



Latest Development of Intelligent Pigging Technology for Transmission Pipeline



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PIPELINE INSPECTION SERVICE PROVIDER

- Founded in 1992
- Location Lohne/Wietmarschen, Germany
- > 140 Employee



3P SERVICES BASE IN LOHNE



PROTECT PEOPLE AND PLANET

OPERATING WORLDWIDE



PROTECT PEOPLE AND PLANET

PETROLEUM, PETROCHEMICAL AND CHEMICAL INDUSTRY

upstream



offshore

midstream & downstream



storage and transports



onshore



refining, plants and process

PIPELINE CHARACTERISATION

Pipeline System

piggable

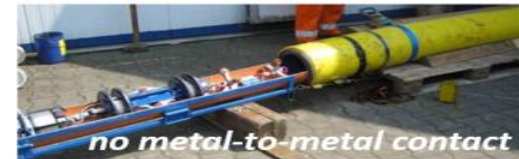
- gathering lines
- im-/export lines
- transmission lines
- inter field lines/flow lines

un-piggable

- platform riser
- loading/offloading lines
- terminal & jetty lines
- caverns
- low flow/pressure lines
- tight bends/mitre bends
- multiphase pipelines
- exotic pipelines (e.g. cement liner, internal coating,...)
- no or single access
- Multidiameter lines



PULL THROUGH & PUMP TESTING



TECHNOLOGIES & SOLUTIONS



Metal Loss

- **Magnetic Flux Leakage (MFL) - 2in to 48in**
- **Ultrasonic (UT) – 3in to 12in**

Geometric Measurement

- **Geometry (GEO)**

Proprietary Sensor Technologies

- **Direct Magnetic Response (DMR)**
- **Short Range Distance (SRD)**

XYZ Mapping



CRACK DETECTION

- Collaboration with a Canadian Entity.
- Micron ILI technology - MFL based crack detection capabilities.
- Cracks can be detected in both the axial and circumferential directions.
- Cracks as small as 0.500" (12.7mm) in length and 20% deep can be reliably detected.



novitech

micron ILI technology

Micron CD-360SM Inspection Systems



CRACK DETECTION

- **Novitech is a highly specialized IHI Company**
- **Head Quartered in Toronto, US Operating Base in Denver**
- **Specialized in Crack Detection and Complex Corrosion**
 - **Providing multiple inspection requirements, from a single inspection platform**
 - **Comprehensive crack threat detection**
 - **Metal loss, Long Seam Examinations**
 - **High Resolution Geometry & IMU Mapping**

CRACK DETECTION

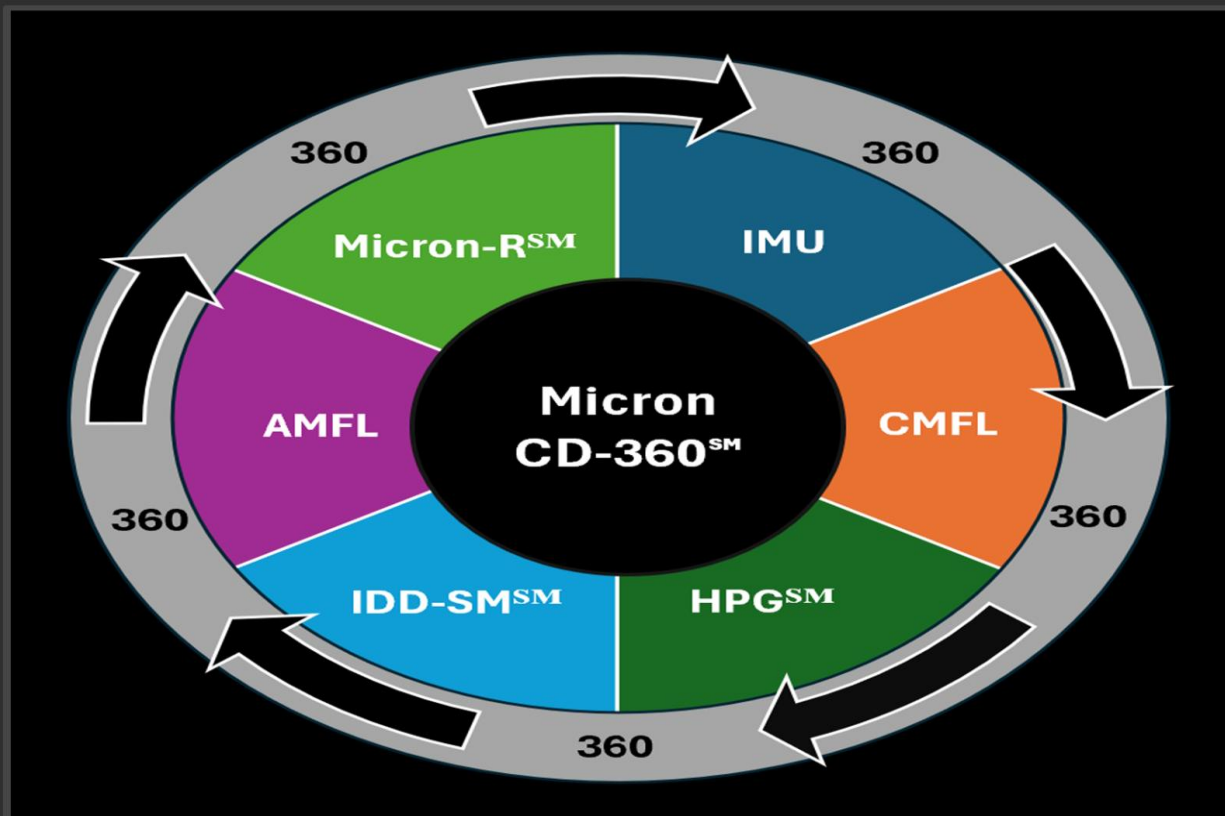
- Years of ILI Tool Development 8.5
- Years of Performing Commercial Work 7
- Number of Runs Completed > 500
- Total Number of Miles Inspected > 14,000 (22,500 kms)
- Repeat customers > 40
- Crack anomaly database > 600 (3rd party verified)
- Employees 43 (all dedicated to ILI)

CRACK DETECTION

- **Current size range from 4 to 18"**
- **4" crack detection tools (development underway)**
- **Larger tool sizes 20 to 24" (design work underway)**
- **Looking for assistance starting with the 20 and 24" tools**
- **Larger tool sizes 30 to 36" (future development)**
- **Low drag versions (in field trials)**
- **Continued work on Axial cracking (body of material)**

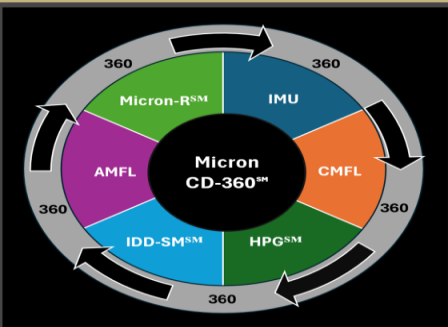
Micron CD-360SM Inspection Systems for complete coverage of Cracking Metal Loss and Critical Flaws

Micron CD-360SM





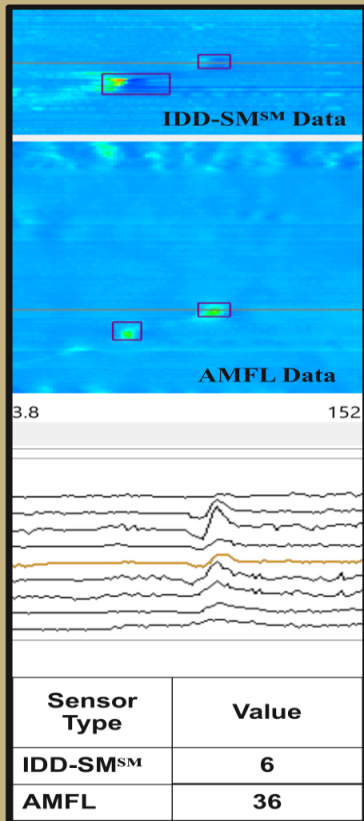
**Micron
CD-360SM
With Six
Primary Sensor
Systems**



Advanced Micron Inspection Systems

Micron CD-360SM (Cracking and Critical Flaws)

1. AMFL CD-640SM (Metal Loss and Crack Detection)
2. CMFL CD-1000SM (Metal Loss and Crack Detection)
3. IDD-SMSM (Crack Detection and Stress Intensity Analysis)
4. Micron-RFSM (Residual Field for Severe Crack Detection)
5. Geometry - HPGSM (High Precision Geometry)
6. IMU Mapping



Magnetic Based Crack Detection Explained

1. Uniform Magnetics and Optimized Flux Density:

- ❖ Magnetic circuits are designed to be uniform and have the optimum flux density in the pipe wall.

2. Sampling Density:

- ❖ AMFL up to 640 samples per square inch
- ❖ CMFL-1 up to 1000 samples per square inch (for standard circumferential inspection)
- ❖ CMFL-2* up to 1000 samples per square inch (for thin wall pipe under development)
- ❖ All sensor systems combined up to 3000 samples per square inch capability

3. No Data Compression:

- ❖ All samples are stored allowing very small magnetic responses to be analysed
- ❖ Lossy data compression can degrade or remove crack responses from the magnetic system

4. Full 12 Bit Dynamic Range: (4096 count range for all Sensors)

- ❖ A non-destructive magnetic test system requires a very wide dynamic range to cover everything from very small cracks to large metal loss anomalies.
- ❖ Combination of electronic and mechanical noise typically 1 to 2 range of counts out of 4096
- ❖ Recommended minimum signal to noise ratio for non-destructive testing is 3:1
- ❖ Crack signals can begin as small as 6 counts out of 4096 (maintaining signal to noise ratio $\geq 3:1$)

Severe CSCC in Complex Corrosion

02:20
04:44
07:07
09:32
11:56
02:20
04:44
07:07
09:32
11:56
02:20
04:44
07:07
09:32
11:56
02:24
03:36
04:48
06:00
07:12
08:24
09:36
10:48
12:00
01:12
02:24
03:36
04:48
06:00
07:12
08:24
09:36
10:48
12:00
01:12

Geometry Data



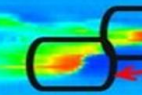
No visible Anomalies in
Geometry Data

Residual Field Data



Severe Crack Field Detected by
Residual Field Sensor Array

IDD-SMSM Data



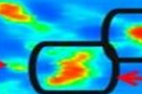
Severe Cracking
Detected by IDD-SMSM
Sensor Array



IDD-SMSM
Designed and Developed
by Novitech

Severe Cracking with
Corrosion Detected by
AMFL Sensor System

Metal Loss



CSCC Predicted Depth 73%
Circ Length 2.5" (64 mm)

CSCC Predicted Depth 60%
Circ Length 4.2" (107 mm)



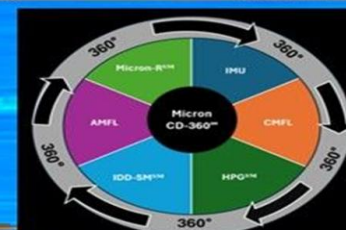
AMFL Data

NPS: 10.750"
Medium: Natural Gas
WT: 0.188" (4.8 mm)
Tool Velocity: 2.8 mph (1.15 m/s)

CMFL Data

Metal Loss detected by
CMFL Sensor System

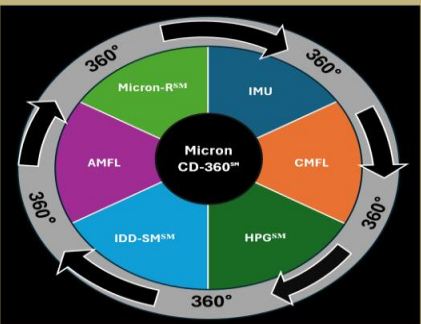
ERW Long Seam



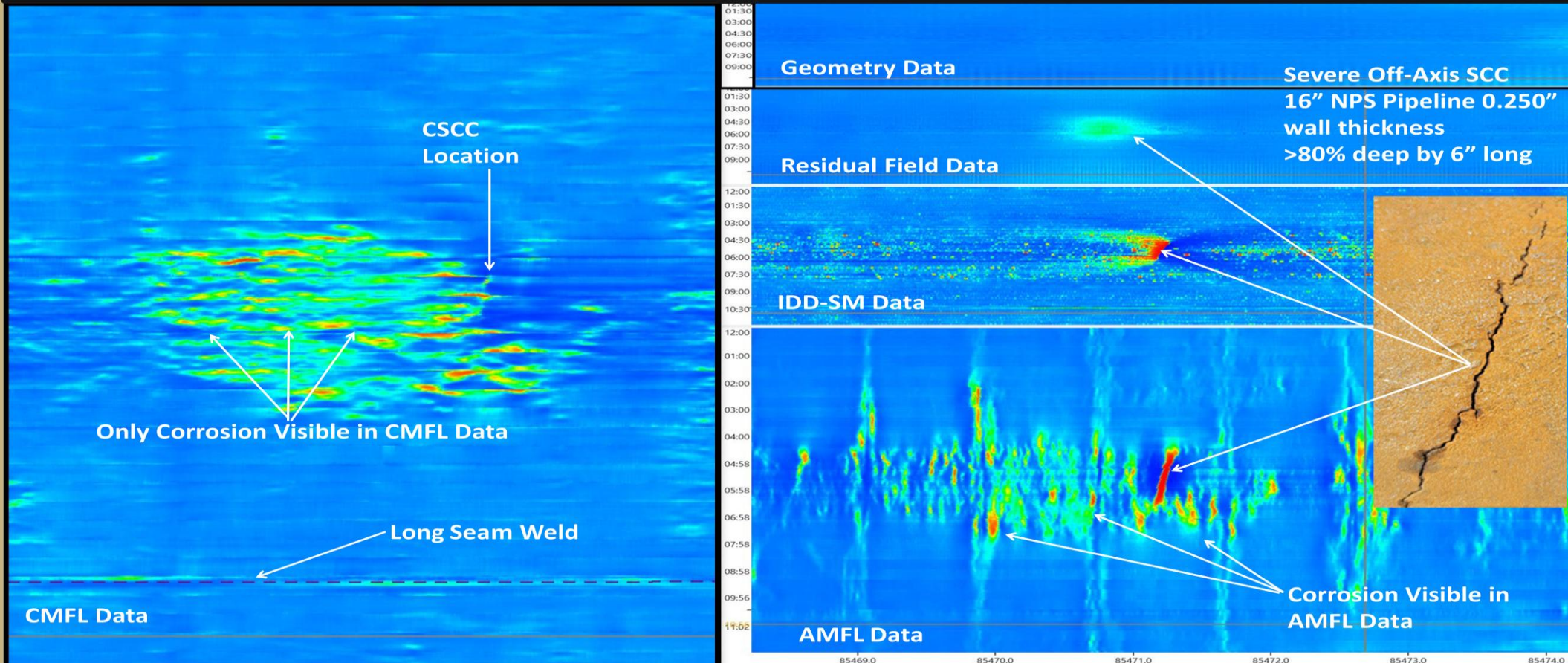


micron
ILI technology

Off-Axis SCC
Analyzed by
Five Sensor
Systems



Severe Off-Axis SCC Analyzed by Five Sensor Systems





Comparison
Between

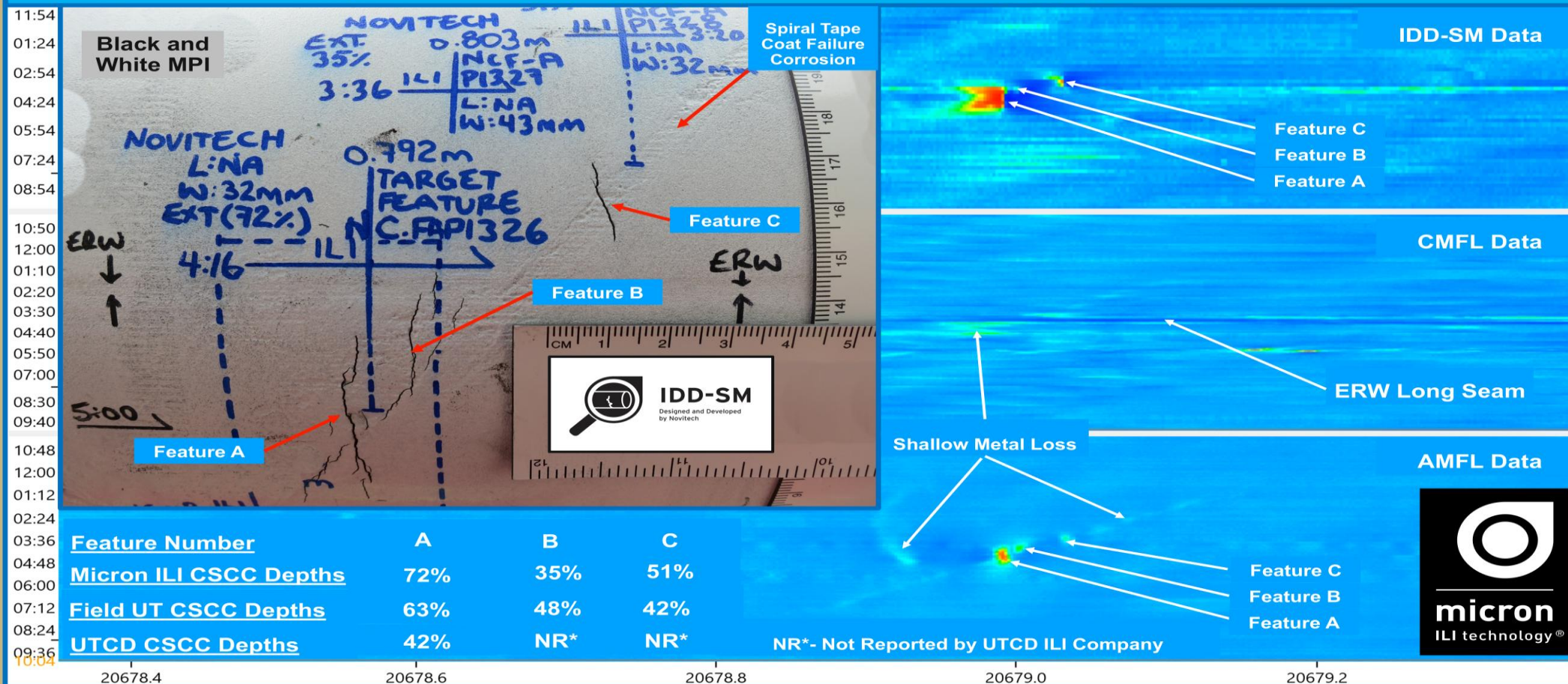
Micron ILI
Technology™

UTCD

And

Field UT
Results

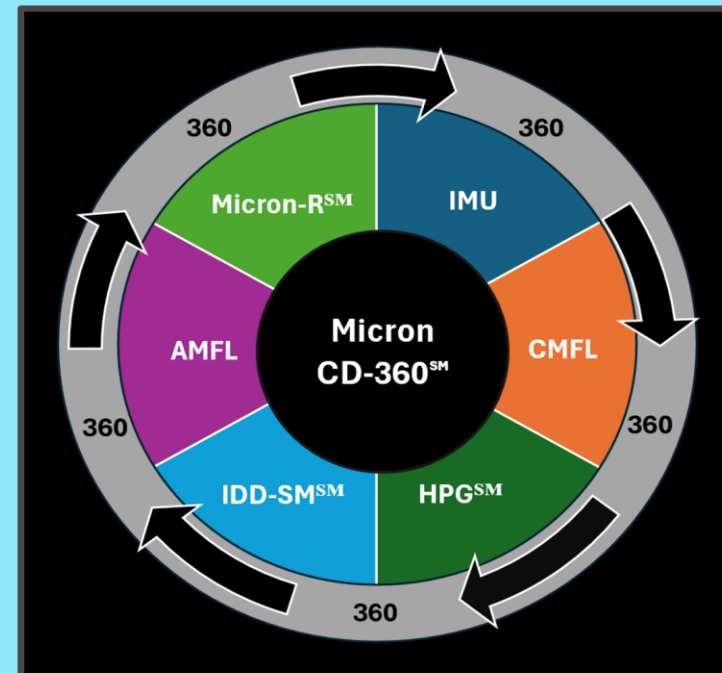
CSCC without Evidence of IMU Bending Strain





CONCLUSION FOR CRACK DETECTION

- Novitech is a well-established high technology ILI company.
- We have a history of innovation, solving difficult industry challenges.
- We are a safe, reliable inspection partner.
- We have proven our technology by the most rigorous means.
- Micron CD-360SM could be deployed by Pipeline operator in a single run to deliver multiple best-in-class inspection reports.

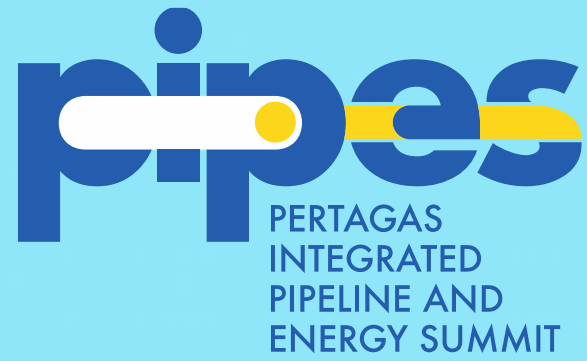


Customers in North America and Hawaii



Customer Base





**TERIMA
KASIH**