

BWRVIP Inspection Committee Report Out



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BWRVIP Inspection Committee Chair

NRC / Industry NDE Technical Information Exchange Meeting
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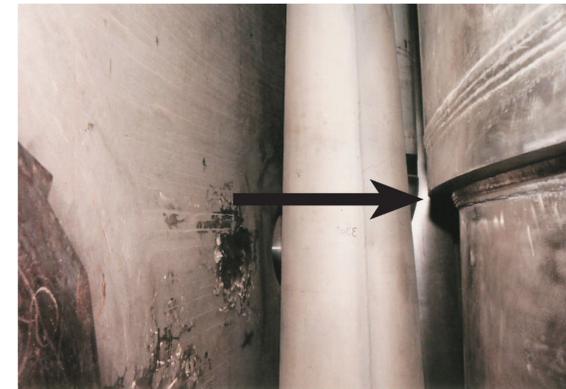
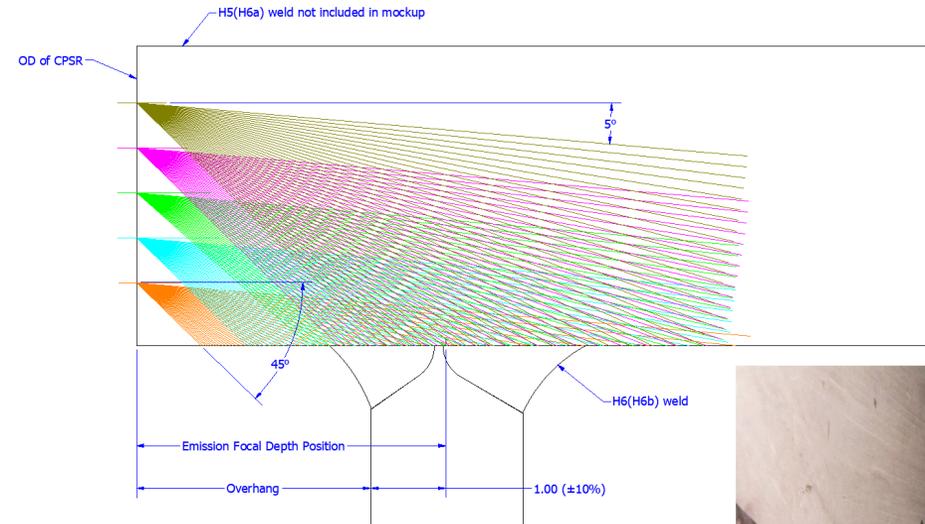
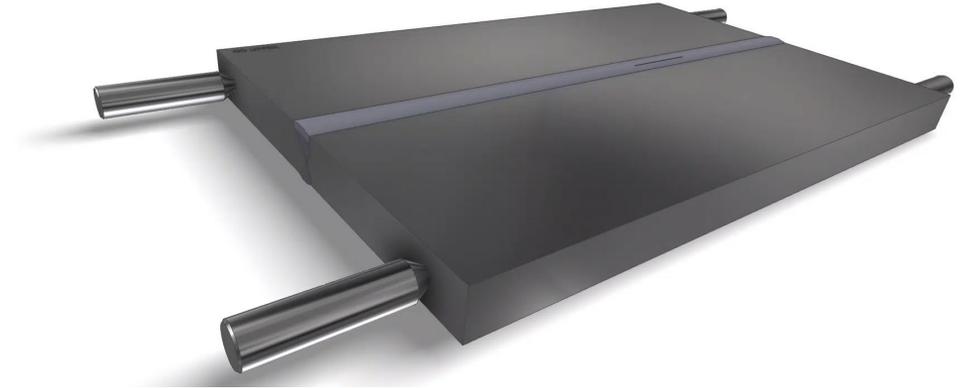
- Update on BWRVIP NDE Development activities
 - Contact UT for access hole covers
 - Benchmarking of BWRVIP demonstrated core barrel UT exam and hot cell evaluation of removed flaw specimens
 - New inspection gap proposed



Update On Inspection Vendor Demonstrations

Update On Inspection Vendor Demonstrations

- Core Shroud Welds
 - 2 completed UT demonstrations, 1 ongoing
 - Automated PA, 1 conventional (for tight access plants) and 2 phased array
- Shroud Support Plate Welds
 - 1 automated phased array UT demonstration completed
- RPV internal attachment weld UT
 - 1 automated phased array UT demonstration completed
 - New inspection capability for BWRVIP Members

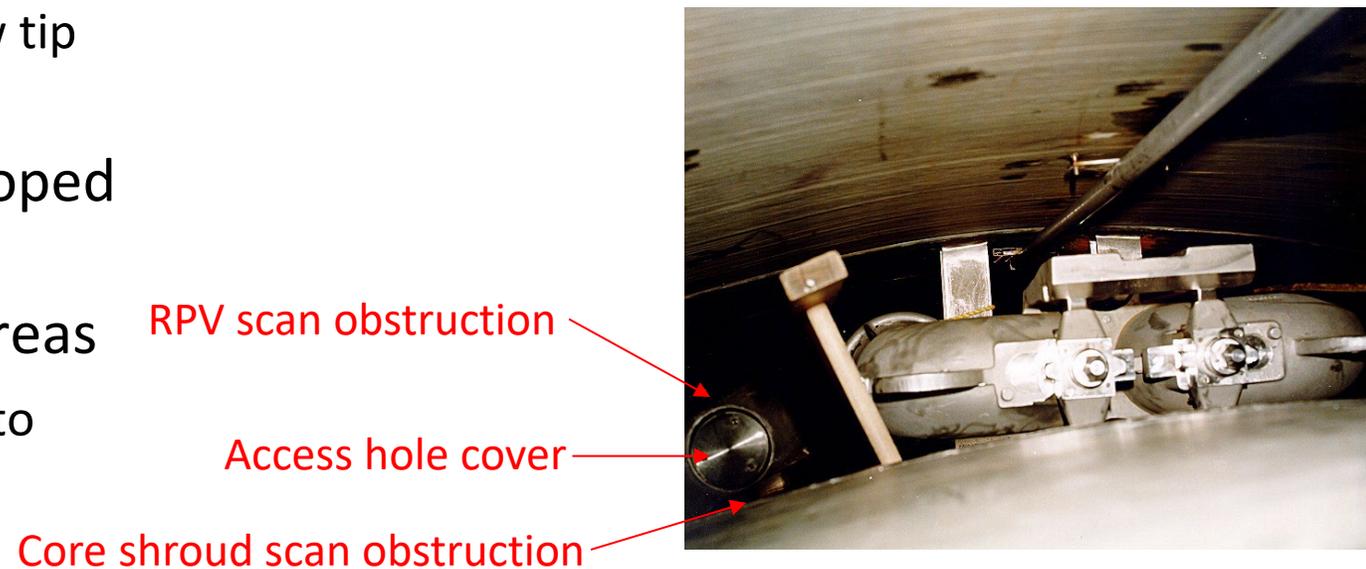
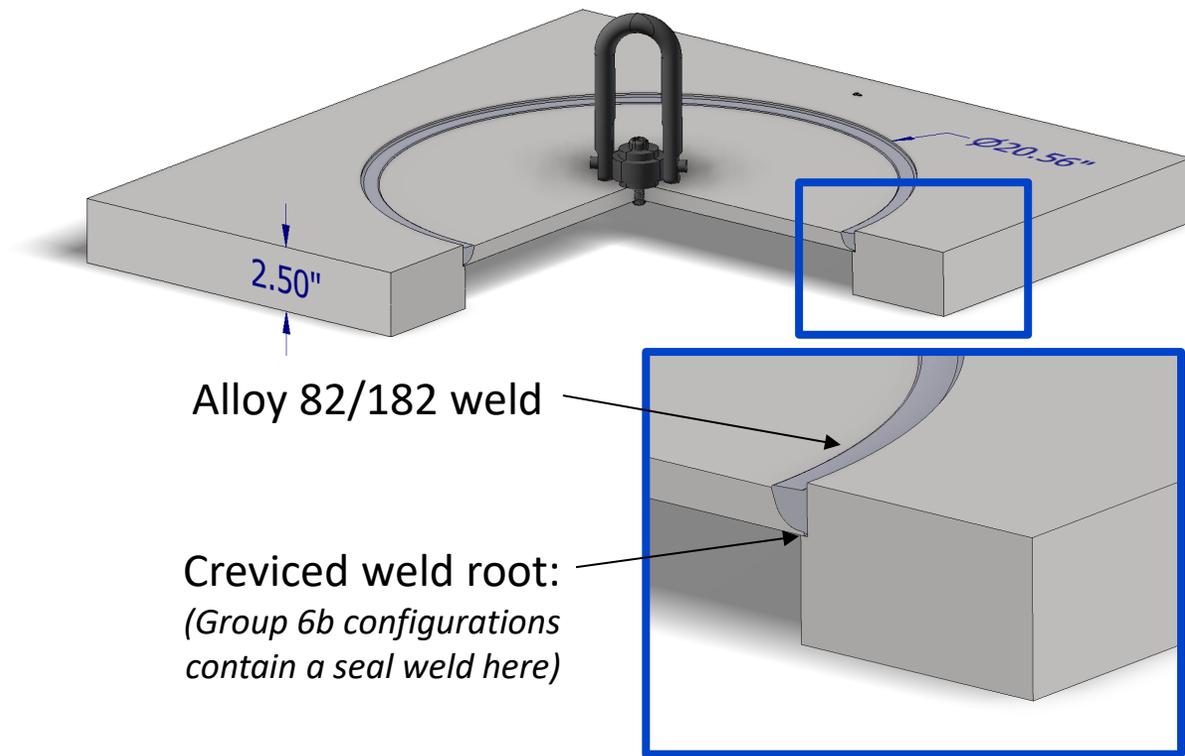




Update on NDE Development
Access Hole Cover UT

Access Hole Cover UT

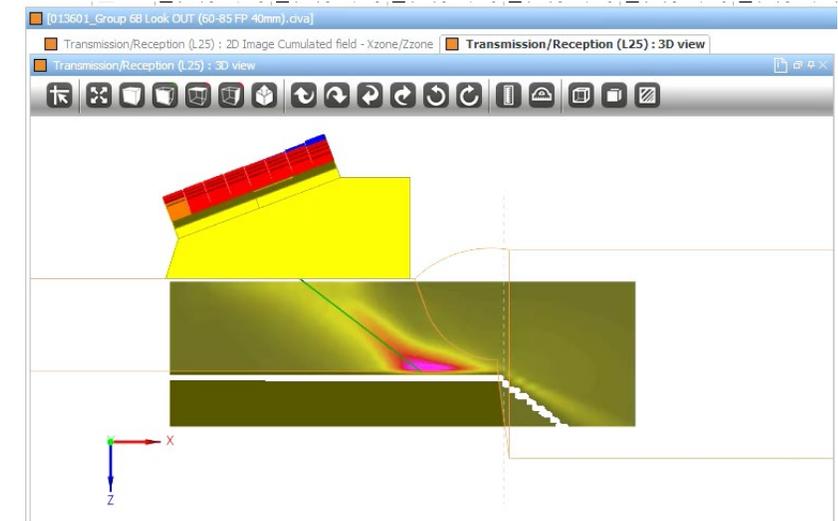
- Contact phased array technique to improve cover plate side scans
 - Applicable to Group 1 (*creviced*) and Group 6b (*seal welded crevice*) configurations
 - Shroud support plate side “looking in” immersion phased array UT scans work well, but are partially obstructed by RPV and core shroud
 - Cover plate side “looking out” immersion UT scans have struggled to detect reliable flaw tip responses
- Contact phased array technique developed to improve detection and flaw sizing reliability within partially obstructed areas
 - Attempted to adapt EPRI DMW technique to access hole cover configurations



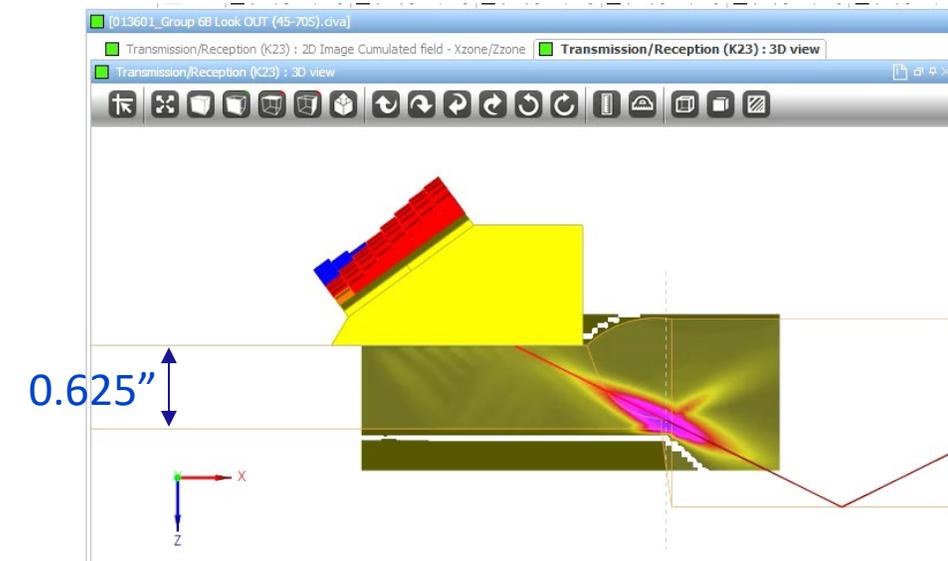
Access Hole Cover UT

- J-groove weld configuration and typical flaw tilt create significant challenges when using refracted longitudinal waves
 - Weld root is on far side of joint, flaws have originated from root and tilted back towards probe
 - Unfavorable flaw tilt for cover plate side scans
- CIVA beam simulations revealed this inspection challenge; scans performed on flawed mockups confirmed the assessment made using CIVA
 - Increasing size of RL probe keeps moving exit point farther back
- A larger matrix array was then used to generate full-vee path shear wave focal laws
 - 2nd leg UT beams are oriented perpendicular to flaws

“Looking Out” Longitudinal Wave Probe

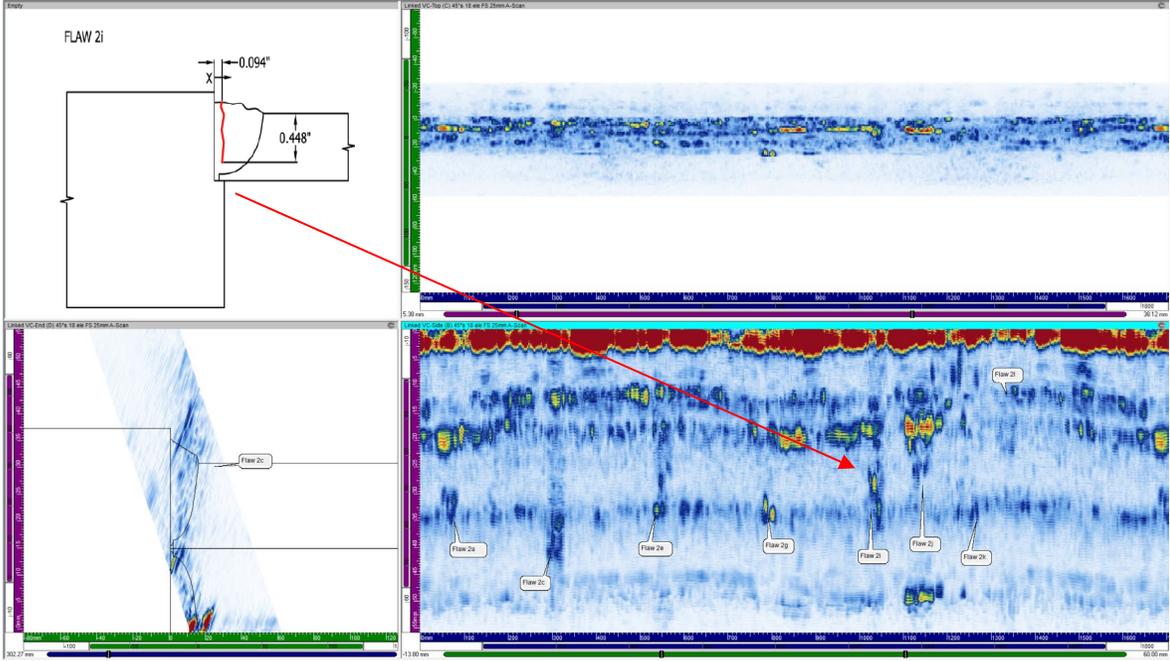


“Looking Out” Shear Wave Probe

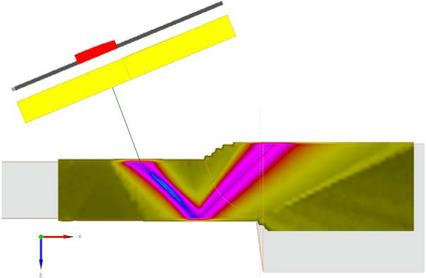


BWRVIP-AHC2 Mockup Immersion Versus Contact UT Comparison

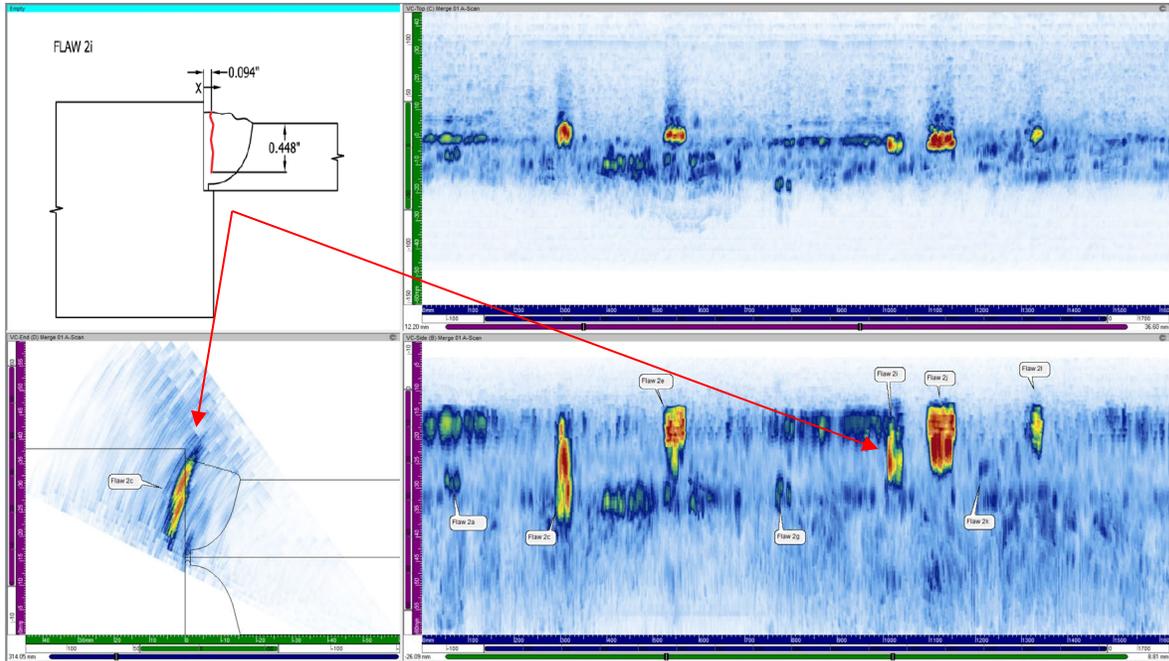
Cover plate side “looking out” immersion UT



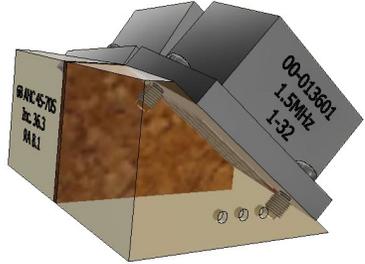
Immersion phased array shear wave UT



Cover plate side “looking out” contact UT

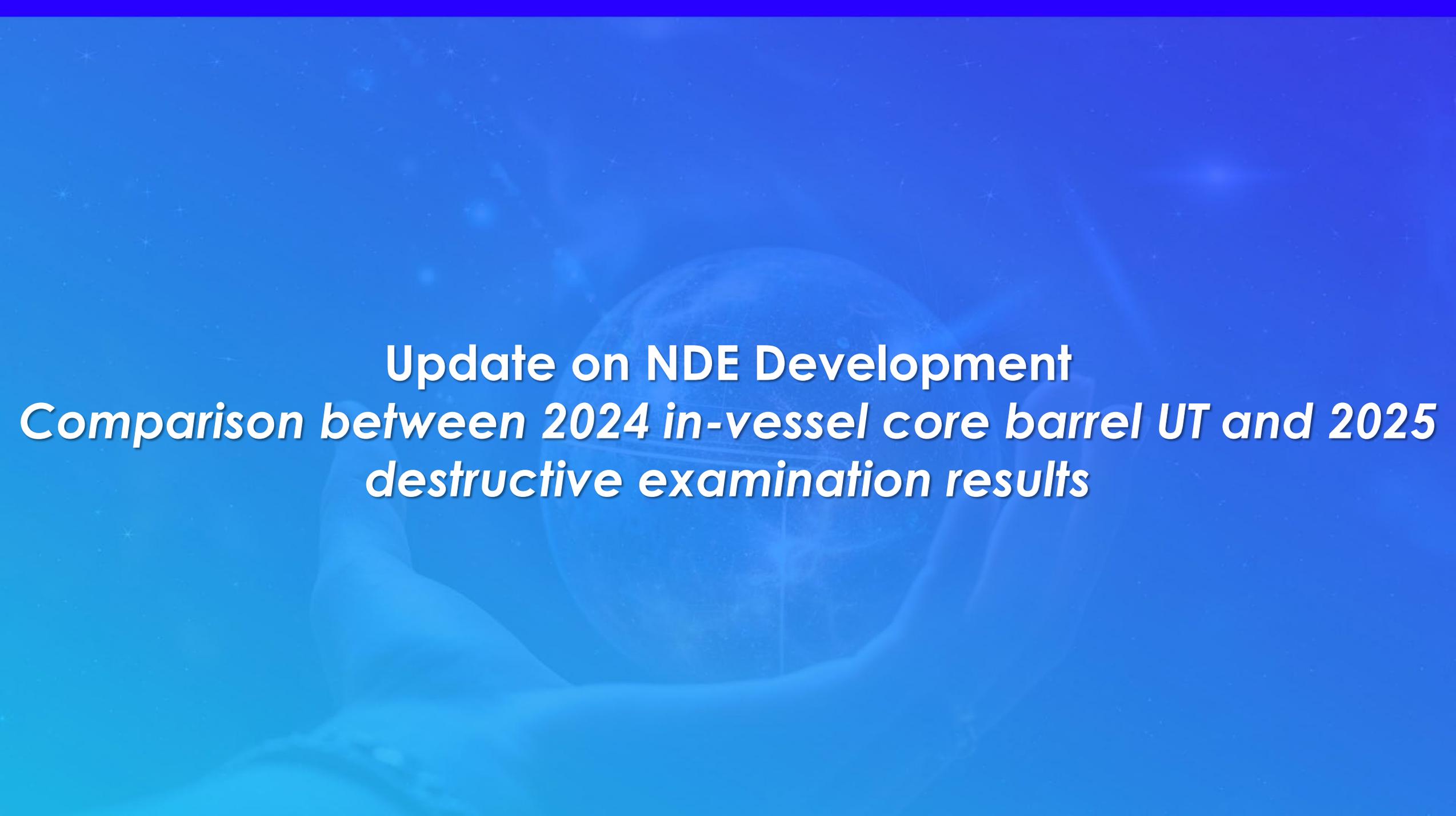


Contact matrix phased array shear wave UT



Summary of Access Hole Cover UT

- Contact “looking in” examinations worked well, but so do the existing immersion UT scans
- Contact phased array “looking out” examinations did not work as originally hypothesized due to J-groove weld joint configuration and typical flaw tilt
 - Inspection challenge identified during probe design using beam modeling; confirmed during mockup scans
- Contact full-vee path shear wave “looking out” scans provided the desired improvement
 - Multiple probe, wedge, and focal law combinations were tested

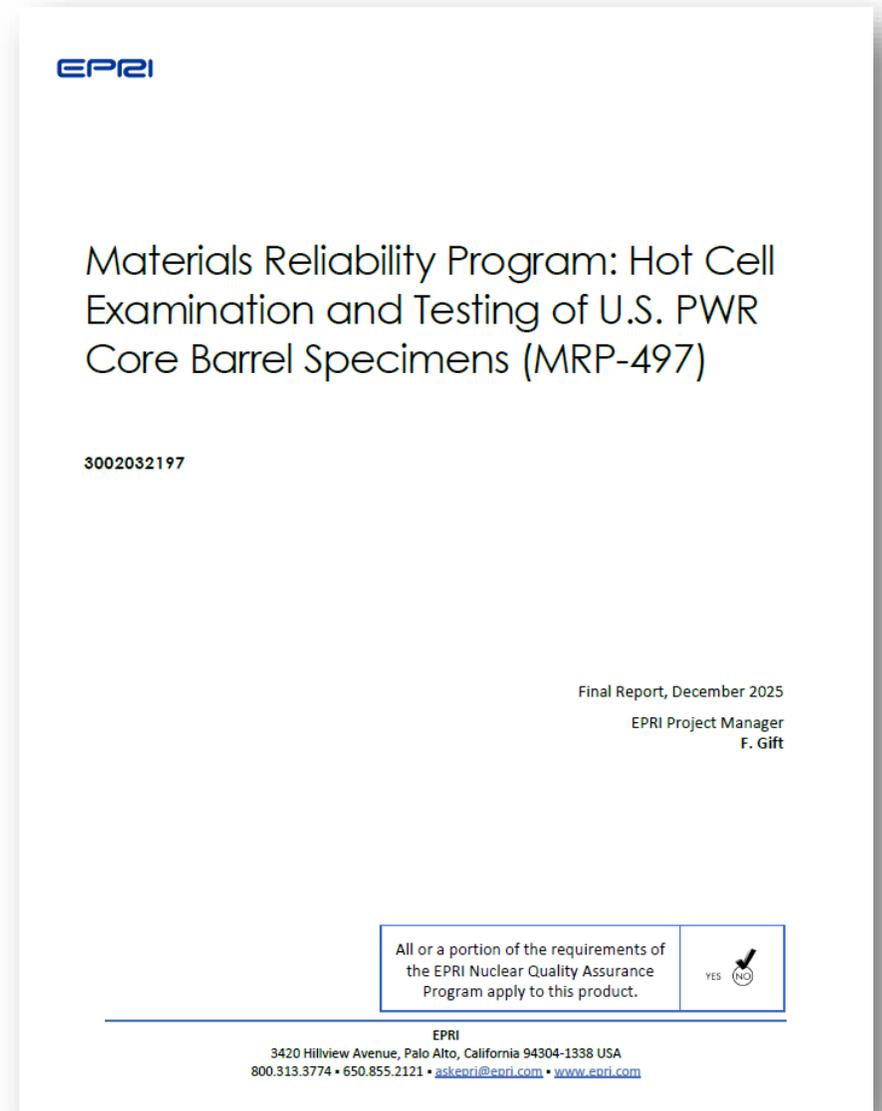


Update on NDE Development

***Comparison between 2024 in-vessel core barrel UT and 2025
destructive examination results***

Background Information

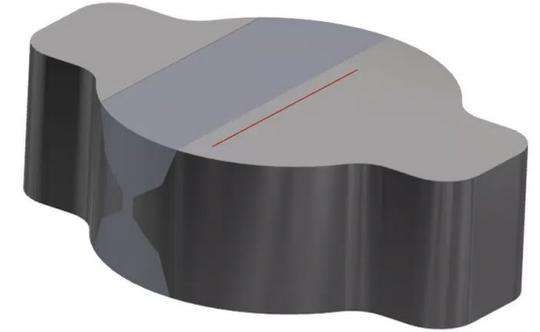
- BWRVIP-Demonstrated core shroud UT technique used to examine the core barrel prior to DE specimen removals during the fall 2024 refueling outage at a Westinghouse 3-loop PWR in the U.S.
 - Two full-thickness DE specimens were removed from the core barrel
 - One specimen fully contained flaw #3
 - One specimen contained the clockwise end point of flaw #4
- A hot cell metallurgical evaluation of the removed flaw specimens have now been documented in a December 2025 MRP report
- **This report provided an excellent opportunity to benchmark the pre-removal UT to the DE results**



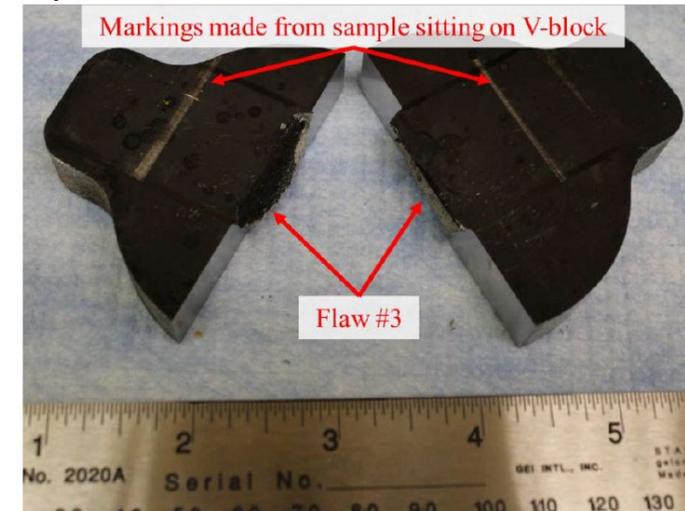
Core Barrel Specimen Comparison of Flaw #3

- *Inspection vendor's reported length of flaw #3 during 2024 RFO: 25 mm [1.0"]
- *Hot cell length sizing confirmation of flaw #3: 26 mm [1.0"] – Inspection vendor UT undersized by ~1 mm
- *Inspection vendor's reported depth of flaw #3 during 2024 RFO: 12 mm [0.46"]
- *MRP DE depth sizing confirmation of flaw #3: 10 mm [0.41"] – Inspection vendor UT oversized by ~2 mm
- **There was excellent correlation between 2024 remote VT, the inspection vendor's 2024 automated phased array UT measurements, and the December 2025 DE report**

EPRI created CAD model created during 2024 RFO showing removed flaw #3:



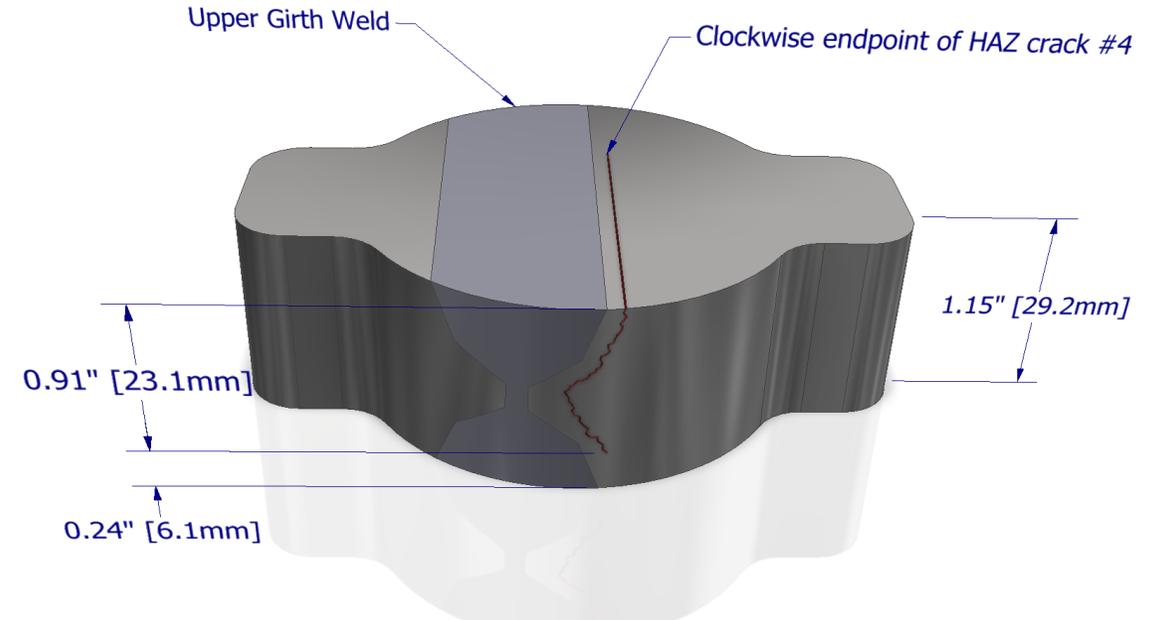
**Flaw #3 removed specimen after fracture faces were separated:*



Core Barrel Specimen Comparison of Flaw #4

- EPRI performed an independent evaluation of the UT data and created a 3D CAD model of the removed specimens, with the UT measured flaw profiles shown within the CAD model
 - Flaw #4 was measured to have a depth of 23.1 mm within the removed specimen
 - Flaw was shown to propagate along the weld bevel configuration
- DE reported a maximum depth of flaw #4 within the specimen as 21 mm
 - UT oversized by 2.1 mm [0.08"]
- Removed specimen also confirmed the flaws path along the weld bevel to be correct

EPRI created CAD model created during 2024 RFO showing removed flaw #4:



Removed specimen containing clockwise end point of Flaw #4:





Update on NDE Development
New Inspection Gap Proposed for BWRVIP Issue
Management Tables

Visual inspection alternatives / supplemental methods

- New inspection gap was created which will be proposed by BWRVIP Technical Committees
 - B-IN-13 – Visual inspection alternatives / supplemental methods
 - Will be included within the Boiling Water Reactor Issue Management Tables
- Research to focus on assessing newer technologies like LiDAR or other 3D laser profilometry methods which may be well suited for measuring flaws or degradation
 - Supplement to remote-VT
- Initial proposal to BWRVIP Inspection and Assessment Committee Members led to expansion of proposed gap
 - E.g., include best practice guidance:
 - 1. aimed at providing a more reliable / consistent measurement of degradation under atypical scenarios
 - For example, when optimum camera placement isn't possible
 - 2. aimed at acceptance standards for color cameras and recommended actions for when a camera fails during an exam

BWRVIP NDE Development Update

- Questions or Comments?

23 U.S. NRC participants of the August 2025 BWRVIP In-Vessel Inspection Courses





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