PHMSA R&D Forum

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Enbridge Pipelines
Liquid System

- ~14,000 km of 16 to 48 inch diameter pipelines
- Almost all piggable ~ 90 trap segments
- Most segments have had multiple inspections with MFL or UT metal loss, plus caliper
- ~2/3 of system inspected with GE ultrascan Crack Detection tool

System Map


Norman Wells
Zama
Fort St. John
Fort McMurray
Edmonton
Hardisty
Kerrobert
Regina
Cromer
Gretna
Clearbrook
Superior
Lewiston
Bay City
Montreal
Toronto
Buffalo
Westover
Sarnia
Toledo
Lockport
Chicago
Casper
Salt Lake City
El Dorado
Wood River
Patoka
Cushing
Tulsa

Pipeline Integrity
Defect Management Approach

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- **Focus on defect management**
  - In-line inspection is key tool
  - Integrity science + operational practices
- **Leverage all available resources**
  - Codes & Standards (DOT 195, CSA Z662)
  - Research (Internal, PRCI, API, ASME, etc.)
- **Uncertainty creates risk**
  - What are the parameters that define damage?
  - What are the fitness-for-purpose thresholds?

Detection Techniques
Full Range of ILI Technologies Utilized

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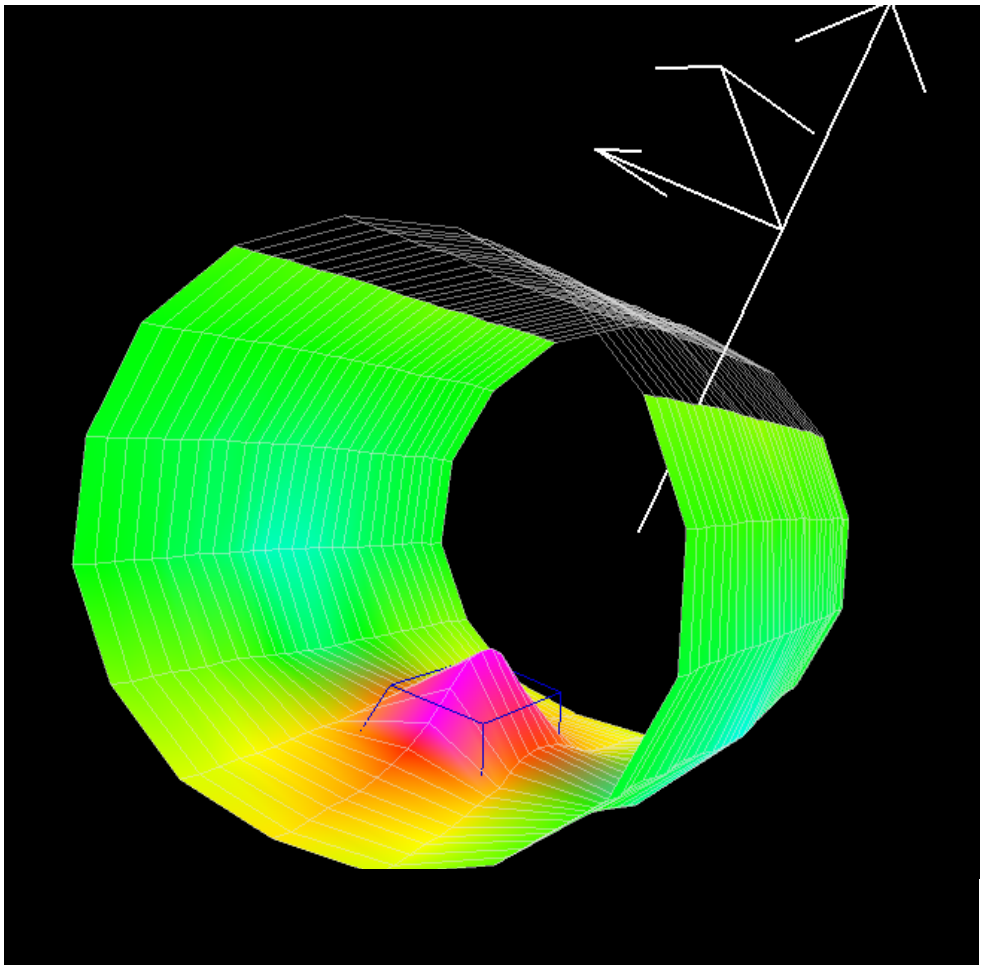
- **Caliper tools**
  - Multi channel
- **MFL tools**
  - M/D reported during corrosion inspection
  - New research
- **Ultrasonic tools**
  - M/D reported during corrosion or crack inspection
  - Not relied upon to find cracks in dents



ILI Experience
Success by Persistence

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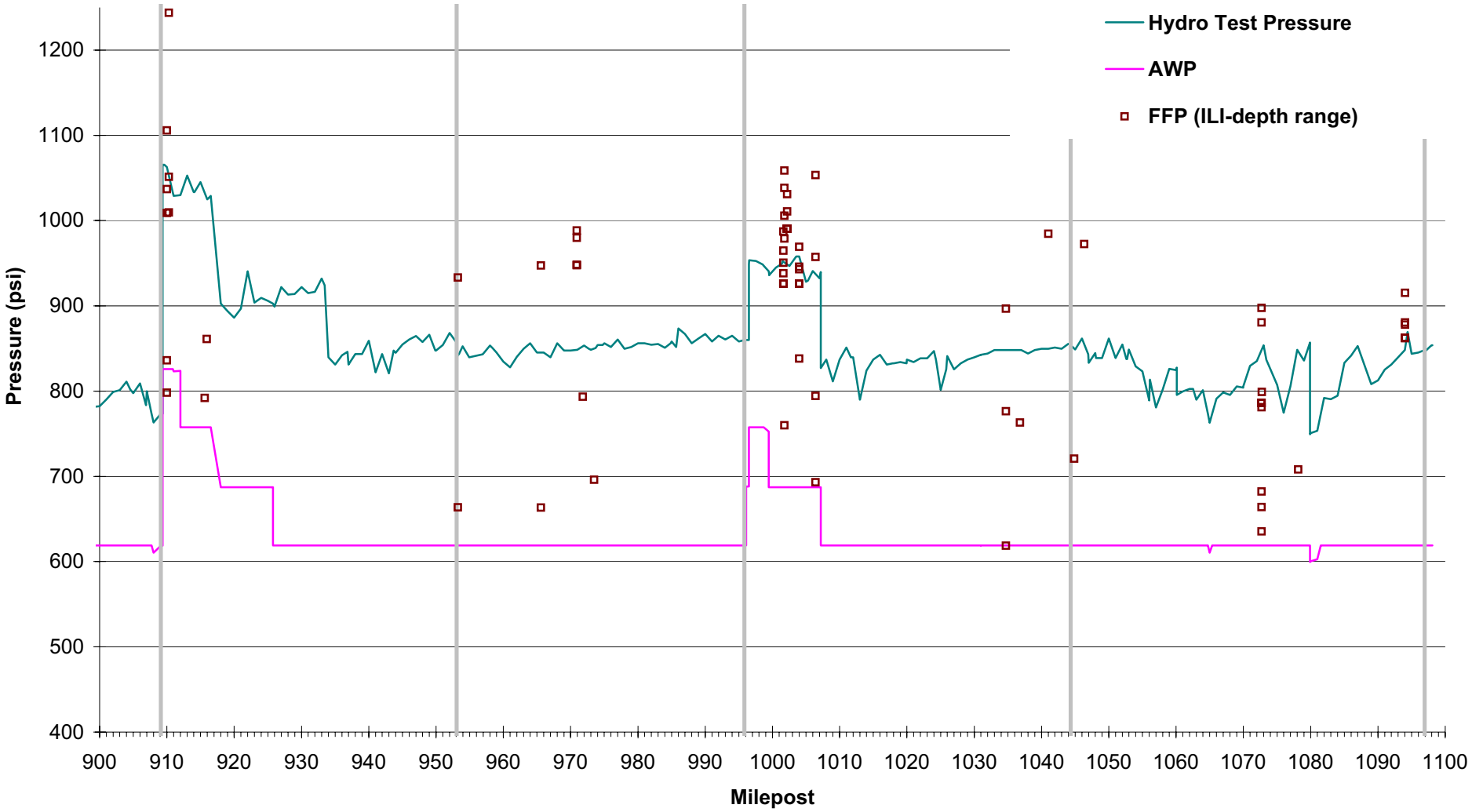
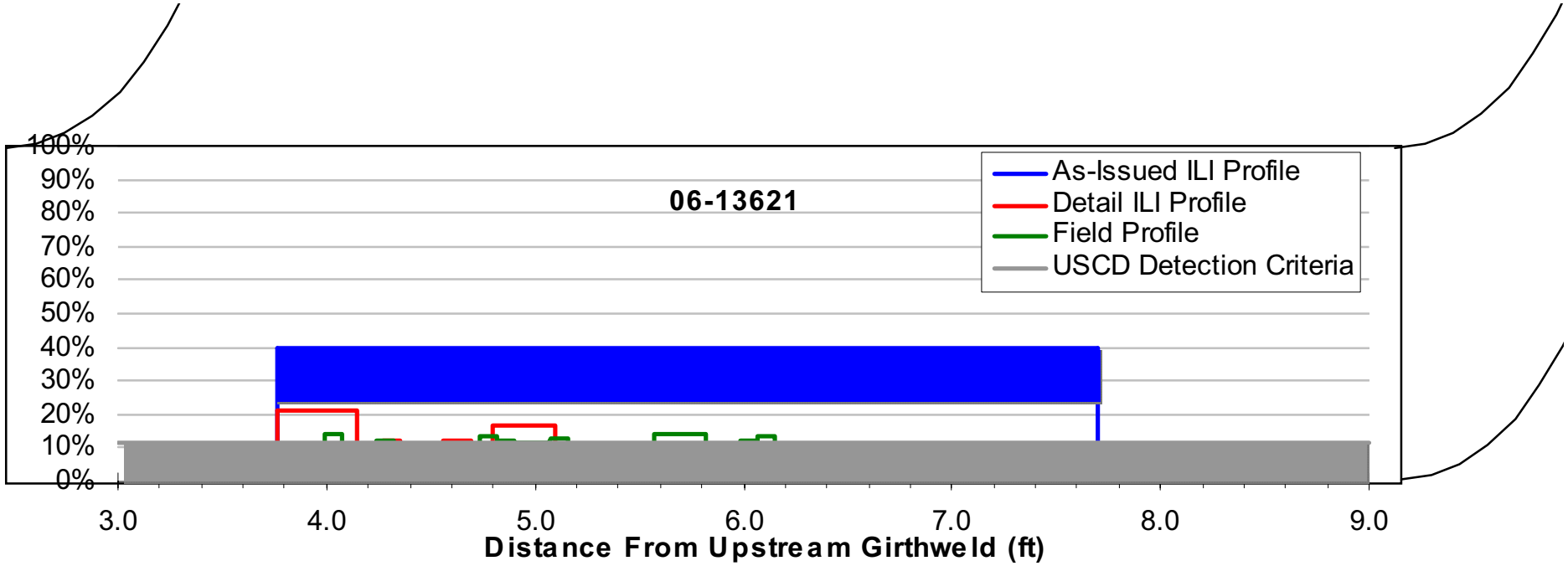
- **Metal loss programs are mature**
  - Programs still require considerable engineering depending on pipeline conditions
  - Validation of inspections still necessary
- **Crack programs have utilized intensive investment in past 10 years**
  - Program has had considerable success
  - Tremendous effort to work together with ILI vendor

Fitness For Purpose
Phase 1 Excavations – 27 GW

(Features Identified in Step 1 Report)



Crack Inspection
Field vs. ILI Result



ILI Experience
Success by Persistence

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- **Mechanical damage inspections emerging**
  - **Attempting to locate combo defects**
  - **Identification of cracks is possible in some cases**
  - **New research using MFL tools**

Commercial MFL
Extended Capabilities

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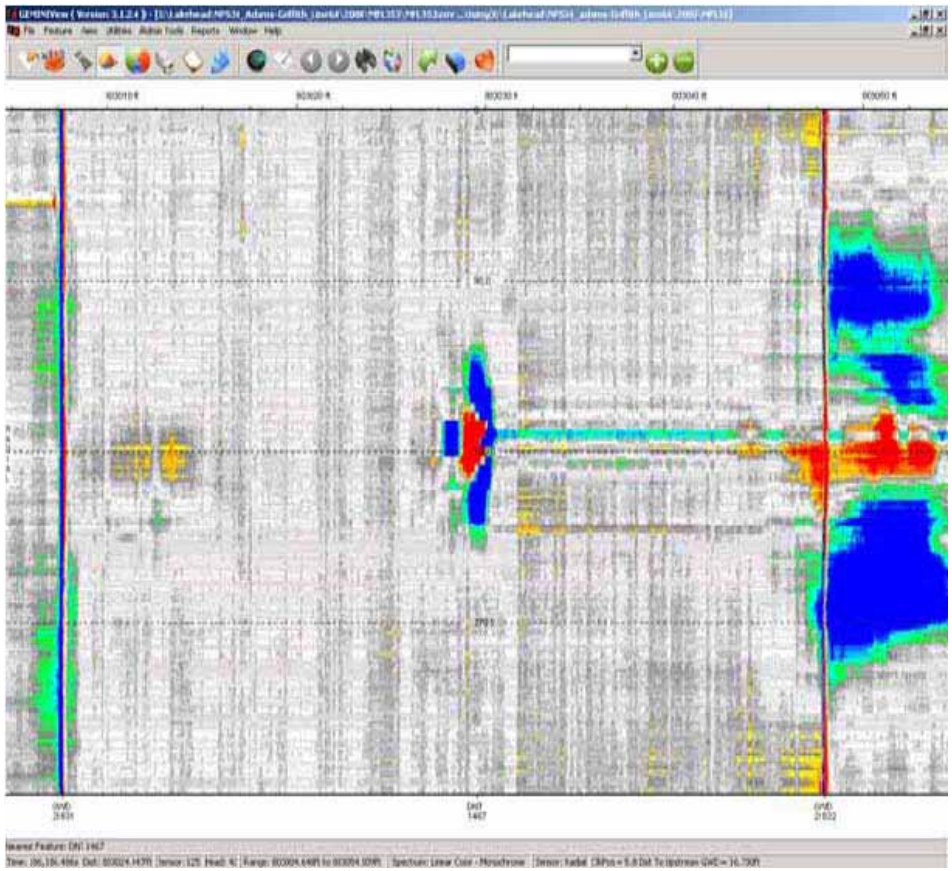
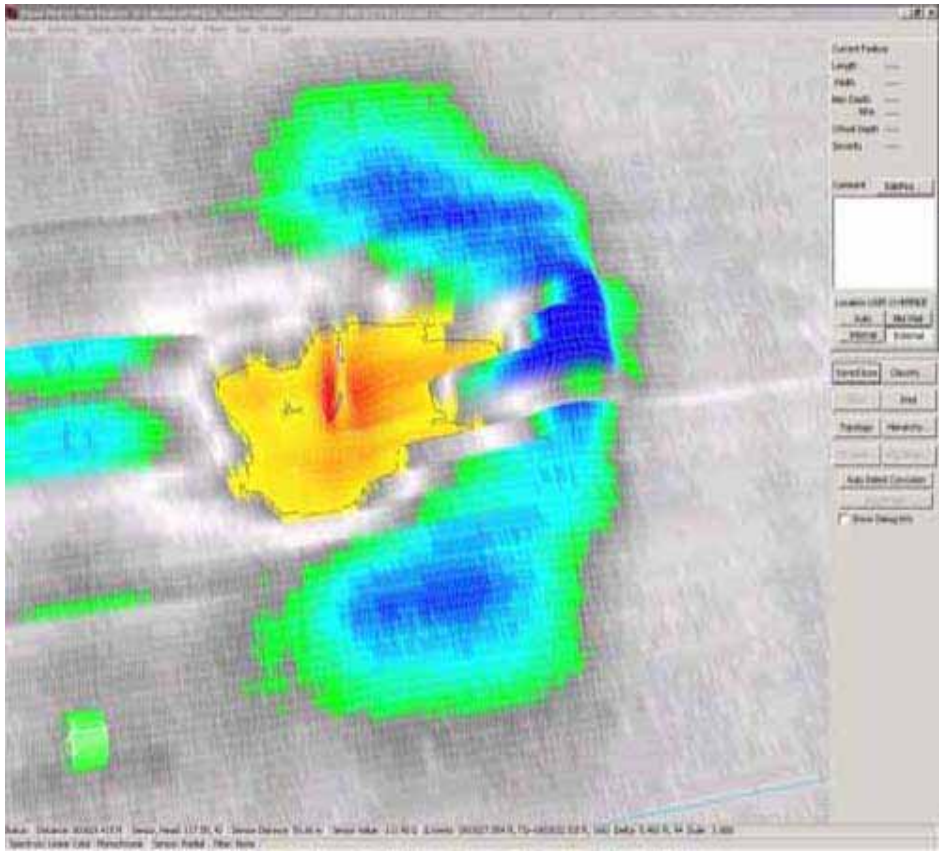
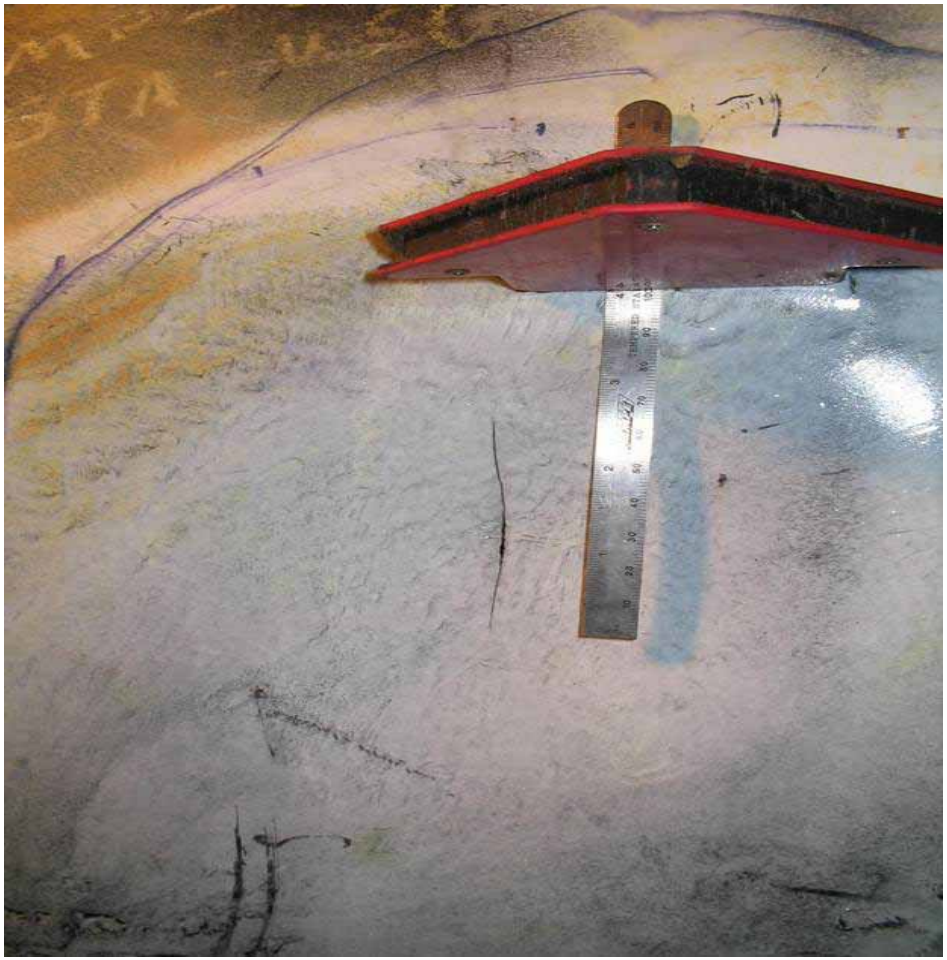


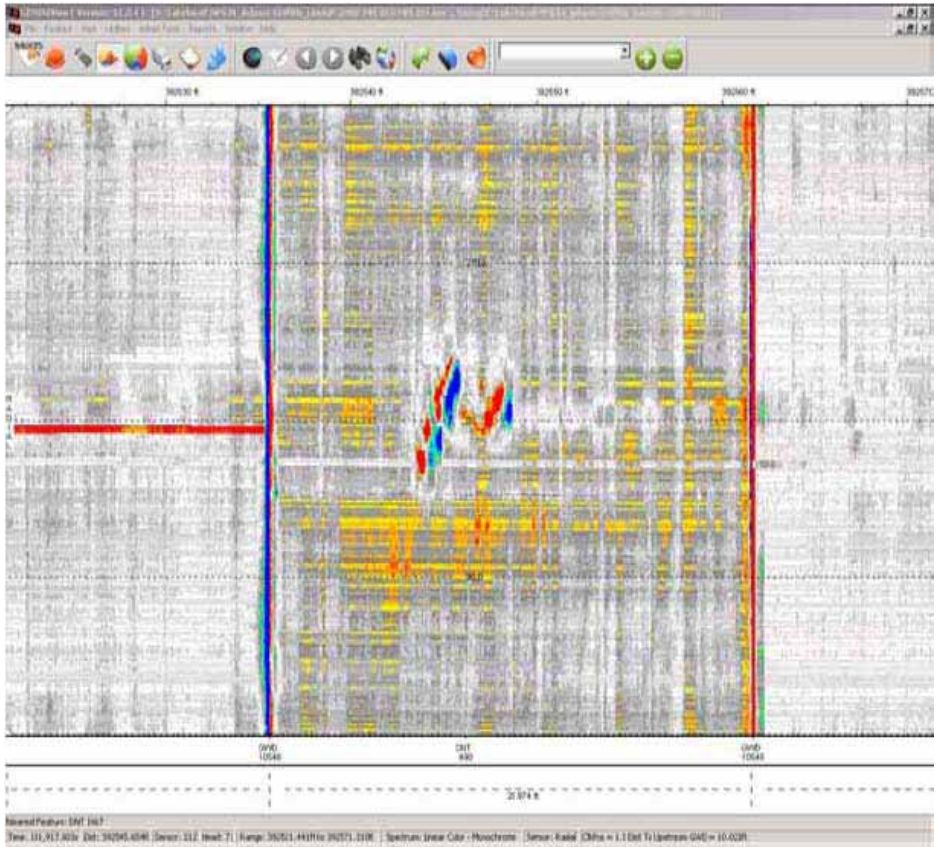


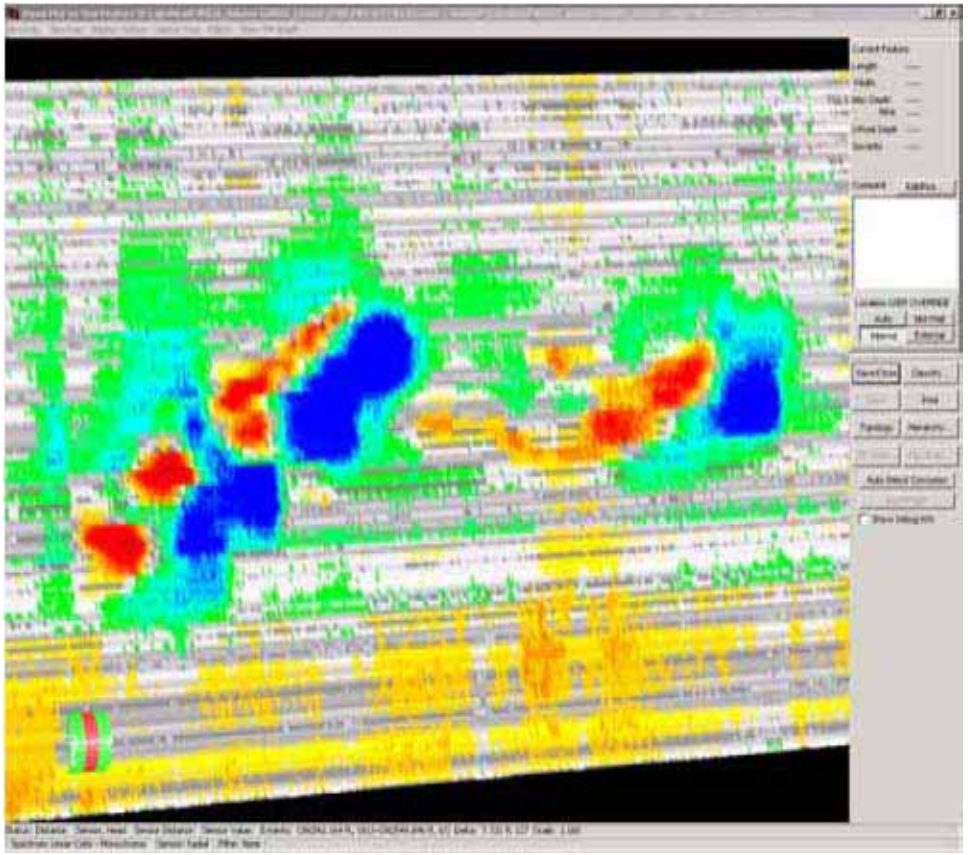
Positive Detection
What Degree of Confidence?



Bottom of Pipe Dent (3.5%) with Circumferential Crack

Commercial MFL
Extended Capabilities





Interesting Field Results
More Questions than Answers

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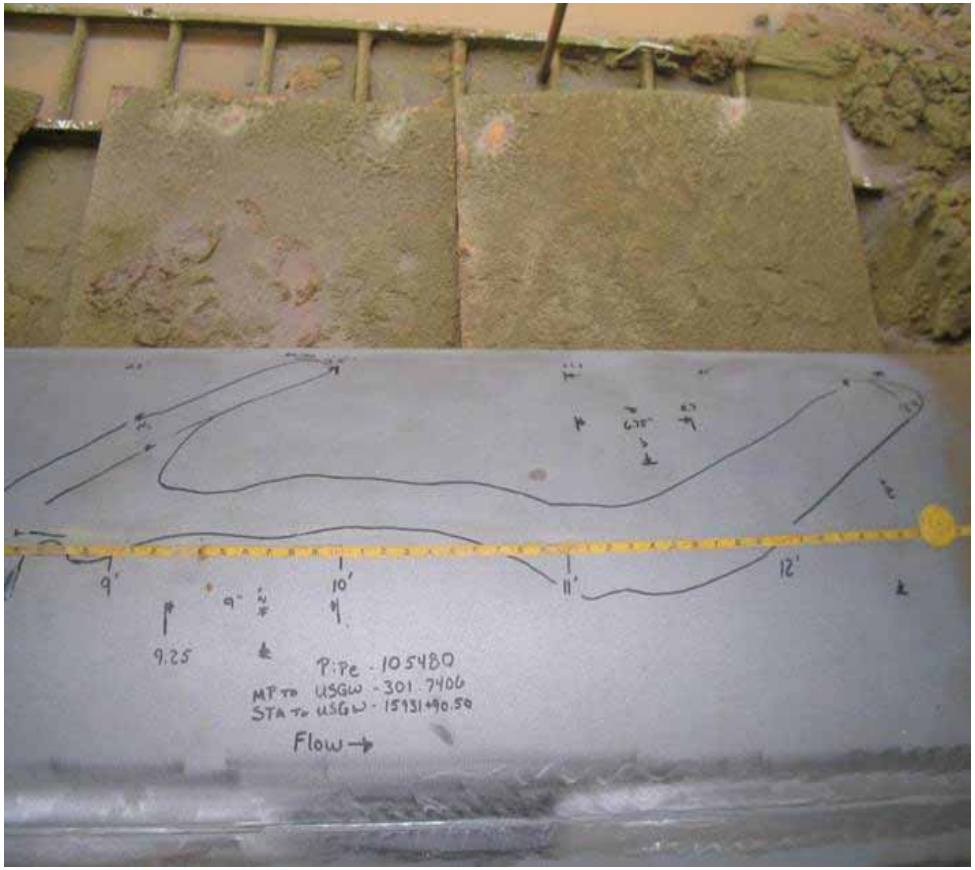

Top of Pipe Mechanical Damage/Gouge Multiple Dents

Industry Research
What do we want?

- **Detection**
  - Reliable detection of secondary features within deformed pipe
  - Detection of cracks in dents
- **Characterization**
  - Industry accepted severity calculations for dents with secondary features

Industry Research
What do we want?

- **Codes and Regulations**
  - **Recognition of existing research showing that smooth dents are not injurious**

CFR 195.452

(ii)60-day conditions.

(A) A dent located on the top of the pipeline (above the 4 and 8 o'clock positions) with a depth greater than 3% of the pipeline diameter (greater than 0.250 inches in depth for a pipeline diameter less than Nominal Pipe Size (NPS) 12).

(iii) 180-day conditions.

(B) A dent located on the top of the pipeline (above 4 and 8 o'clock position) with a depth greater than 2% of the pipeline's diameter (0.250 inches in depth for a pipeline diameter less than NPS 12).