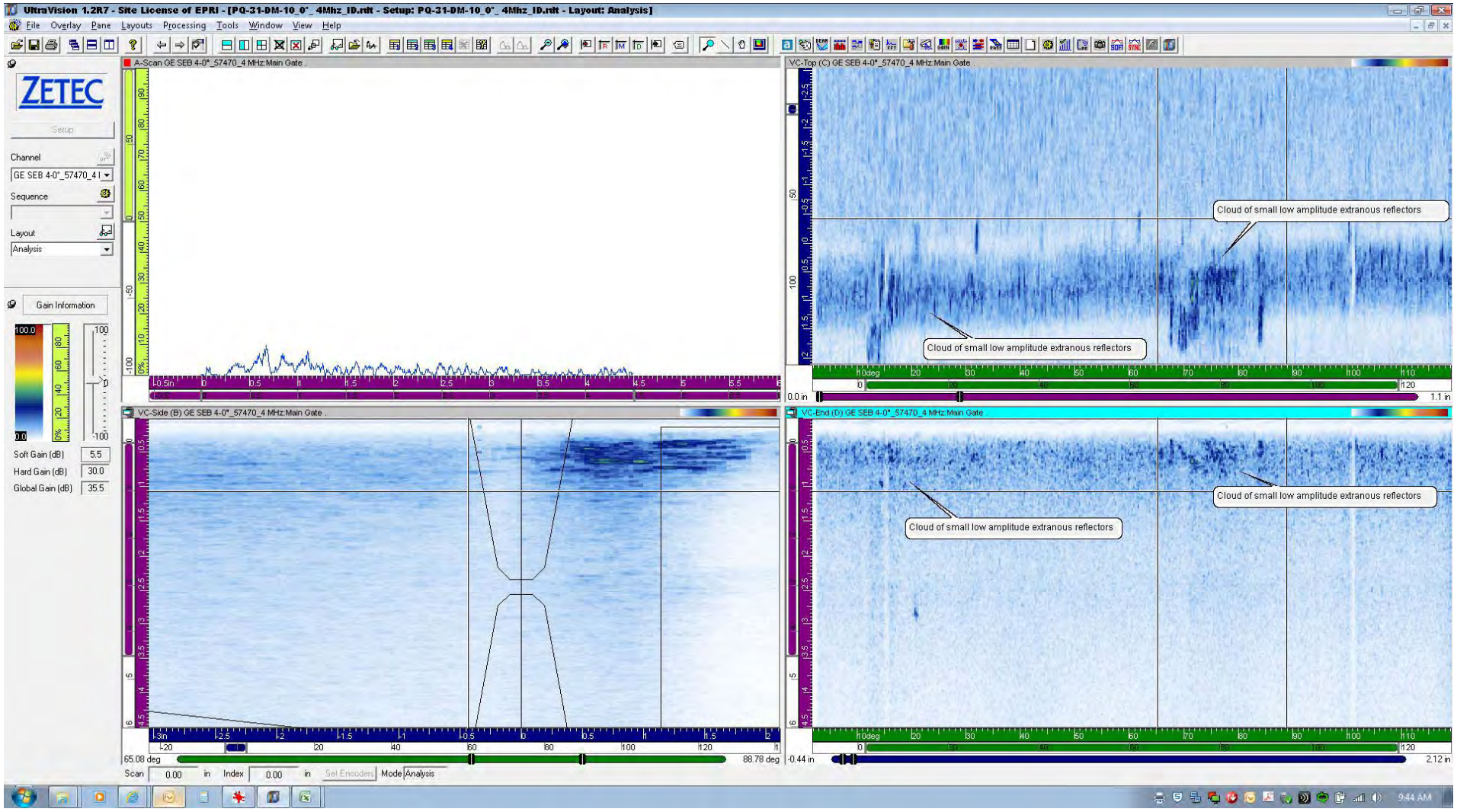
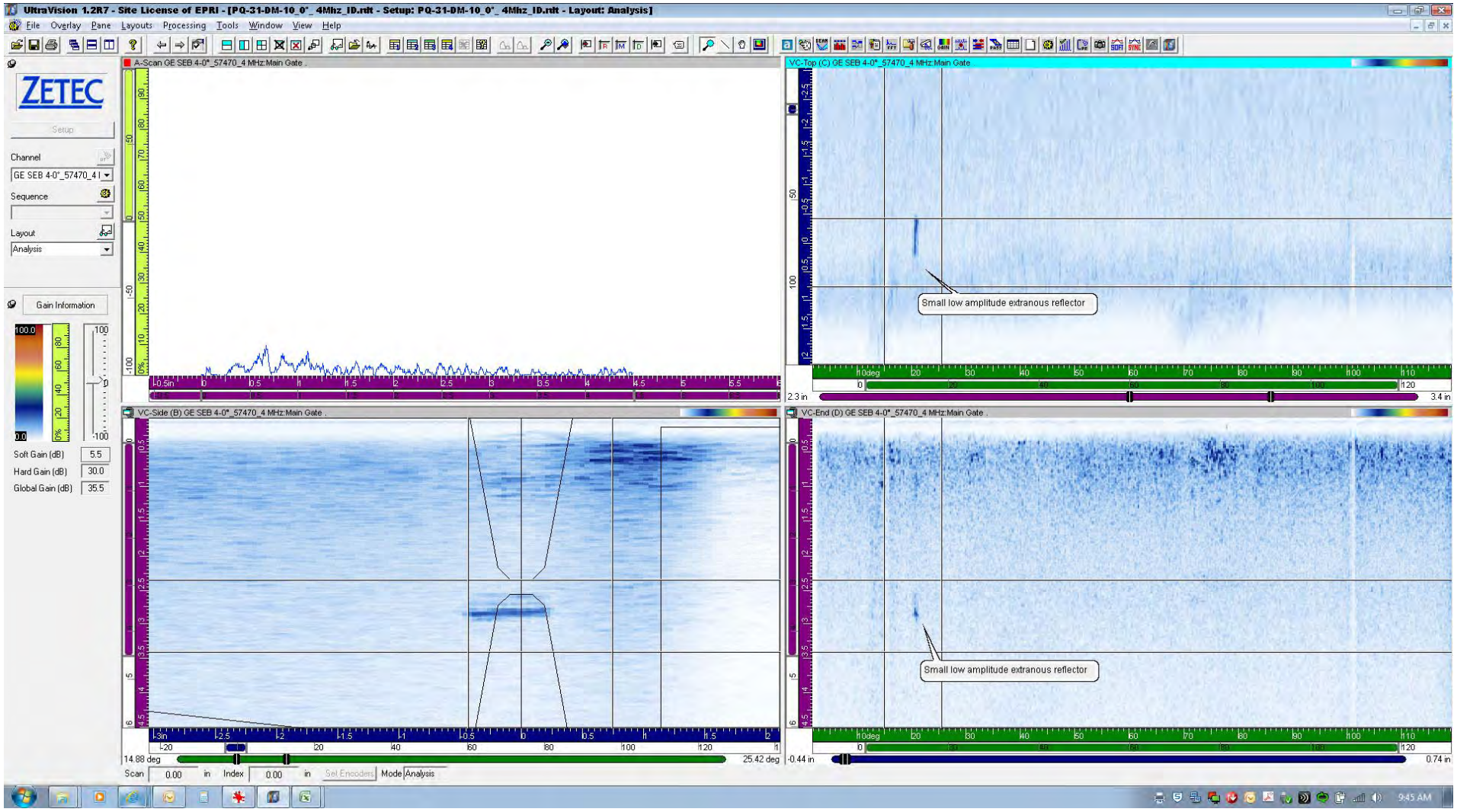
Site Specific Mockup Evaluation
PQ31-DM-10 – Extraneous Reflectors

- 0°_4.0MHz_ID Surface



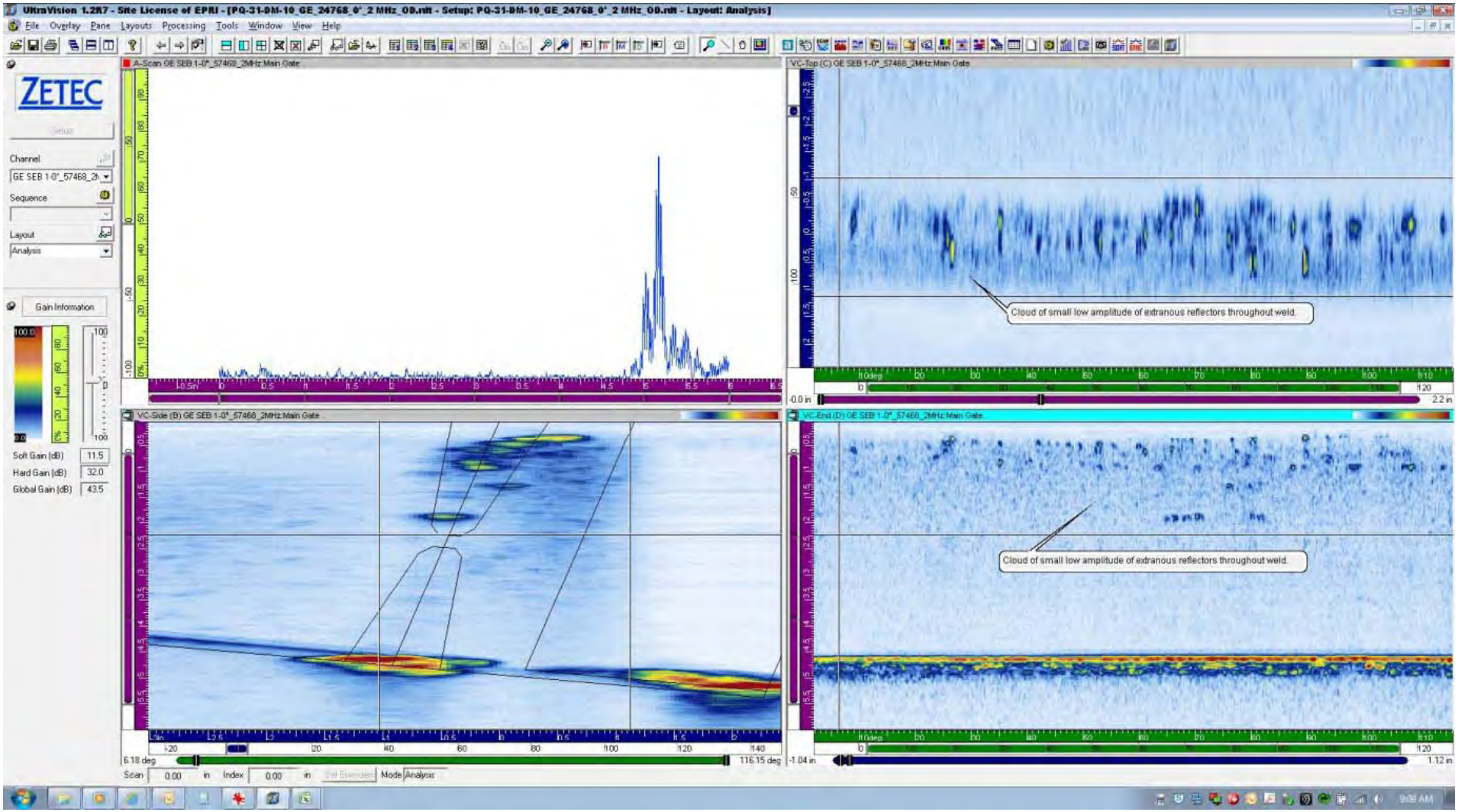
Site Specific Mockup Evaluation
PQ31-DM-10 – Extraneous Reflectors

- 0°_4.0MHz_ID Surface



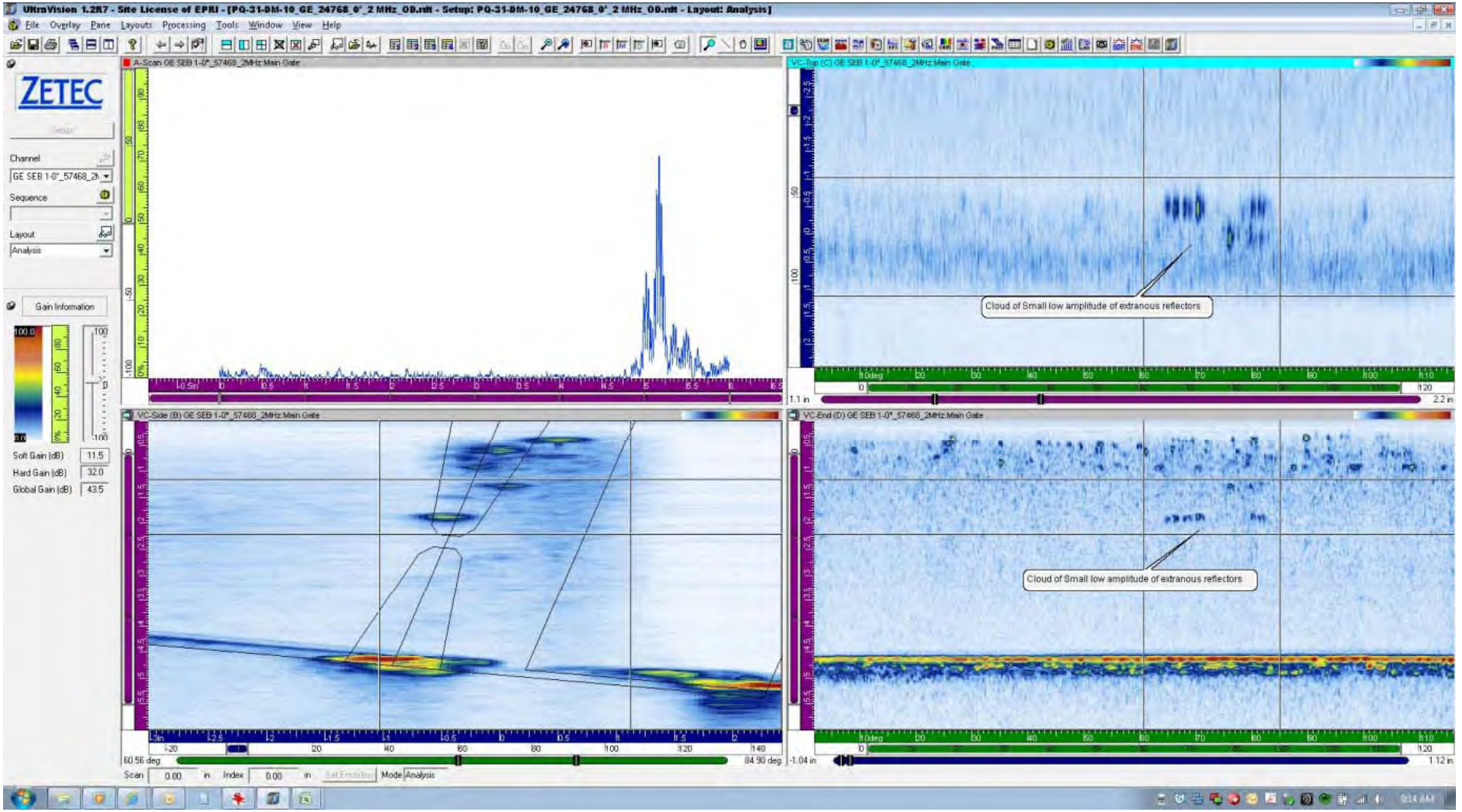
Site Specific Mockup Evaluation
PQ31-DM-10 – Extraneous Reflectors

- 0°_2.0MHz_OD Surface



Site Specific Mockup Evaluation
PQ31-DM-10 – Extraneous Reflectors

- 0°_2.0MHz_OD Surface



Site Specific Mockup Evaluation
PQ31-DM-10 – Extraneous Reflectors

- 49°_1.5MHz_OD Surface_LKDN