

# GE PII Pipeline Solutions a GE Oil & Gas and Al Shaheen joint venture.

Geoff Foreman - Senior ILI technology Advisor



# PII's mission: "...help our customers achieve zero failures..."

## Find these...

... pipelines are exposed to a number of threats having the potential to cause severe damage



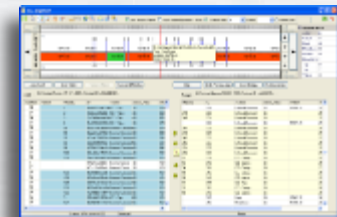
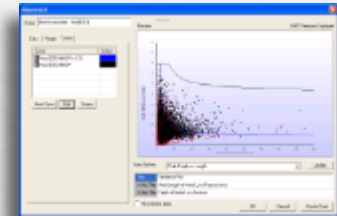
## using technology...

... PII's high technology tools detect & quantify defects such as cracks, corrosion & dents



## and engineering IP

... PII's assessment & software tools identify pipeline threats and determine condition



# In line inspection is a process

# Ensuring the process of Pipeline Integrity...

Prove the pipeline is "piggable"



Pipeline Expertise



ILI Tool Run

Applied Physics



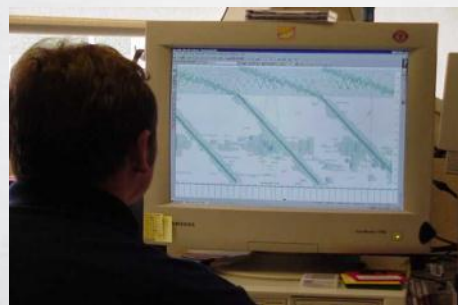
Carry out Mitigation Action



Carry out repairs)

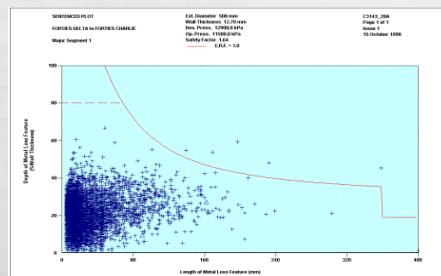


Carry out Report Validation (Confirm Defect size)



Analyze the data & produce the inspection report

Analysis Algorithms



Integrity assessment and plan responses

Engineering Expertise



NDE Expertise



# GE PII Pipeline Solutions Integrity Services



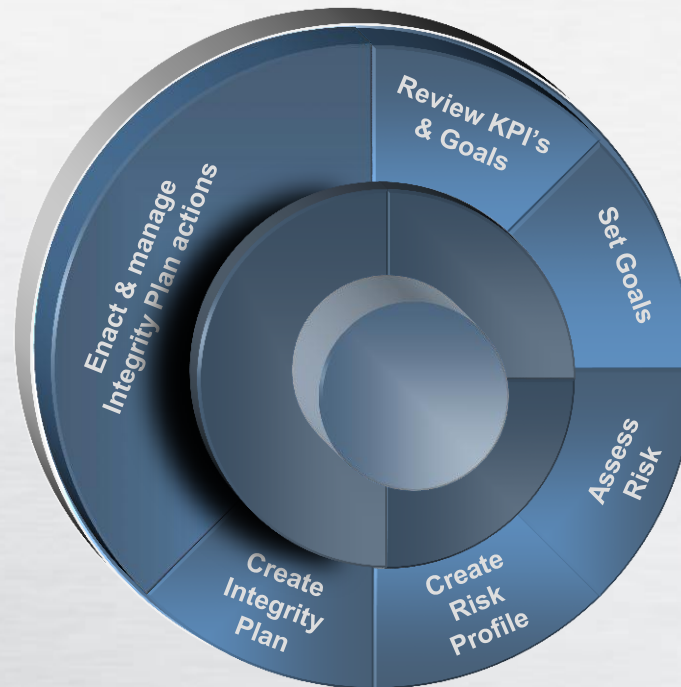
# The Integrity Management Process

The Integrity Management Process... set integrity goals, understand risks, manage risks...

**Set integrity goals:** -  
set & review integrity  
management KPI's ...

**...understand risks:-**  
carry out a risk  
assessment &  
create a risk  
profile of pipeline

**...manage risks:** -  
create an integrity  
plan & execute actions



# GE PII Pipeline Solutions ILI Services



# Capabilities for Corrosion & Other Threats

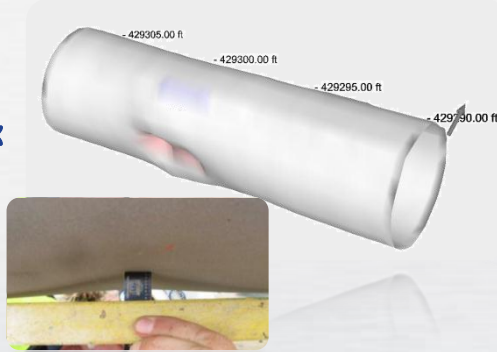
## MISSION

Identify and size significant corrosion (volumetric metal loss)



Discriminate and identify more complex threats

Eg Mechanical Damage



Spatially map the pipeline centerline route (from the inside...)

Identify deformation threats



## ENABLING TECHNOLOGIES

Magnetic Flux Leakage ("MFL")



Piezoelectric Ultrasonics



Transverse MFL



Geometry / Caliper Mapping

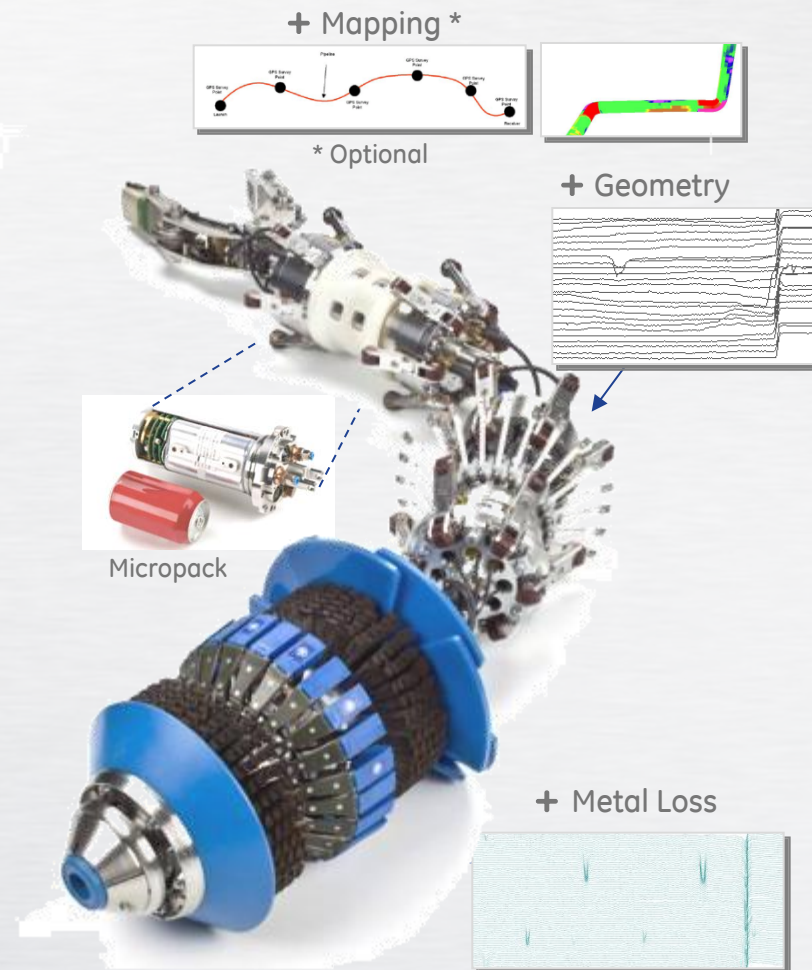




# MagneScan (MFL4) ... Hardware

## Performance Attributes:

- Integrated 4-in-1 Metal Loss sensor ... 2mm axial sampling
- Highest number of MC sensors ... 216 Hall Effect
- Integrated High Resolution Caliper ... 24 sensors (1 per 0.8"/20mm circ)
- High accuracy Fiber Optic Gyroscope IMU ... Inertial Measurement Unit



Multi-mission ... super high resolution

Note: detail relates to 6 inch system

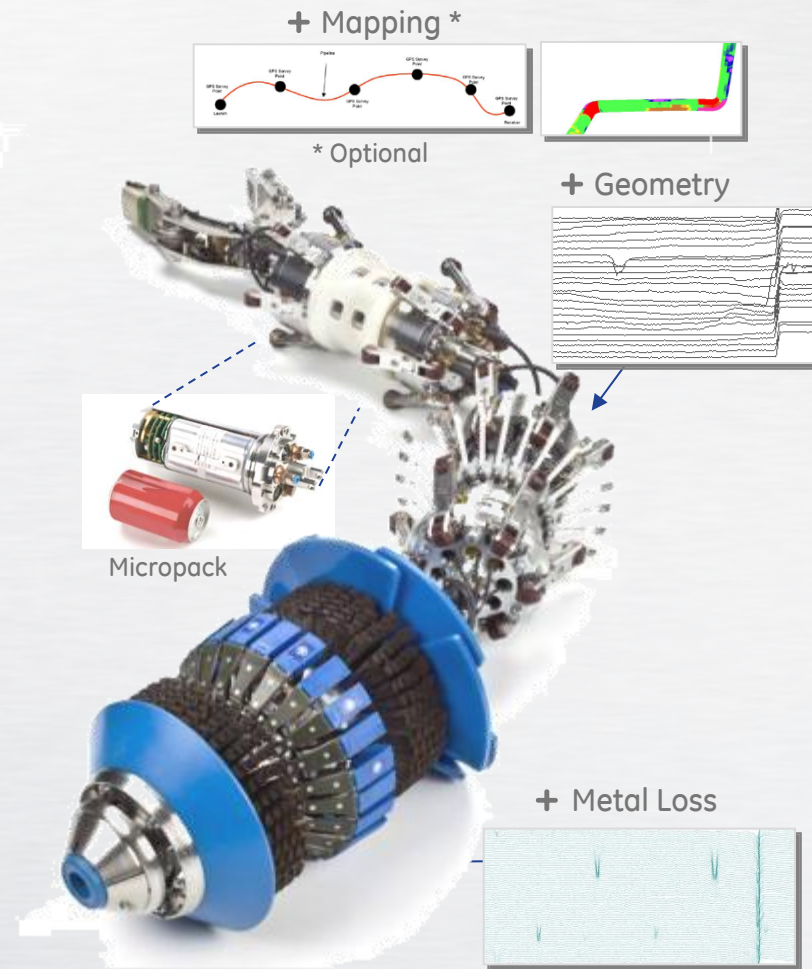
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- High accuracy Fiber Optic Gyroscope IMU ... Inertial Measurement Unit

## Operating Attributes:

- Short tool ... 4ft 6" (1.3m)
- Flexible ... 1.5D Back-to-Back bends & 78% bore passing
- High field "Speed-stable" Magnetizer up to 11mph (5m/s)
- Speed control (EVBP) in larger diameters
- ATEX Certified



Fast ... flexible ... Safe

Note: detail relates to 6 inch system

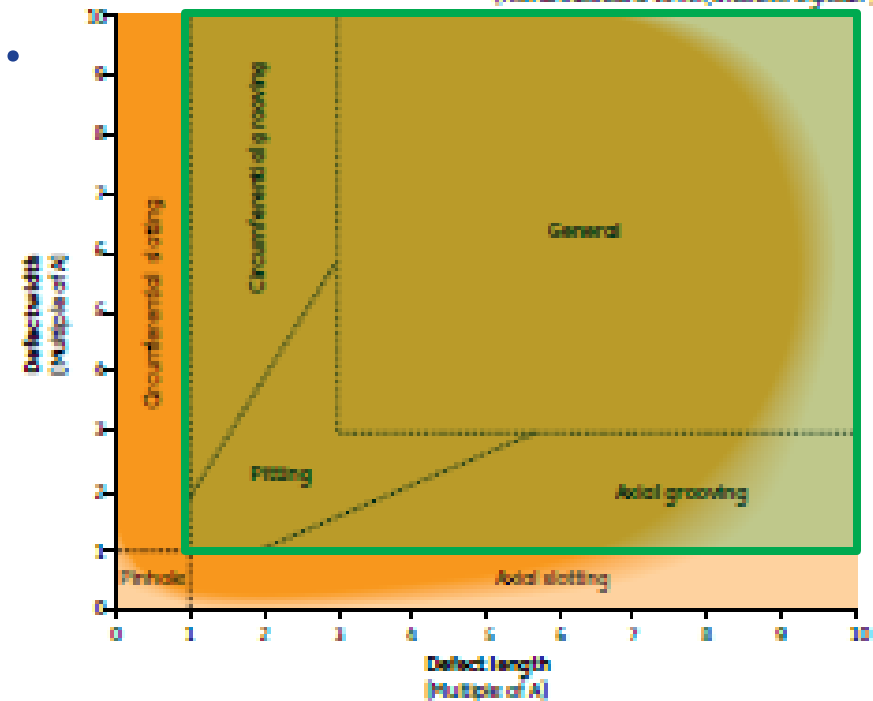
# MFL4 Super High Res ... Specification

- Detecting 5% General Metal Loss & 8% Pitting
- Depth Sizing GML & Pitting +/-10% @ 90% Certainty

Pipeline Operators Forum (POF)

Metal Loss Definitions

(A: Wall thickness or 10 mm, whichever is greater)



Parameter		General Metal Loss		Pitting		Axial Grooving		Circumf. Grooving	
Depth @ POD = 90%	nwt	5% @4A		8% @2A		8% @4A*2A		5% @2A*4A	
	Certainty	80%	90%	80%	90%	80%	90%	80%	90%
Depth Sizing Accuracy	nwt (+/-)	8%	10%	8%	10%	-13%/+8%	-15%/+10%	-8%/+13%	-10%/+15%
Width Sizing Accuracy	mm (+/-)	12	15	12	15	12	15	12	15
Length Sizing Accuracy	mm (+/-)	7	10	4	5	7	10	7	10

Market leading spec



Note: specifications apply up to 5m/s within specified wall thickness range by tool diameter

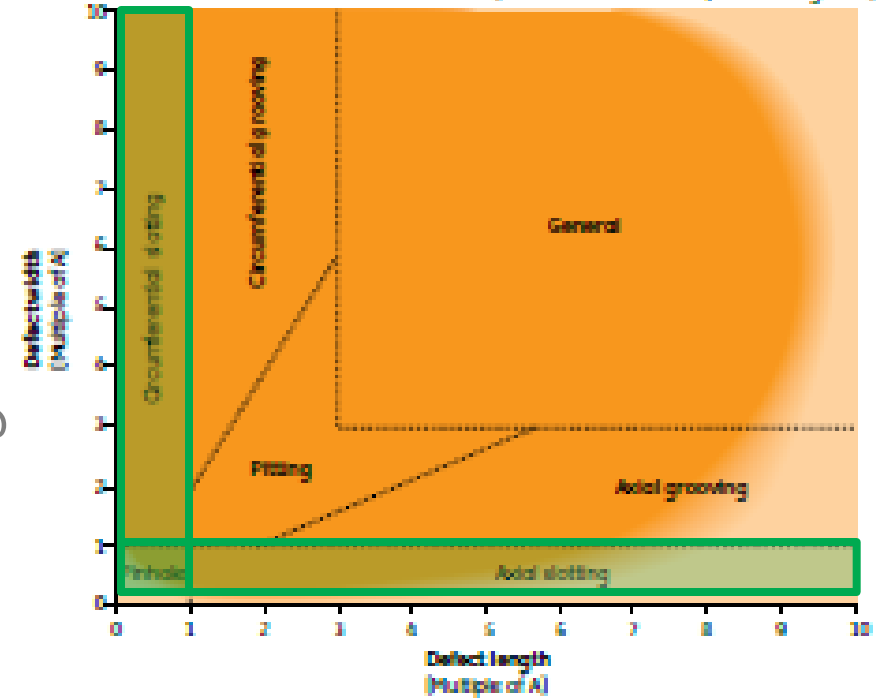
# MFL4 SHR Plus ... Specification

- Detecting 5% General Metal Loss & 8% Pitting
- Depth Sizing GML & Pitting +/-10% @ 90% Certainty
- Plus Detecting & Sizing Pinholes (PH), Axial Slots, Circumferential Slots

Pipeline Operators Forum (POF)

Metal Loss Definitions

(A: Wall thickness or 10 mm, whichever is greater)



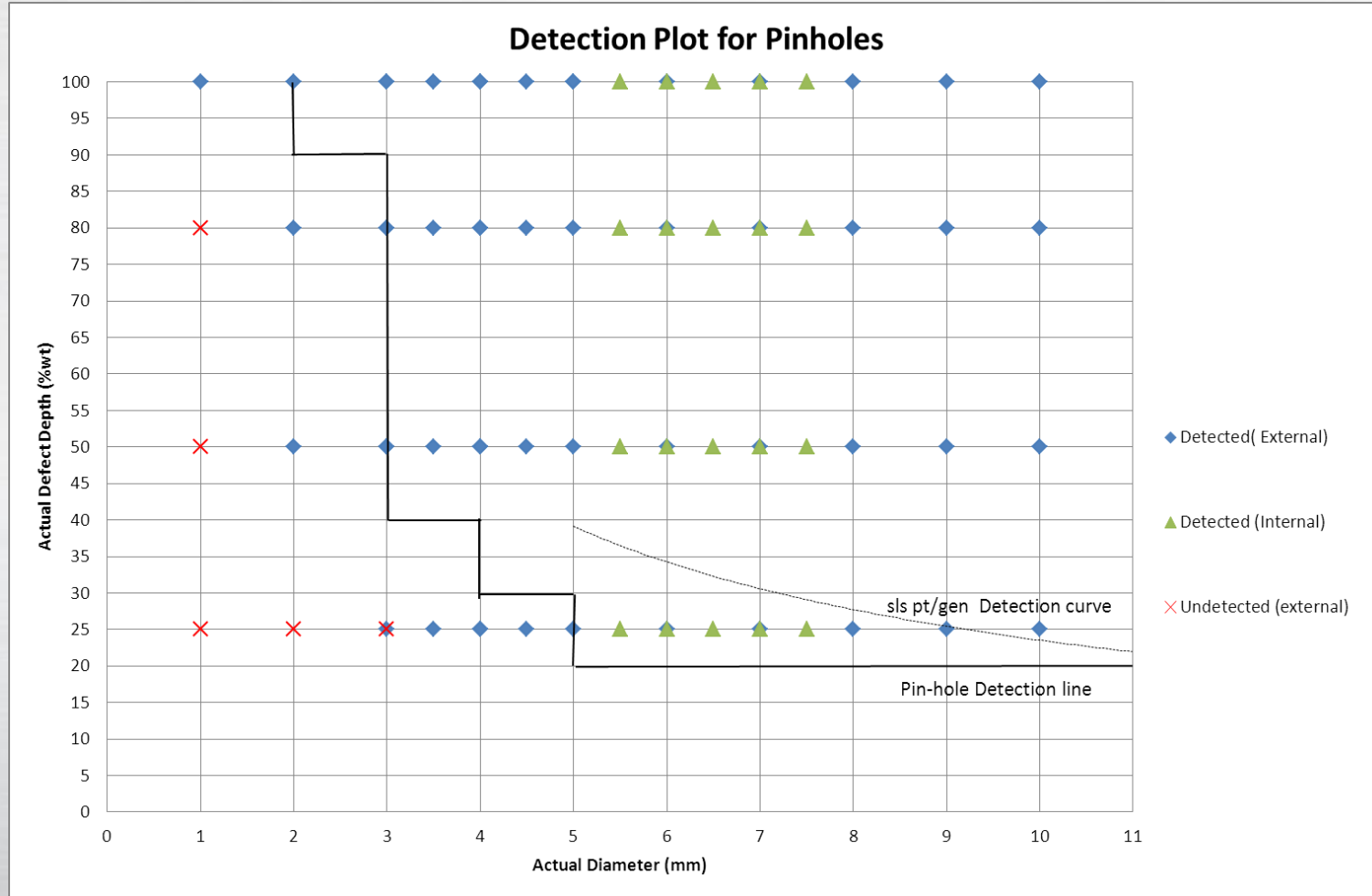
Parameter		General Metal Loss		Pitting		Axial Grooving		Circumf. Grooving		Pinhole ***		Axial Slot **		Circumf. Slott **	
Depth @	nwt	5%		8%		8%		5%		15%		15%		5%	
POD = 90%		@4A		@2A		@4A*2A		@2A*4A		@0.5A		@0.5A*2A		@2A*0.5A	
	Certainty	80%	90%	80%	90%	80%	90%	80%	90%	80%	90%	80%	90%	80%	90%
Depth Sizing Accuracy	nwt (+/-)	8%	10%	8%	10%	-13%/+8%	-15%/+10%	-8%/+13%	-10%/+15%	-13%/+8%	-15%/+10%	-17%/+8%	-20%/+10%	-8%/+13%	-10%/+15%
Width Sizing Accuracy	mm (+/-)	12	15	12	15	12	15	12	15	12	15	12	15	12	15
Length Sizing Accuracy	mm (+/-)	7	10	4	5	7	10	7	10	4	5	7	10	7	10

Sizing PH > 5mm ... Detecting PH > 2mm @ 90% depth



# Pinhole features ... MFL4 blind pull tests for global gas & liquid operator

	Features	Detected	Det%
<b>In-Spec</b>	<b>64</b>	<b>64</b>	<b>100%</b>
Non-spec	13	8	62%
<b>Total</b>	<b>77</b>	<b>72</b>	<b>94%</b>



**100% detection of in-spec features (64/64)**  
**94% detection of all features (72/77)**

# Capabilities for Crack Threats

## MISSION

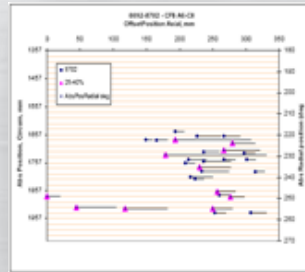
Identify and size significant cracks



Accurately locate and predict potential crack threats to pipeline integrity



Predict potential failure using advanced crack assessment and industry best practices

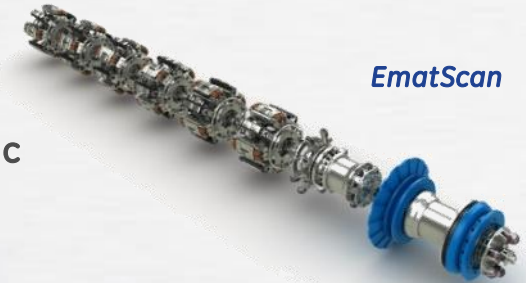


## ENABLING TECHNOLOGIES

Phased Array Ultrasonics



ElectroMagnetic Ultrasonics

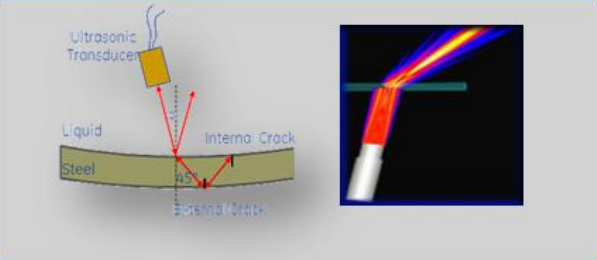


Piezoelectric Ultrasonics

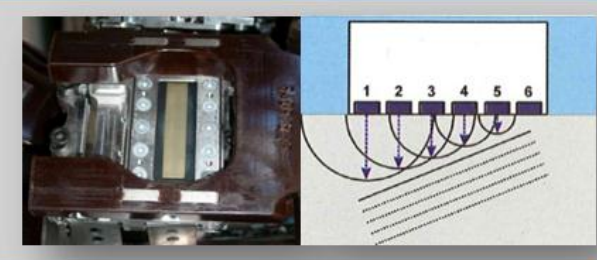


# Crack Inspection Ultrasonic Technologies

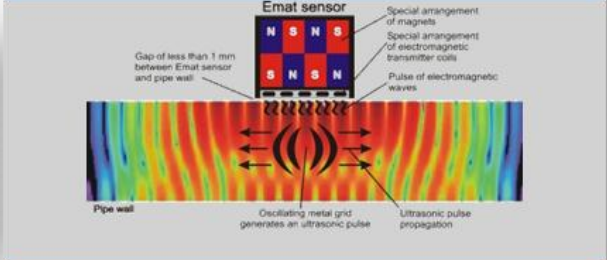
## Shear Wave



## Phased Array



## EMAT



**Ultrascan CD**

**21,752**

Miles inspected

**Ultrascan Duo**

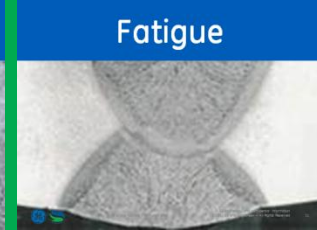
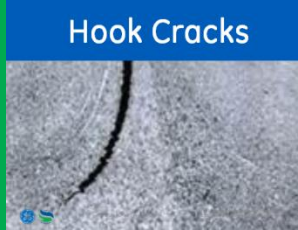
**13,255**

Miles inspected

**EmatScan**

**2,408**

Miles inspected



# Ultrascan DUO

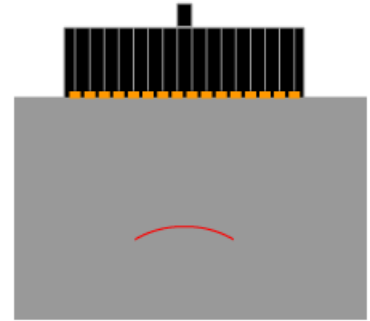
## Phased Array Technology for Pipelines

### Virtual Sensor & Beamforming

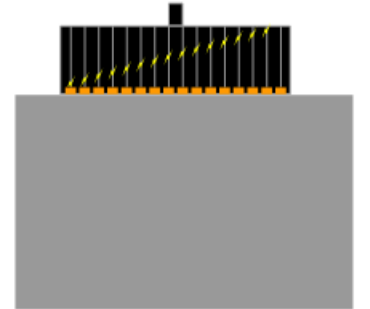
- Multiple Simultaneous Inspection Modes
- Change “Virtual sensors” with no change in Hardware
- Coordinate PAUT element firing - Focus & Direction Control
- Multiple Carriers for Redundancy of Wall Coverage
- 24-42” Diameters



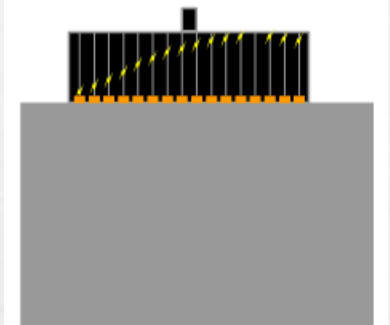
### Beam Focusing



### Beam Steering



### Beam Focusing and Steering



New Industry Benchmark for Pipeline Inspection





# UltraScan™ DUO

## Crack Inspection Technology For Liquid Pipelines



# EmatScan

## Ultrasonic Crack Inspection in Gas Pipelines

### Electro Magnetic Acoustic Transducer

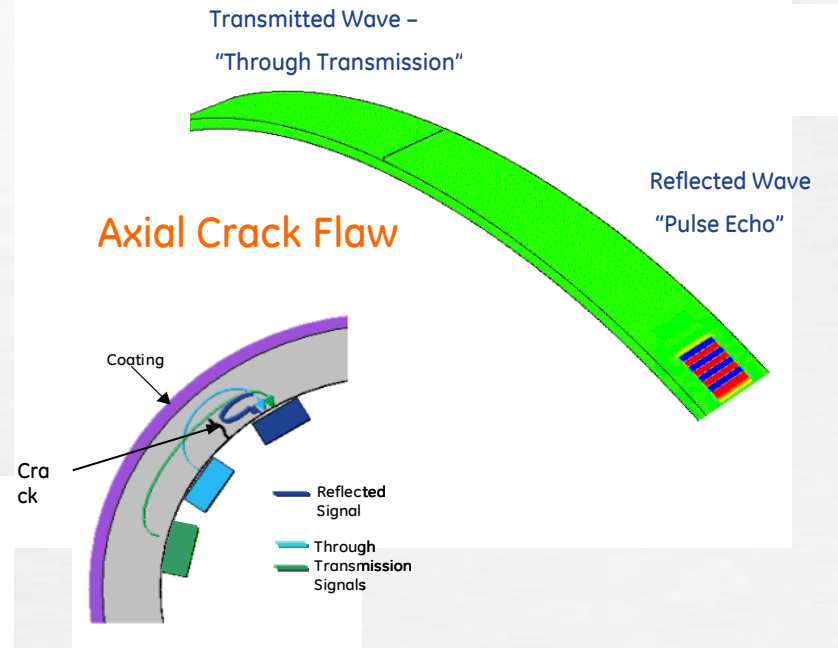
#### EMAT Waves are Guided Waves

Generation of ultrasonic waves in the pipe wall by Electromagnetic pulses

No couplant required – Operates in Gas

Discrimination of UT Reflector type crucial to characterization (Crack vs. Non-Crack)

Important to keep “purity” of Mode

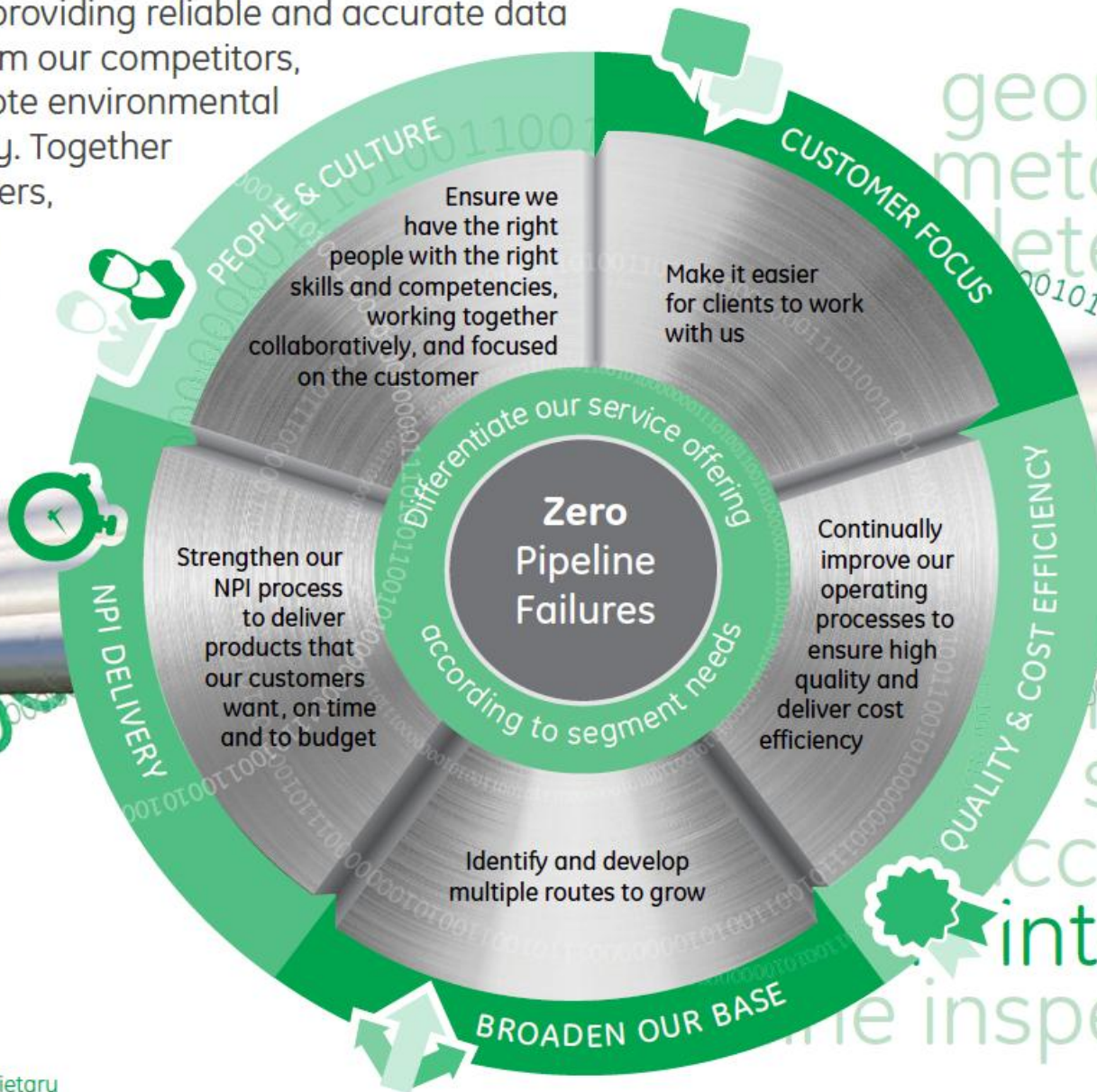


# EmatScan™

## Crack Inspection Technology for Gas Pipelines



At PII, we are dedicated to predicting our customers' potential problems, before they become real problems. Our heritage of providing reliable and accurate data sets us apart from our competitors, and helps promote environmental and public safety. Together with our customers, our goal is zero pipeline failures.



# Thank you.

