AI/ML for CRDM UT Analysis

Nuclear

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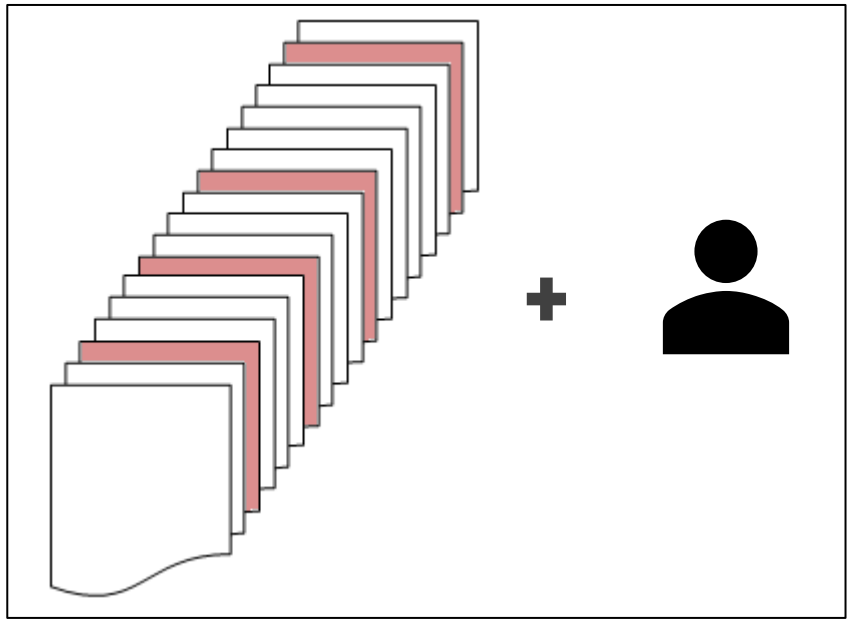
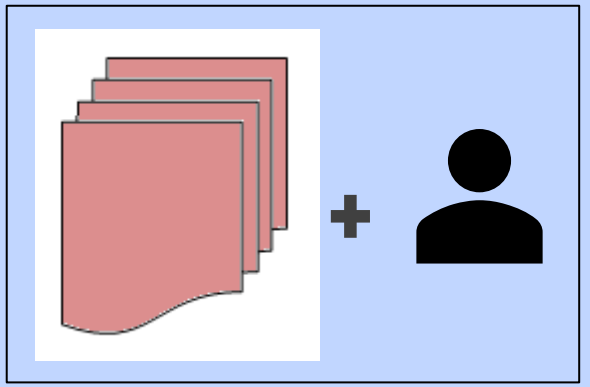
Annual NRC-Industry NDE Technical Information Exchange Meeting
Thursday, 23 January, 2025 – NRC Headquarters, Rockville, MD

How Would AI Assist in UT Inspections?

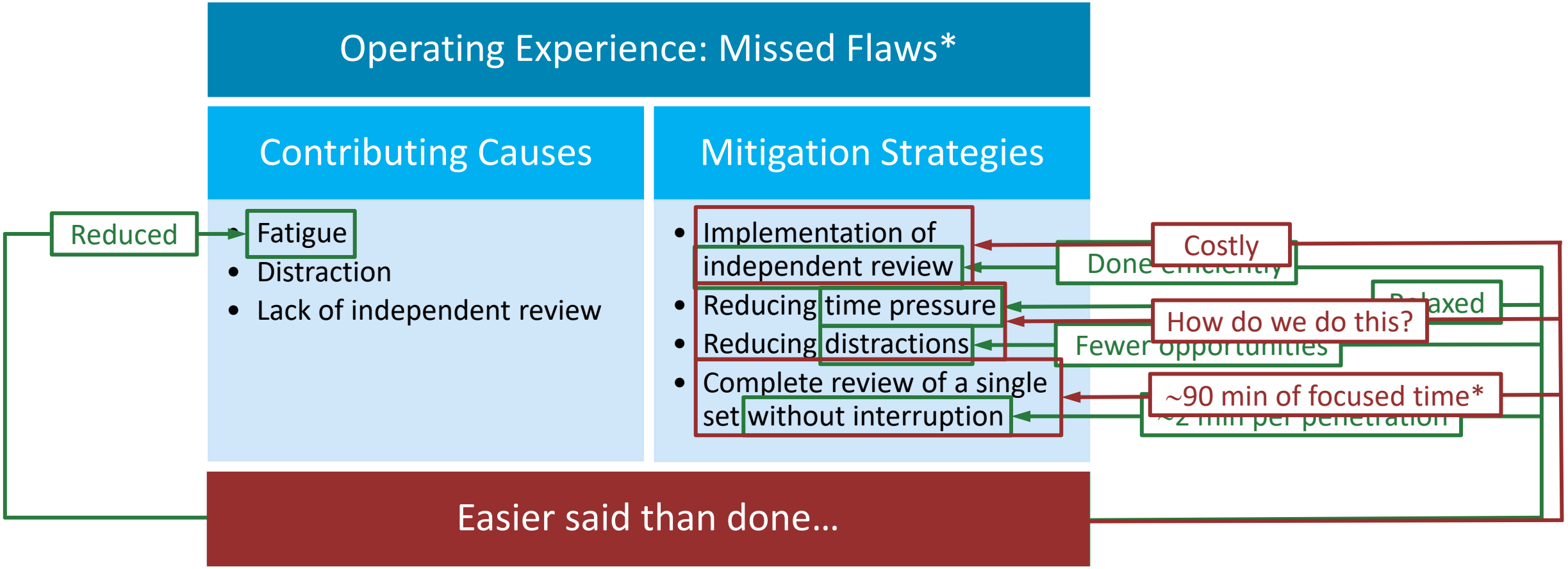
- Current Inspection
  - Examiners distribute their energy across a high volume of (mostly benign) data



- AI Assisted Inspection
  - Examiners focus their energy on the regions that require more careful review, while AI takes care of the more monotonous portion



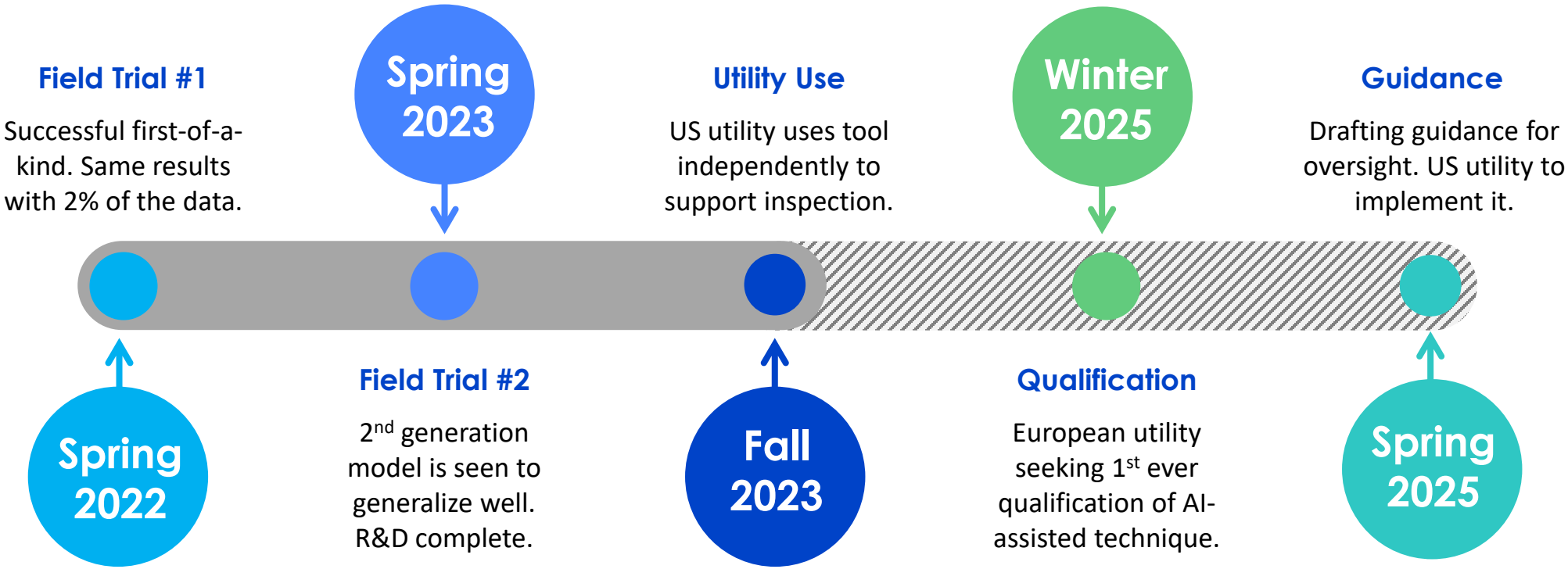
Case in Point: Human Factors in RVUH



* T. Sanquist, S. Morrow, J. Harrison, C. Nove. *Human Factors in Nondestructive Evaluation*. NUREG/CR-7295 PNNL-32505 (ML22083A071)

AI-Assistance enables implementation of identified error mitigation strategies

Activity Highlights



RVUH: Ready Now

Credited as part of inspection

- European utility currently seeking qualification for 2025 inspection (ENIQ)
- Vendors can now develop procedures with AI-assisted analysis for qualification (ASME)
- EPRI working on qualification protocol

Utility oversight
- Utility staff data review
- Facilitates data comparison

Review previous outage data
- Prioritize inspection order (US 2023)
- Assess needed resources
- Pre-job brief/prep

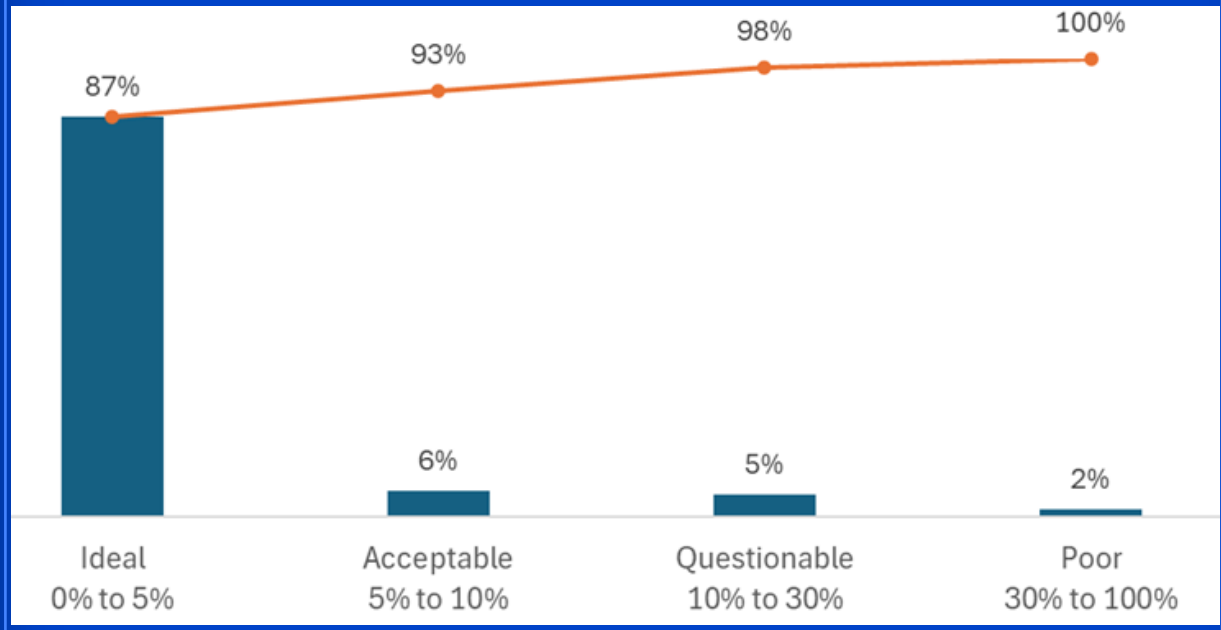
Utilities can leverage these capabilities **NOW**

AI-Assistance Tool Can Be Leveraged Now

Observed Flag Rates

- Latest model was used on data from 4 reactor vessel heads made available by the industry
- Highest average file flag rate observed was ~7%
  - At 2023 field trial: excessive weld noise
- All others have average below 5%
- **93%** of all files have flag rate below 10%
  - Most value is already realized

AI-Assisted Analysis of Reactor Vessel Upper Head Penetration Ultrasonic Inspections (3002029360)



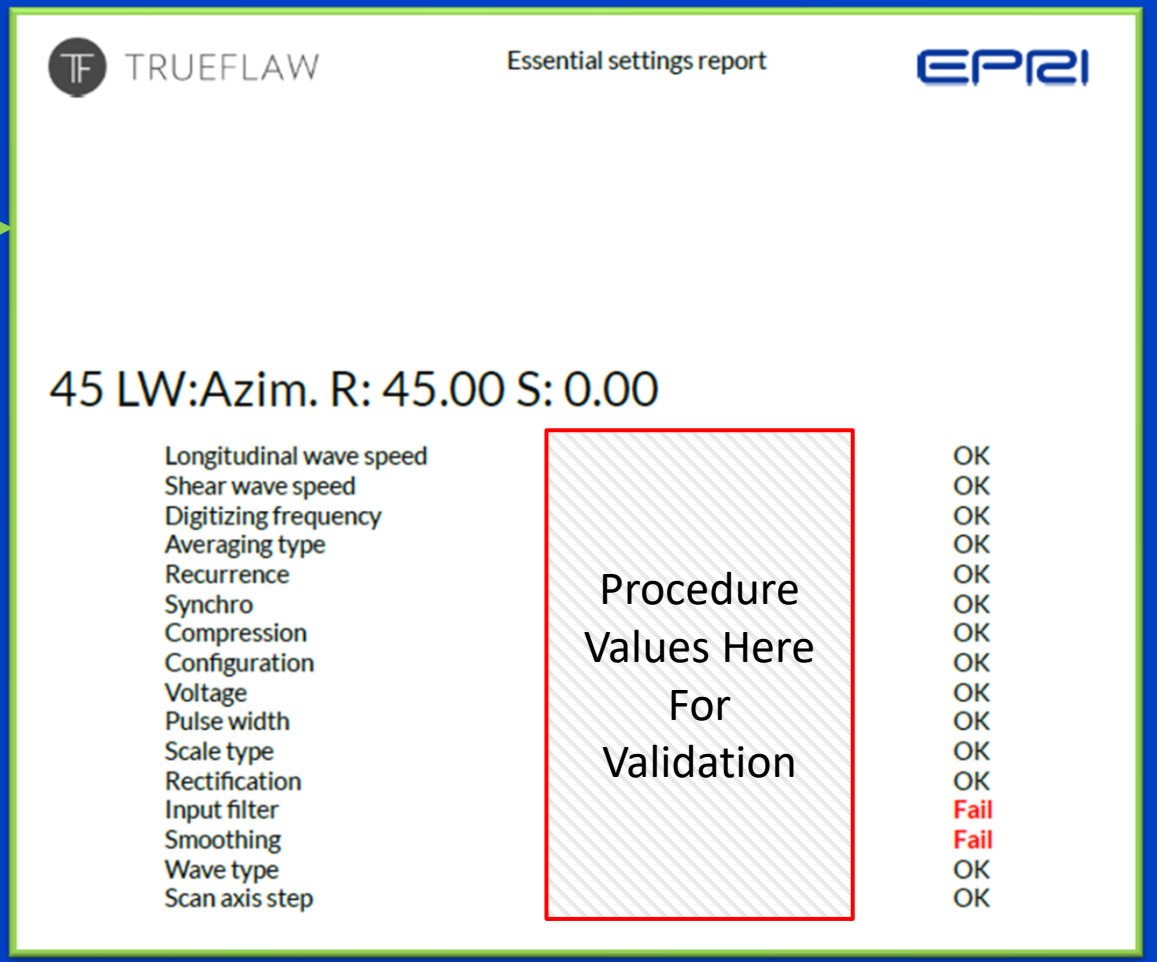
Head	Inspection	Penetrations Analyzed	Average File Flag Rate
H02	ISI	81	6.8%
H03	PSI	44	0.3%
H04	ISI	56	1.1%
H05	PSI	73	3.2%

H02 is the head from the 2023 field trial. The head from the 2022 field trial is not included here as it was analyzed with an earlier version of the model.

Upcoming Tools & Resources

- UT data quality checks
  - Essential variables check
  - Scanning issues, such as poor coupling, missing scan lines, etc
- AI data compatibility checks
  - Is the data covered by training or do we have a previously unseen condition?
- Automated RVUH coverage calculations
- MRP guidance & CBT
- ➢ *UT Comparison Tool*

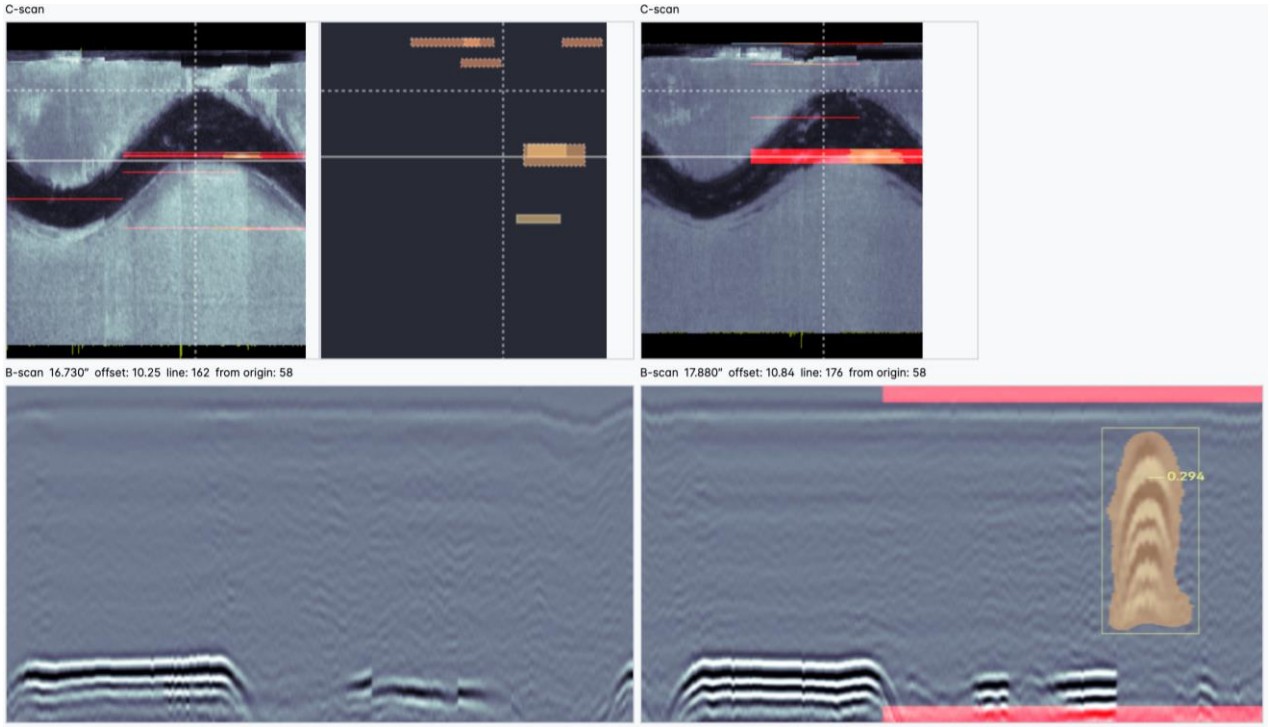
Available in 2025



UT Comparison Tool

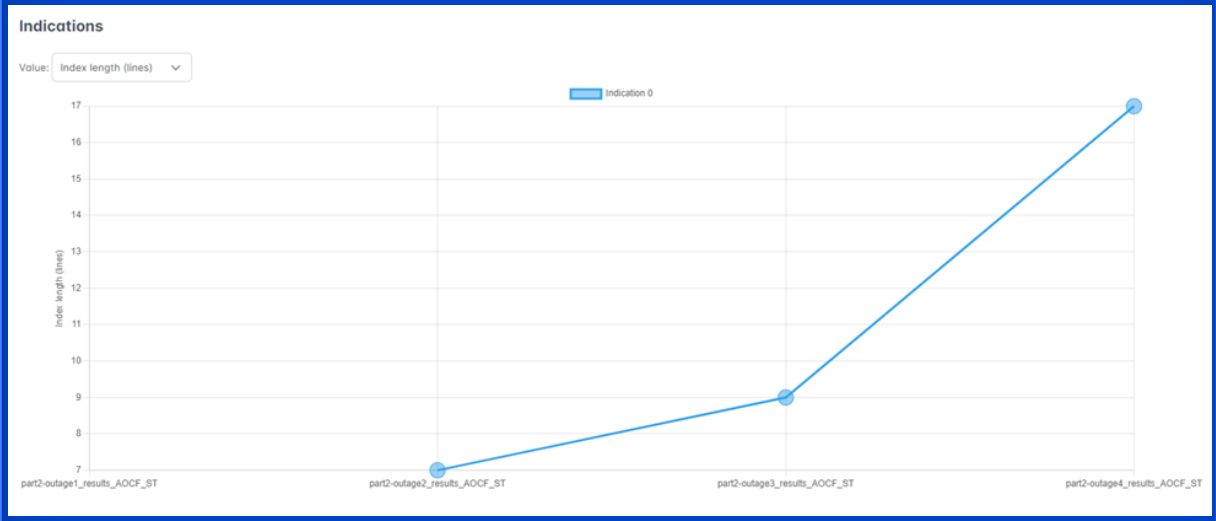
Comparing Two Files

- Linked, aligned side-by-side view of 2 files
- Differences highlighted



Identifying Trends Across Multiple Files

- Automated measurements from matching indications can be trended



In the example above, a measurement related to flaw length is tracked. In the first (right-most) inspection it was not present and has grown consistently after first appearing at the second inspection (sequential inspections are ordered left to right).

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