FlexIQ™ – Redefining Flexible Riser Integrity Management

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The relation of NDT and Integrity assessment

- *NDT tools (like ILI tools) need to be developed that find defects relevant to the integrity of a structure*

  - *High Resolution MFL pigs were developed in order to not only find corrosion but also to leave it unrepaired where possible. (British Gas 1980ies)*

  - *An eddy current pig was developed to find internal fatigue cracks. The threat is now considered of minor importance. The tool is not available any more (Pipetronix 1980ies)*

  - *The shear wave UT crack inspection pig was developed after calculating what the relevant crack length is. (Pipetronix 1990ies)*

The relation of NDT and Integrity assessment

- *Methods of integrity assessment have to consider the reliability of the input data*

    - *DNV RP F101 make ample reference to the accuracy and reliability of the measurement.*

    - *Using an FAD approach for crack assessment can result in all findings to be rated "not permissible" because properties are not sufficiently determined*
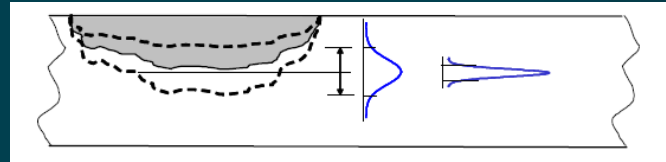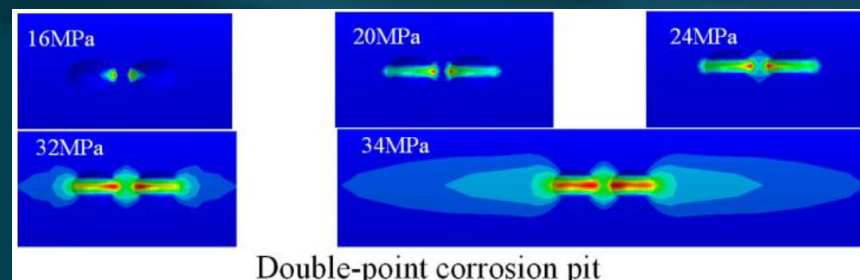
FEM in structural integrity assessment

- *The most detailed method to calculate the strength of components under various kinds of loads*

Double-point corrosion pit
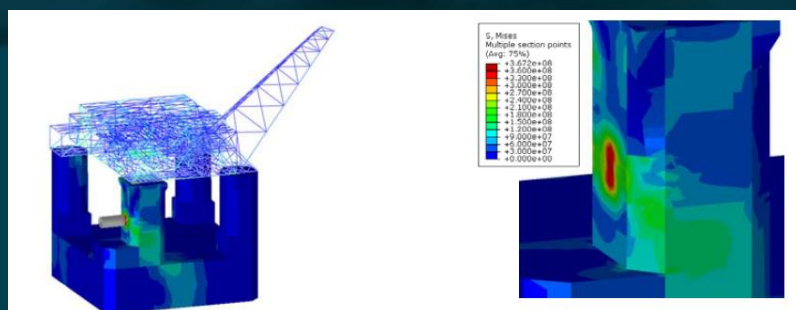
J. Xie, C-FER, Finite Element Calculation for structural performance of offshore platforms, 2012 Simula Conference

J. Zhang, **Effects of Ellipsoidal Corrosion Defects on Failure Pressure of Corroded Pipelines Based on Finite Element Analysis** *Int. J. Electrochem. Sci.,* 10 **(2015)** 5036 - 5047

- *What is difficult about the modelling of Flexible Riser?*

  – *Layer structure, number of surfaces, edge effects*
  – *Small single wires*
  – *Cyclic loading with complex spectrum of loads, wave action*
  – *Friction in between layers*
  – *Size of the structure in relation to size of stress concentrations*
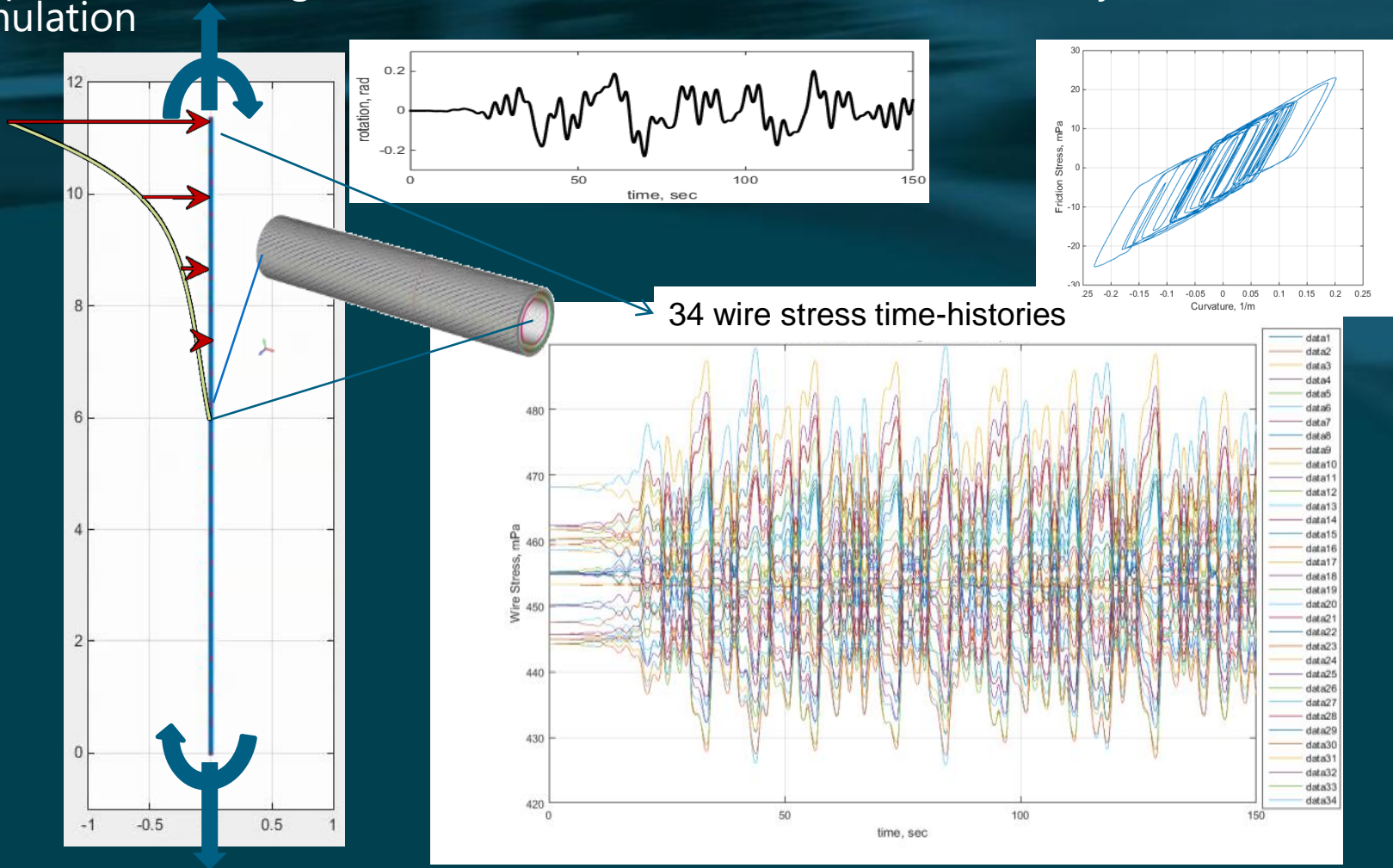
FLEXAS™ by INTECSEA
FEM for flexibles
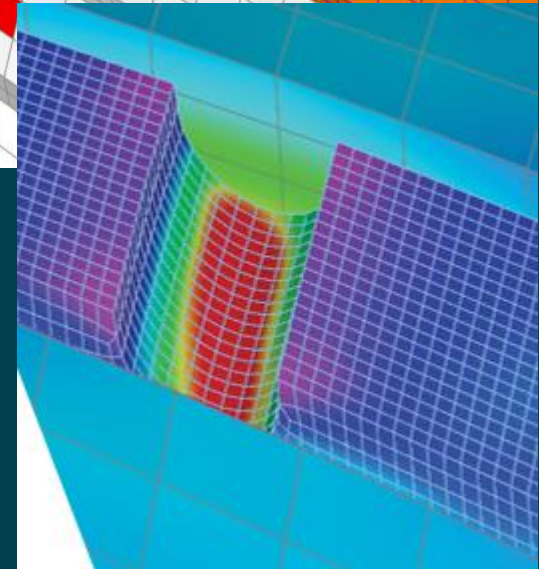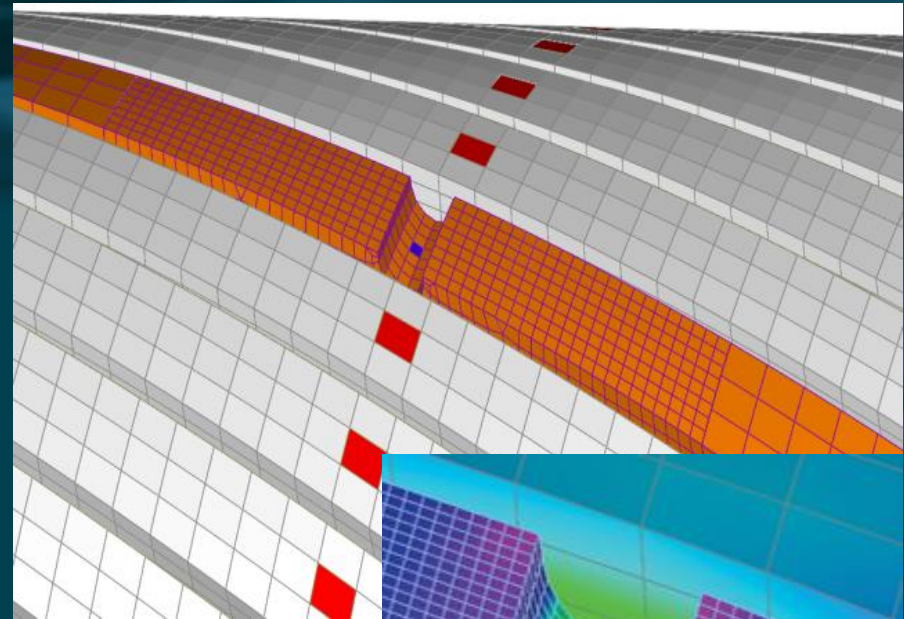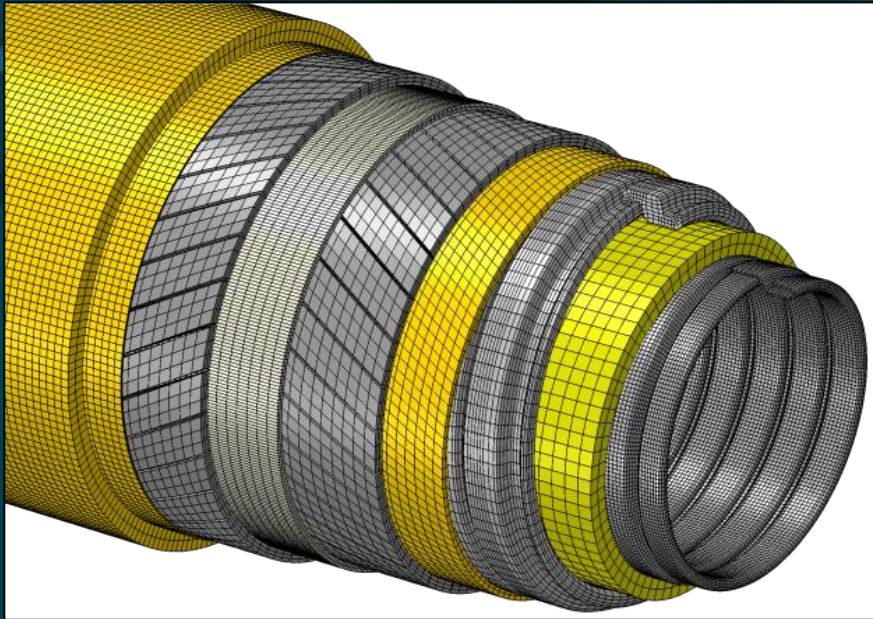
In bulk material elements can be larger depending on loads.

With fine structures number of elements become high with high computational effort.

Flexas™ Example for riser stresses

20 pitch (12m) hang-off simulation, 80 million DoFs nonlinear dynamic simulation

34 wire stress time-histories

Total computation time for this nonlinear dynamics simulation (FLEXAS™): 300 secs
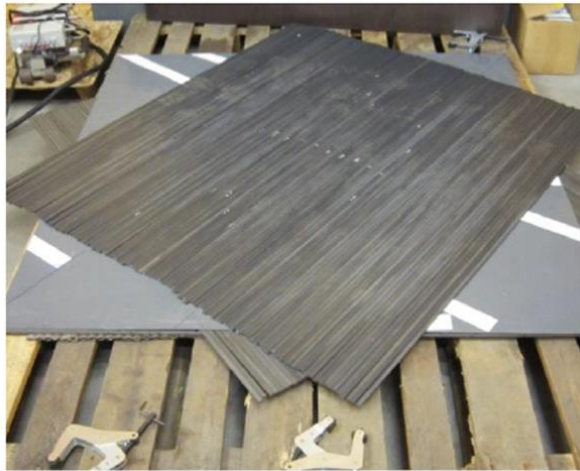
MEC-FIT™ by Innospection

- *MEC-FIT™ is an adaptation of the well established MEC-technology to flexible riser inspection. It uses an Magnetic Eddy Current technique to find defects in armour layer.*

Top-side deployment
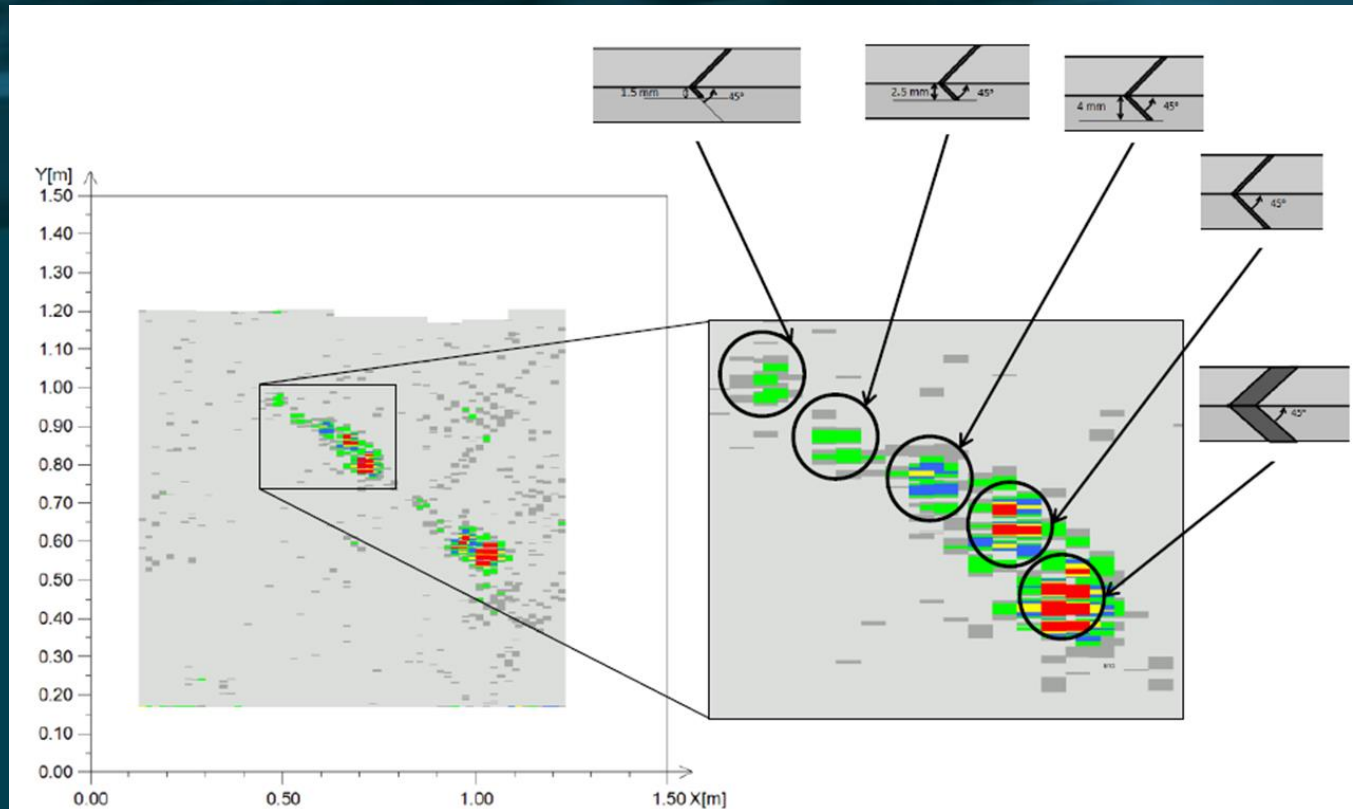

ROV based deployment

MEC-FIT Qualification

- *All structures are different.*
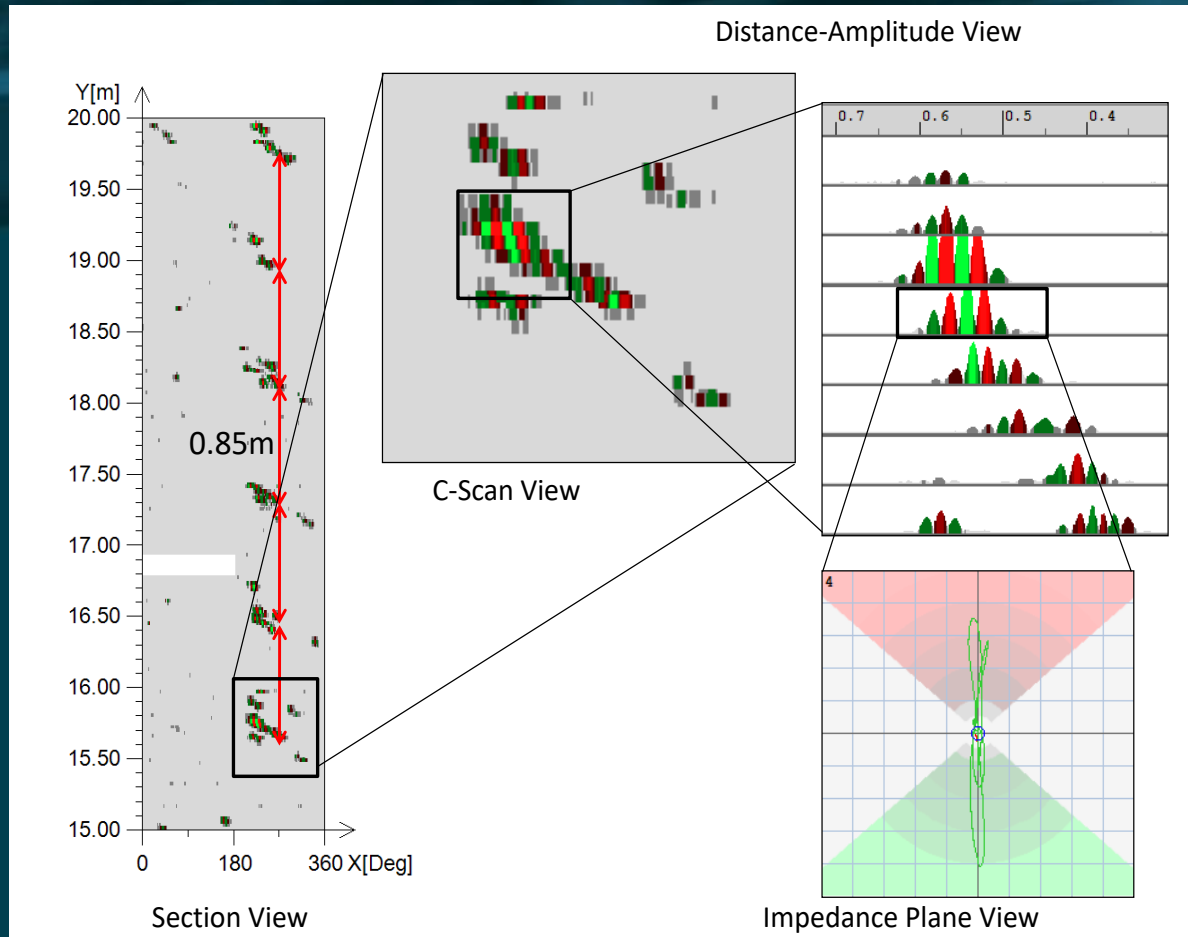- *System is qualified for every project.*

MEC-FIT™ Defect Signals

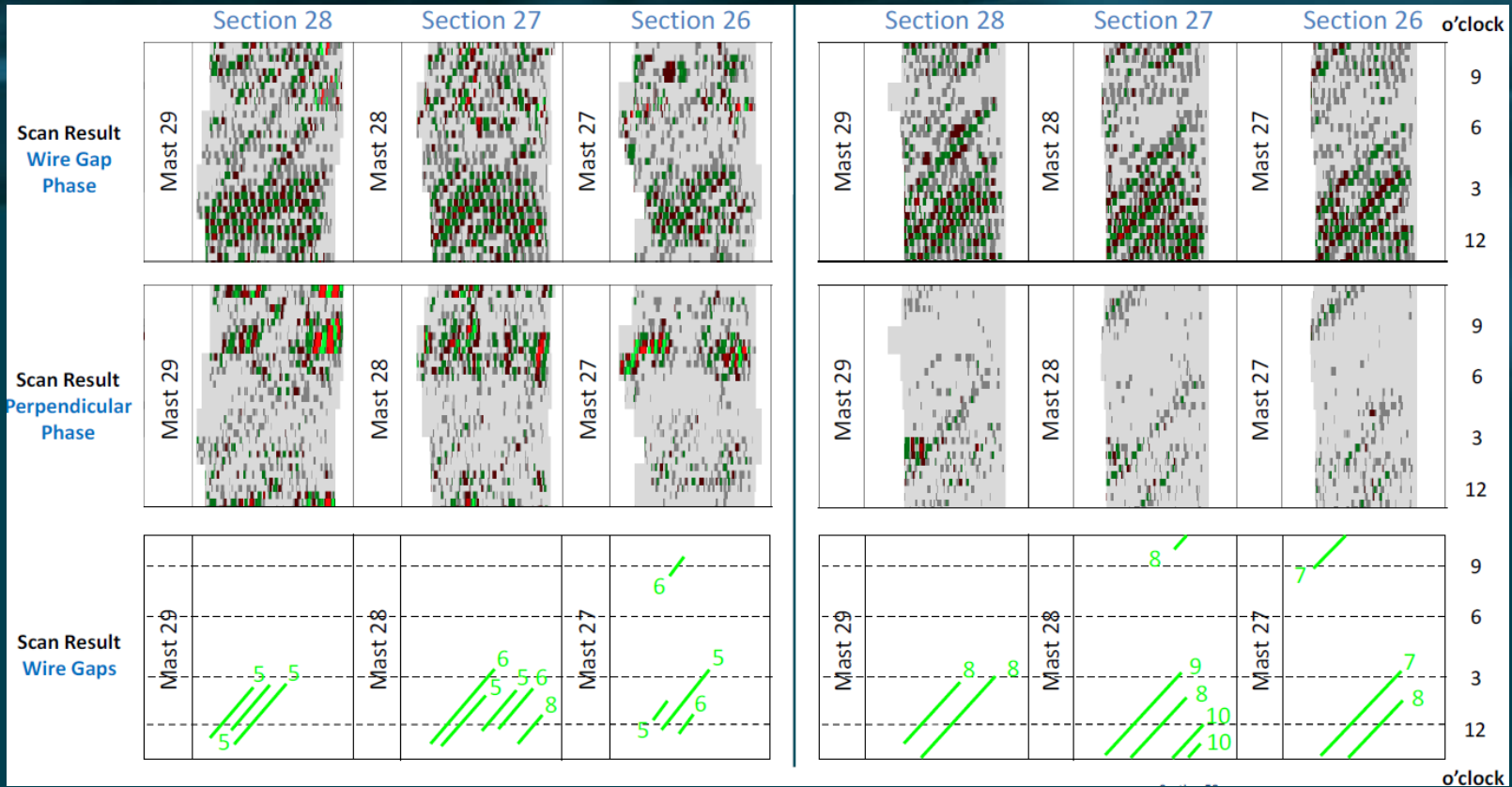*Signals of single wires can be separated. Amplitude depends on depth and opening for through cracks.*

MEC-FIT™ Data Analysis

Distance-Amplitude View

C-Scan View

Section View

Impedance Plane View

- *Several levels of detail*
- *Overview for context information*
- *Impedance plane for defect classification*

Sample report page
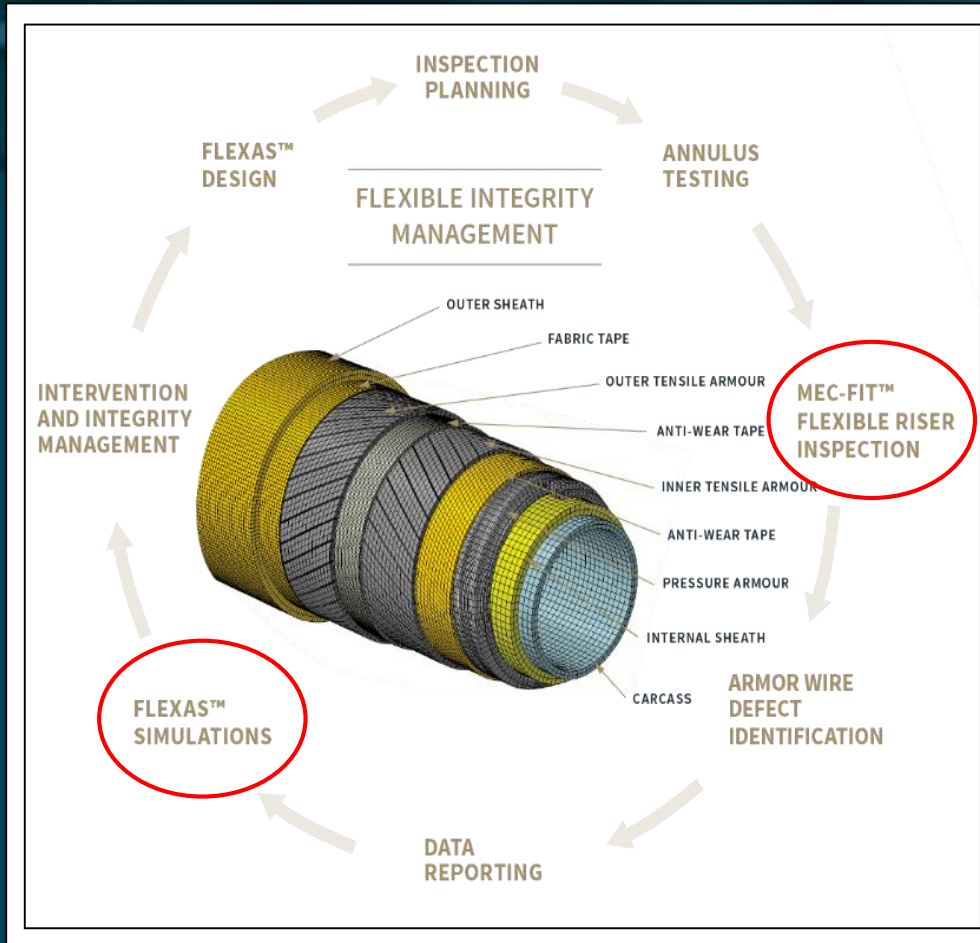# Wire misalignment

Flexas™ + MEC-FIT™ → FlexIQ™

What does the combination of the two methods allow?

- *Combination of defects, what is the effect on lifetime*
- *Allowable gap-sizes in case of wire-misalignment*
- *Establish permissible operating conditions for a certain wire distortion detected by inspection*

FlexIQ™
Cycle of continuous integrity management

Considered two aspects of flexible riser inspection.

FlexIQ expands to all aspects of flexible riser integrity.

Conlusions

- *FlexIQ™ offers a fully integrated service for inspection, analysis, and data management.*

- *It is now possible to apply methods of continuous integrity assessment to flexible risers just the way it is known to rigid pipe.*

- *In consequence a continued service of flexible riser will become possible, where lifetime of an asset does not depend on its age but its condition*