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# COMMON PIPELINE ANOMALIES

Henry S. Green Jr



Appalachian Underground Corrosion Short Course

# Better Cleaning, Better ILI Data

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# Better ILI Data

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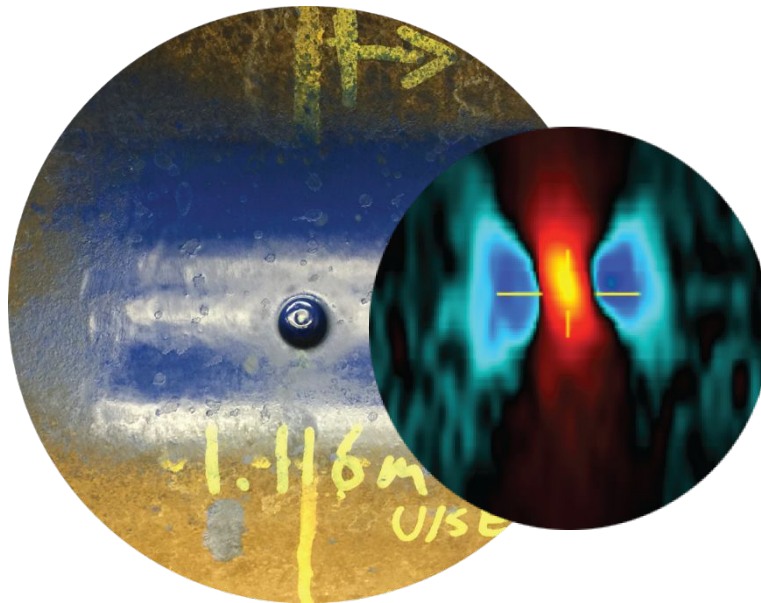




# ILI PERFORMANCE

## Methodologies

Calibrate and verify our sizing models



Real Corrosion

Machining

ECM Defects





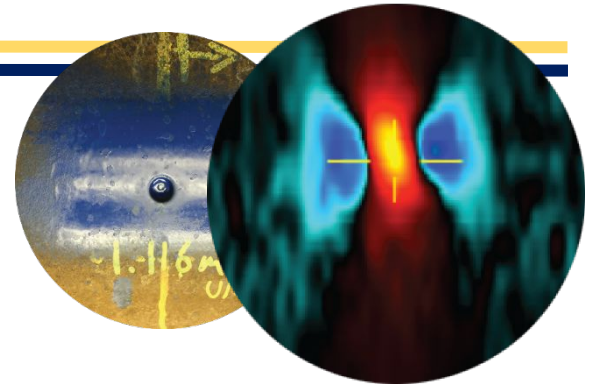
# ILI PERFORMANCE

## Methodologies

Process requires quality source data



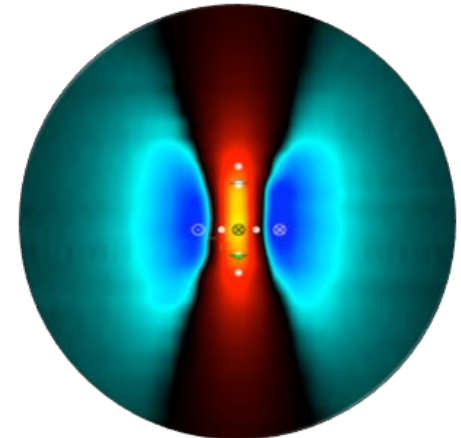
Machined defects



Signal capture



ECM defects



Parameterization



Pull testing

# We are Pipeline Integrity

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## ILI Solutions-Based Innovation

Caliper Deformation Technology



MfL Multi-Tech Tool



# MfL Combo Tool

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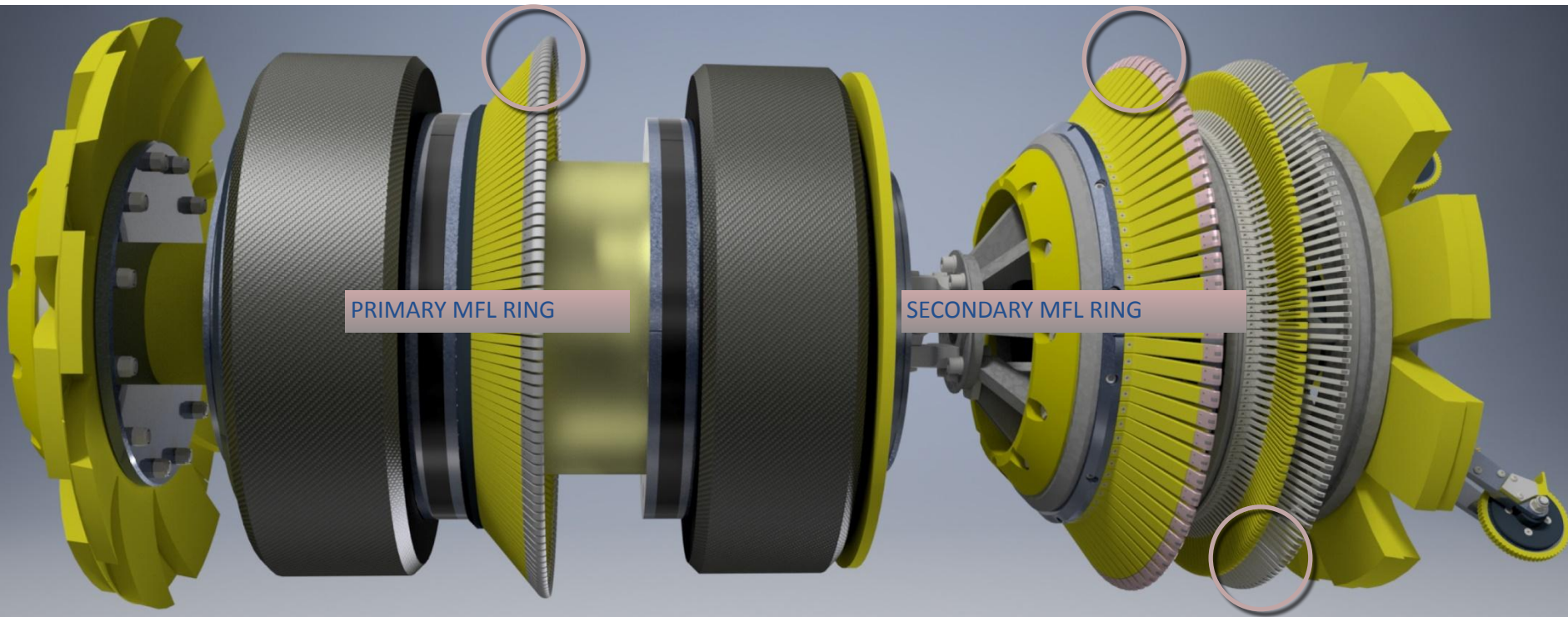


# MfL MULTI-TECH ILI TOOL

## MfL Combo Tool

MFL SENSOR DENSITY

RESIDUAL SENSORS



PRIMARY MFL RING

SECONDARY MFL RING

CALIPER

# MFL SENSORS

A decorative graphic consisting of two horizontal lines, one yellow and one dark blue, with a thin grey circle partially overlapping them on the left side.The background of the slide features a low-angle, perspective view of a curved, metallic structure, possibly a ship's hull or a large industrial pipe. The structure is composed of many parallel, curved segments, some of which are painted yellow and others grey. The sky in the background is a clear, light blue.

General Corrosion

Pinhole Metal Loss

External Metal Loss

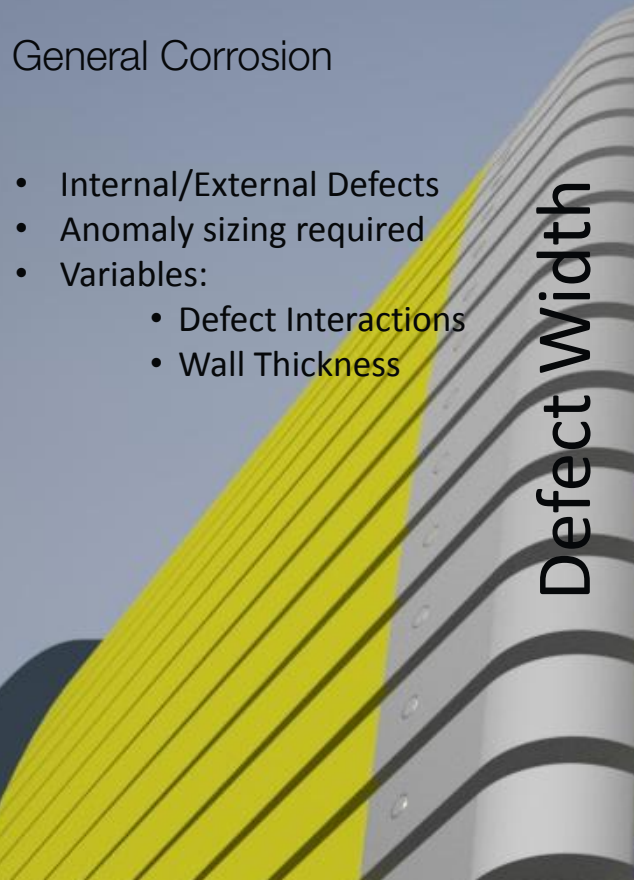
Internal Metal Loss

Laminations



# MFL SENSORS

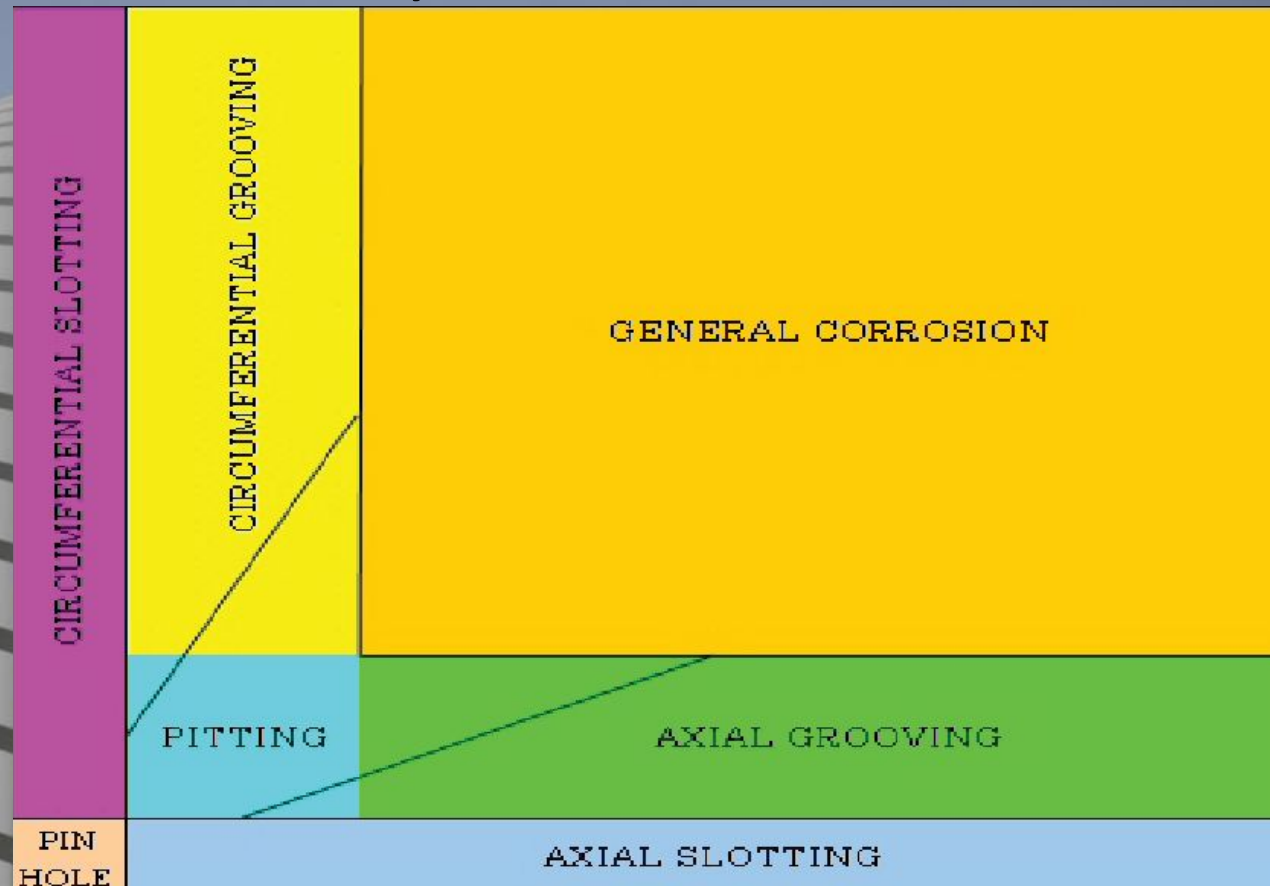
## Anomaly Classification Chart



General Corrosion

- Internal/External Defects
- Anomaly sizing required
- Variables:
  - Defect Interactions
  - Wall Thickness

Defect Width



Defect Length

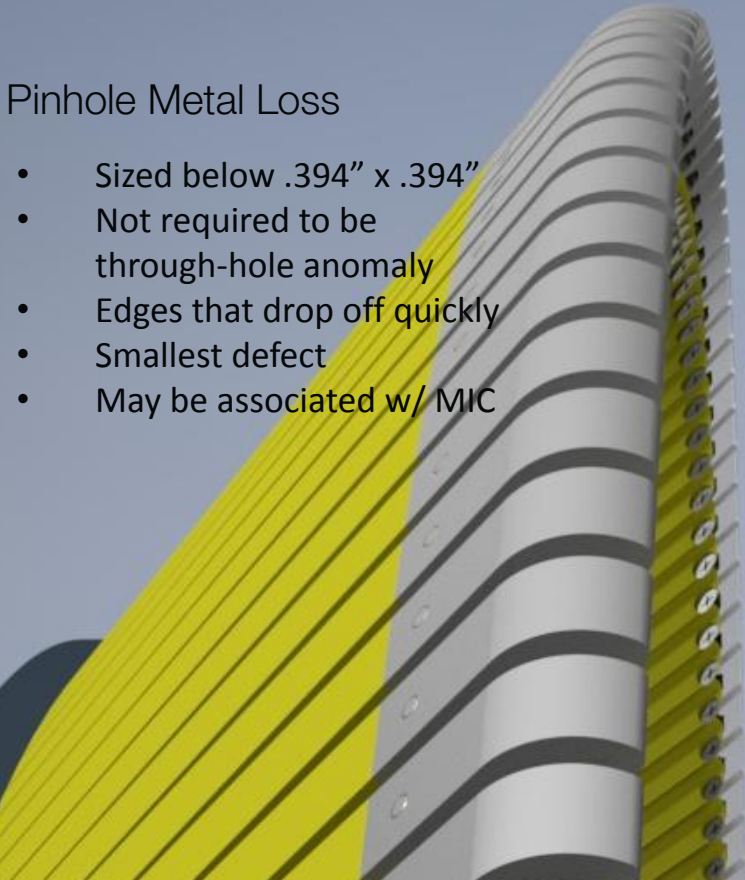


# MFL SENSORS

## PRIMARY MFL RING

### Pinhole Metal Loss

- Sized below .394" x .394"
- Not required to be through-hole anomaly
- Edges that drop off quickly
- Smallest defect
- May be associated w/ MIC

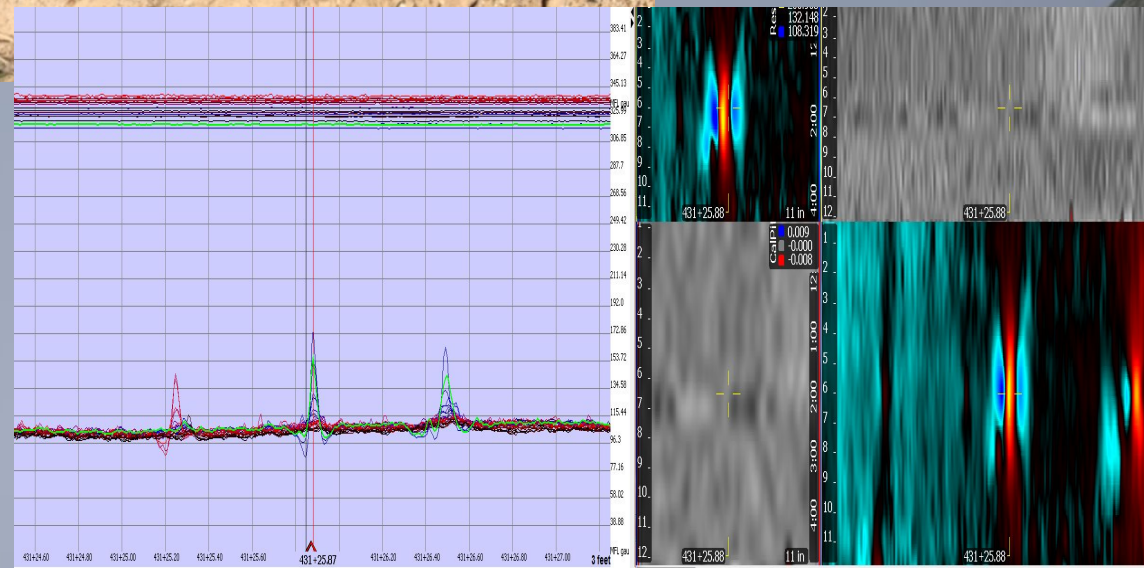
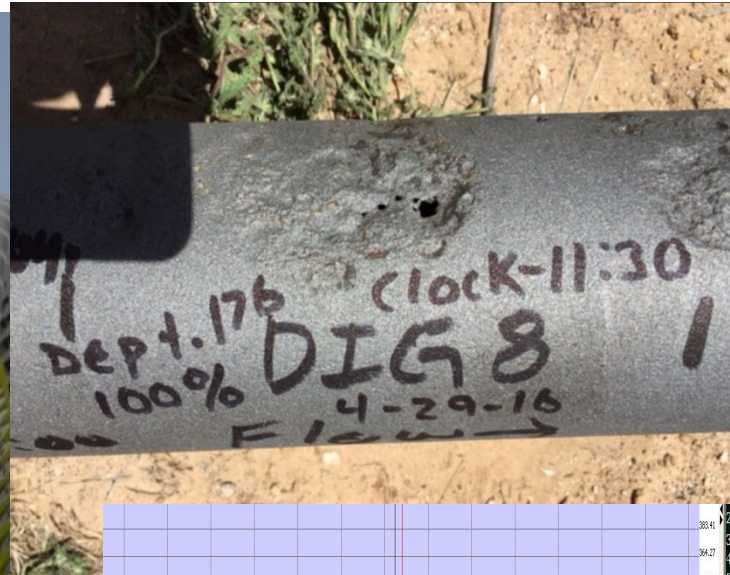


# MFL SENSORS

## PRIMARY MFL RING

### External Metal Loss

- Metal Loss signature (peak) on MFL data set
- No internal surface change measured



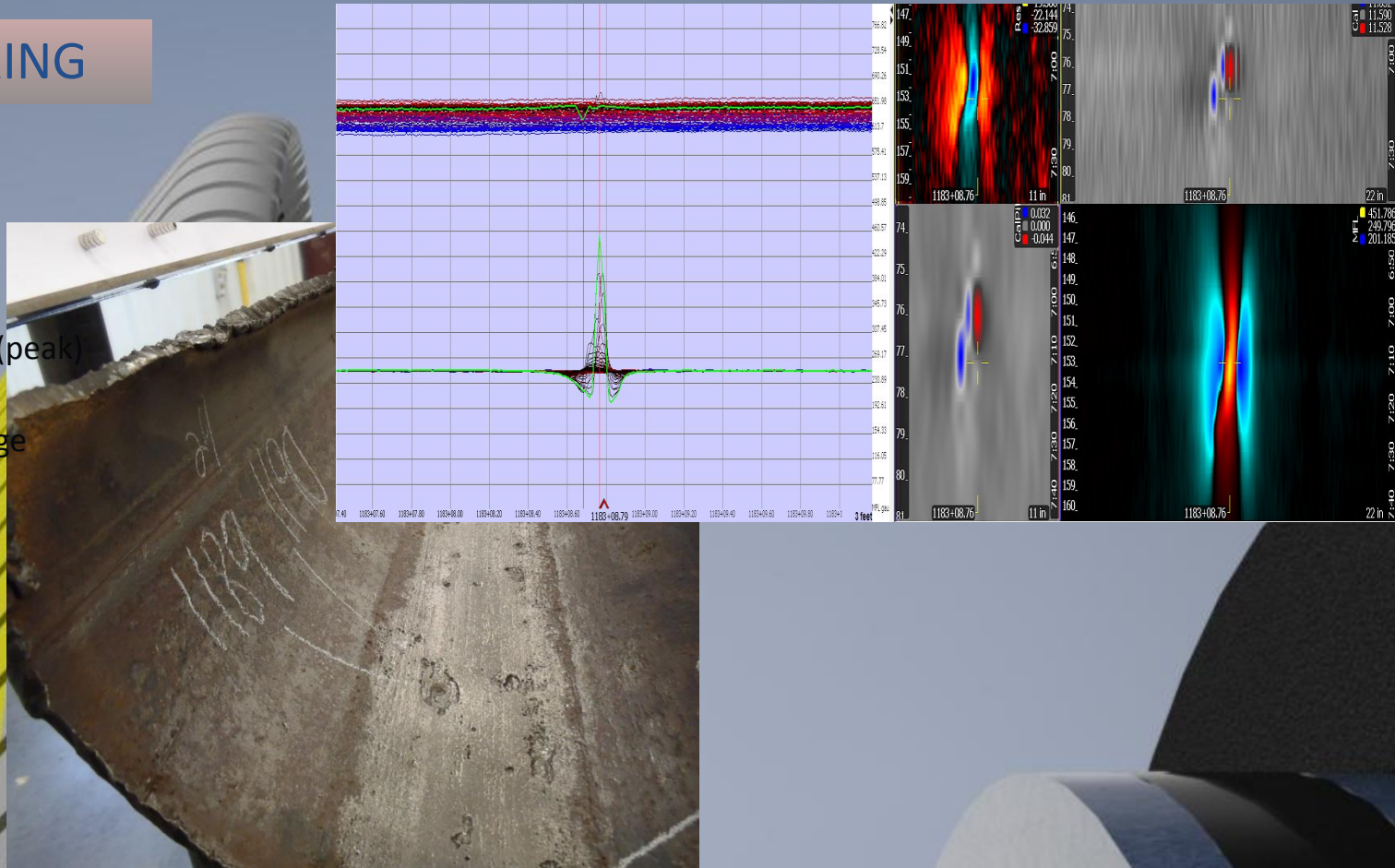


# MFL SENSORS

## PRIMARY MFL RING

### Internal Metal Loss

- Metal Loss signature (peak) on MFL data set
- Internal surface change measured





# MfL SENSORS

SUPPLEMENTARY DATA

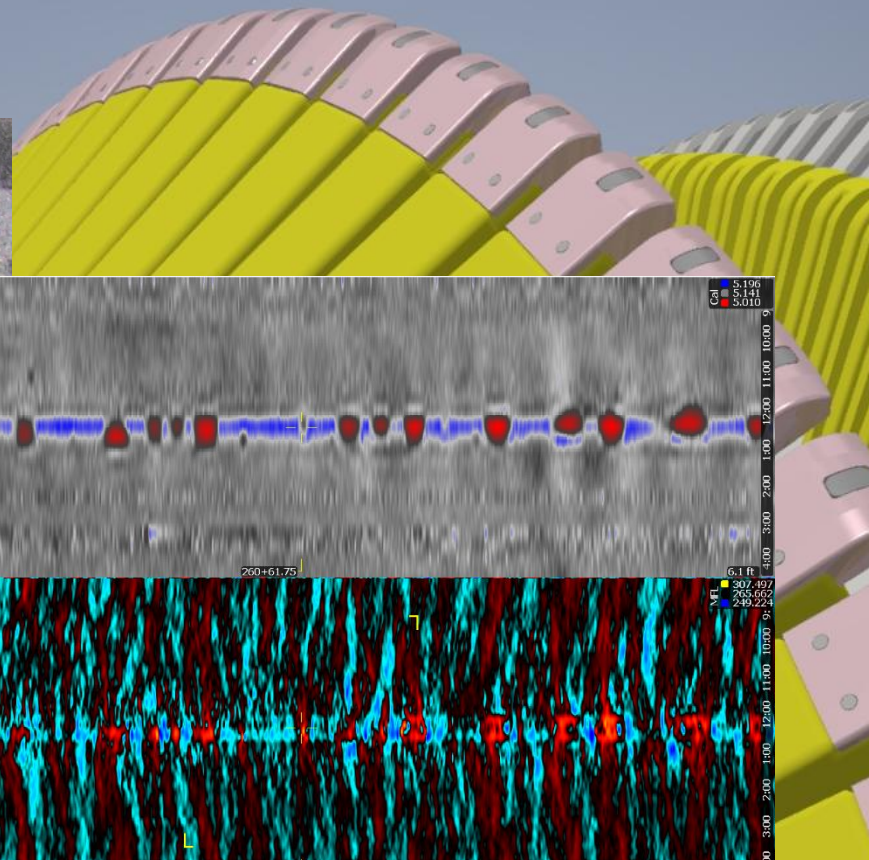
## PRIMARY MfL RING

Lamination



04/30

- Mid-wall originated anomaly
- Requires internal surface break for classification (MfL technologies)

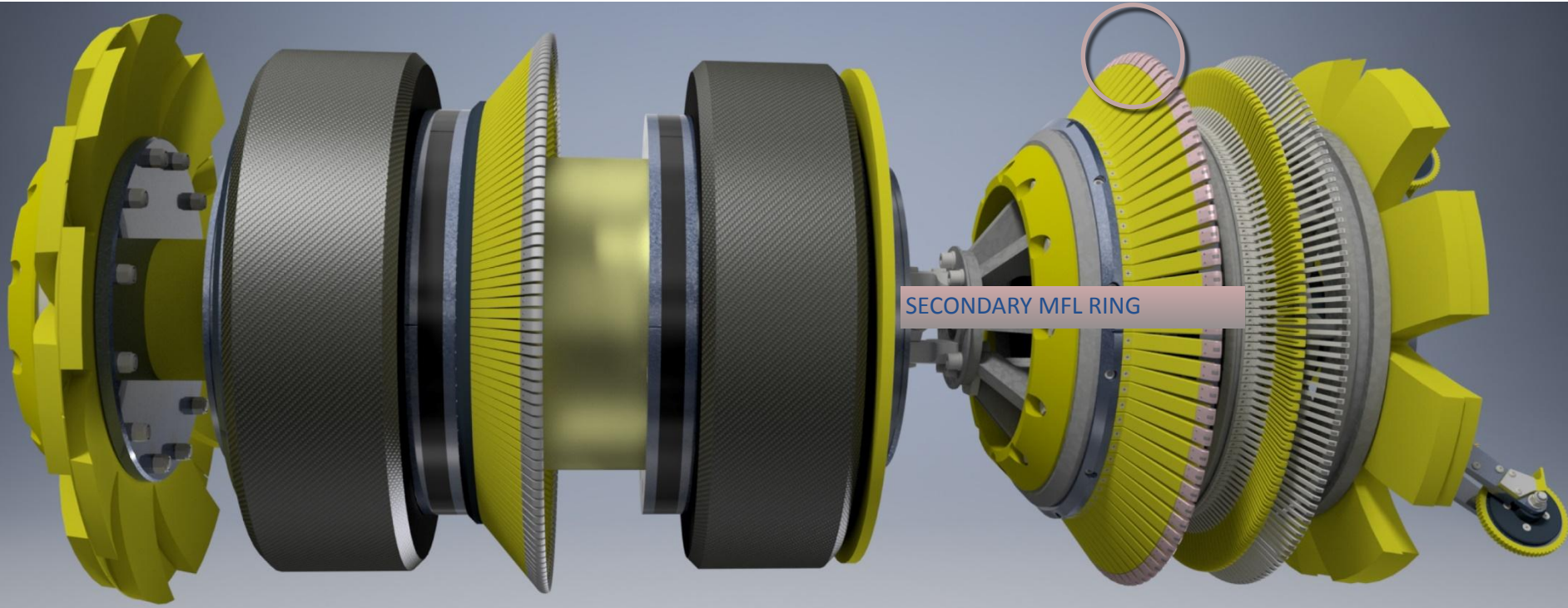


# MfL MULTI-TECH ILI TOOL

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## RESIDUAL

RESIDUAL SENSORS





# MfL RESIDUAL SENSORS

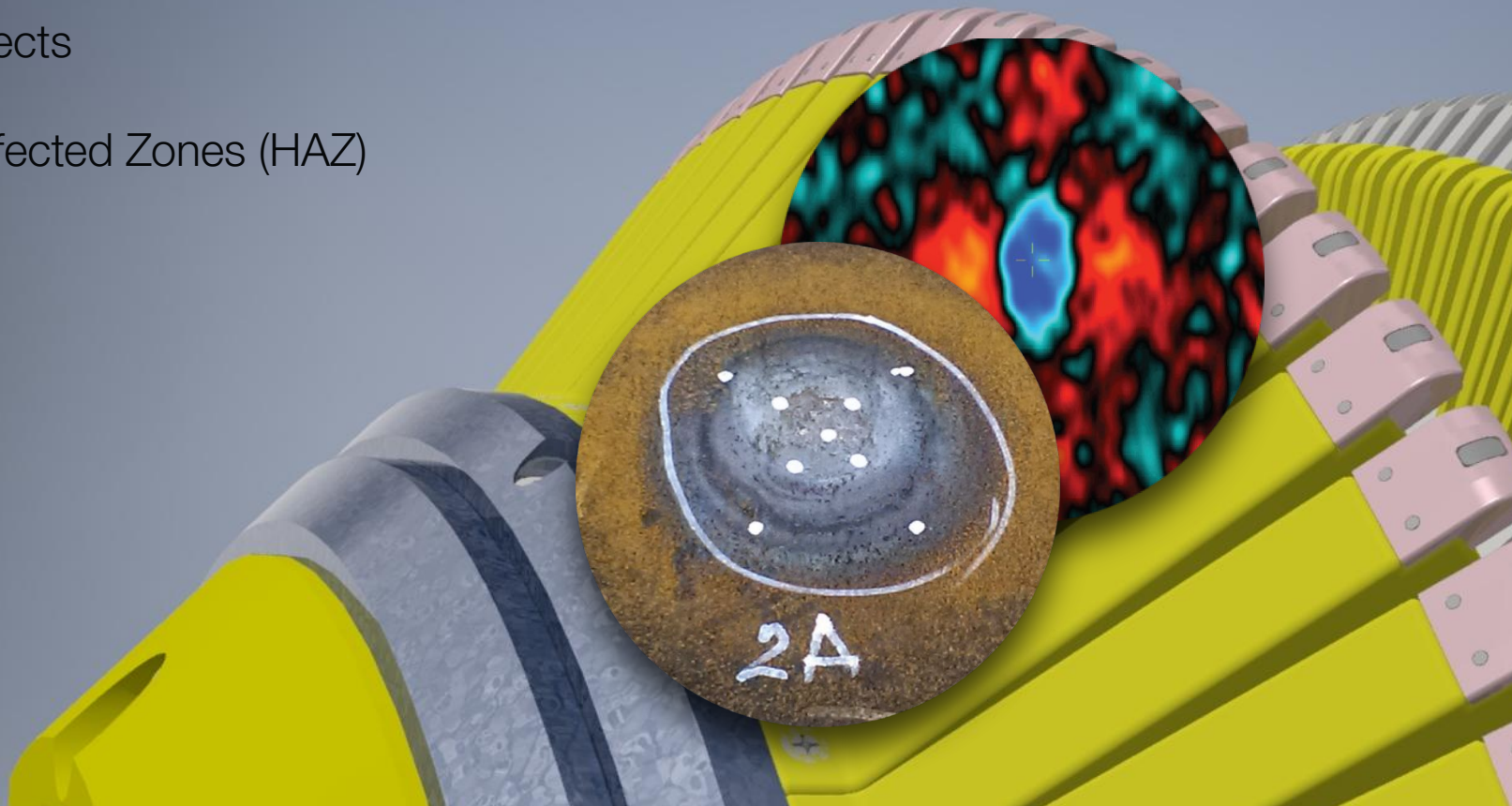
## SUPPLEMENTARY DATA

### SECONDARY MfL RING

### ENHANCES ANALYSIS

Mill Defects

Heat Affected Zones (HAZ)





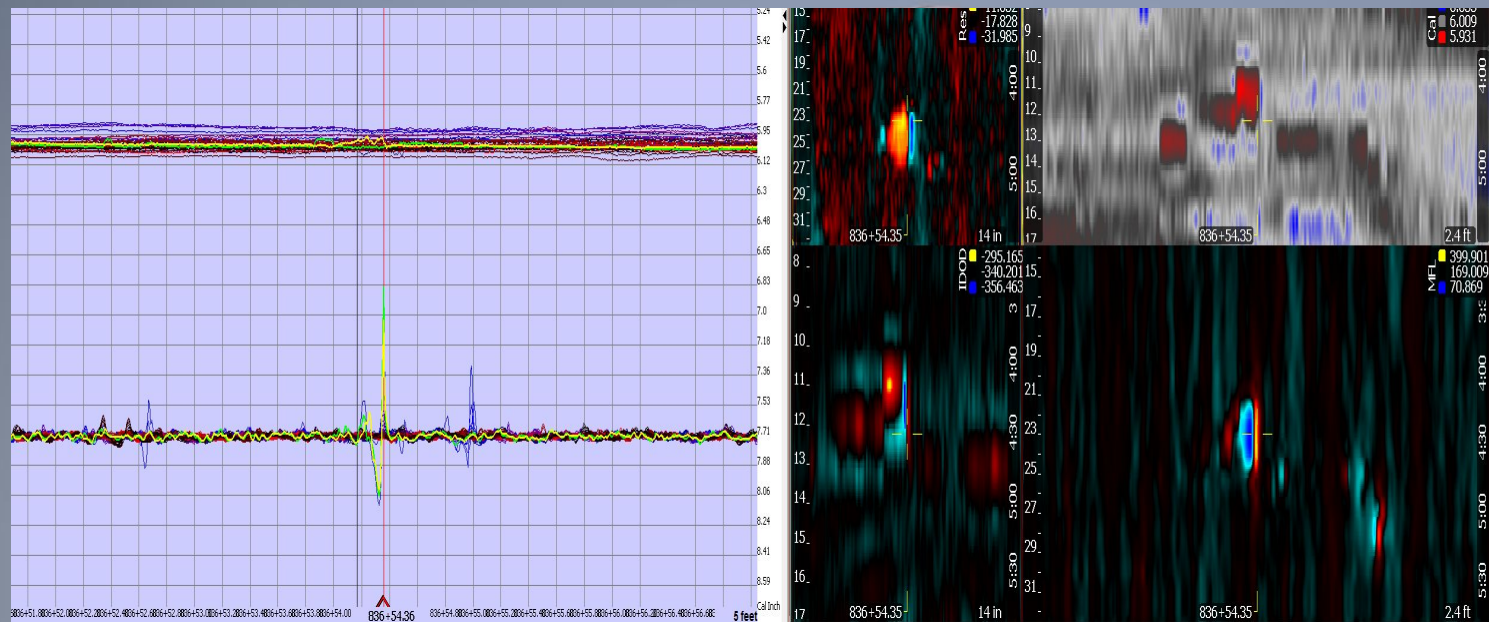
# MfL RESIDUAL SENSORS

## SUPPLEMENTARY DATA

### SECONDARY MfL RING

### ENHANCES ANALYSIS

#### Mill Defects



- Sharp bipolar signal on the MfL and Residual data sets
- Internal surface change measured
- Non-typical Dent or Metal Loss signature

# MfL RESIDUAL SENSORS

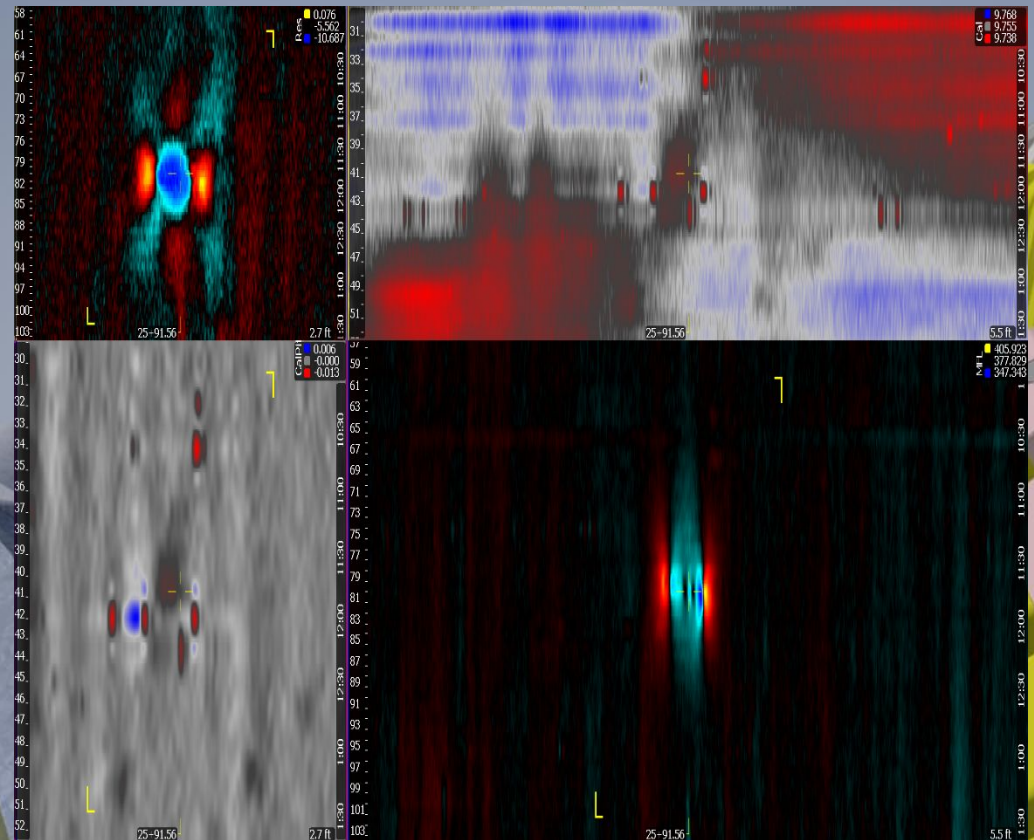
## SUPPLEMENTARY DATA

### SECONDARY MfL RING

### ENHANCES ANALYSIS

#### Heat Affected Zones (HAZ)

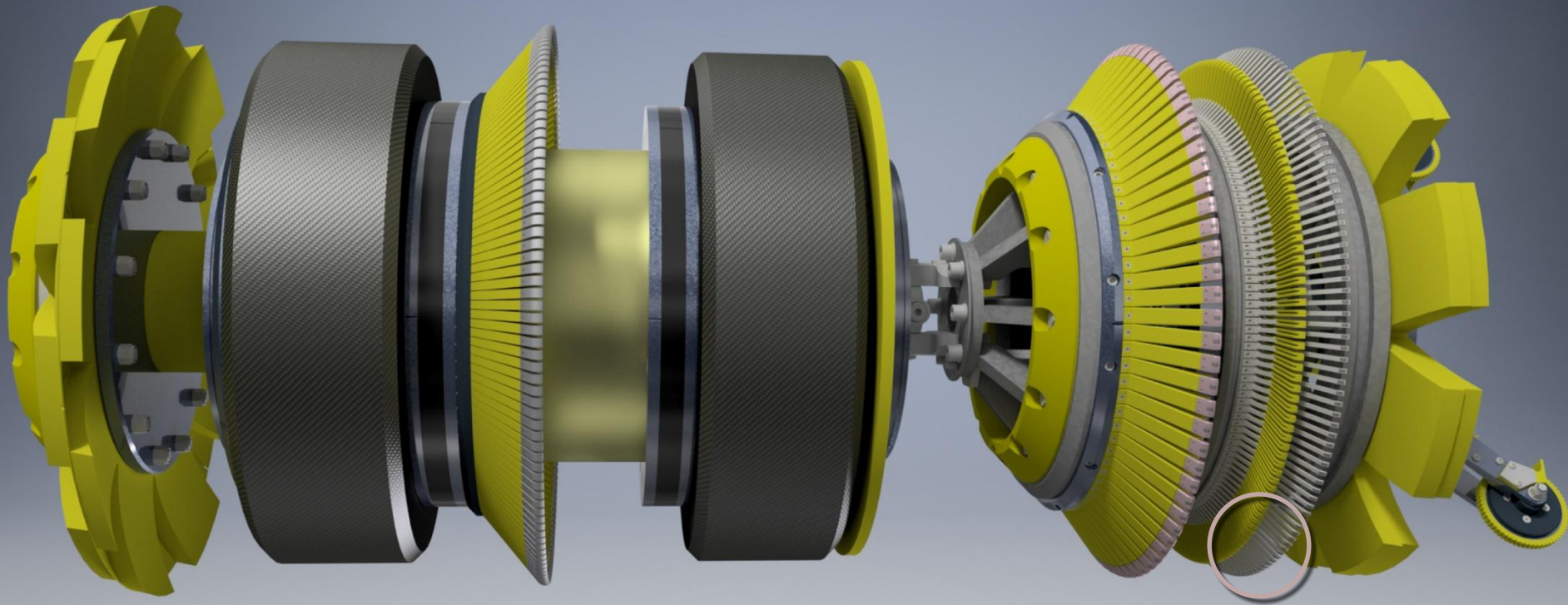
- Internal surface change measured
- Metals in close proximity (MfL)
- Can make determination between:
  - Type A Sleeves (Reinforcing)
  - Type B Sleeves (Pressure Containing)



# MFL MULTI-TECH ILI TOOL

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## CALIPER



CALIPER



# MFL CALIPER SENSORS



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CALIPER RING

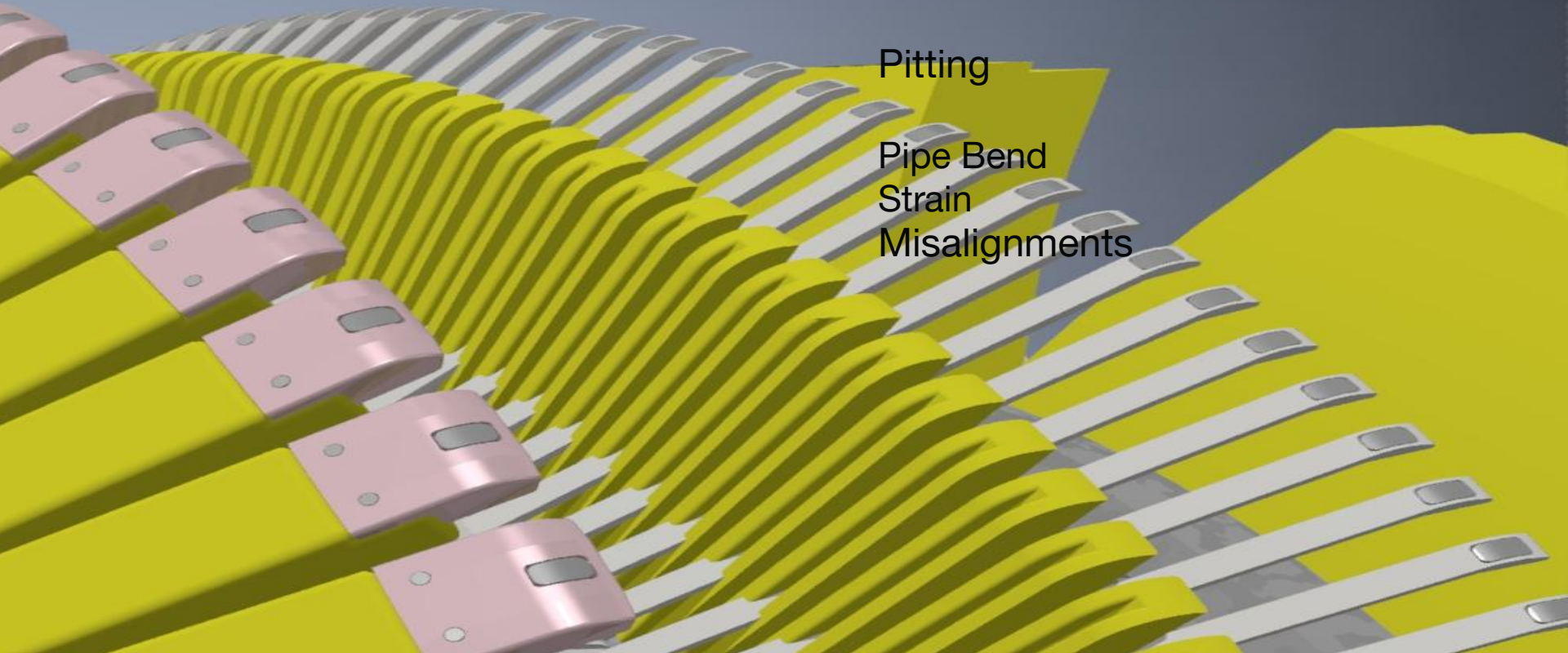
Dents

Pitting

Pipe Bend

Strain

Misalignments

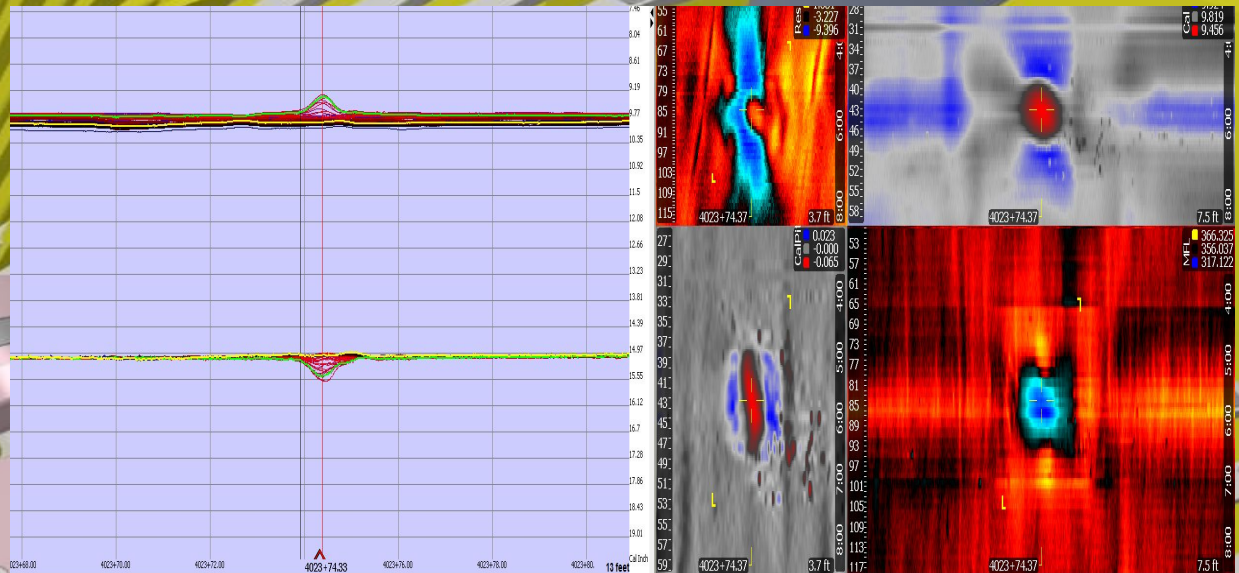


# MFL CALIPER SENSORS

## CALIPER RING

### Dents

- Dent signature (fairly smooth movement on Caliper and MfL sensors)
- Caliper Sensors show movement in the interior of the pipe





# MFL CALIPER SENSORS

## CALIPER RING

### Gauges

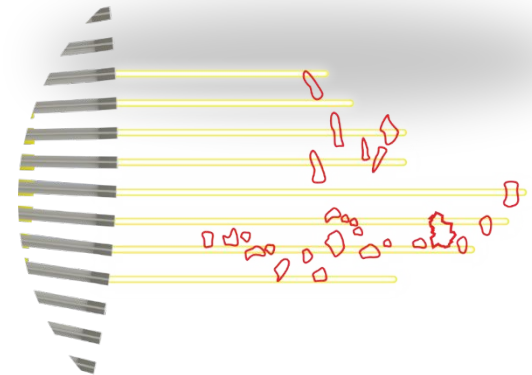
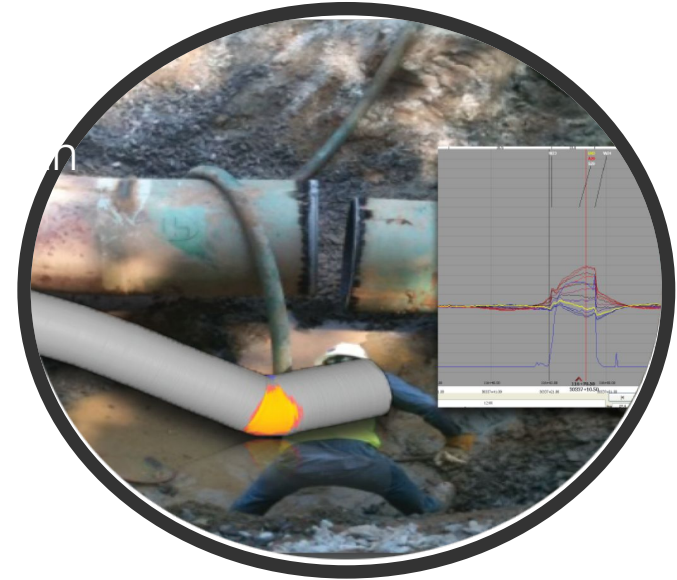
- Pipeline metal has been upset
- Identification of third party damage





# Caliper

## GEOMETRIC DETECTION

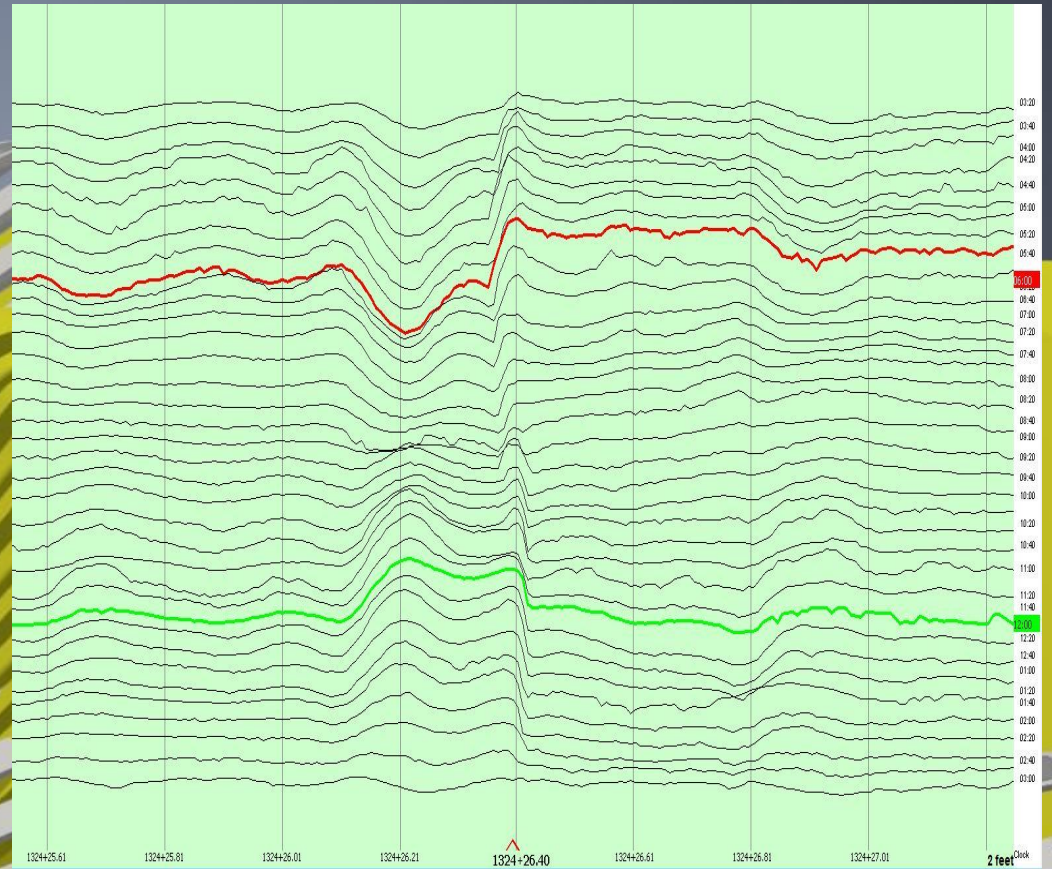


# MFL CALIPER SENSORS

## CALIPER RING

Misalignments (Hi-Low Welds)

- Offset girth welds



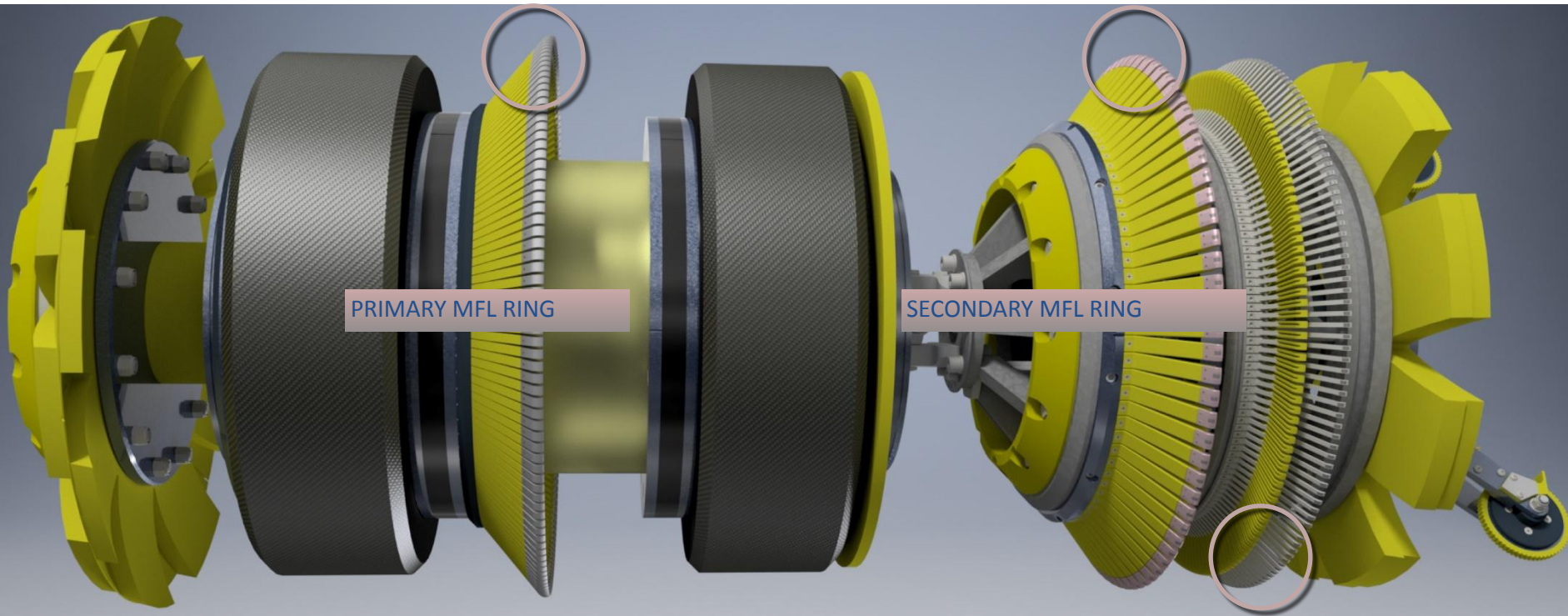


# MfL MULTI-TECH ILI TOOL

## MfL – Multi Data Sets

MFL SENSOR DENSITY

RESIDUAL SENSORS

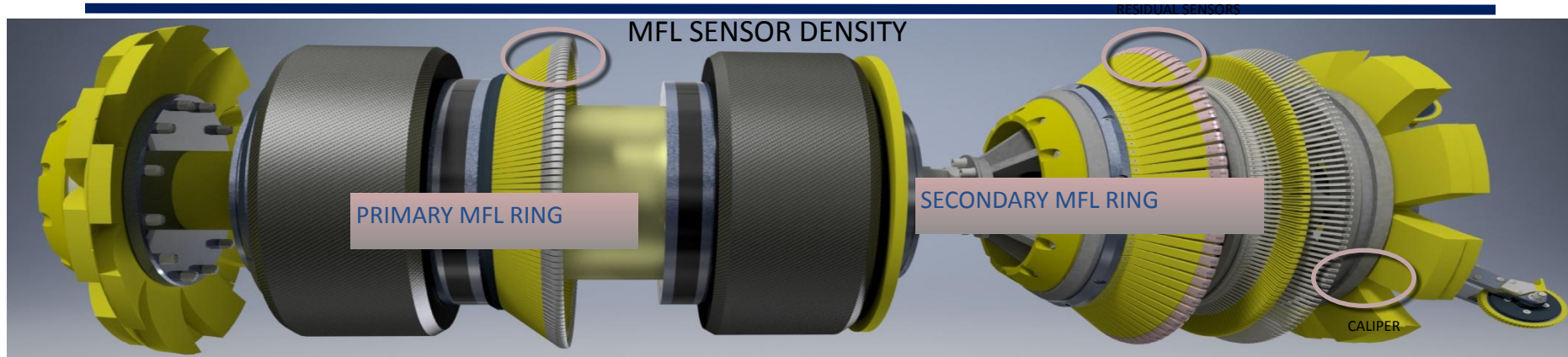


CALIPER

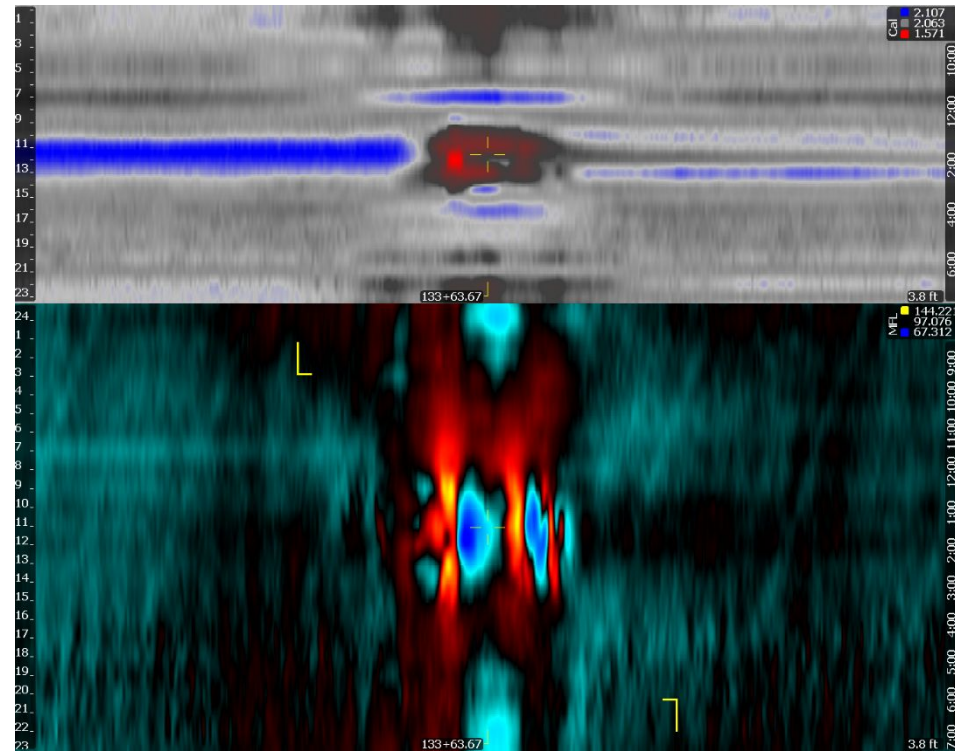


# MfL MULTI-TECH ILI TOOL

## Dent with Metal Loss



- Dent signature on Caliper data set
- External Metal Loss signature on MfL data set
- Metal Loss occurs at same position/orientation as Dent





# MFL MULTI-TECH ILI TOOL Expansions

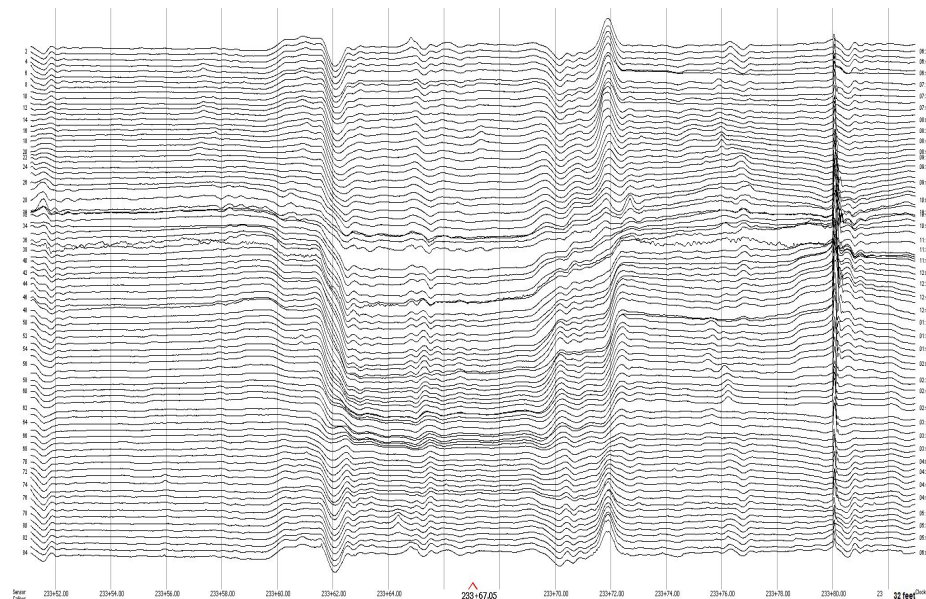
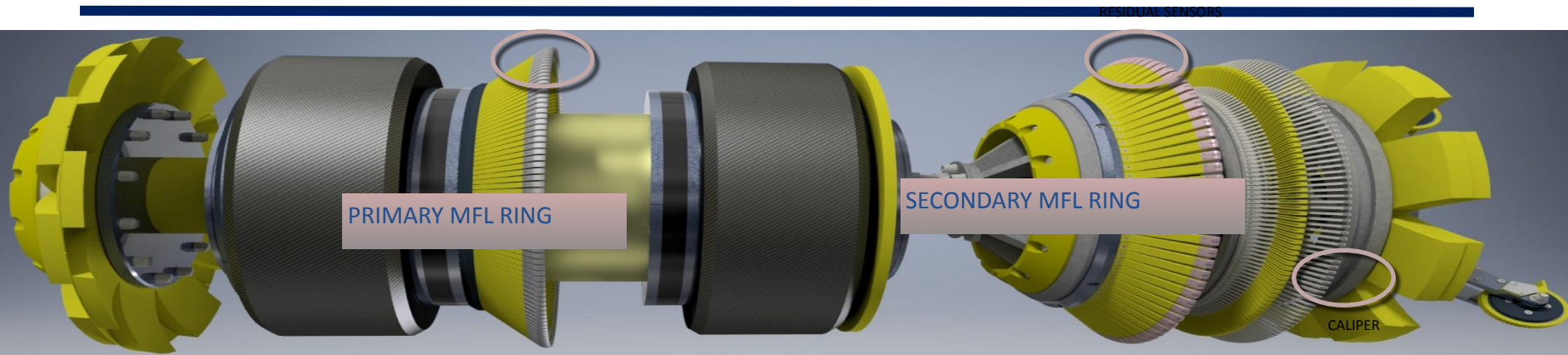
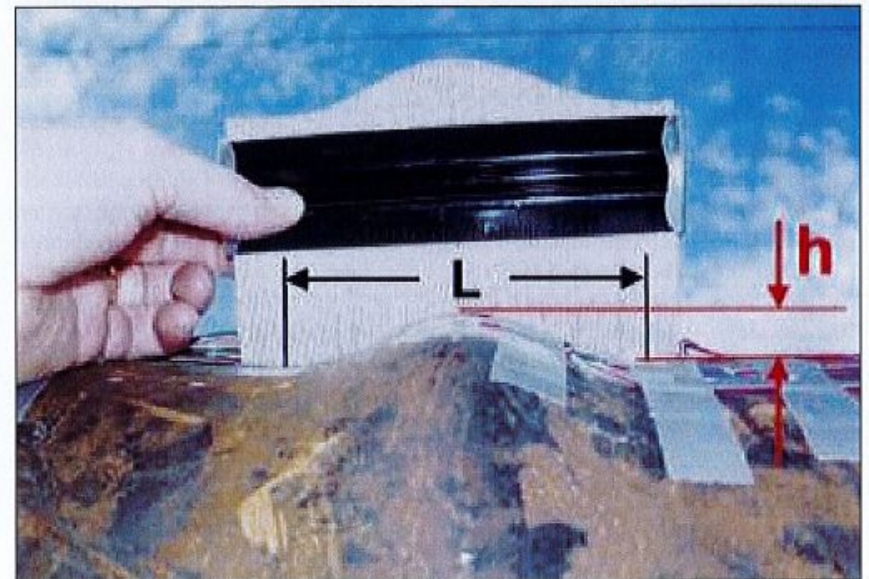


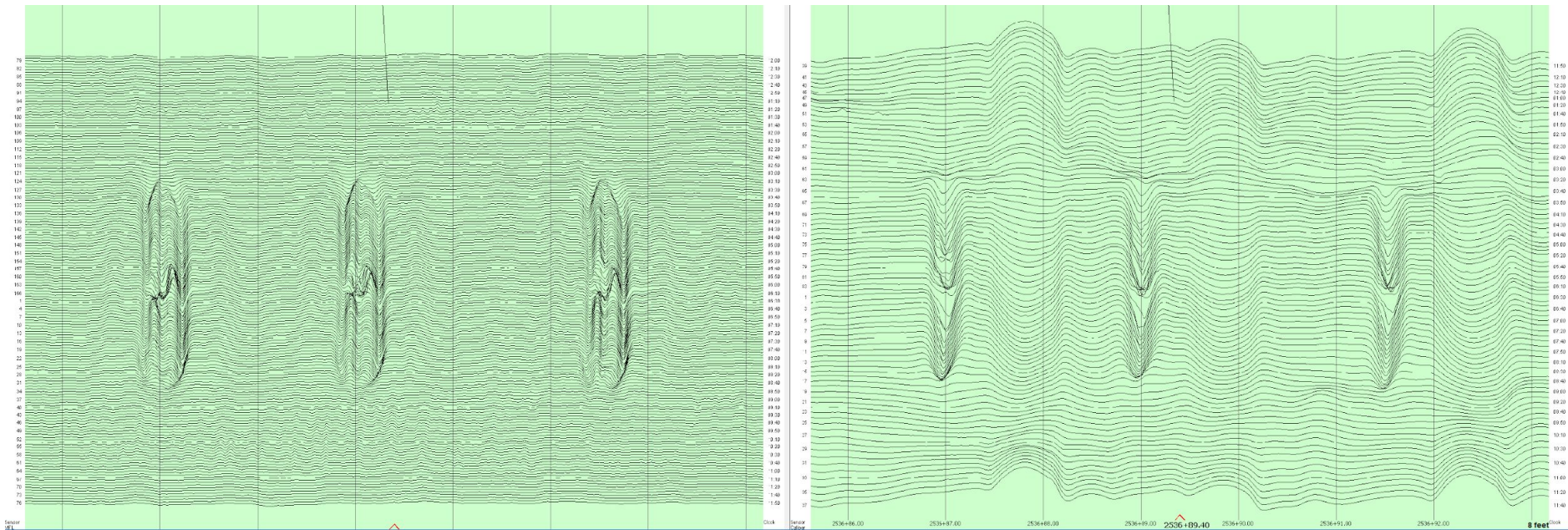
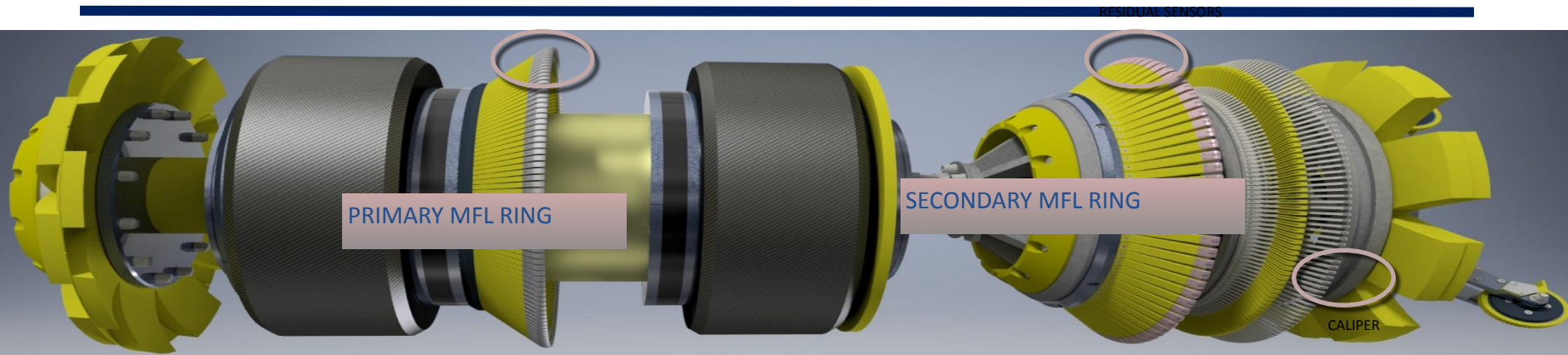
Figure 1. Measurement made using steel profile comb with "h" and "L" values.



- May occur in complete pipe joint or the middle of a pipe section



# MFL MULTI-TECH ILI TOOL Wrinkles

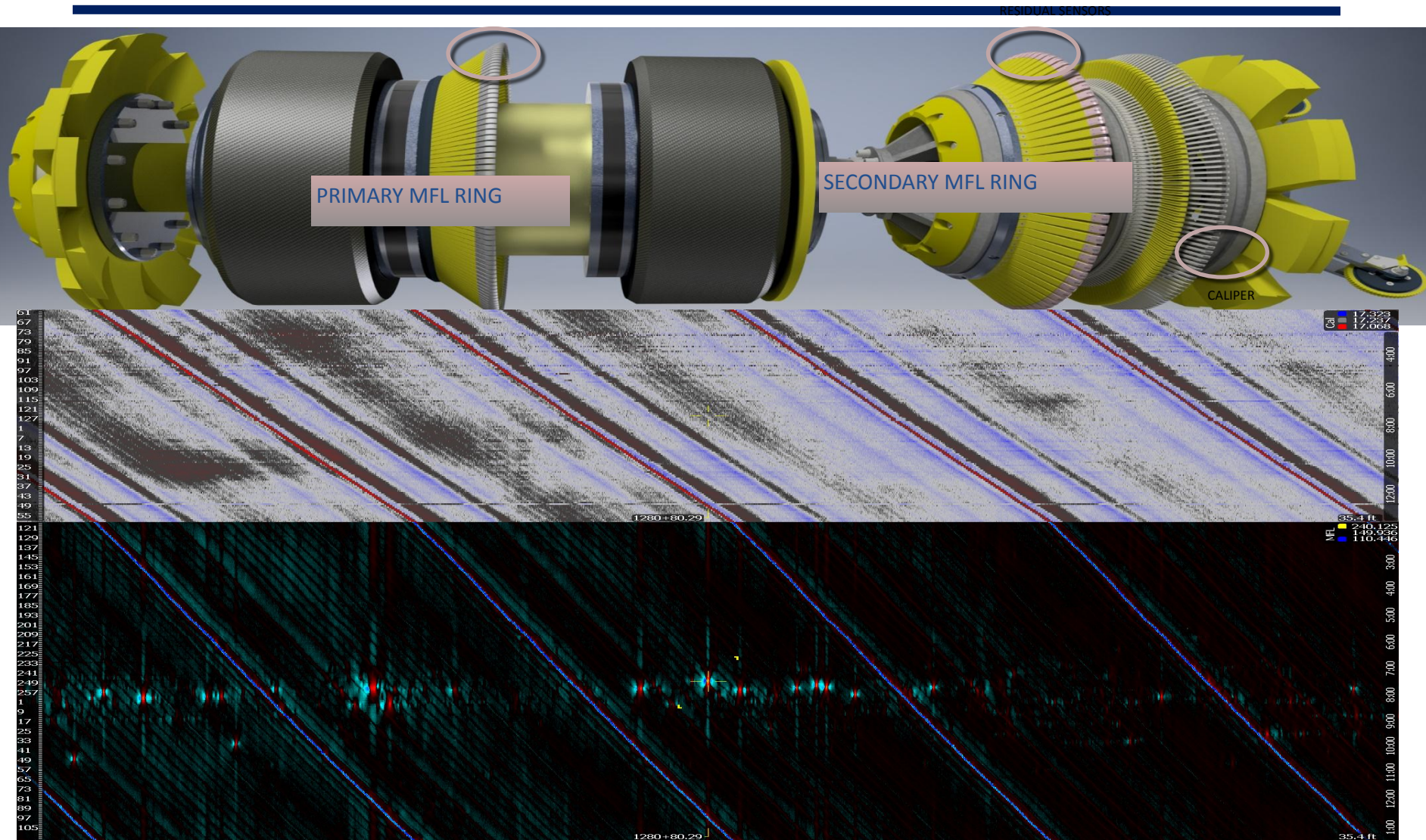


- All Caliper Sensors move from baseline



# MFL MULTI-TECH ILI TOOL

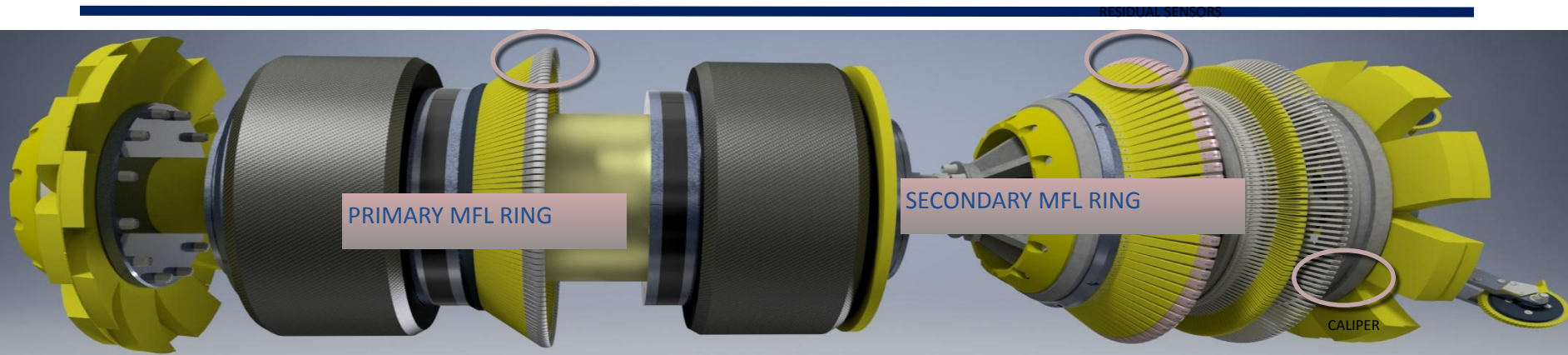
## External Metal Loss in Spiral Seam Pipe





# MFL MULTI-TECH ILI TOOL

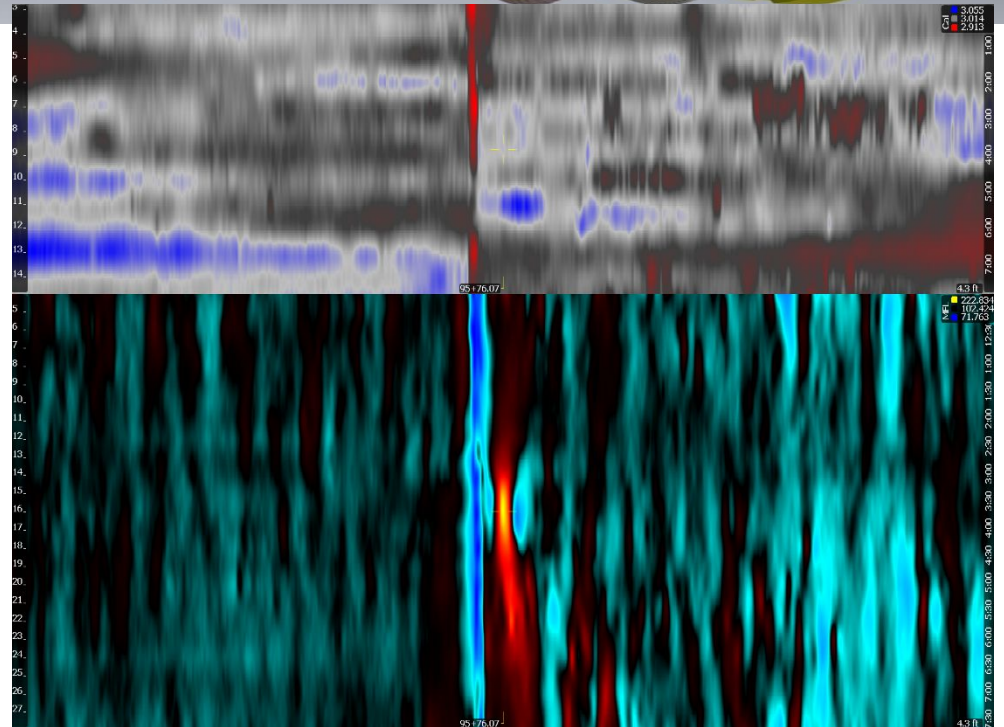
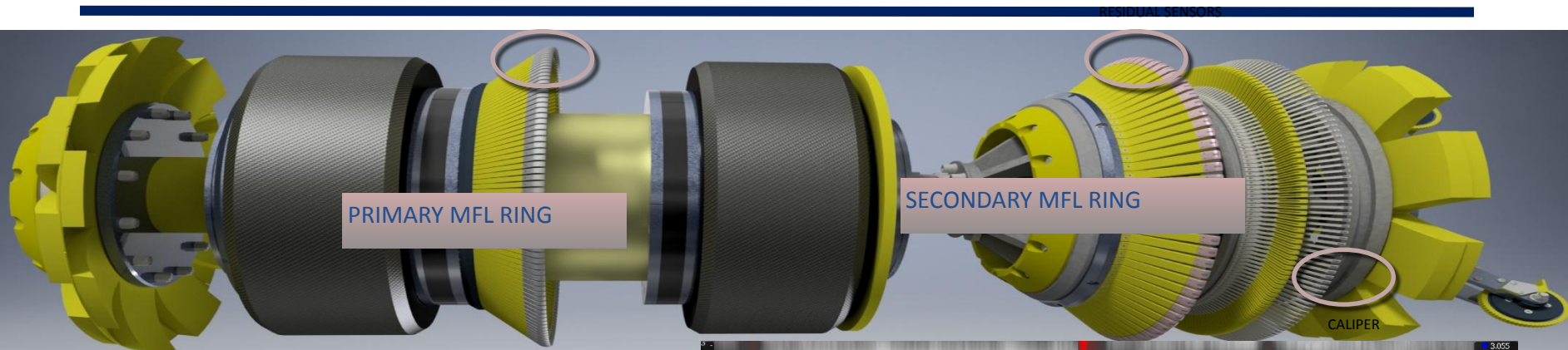
## Dent in Spiral Seam Pipe





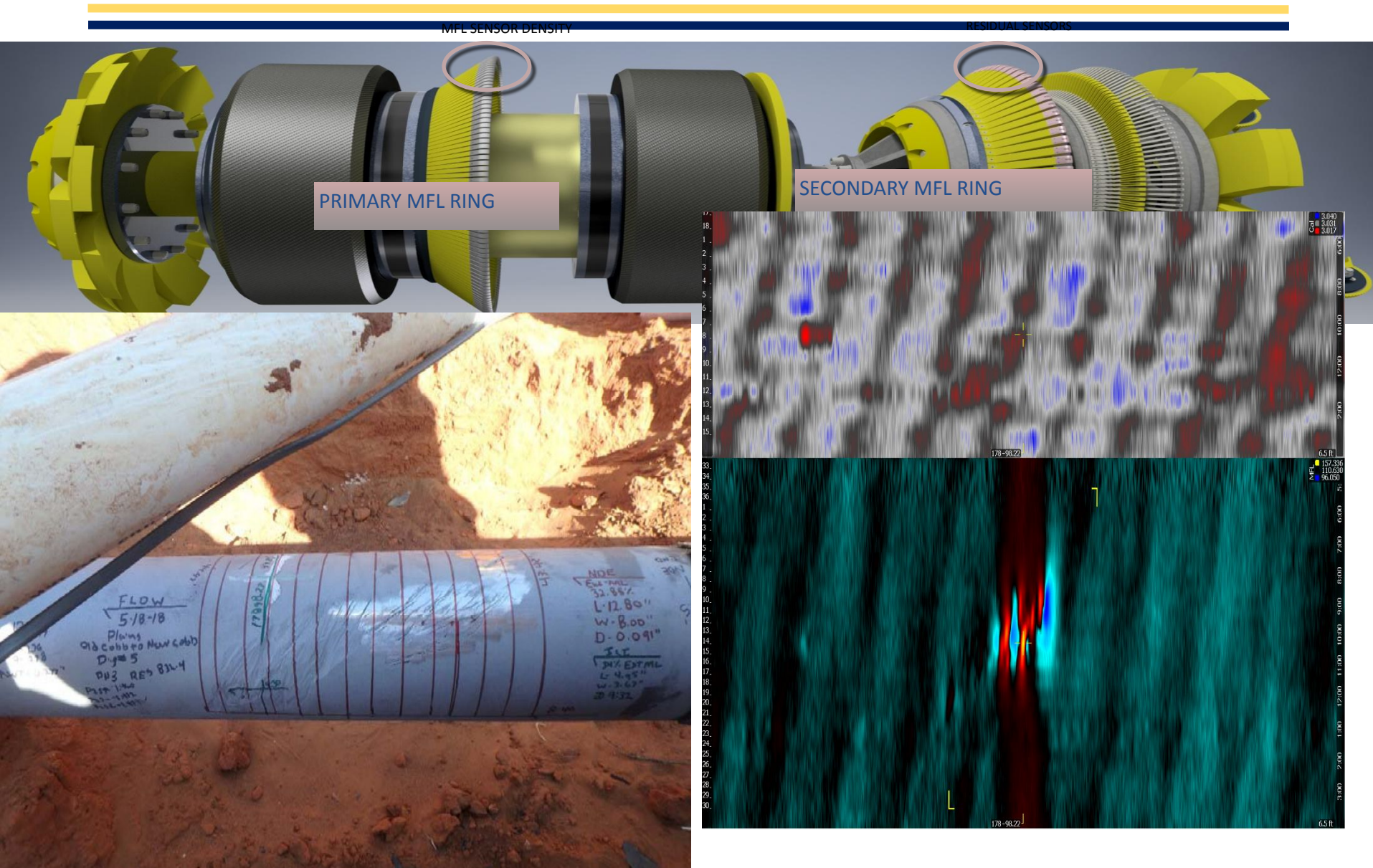
# MFL MULTI-TECH ILI TOOL

## Internal Metal Loss near Weld





# MFL MULTI-TECH ILI TOOL Gauges



# Data Analysis

Visualize

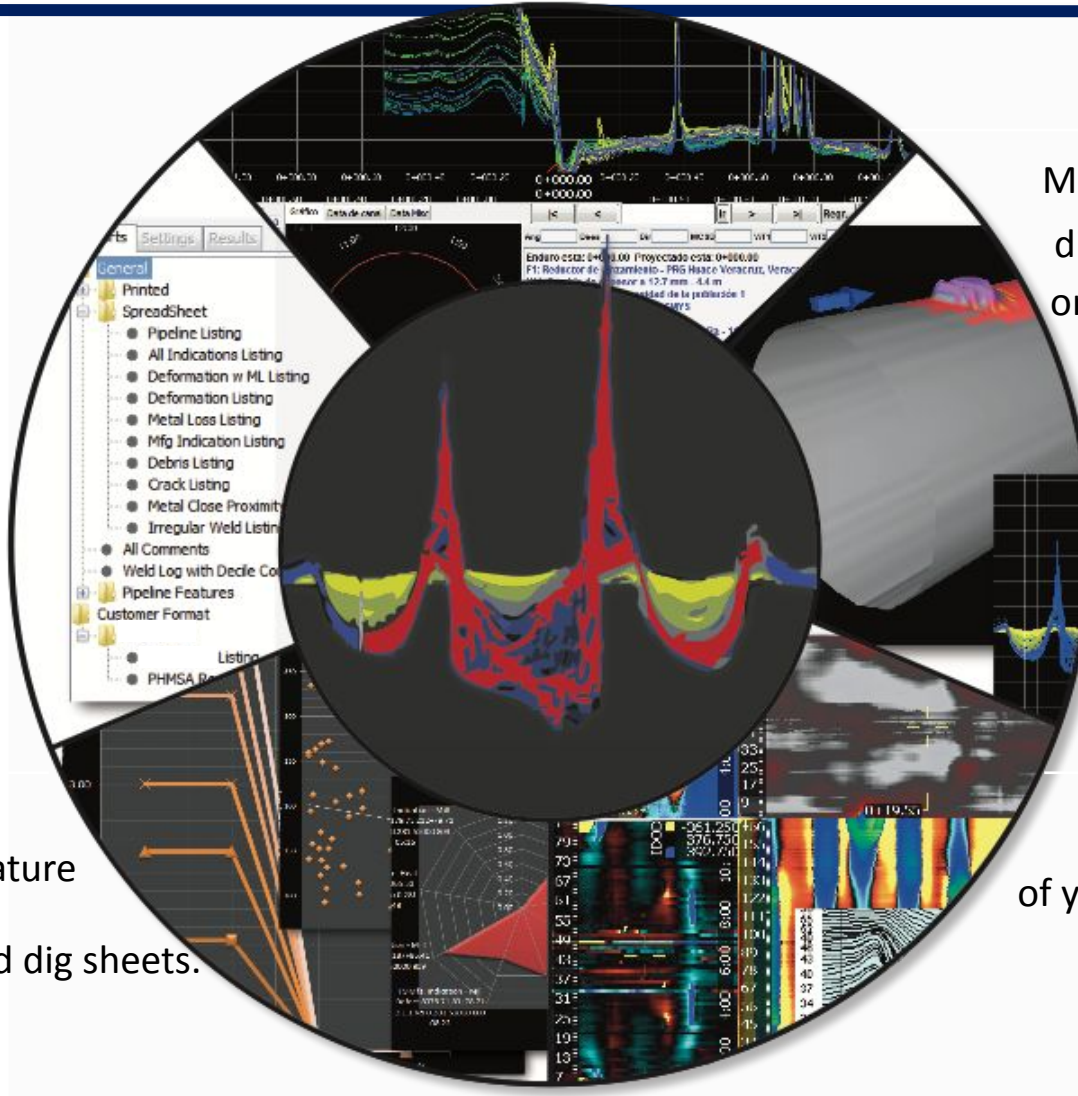
Multiple sensor displays for each on-board technology.

Explore

Intuitive navigation of your ILI data.

Report

Easy export of priority feature lists, plots and dig sheets.





**THANK YOU**