



PPSA ANNUAL SEMINAR

Wednesday 15th November 2023

**The challenge of an all-in-one
inspection - first results and benefits**

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Trapil a pipeline operator

Inline Inspection Activities

XTRASONIC NEO technology and advantages

Introduction to principle of SCC and fatigue crack

How to adapt the ILI analysis in order to verify and improve POD, POI and POS of cracks ?

Conclusion



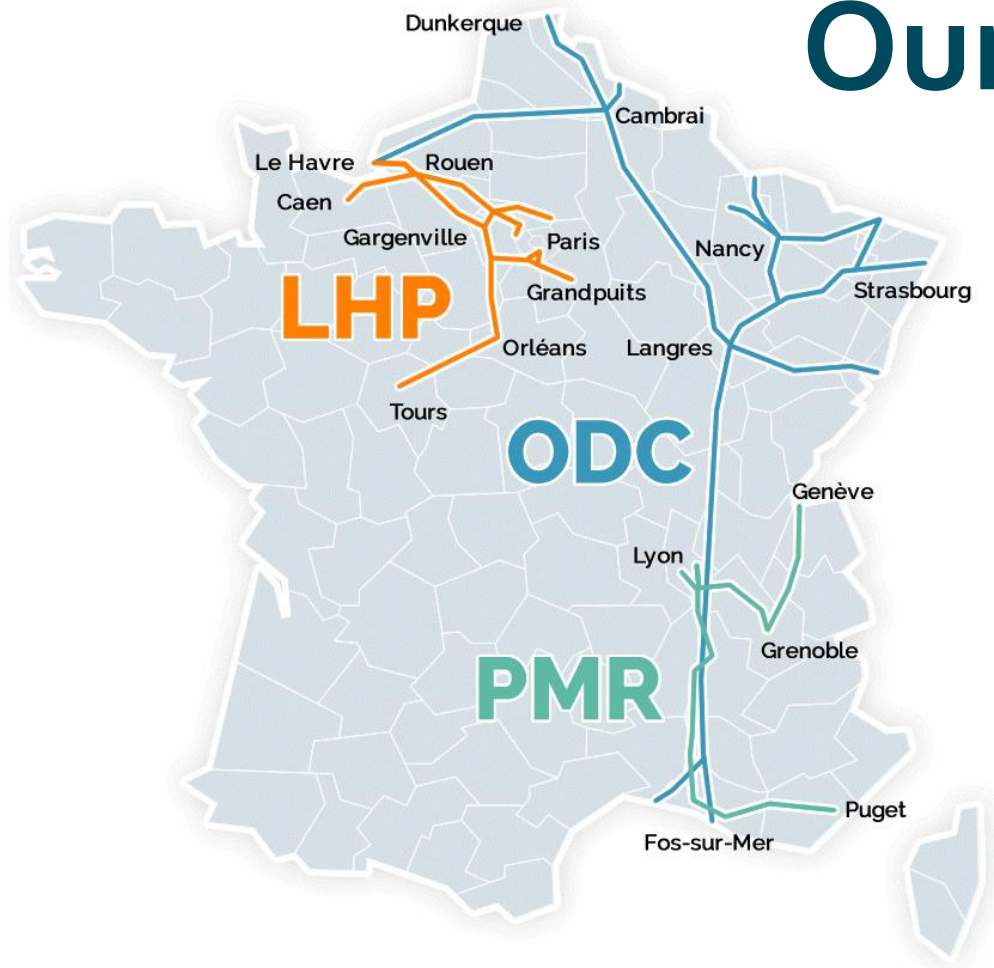
Our networks

TRAPIL's core business is refined petroleum products transportation in the safest conditions.

Created in 1950, TRAPIL

« Société des Transports Pétroliers par Pipelines » operates 3 multi-product pipelines :

- The Le Havre/Paris (LHP), which it owns
- The NATO pipelines in France (ODC)
- The Pipeline Méditerranée/Rhône (PMR)



Few figures



160 pumping and
delivery facilities



4,700 km of pipelines



766 employees



850,000 m³
of tank farms

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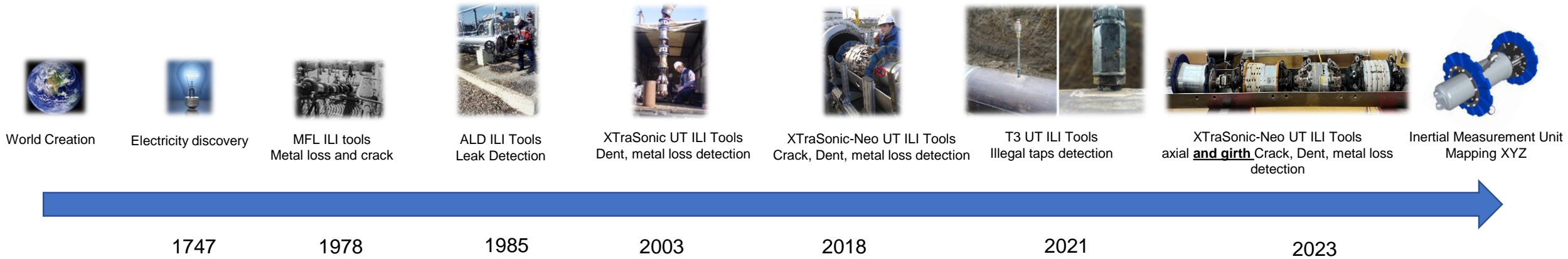
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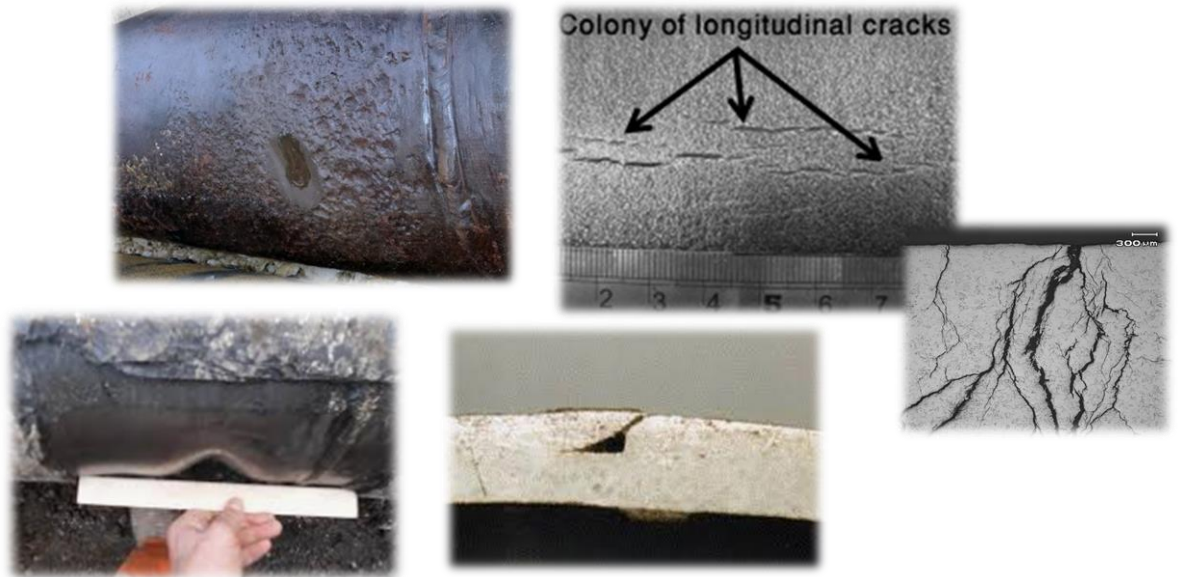
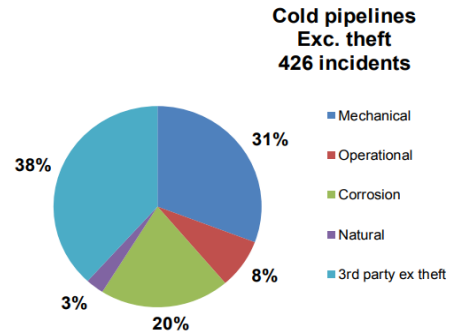
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Inline Inspection Activities in Trapil: A story of 40 years



Distribution of major spillage causes for cold pipelines



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XTRASONIC NEO technology and advantages



- XTraSonic-Neo ILI (6 up to 34", today 12" and 20/22" available) can locate, identify and size dent, metal loss and cracks anomalies in oil or refined product pipeline in a single run
- Offer reproducibility of results by using latest technologies in Non Destructive Testing
- Improve the safety on site and limit operating costs as a result of a very small and compact tool
- Offer availability and smart services for specific requests

Combined Crack, Metal Loss and Dent Detection



XTraSonic-Neo 12" and 20 to 22"

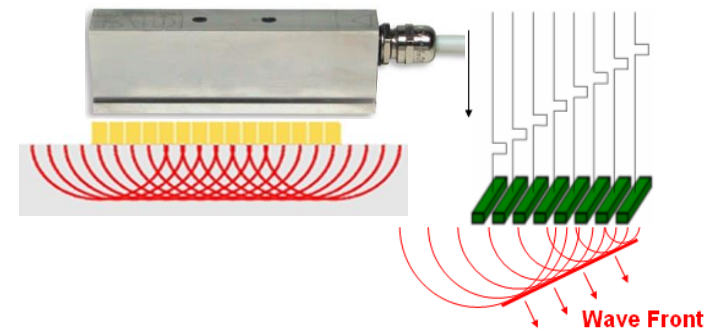
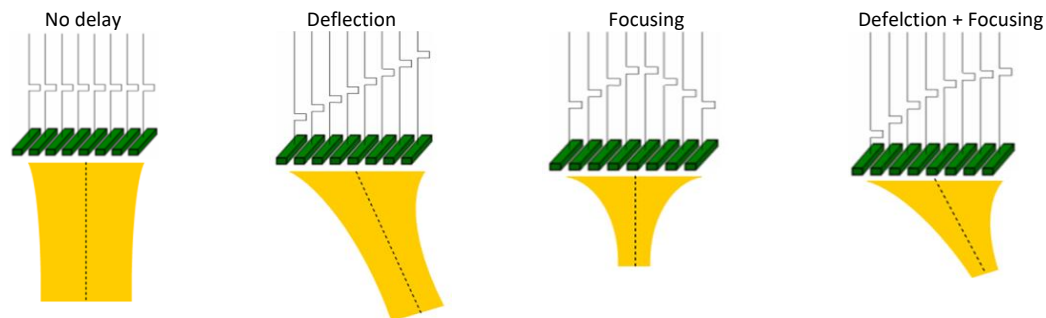


XTRASONIC NEO technology and advantages

Phased Array ultrasonic basis

- Used of same physical phenomenon than conventional UT –usually pulse echo)
- Difference UTPA/ UTC = equipment
- PA probe composed of series of individual elements, electronically independent
- Used of time delay laws to generate directionally controllable wave fronts (focusing, deflection)

128 x  = 



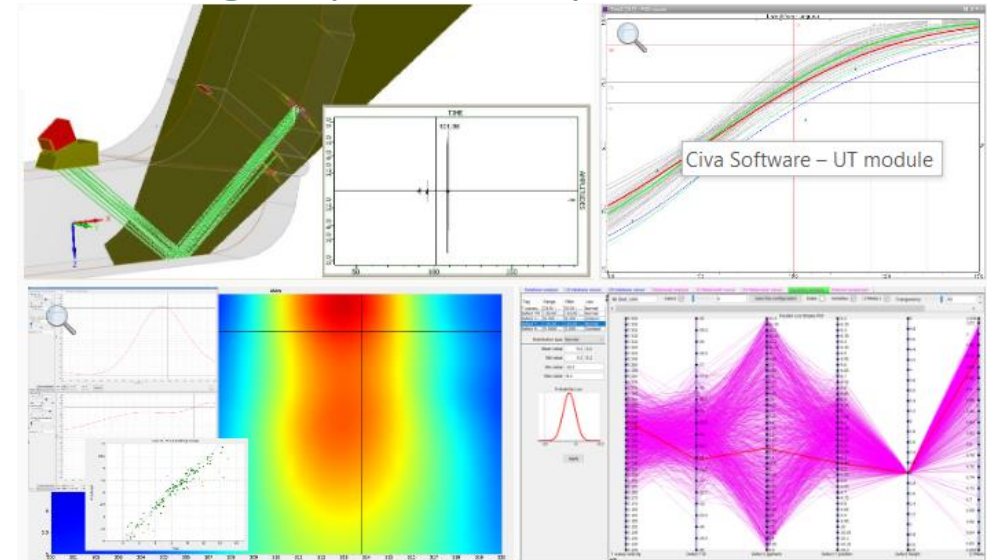
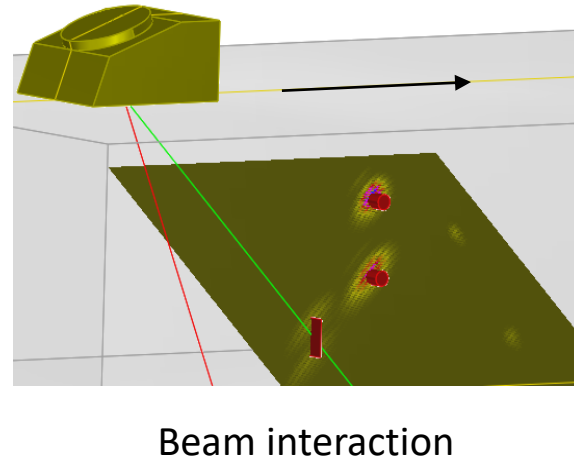
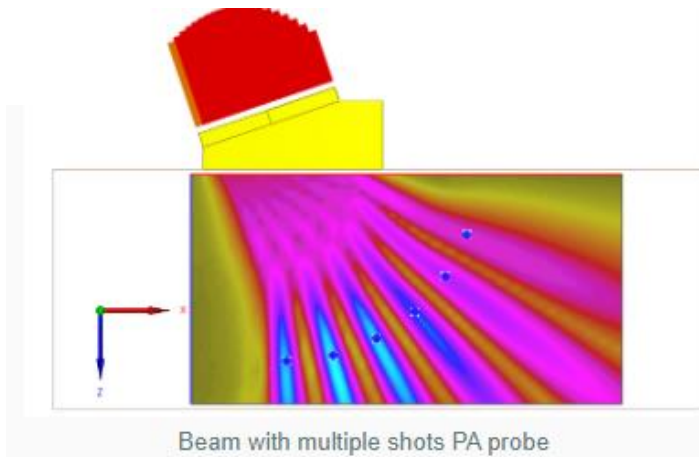
XTRASONIC NEO technology and advantages

Civa Software – UT module

UT simulation tools include:

- Beam computation (beam propagation)
- Inspection simulation (beam interaction with flaws)
- Parametric study

User can simulate a whole inspection process (UT, PA, TOFD) with a wide range of probes, components and flaws.

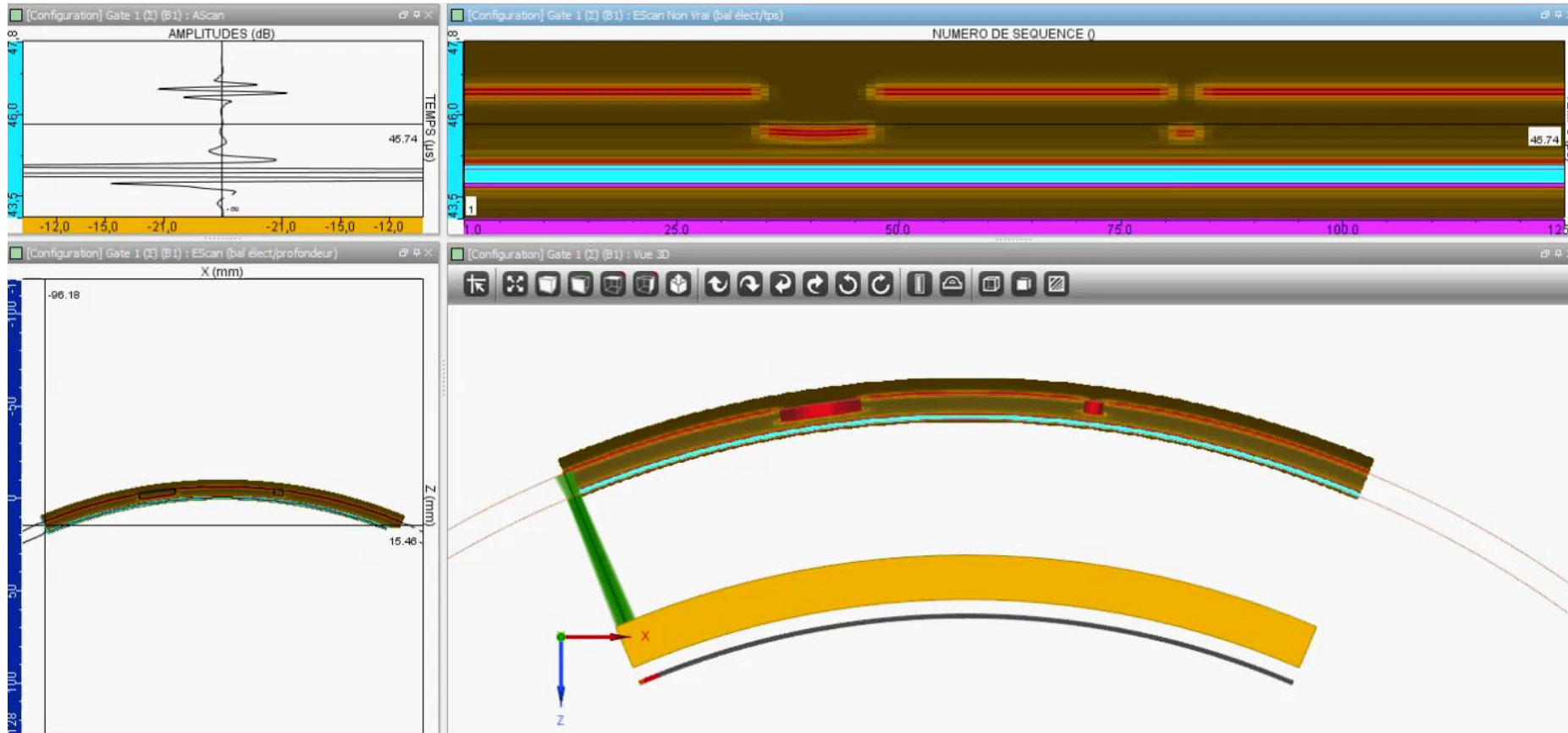


Inspection simulation with POD curve, parametric analysis ...

XTRASONIC NEO technology and advantages

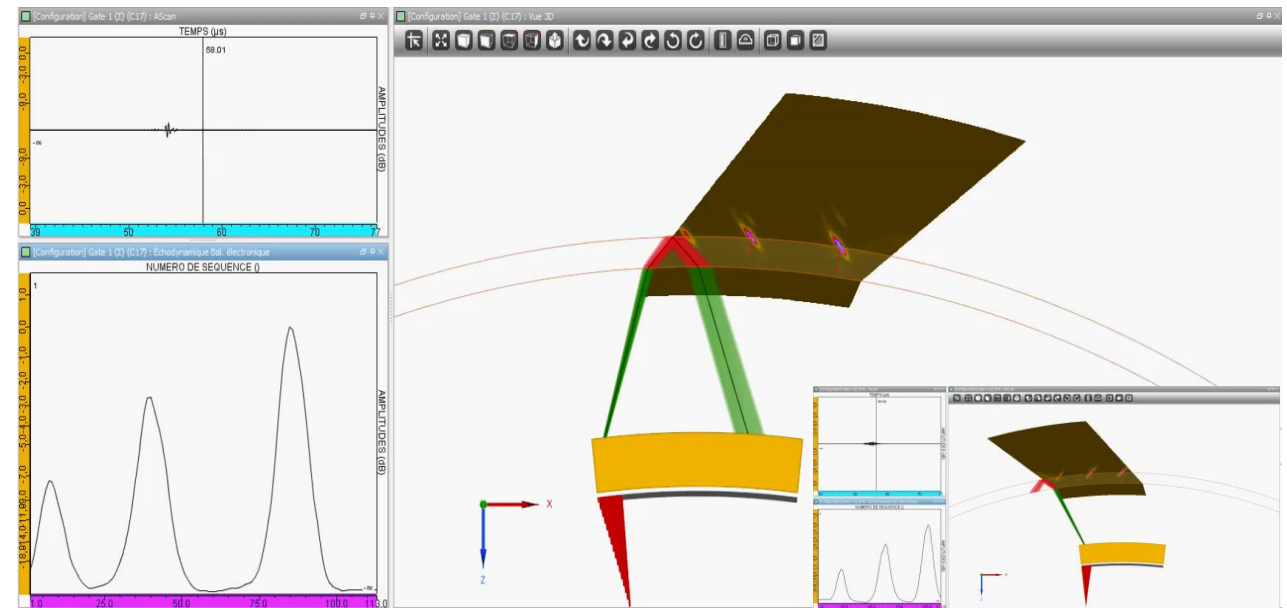
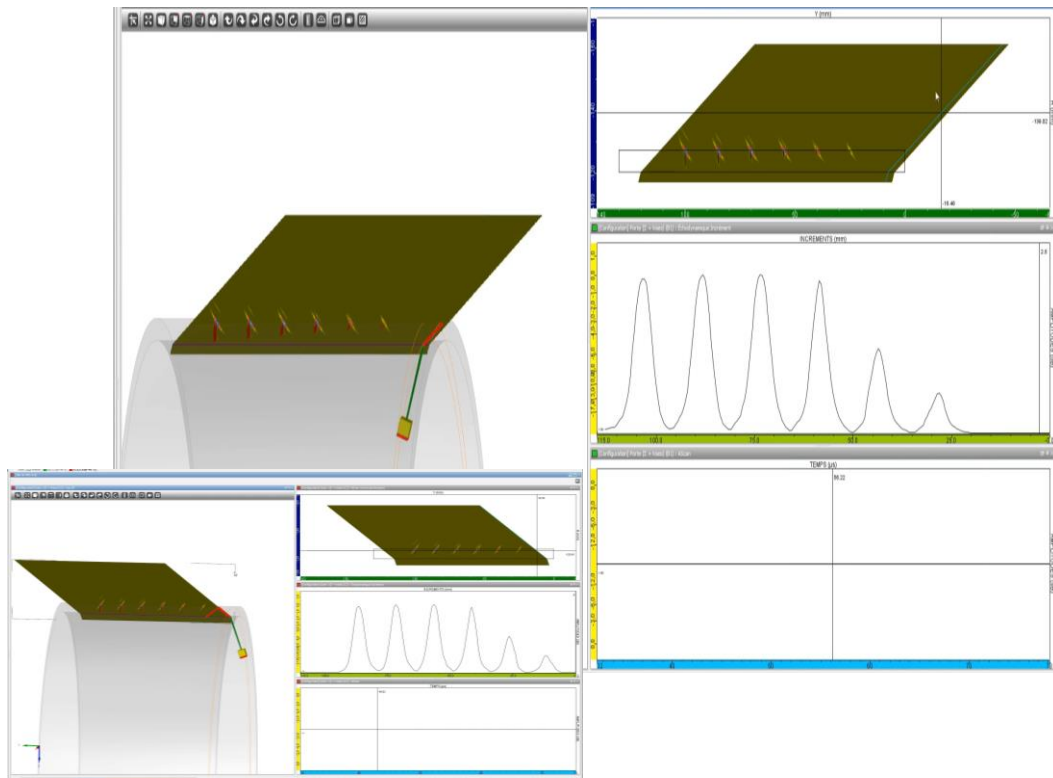


Longitudinal wave : How does it work ?



XTRASONIC NEO technology and advantages

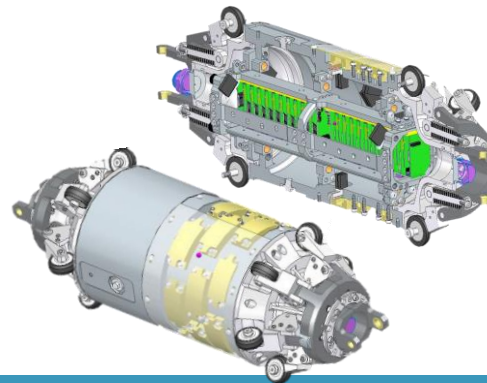
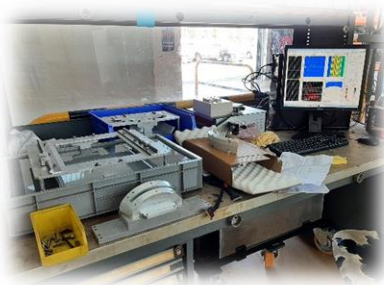
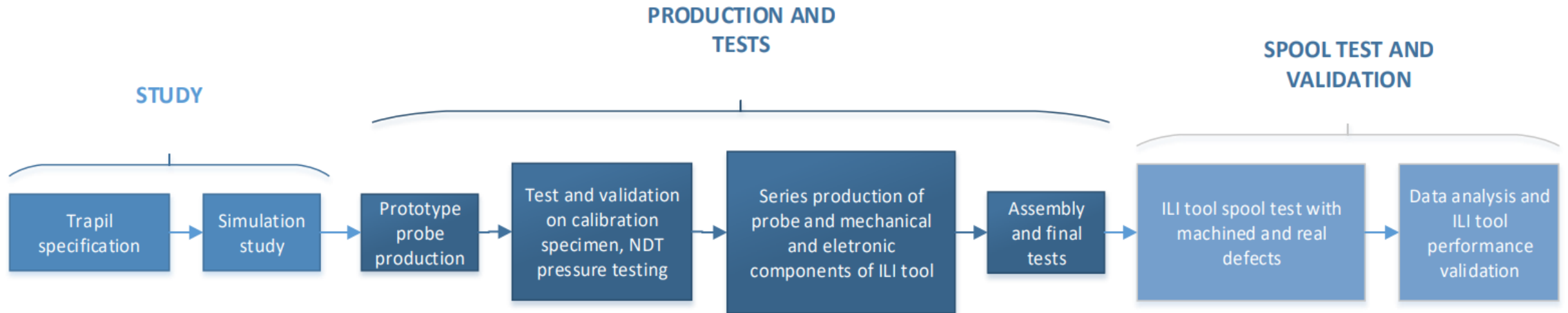
Shear wave : How does it work for axial and circumferential crack?



XTRASONIC NEO technology and advantages



Inspection tool design and validation process



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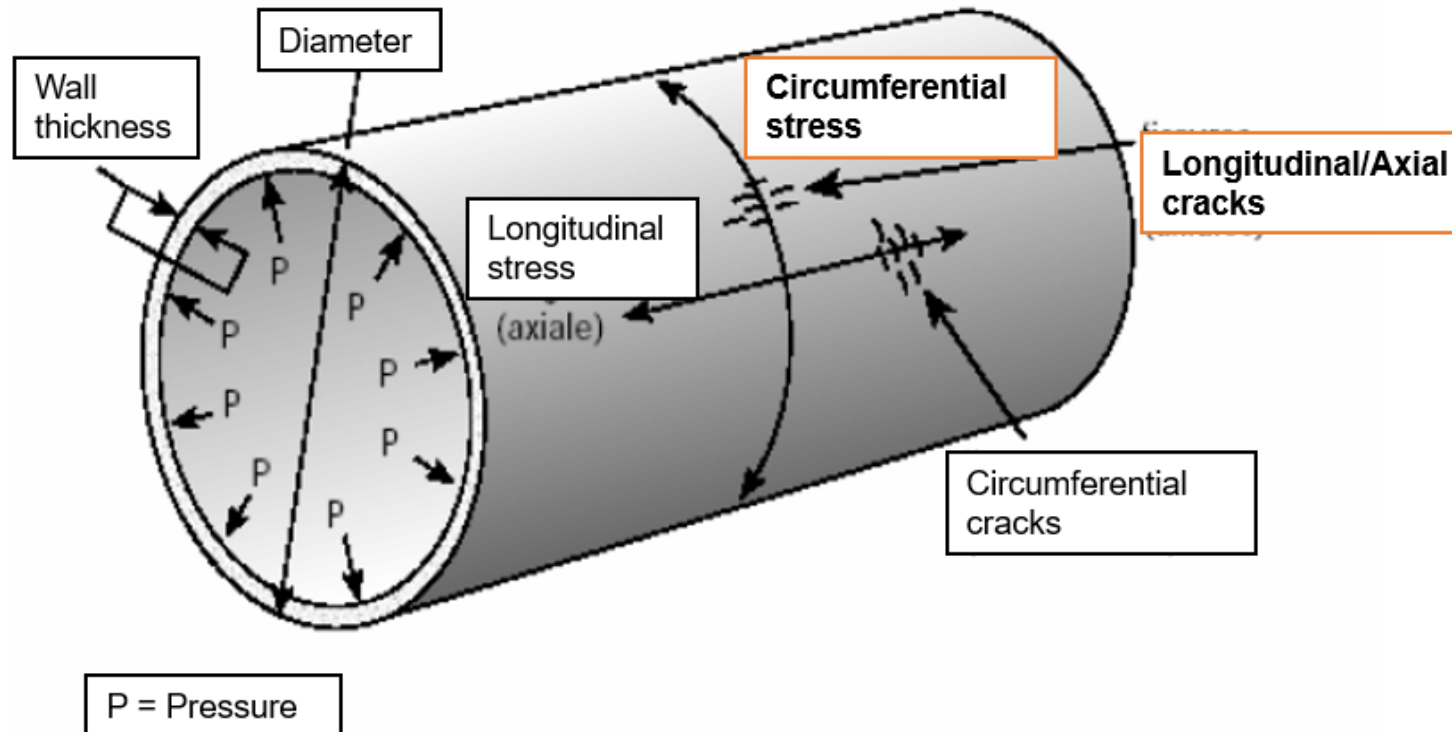


Introduction to principle of SCC and fatigue crack

What is fatigue material ?

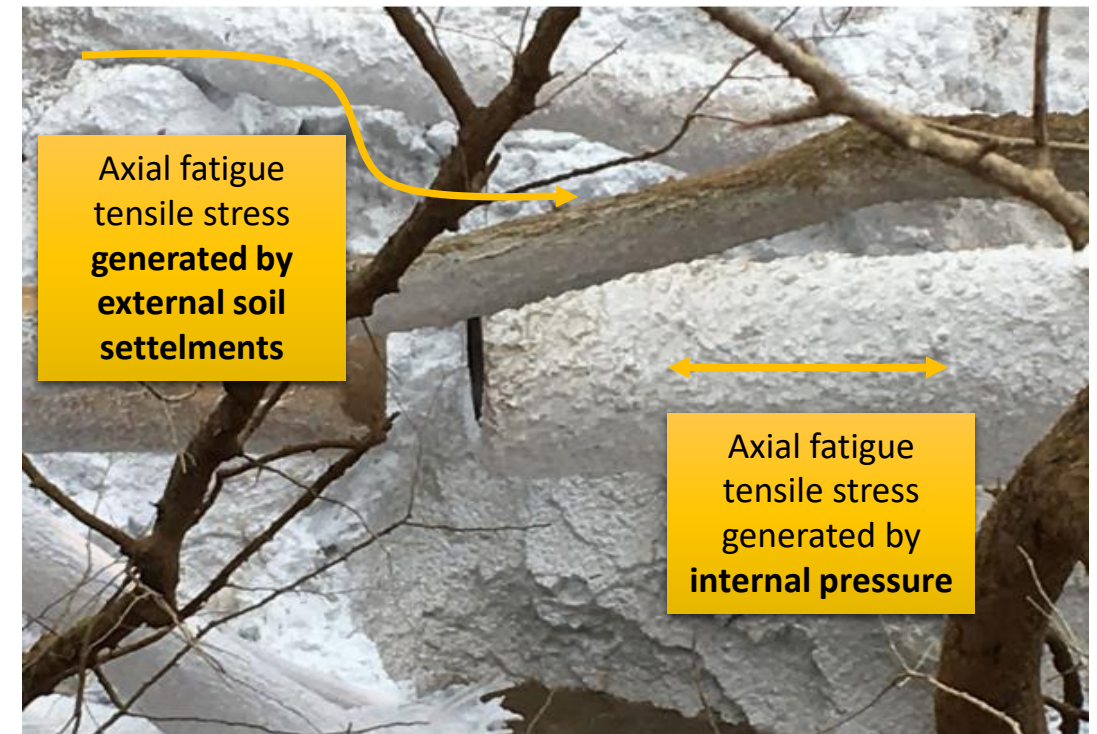
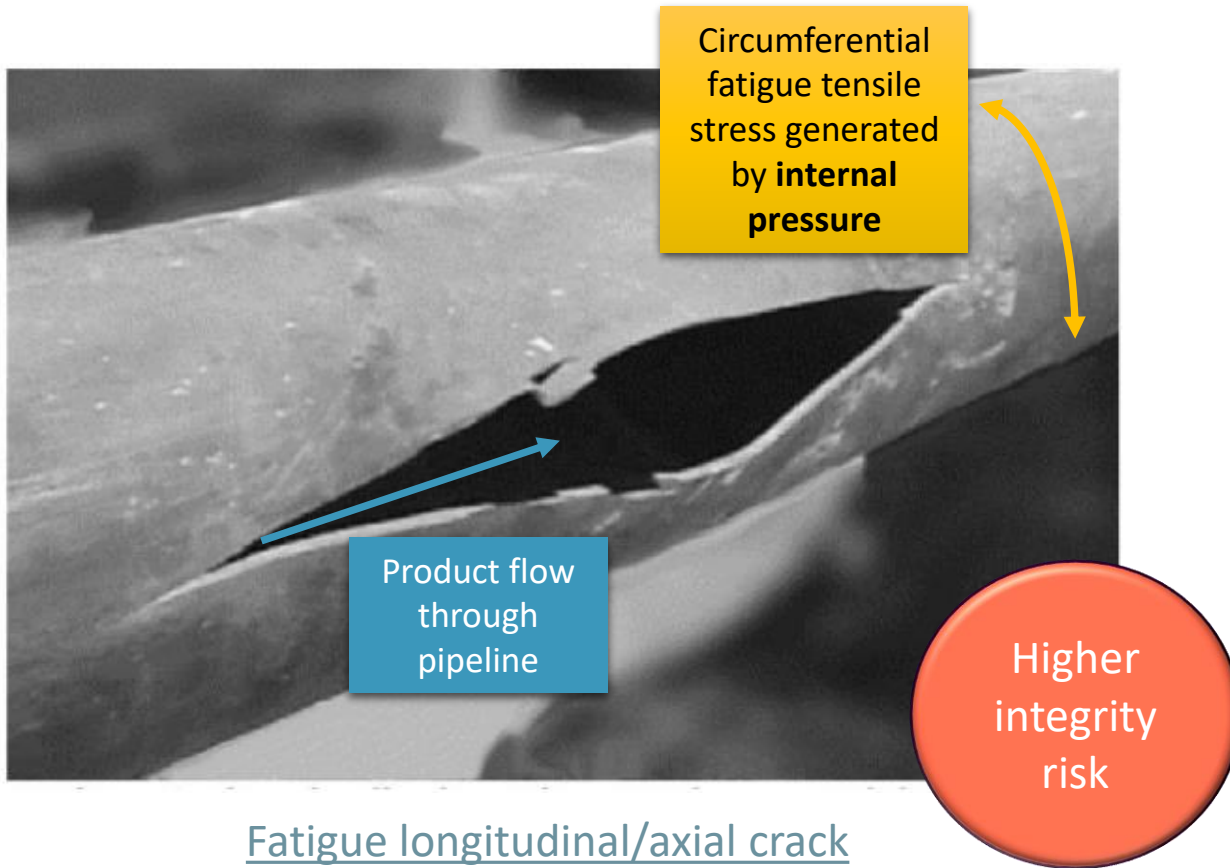
Material fatigue is the **damage** or **failure** of a material subjected to varying and frequently **repeated stresses**

In a pipeline, main stresses are :



Introduction to principle of SCC and fatigue crack

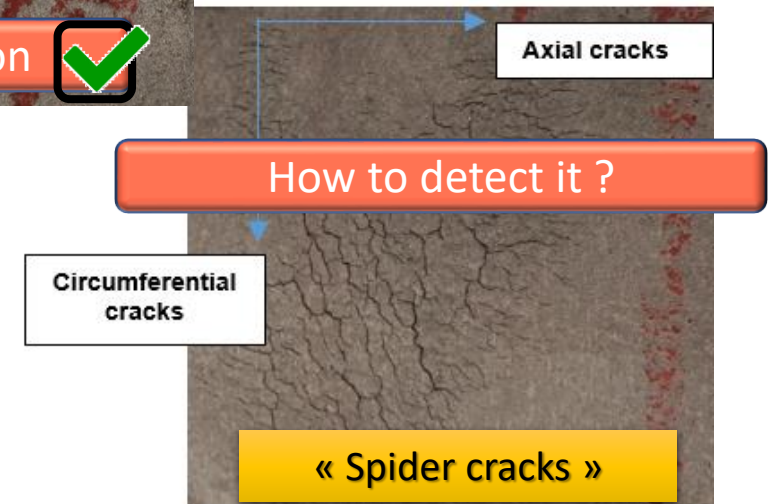
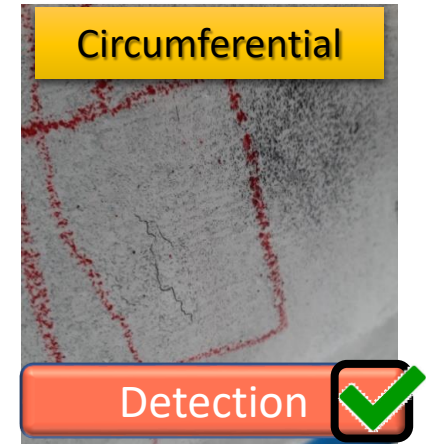
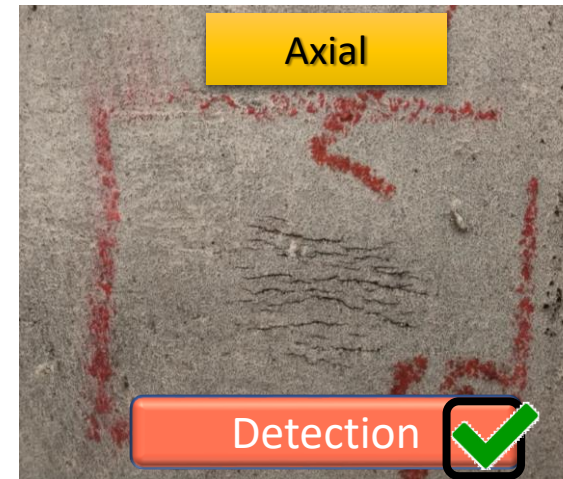
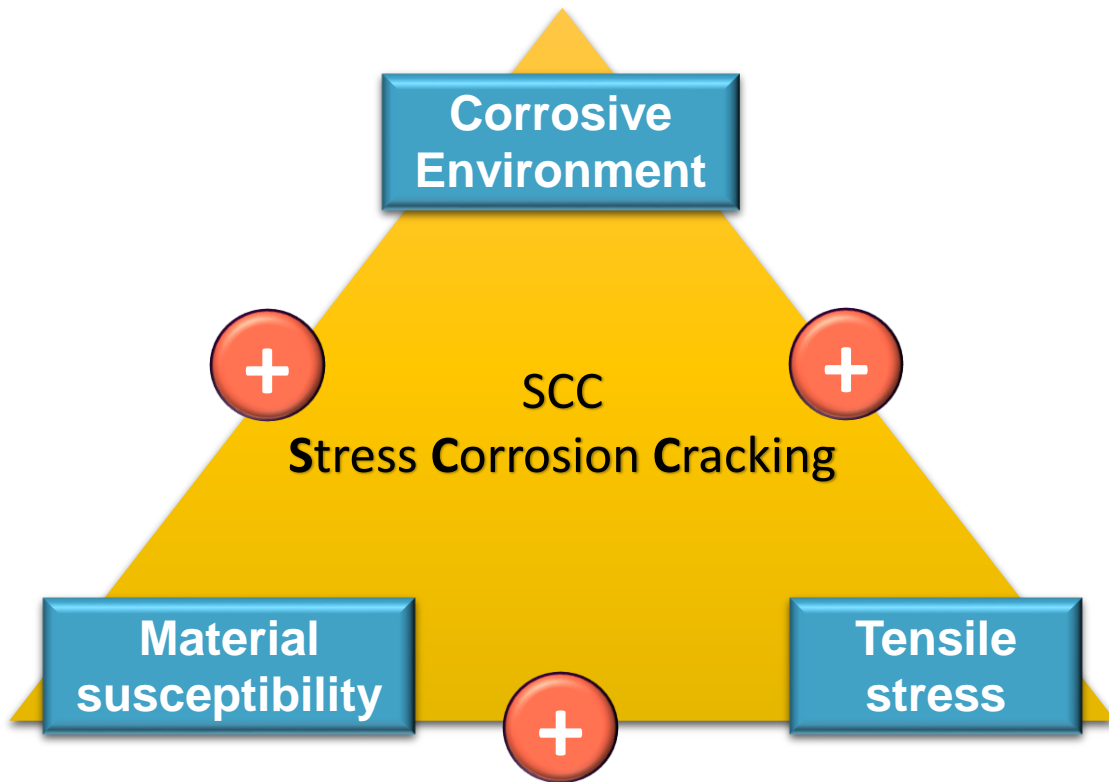
Consequences of material fatigue on a pipeline : Fatigue cracks



Fatigue circumferential crack

Introduction to principle of SCC and fatigue crack

Consequences of material fatigue on a pipeline : SCC



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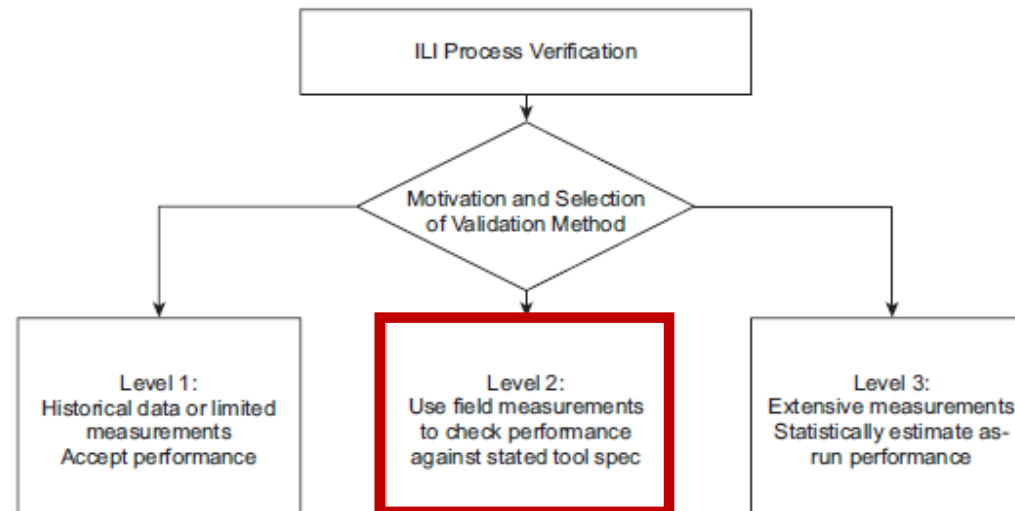
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How to adapt the ILI process in order to verify and improve POD, POI and POS of cracks ?

How to verify the ILI tool process ?

POD : Is the anomaly detected by the ILI process ?
POI : Is the anomaly correctly identified by the ILI process ?
POs : Is the anomaly correctly sized by the ILI process ?



How to adapt the ILI process in order to verify and improve POD, POI and POS of cracks ?

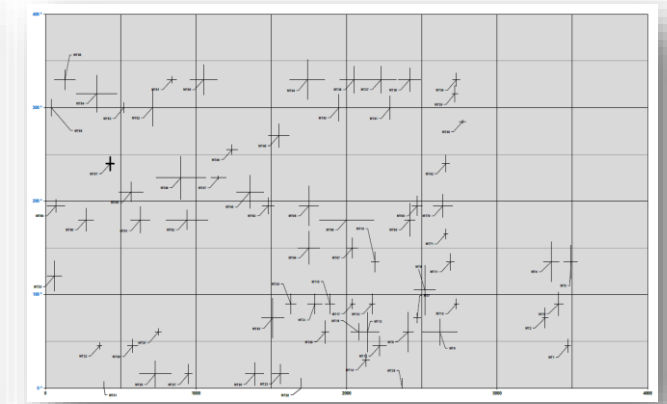
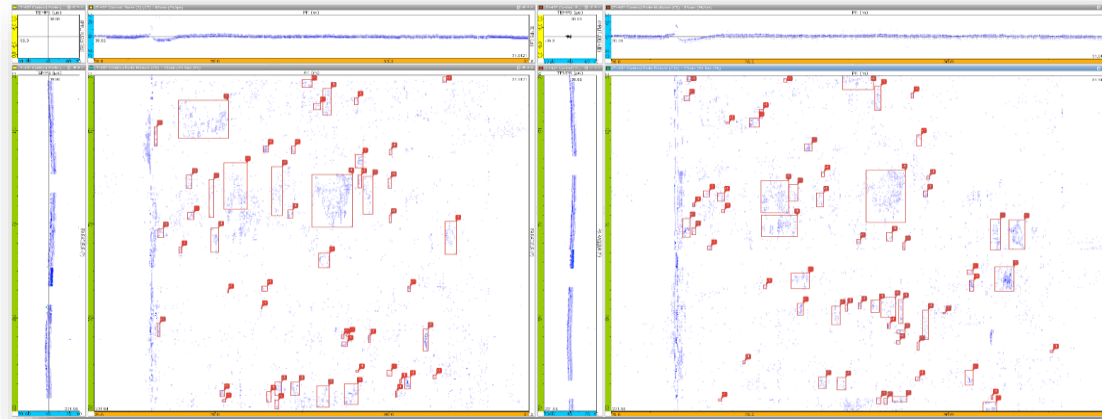
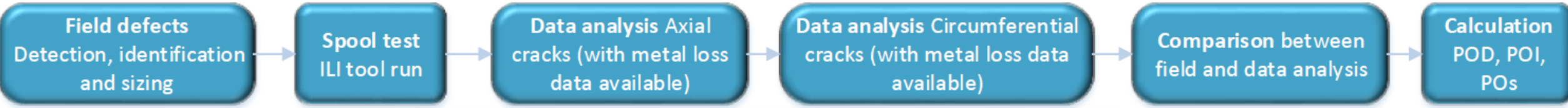
How to verify the ILI tool process ?



Defect Identity	Axial/Circumferential/Both	Artificial/Real	Number
Metal loss	-	Artificial	4
Crack field	Axial	Real	101
Crack field	Circumferential	Real	22
Crack field	Both ("Spider cracks")	Real	14
Notch like	Axial	Artificial	4
Notch like	Circumferential	Artificial	4

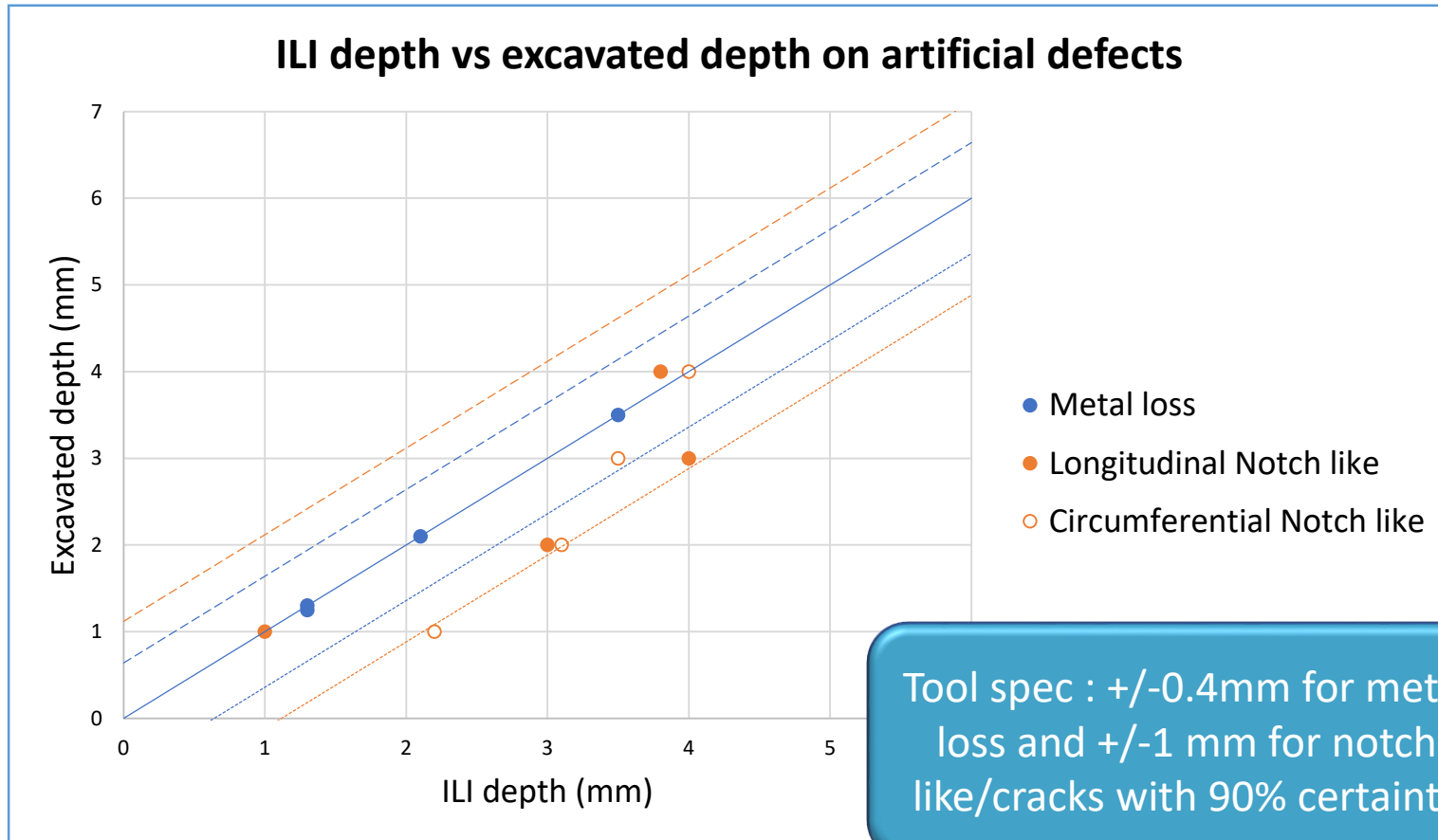
How to adapt the ILI analysis in order to verify and improve POD, POI and POS of cracks ?

Evaluating and improve POD of cracks



How to adapt the ILI process in order to verify and improve POD, POI and POS of cracks ?

Evaluating and improve POs on artificial defects

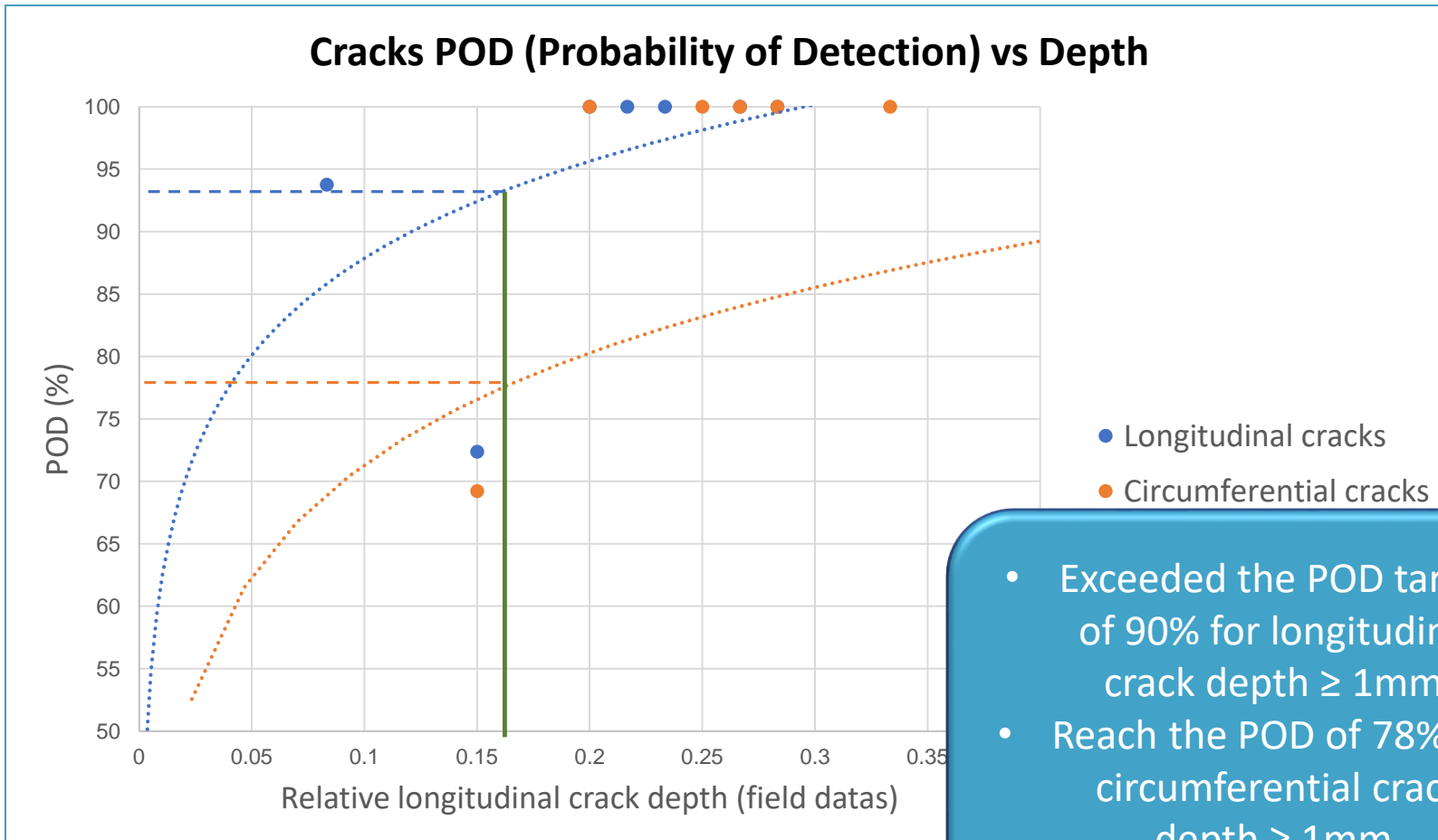


Improvement → Add more artificial defects and have more feedback on site in order to modify :

- Cracks sizing chart
- Algorithmic tools for sizing models
- Data analyst training

How to adapt the ILI analysis in order to verify and improve POD, POI and POS of cracks ?

Evaluating and improve POD of cracks



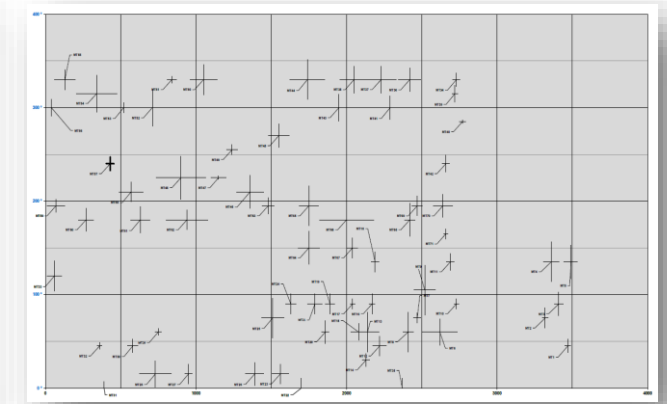
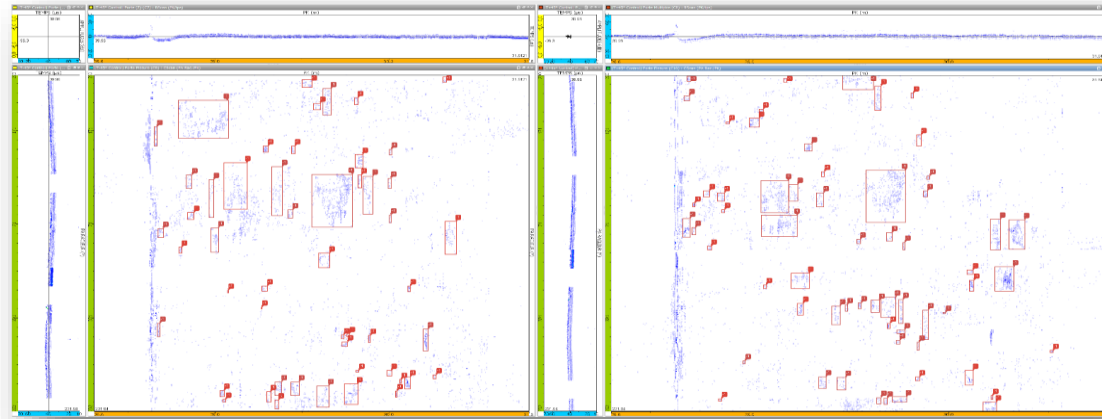
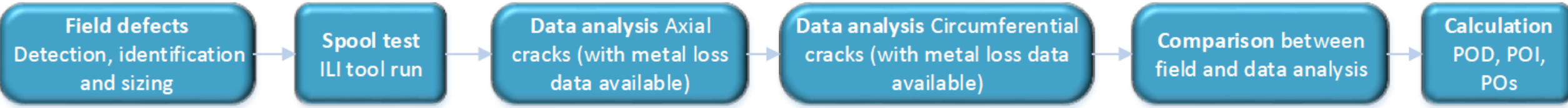
Improvement → Increase POD on skewed cracks :

- Crossing circumferential and longitudinal cracks data during the analysis
- More feedback on-site

- Exceeded the POD target of 90% for longitudinal crack depth $\geq 1\text{mm}$.
- Reach the POD of 78% for circumferential crack depth $\geq 1\text{mm}$.

How to adapt the ILI analysis in order to verify and improve POD, POI and POS of cracks ?

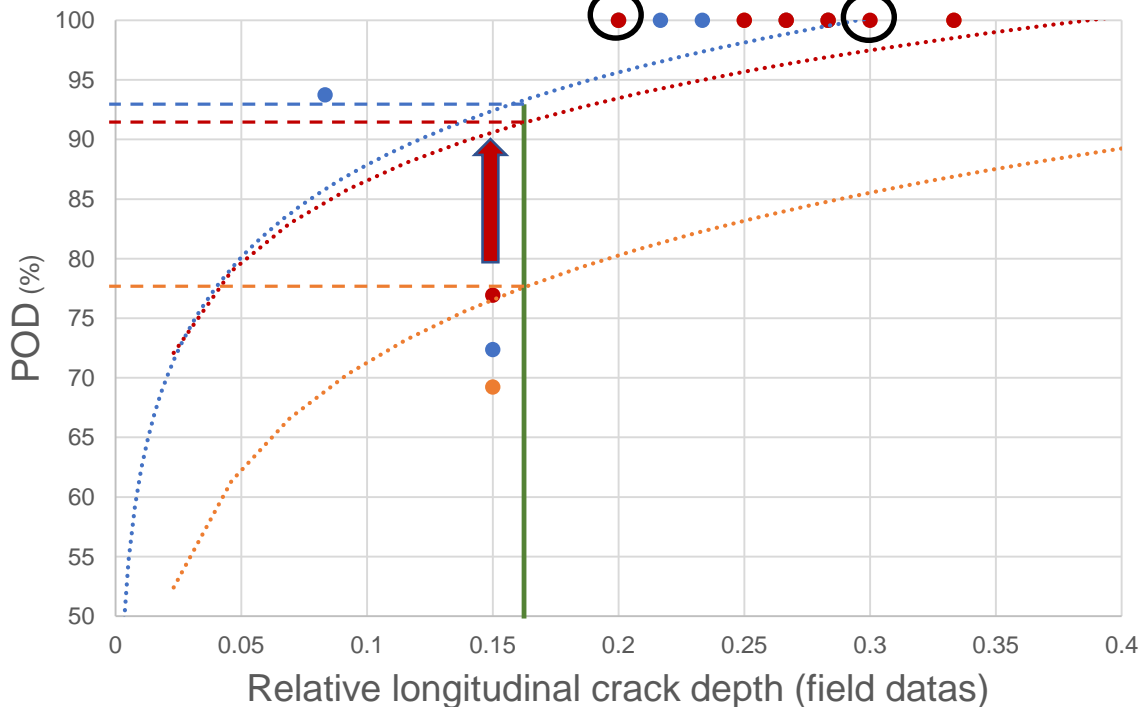
Evaluating and improve POD of cracks



How to adapt the ILI analysis in order to verify and improve POD, POI and POS of cracks ?

Evaluating and improve POD of cracks

Cracks POD (Probability of Detection) vs Depth / With cross-referencing datas



Increasing circumferential cracks POD after cross referencing datas with longitudinal cracks.

- Longitudinal cracks
- Circumferential cracks
- Circumferential cracks (Cross-Referencing datas)
- Spider cracks

- From 78% to 85% for circumferential crack depth $\geq 1\text{mm}$. +7% POD
- All in one tool enables :
 - Better crack POD
 - Spider crack identification

- Improvement** → Increase POD :
- More feedback on-site

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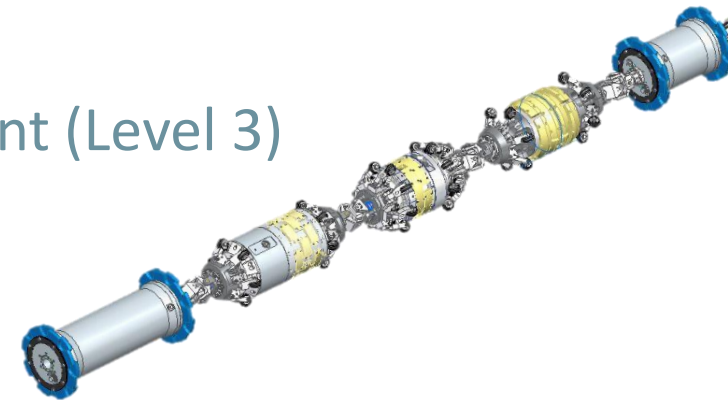


All in one ILI tool, benefits ?

- The validation of the performance of an ILI tool is an iterative process
- Phased Array + “all-in-one” tool would allow significant gains in terms of pipeline operation and improve tool specification
- Improve pipeline integrity management

Perspectives ?

- Get more field data → ILI tool process verification more significant (Level 3)





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