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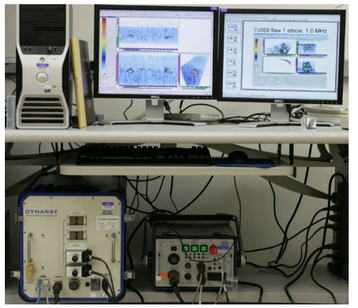
Pacific Northwest NATIONAL LABORATORY

# Evaluation of Automated Data Analysis Systems for In-Service Inspections in Nuclear Power Plants

## Overview

- The commercial nuclear power industry is facing a potential shortage of certified nondestructive evaluation (NDE) analysts to meet future in-service inspection demands.
- Machine learning (ML) systems are nearing the capability to pass performance demonstration tests for ultrasonic testing (UT) inspections of reactor pressure vessel upper head penetrations in nuclear power plants (NPPs).
- NRC-sponsored current research projects at PNNL are focused on evaluating the performance of commercially available ML systems for assisted data analysis.
- PNNL's assessments are aimed at identifying factors affecting the use of assisted data analysis algorithms, including ML, for ASME Code-required ultrasonic in-service inspections.

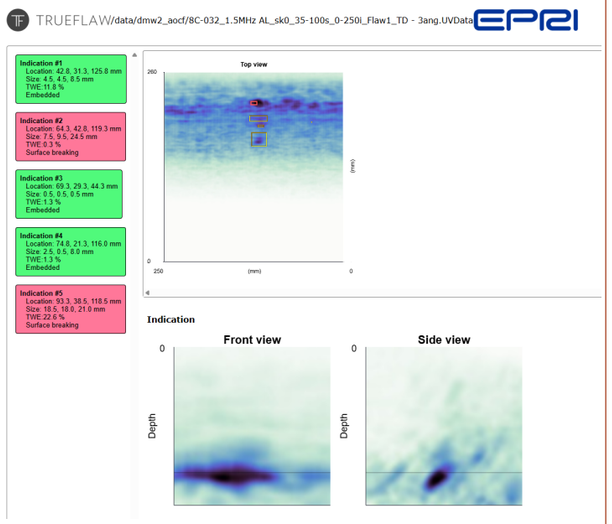
## ML Model Evaluation




- Dissimilar Metal Weld (DMW) UT data files collected at PNNL as per procedures were processed through different ML models (1 & 2) received from the vendor in April and July of 2025, and the results were compiled
- Each indication in the output files was validated against the true-state information by a UT Level III Inspector.

## Discussion

- Model 1 did not have a 100% detection rate, but Model 2 did. However, Model 2 also had a higher false call rate than Model 1.
- The models also give multiple indications of a flaw, which can include mode-converted responses and tip signals.
- Limitations include a high false call rate.




## Next Steps

- Evaluating data augmentation approaches, virtually-modified flaw data sets using the box.
- Evaluating the performance of new or updated ML models.
- Reviewing other statistical metrics for ML performance, including the Performance of Detection curves.
- Retraining ML DMW models to assess the need for site-specific requirements.
- Evaluate other ML models, such as those developed for pressure vessel upper head penetrations, in-vessel visual Inspections, manual phased array, and core shroud.

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