

Attachment 3



Dissimilar Metal Weld Qualifications

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Performance Demonstration



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Outline

- Status of UT qualification for DM welds
- Demonstration Status
- UT reliability estimates for various weld configurations & procedure variables
- Ongoing Industry Initiatives to Reduce Limitations
- Summary



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Status Overview

- Qualified NDE (detection & sizing) is available for large population of DM welds
- The PDI sample set spans what we thought was the majority of configurations present in plants
 - Never planned to cover everything
 - Discovering that we don't know the actual configurations that well
- Remaining limitations to detection are primarily due to geometry
 - Tapers
 - ID geometry
 - Weld crowns
 - Adjacent welds
 - Slope of vessel nozzle
 - Short safe-ends
 - Cast SS



Where we have good access, UT detection reliability is very high

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Overview

- "Qualified" detection means—The procedure achieved 100% detection of at least 30 flaws in a range of configurations (thickness, diameter, flaw types/location, geometry)
 - Not all personnel can achieve 100% detection
 - Detection qualification for OD examination has been achieved only for smooth OD conditions
 - ID detection qualification achieved (3 teams qualified even with ID geometry conditions, others have achieved only circumferential detection)
 - Alternative techniques have been used in some cases in order to fully characterize defects properly
 - ET for flaws in close proximity to the inside surface where UT resolution is limited
 - ET for areas where geometry prohibits search unit to move completely over the flaw
 - Bias—if the technique doesn't work for certain conditions, qualification isn't attempted



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Overview Cont;

- "Qualified" sizing means--The procedure achieved Appendix VIII criterion of 0.125" rmse for a minimum of 30 flaws
 - Qualification has been achieved from OD-auto (smooth surfaces up to ~2.5")
 - manual-not achieved-larger errors
 - Sizing error for ID exceeds 0.125 rms, but is measurable and useable in flaw evaluations
 - 0.125" criteria may not be fully achievable
 - Vendors have made significant changes to software and techniques in order to achieve meaningful sizing results



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Qualification Pass Rates

- Manual DM Qualifications (UNAUDITED DATA)
 - OD
 - Unable to query data effectively, but the estimated pass rates are;
 - ~73% detection,
 - ~33% length sizing
 - 0% depth sizing
 - No further attempts have been performed for depth sizing
 - Approximately 17 attempts, all resulted in a RMS of >0.125



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Qualification Pass Rates

- Automated DM Qualifications (UNAUDITED DATA)
 - OD
 - Unable to query data effectively, but the estimated pass rates are;
 - ~73% detection,
 - ~63% length sizing
 - ~45% depth sizing
 - ID
 - Unable to query data effectively, but the estimated pass rates are;
 - ~91% detection
 - ~88% length sizing
 - 0% depth sizing



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Qualification Status OD

- Automated
 - 4 vendors have qualified procedures for detection and length sizing
 - General Electric
 - Framatome ANP
 - WESDYNE
 - LMT
 - A total of ~ 19 candidates have successfully qualified for detection and length sizing
 - 3 vendors have qualified acceptable (<0.125"RMS)depth sizing procedures
 - General Electric,
 - Framatome &
 - WESDYNE)
 - A total of ~ 13 analyst have successfully qualified for depth sizing
 - Procedures are limited primarily to BWR configurations/thickness
 - No tapers or transitions, flush weld crowns



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Qualification Status ID

- 5 vendors have qualified procedures for detection and length sizing
 - WESDYNE (USA) *
 - AREVA (USA)
 - AREVA (GERMANY)
 - INTETEC (CROATIA) *
 - IHISWT (USA)
 - *Have axial flaw detection limitations
- A total of = 13 candidates have successfully qualified for detection and length sizing
- 3 vendors have demonstrated reliable depth sizing capability, but above code acceptance criteria
 - AREVA USA,
 - AREVA Germany &
 - WESDYNE
- A total of = 12 analyst have demonstrated depth sizing capability within the procedure limits



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Qualification Results

- Database contains un-validated results of every detection attempt and every sizing measurement taken in PDI qualifications
- Database includes for each measurement
 - Flaw size, type, orientation
 - Procedure-Technique (ID, OD, Auto, Manual)
 - Sample Identification (configuration, material, size,....)
- At MRP's request Queries were made to evaluate detection results for
 - Axial and circumferential defects
 - Auto-vs-manual
 - Passed candidates-vs passed + failed
 - Pipe diameter effects
- MRP is using this data in I&E Guideline under development



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UT Reliability

- Queries are tedious at this stage
 - Proposal in process to improve data mining capabilities and validate data
- Caution: Queries are NOT validated
- Caution: Detection of circumferential and axial defects in some configurations was tried preliminarily, but if unsuccessful the effort was discontinued prior to starting an official qualification—this data is not in the statistics!
 - Where the procedure doesn't work- detection qualification is not attempted



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UT Reliability

- Passed means 100% detection by the procedure, 80% for the personnel
- "Passed only" data is optimistic estimate because not all personnel can achieve 100% performance of the procedure (might be only 1 person!)
- Using P+F gives a more realistic estimate of effectiveness
- Data confirms this



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Example of Detection Results (OD)

Case	Detection rate*	Number of attempts*
All flaws	86%	2835
All circ flaws	89%	1946
All axial flaws	78%	889
All OD automated	87%	712
All OD manual	77%	1183

* Does not include non-detection of circumferential and axial defects from OD in several samples-no procedure has worked there yet



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Example of Detection Results (OD)

Case	Detection rate*	Number of attempts*
All circ flaws from OD-auto	89%	477
All circ flaws from OD-manual	82%	806
All flaws auto	92%	1652
All flaws manual	77%	1183

* Does not include non-detection of circumferential and axial defects from OD in several samples-no procedure has worked there yet



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Detection Results (ID)

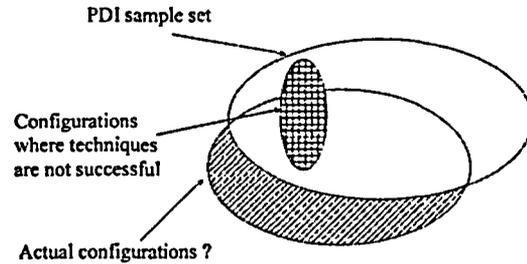
- Detection Rate Quite High
– >90% for Axial and Circumferential Flaws
- Candidate Pass Rates for Detection and Length Sizing using Qualified Procedures ~90%
- Candidate Depth Sizing accuracy very close to the procedures demonstrated capability



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Sample Applicability



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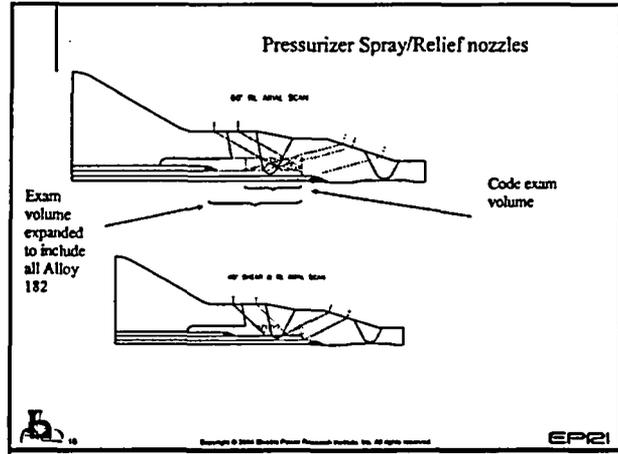
Example of Specific Configuration UT Effectiveness

- Can apply the results of the queries from the database for configurations bounded by the qualification set
- For configurations not bounded by the qualification set, must consider specific geometric conditions
 - Various approaches being considered
 - Geometric modeling
 - CAD
 - Need specific dimensional data (template)
- Application of qualified UT procedure to an example spray nozzle to show how much of the examination volume can actually be interrogated
- Illustrates the influences of the geometry in a complex, but common configuration- Westinghouse units
- There is no industry consensus on how to calculate coverage- ASME Code has dropped the issue after failing multiple times to reach consensus.

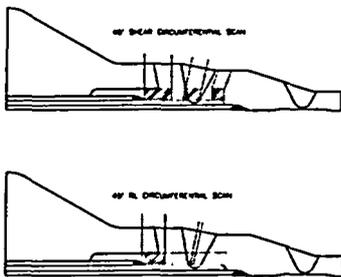


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Pressurizer Spray/Relief nozzles



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Industry Initiatives to Address Limitations

- MITAG Programs
 - Conventional Transducer Research
 - Phased Array
 - EMAT
 - Fabrication of Non-Smooth Dissimilar Metal Welds
 - Research in applications to examine Non-Smooth Dissimilar Metal welds
- NDEC Programs
 - Development of Configuration Database (Proposed)
 - Development of Statistical Databases (Proposed)
 - Flexible Phased Array Technology
 - Dissimilar Metal Weld Training Courses
 - Fabrication of additional mock-ups that address gaps in qualification set
 - Assisting with the fabrication of site specific mock-ups
 - Coordination with MEOG/MRP and BWR/VIP
- MRP Programs
 - Development of Inspection Guidelines
 - + Includes industry guidance on what to do if qualified UT is not available
 - Survey of as-found configurations
- PDI
 - Enhancing Generic Procedures
 - Developed Site Specific Mock-up Criteria
 - Working on standardization of coverage calculations
 - Guided Practice



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Summary

- Where access can be achieved, detection is highly reliable
- Configuration has strong effect on UT effectiveness
 - Still have some detection gaps for difficult configurations
 - R&D effort focused on the gaps
 - Alternative examination techniques may be required in order to fully characterize indications (ID Examinations)
- Sizing is qualified for many applications
 - Even where not qualified, sizing error is measurable (EXCEPT for MANUAL sizing)
- Un-validated Database of UT detection & sizing is available for wide range of procedures, flaw types & locations, but additional work is needed to effectively mine data
- Available Queries show the range of UT capability, but need to be validated



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