AI/ML for In-Vessel Visual Analysis

Nuclear

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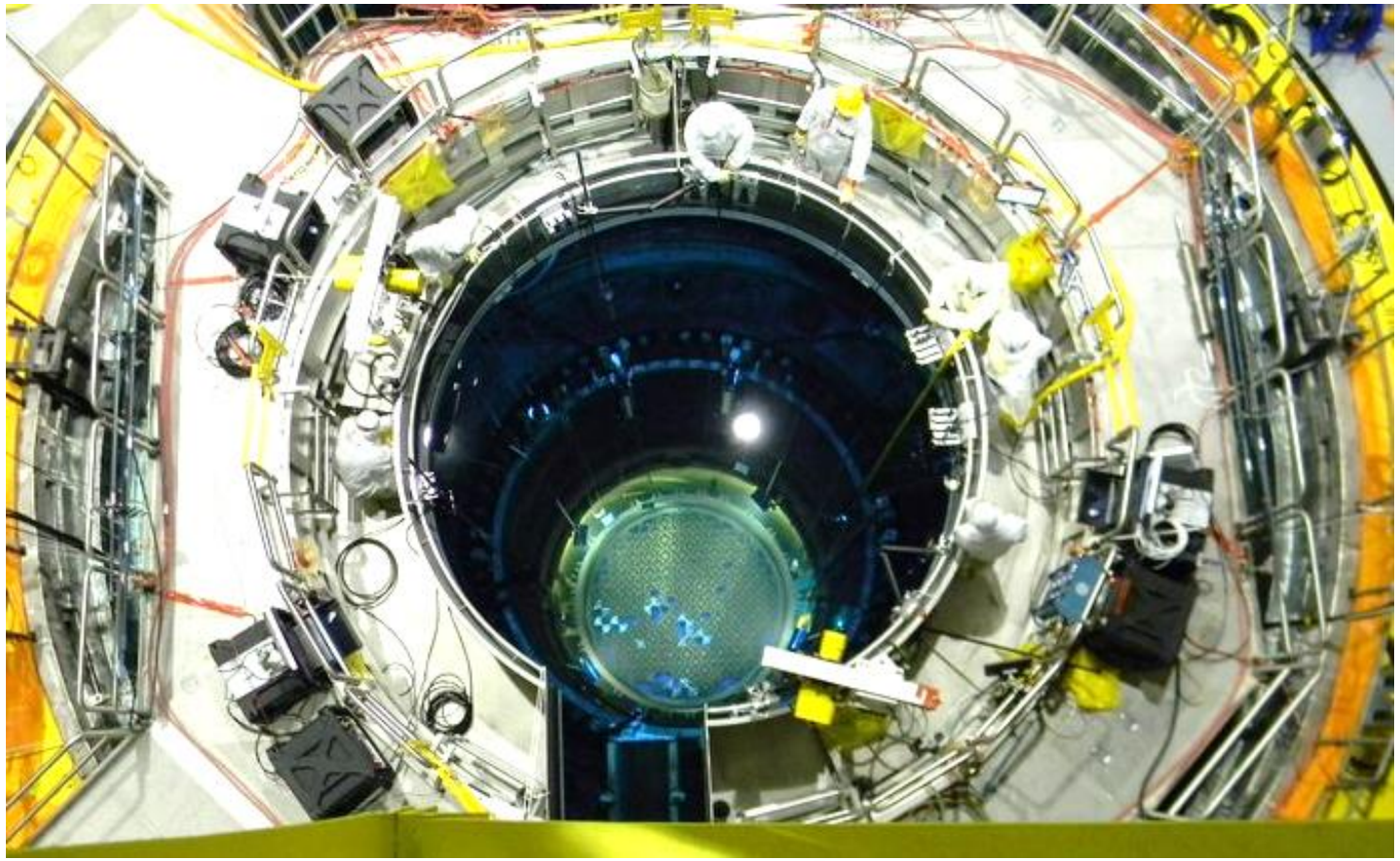
Remote Visual Inspection of Reactor Internals



fatigue

Missed flaws

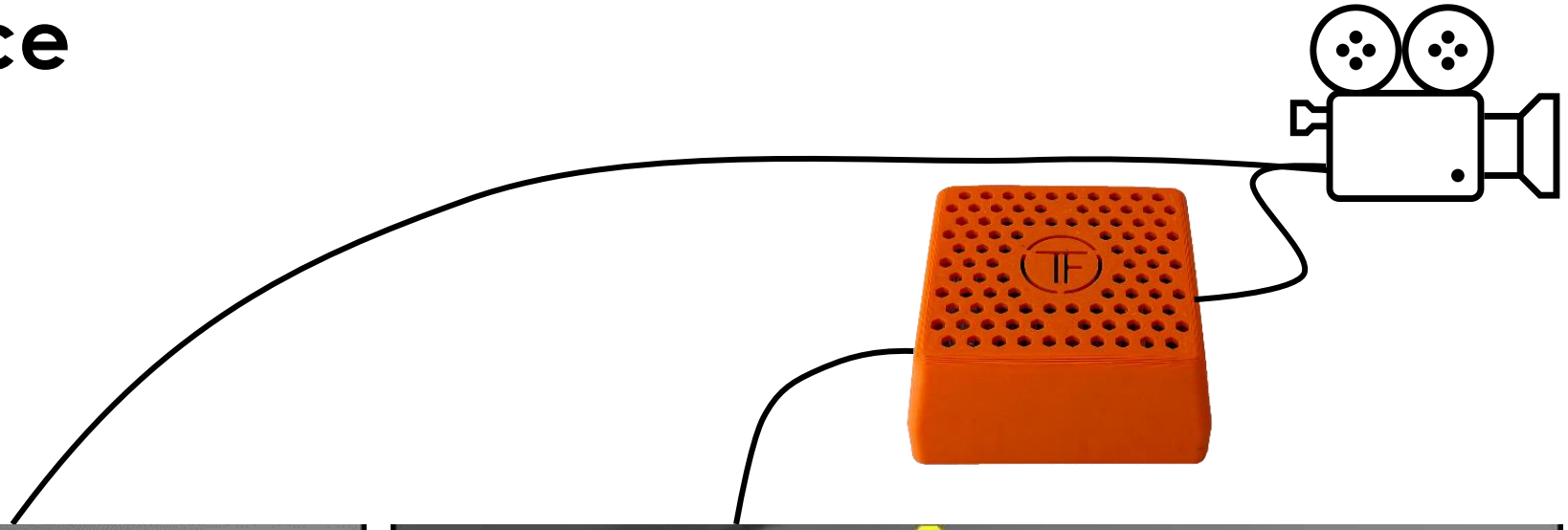
distraction

Preliminary analysis in **real time** *followed by* Post-inspection review

Goal: Develop a tool that can assist examiners in both activities

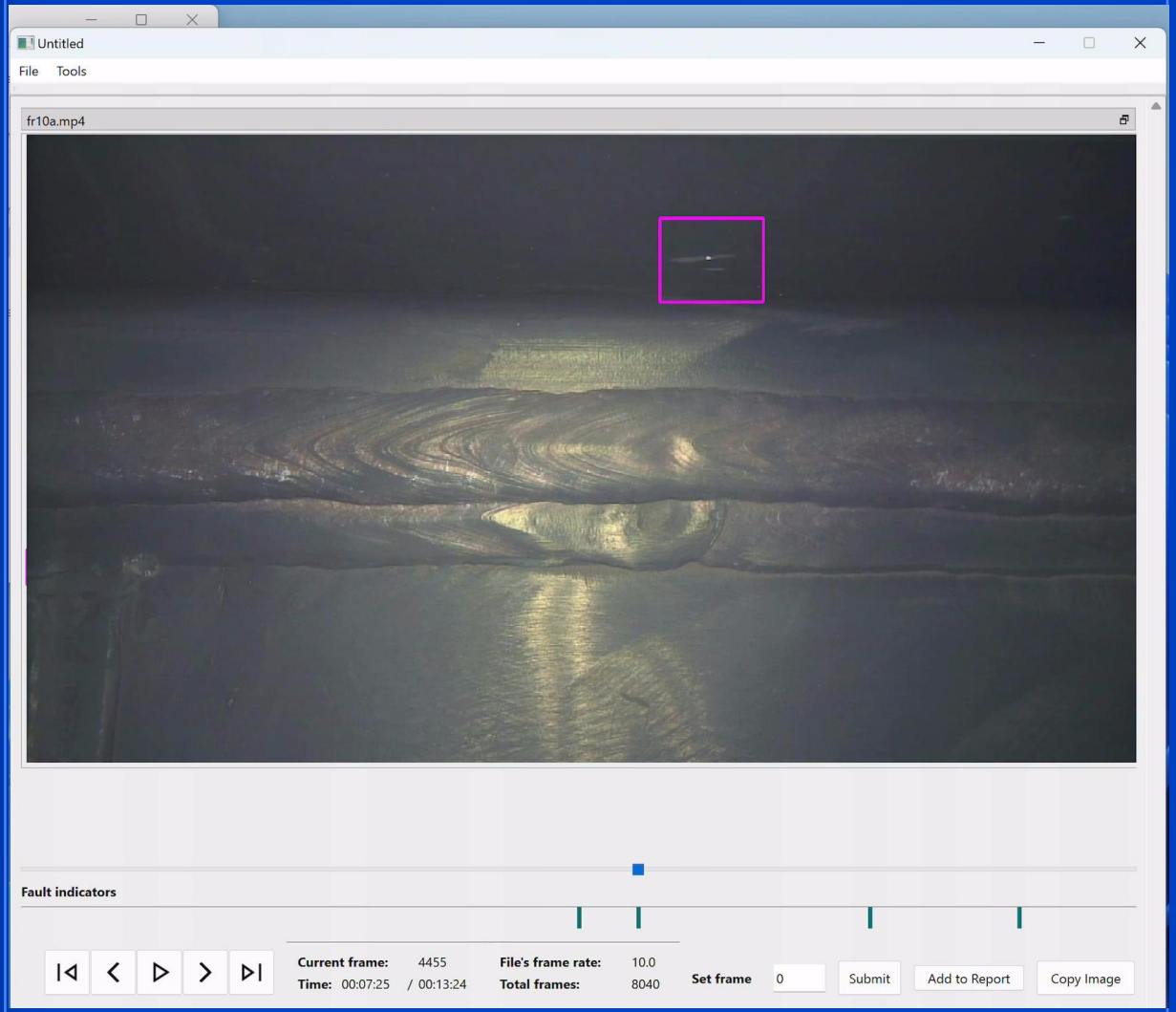
Real-Time Assistance

- Live aid to inspectors
- Reduce re-looks
- Plug-and-play setup

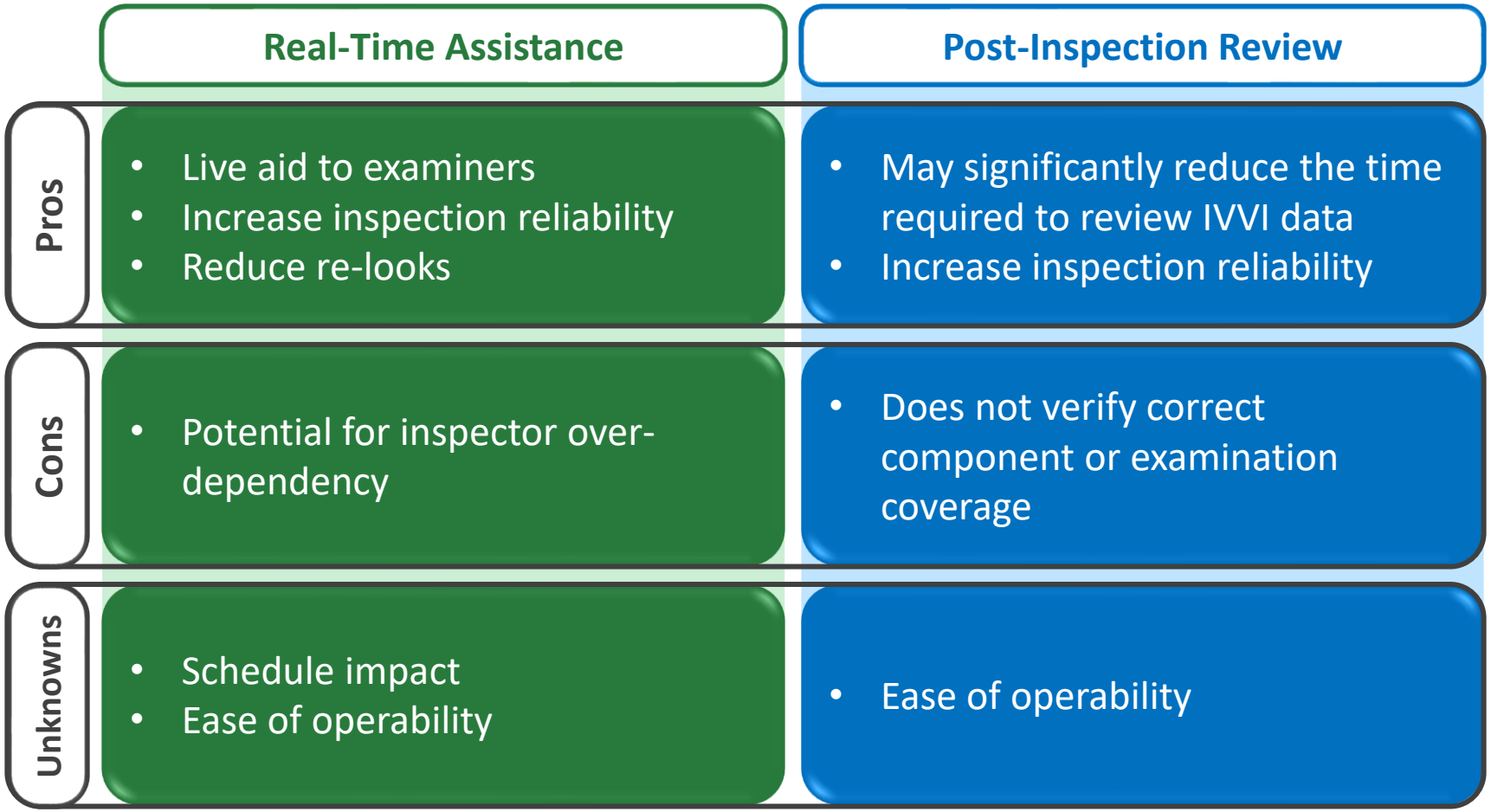


Post-Inspection Analysis

- SW loads video and model results
  - Some further processing of live output
- Level II/III can review/analyze results
- Reviewer can go straight to the indications flagged by AI
  - Review and dispose of them (RI or NRI)
- Generate summary reports with screenshots
- PRE-SW: Assisted Analysis of Remote Visual Examination (AARVE) v0.1 Beta (3002026528)



Implementation Modes



Field Trials to Provide Insight

Field Trial

On Site Setup

Day 1

- Initial reluctance from inspection vendor
  - *Concern*: potential distraction to examiner
  - *Request*: set it up away from inspection personnel and first observe performance

Real-time AI results available immediately upon connection. Initial observations indicated adequate sensitivity.

Day 2

- Inspection vendor moved the AI equipment into the Level III area
  - *"As simple as plug'n'play"*

Real-Time AI Performance

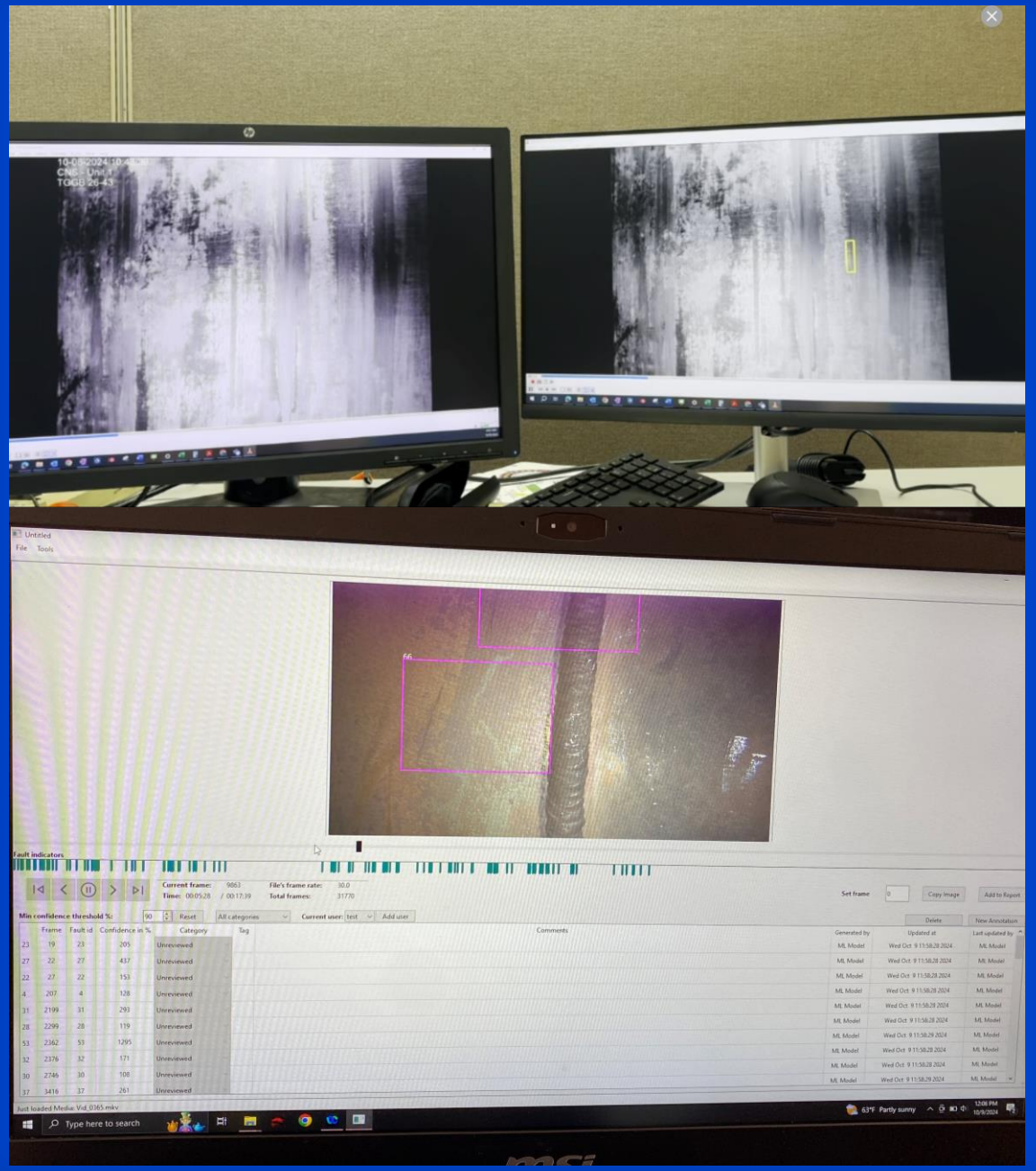
- Scope:
  - HD, SD; B&W, Color
  - Jet pumps, core spray, top guide, dryer
- No noticeable delay in real time AI
- Sensitivity level seen to be adequate
  - No adjustments performed
- AI flagged **ALL** previous indications without significant overcalls
  - Majority of boxes considered justifiable

Overall positive feedback from vendor & utility

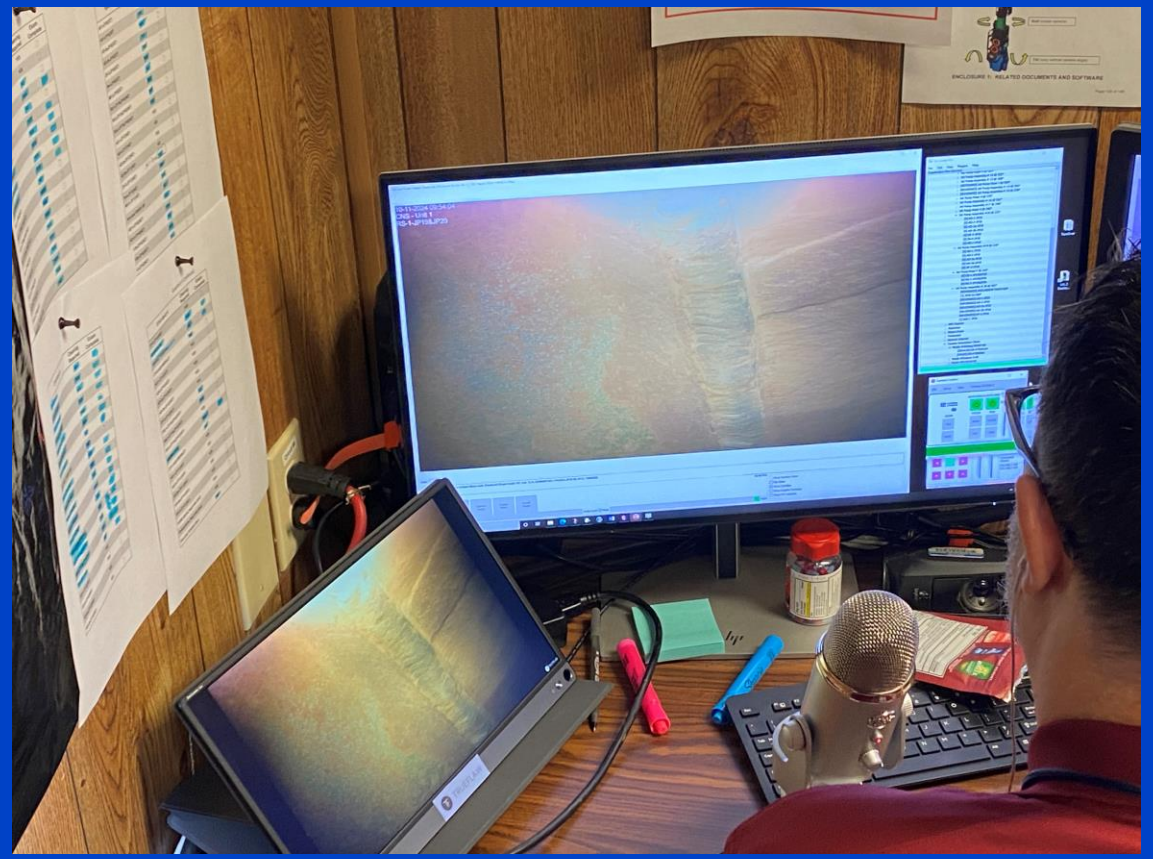
Post-Inspection Review Performance

- Assessed by utility reviewer & support team
- Processing speed was slower than expected
  - On-site update to pipeline: 1.5× improvement
  - Further improvements can be made
- Observed differences between real-time and post-inspection outputs
  - Issue corrected on-site
- EPRI GUI was not effective
  - Redundancies with inspection vendor review SW
  - Videos contained too many boxes for reviewer to manually classify each one
    - Indication ID reconciliation needs improvement

Proposed approach & solution needs work



Feedback, Lessons Learned & Observations



- Real-time AI can improve the quality of inspections by recommending Level IIs to provide audio to areas containing boxes
- Two monitor approach can be distracting
  - Shift to one monitor with the ability to toggle AI boxes on/off
- AI performed best where previous site data was available for training
- Continue to improve post processing speed
- Image stitching could be a valuable add on

Next Steps

- Address lessons learned from field trial(s)
- Additional field trials
  - 2 field trials planned for Feb 2025 (US)
  - 1 field trial planned for Fall 2025 (Int'l)
- Taking volunteers for PWR field trial hosts
- Compare AI performance on "new" site before/after adding site data to training

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